International Financial Management

Seventh Edition

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Preface to the Seventh Edition

The process of opening up of the Indian economy and financial markets, which began in 2000, has accelerated the pace of globalization of the Indian economy, especially during the last few years. Also, Indian financial markets are being brought at par with global financial markets by introducing new financial instruments and trading platforms. Liberalization of the capital account is also progressing at a fairly rapid pace. Ongoing WTO negotiations are leading to a more and more open economy.

Beginning in 2009-10, some of the member countries of the Euro Area – Portugal, Spain, Greece and Ireland – have faced serious fiscal and balance of payments problems. There are speculations about some of them walking out of the European currency union. Such events will have serious implications for world trade and financial markets.

Since the publication of the sixth edition, in 2011, some significant developments have taken place in Indian financial markets. Liberalisation of the capital account, and introduction of exchange traded currency futures and currency options are some of the important policy initiatives which have widened the scope of pro-active approach to managing currency risks and other aspects related to international finance. More recently, the government has opened up the Indian capital market to foreign companies to raise capital via the Indian Depository Receipts mechanism. The exchange traded currency derivative products are accessible to all categories of investors and do not require any underlying exposure.

Foreign Direct Investment (FDI) regulations are also continually being liberalized. During the last couple of years, a number of large Indian firms have become MNCs with significant acquisitions abroad.

Credit derivatives such as credit default swaps have also been introduced. The net result of all these changes is going to be widening and deepening of financial markets including plain vanilla derivatives and complicated structured products.

In the light of these changes, I felt certain key chapters of the book, dealing with global monetary system and global financial markets, and global and Indian foreign exchange markets, needed extensive revision. The chapters on currency futures and options also needed to be updated to include recent regulatory changes. The latest edition besides updating the content continues to discuss case studies which illustrate substantive practical applications of concepts and techniques discussed in the chapters. The cases have been organized chapter-wise and can be used both to generate in-class discussions as well as to test the students' understanding of the key concepts and theories covered in the text.

Thus the main motivation for the revision is to incorporate the significant changes that have taken place in the global financial architecture, the regulatory structures at home as also the new products that have appeared on the Indian scene. All these are having and will continue to have significant impact on corporate finance, and finance managers must quickly equip themselves with a thorough understanding of these changes.

P G Apte

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Preface to the First Edition

The book is intended as a text for MBA students who wish to study International Corporate Finance as a part of their specialisation in the area of Finance.

During the last five years or so, particularly after the opening up of the Indian economy, the study of corporate finance in a multinational context has acquired tremendous importance. Till very recently, most Indian companies had little involvement in global financial markets apart from financial transactions related to imports and exports. The exchange control regime did not allow the corporation, much flexibility either in managing their (very limited) currency exposure or exploiting the numerous opportunities presented by world financial markets. The situation has changed radically in the last three years and now every finance manager and corporate treasurer must acquire a sound understanding of the nature and management of exposure, international financial markets and instruments. No serious student of finance can now afford to view the finance function in a purely domestic context.

This book has grown out of lecture notes and other materials I have been preparing and updating for the MBA courses in International Finance, at the Indian Institute of Management, Bangalore, for the last seven or eight years. In addition, I have used some of the material from the Executive Development Programmes in International Corporate Finance.

Needless to say, no textbook by itself can convey the full richness of either the theoretical development or subtleties of practice in its chosen field. Serious students, particularly advanced students, must supplement the material in the book with journal articles as well as perusal of financial periodicals such as *Euromoney*, *The Economist*, *Multinational Business*, and others. Scanning of financial newspapers is also strongly recommended.

It is the fate of almost every textbook that by the time it reaches the reader, some parts of it are somewhat outdated. This is all the more so in case of the present book, because of the rapid changes that have taken place—and are expected to take place. The last couple of years have witnessed, in rapid succession, liberalisation of exchange control, full convertibility of the rupee on the current account, opening up of the Indian financial markets to foreign institutional investors and increasing resort to global debt and equity markets by Indian firms. The future promises more changes as the Indian economy gets integrated into the global economy.

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Acknowledgements

As with the earlier editions, for this edition too, I owe a debt of gratitude to fellow academicians, former teachers and practitioners around the world whose work I have drawn upon in updating the book.

I am also indebted to Dr. Prasanna Chandra, my former colleague, whose suggestions and advice added considerable value. Similarly, the insights provided by Dr. Zarir Gandevia, my former student and a practicing banker, continue to be of great significance value in orienting the discussion to practical aspects of complicated financial structures and products.

I sincerely thank my colleagues, Prof. Sundarajan for contributing the chapters on International Accounting—a unique feature of the book—and Prof. Padmini Srinivasan for revising the chapter on Tax Implications of International Activities.

Professor P C Narayan's contribution in the form of a write-up on international banking, based on his deep insights acquired as a practicing banker, continues to be a valuable feature of the sixth edition and the cases prepared by Dr. Sanjeevan Kapshe will continue to be of substantial value to the readers. I am grateful to both of them.

I am thankful to my wife, Madhuri, and son, Alok, for always being a source of tremendous support and encouragement for me.

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Chapter 1

Financial Management in a Global Context

1.1 INTRODUCTION

Let us begin by posing the question as to why does a manager need to study international finance. Would it be possible to effectively handle the finance function in a corporation without a thorough understanding of global financial markets and issues related to financial risk in a global context? While this book begins with this question, we hope to demonstrate to the reader that in today's world, finance cannot be anything but "international". Also, managers handling other functions such as marketing, procurement, outsourcing, etc., also need to acquire basic familiarity with international finance. While political strife continues to take its toll of human lives and enormous economic losses and some barriers to international flows of goods, services and investment are still in place, there is no doubt that in many ways the world economy is becoming a single gigantic and complex organism with highly interdependent constituents. Supersonic transport, satellite communications and the internet have literally shrunk the world while the phenomenal growth in international exchange of goods, services, technology, and finance has knit the national economies into a vast network of economic relationships. No nation today can afford to think of itself as an isolated economic entity unto itself.

The six decades following the World War II have witnessed an enormous growth in the volume of international trade. This was also the period when significant progress was made towards removing the obstacles to free flow of goods and services across nations. The case for and against free trade continues to be debated, international trade disputes in various forms erupt between nations every once in a while and protectionism in novel disguises raises its head from time to time. However, there is no denying the fact that the rapid economic growth and increasing prosperity in the West and some parts of Asia owe much to this ever-growing flow of goods and services in search of newer and more remunerative markets, and the resulting changes in the allocation of resources within and across countries. Table 1.1 and Figure 1.1 give some idea of the pervasiveness of cross-border trade in goods and services and its phenomenal growth during the last four decades.

However, the growth in world trade has not been even, spatially or over different sub-periods during the four decades following World War II. Nevertheless world trade has grown at a pace much faster than world output so that for many countries, the share of exports in GDP has increased significantly. Table 1.2 provides some data on the comparative average annual growth rates in real GDP and exports for different country groupings, over different time periods.

Even developing countries like India, which for a long time followed an inward-looking development strategy concentrating on import substitution, eventually realized the vital necessity of participating vigorously in international exchange of goods, services, capital and technology. The 1980s and 1990s witnessed a significant shift in policy towards a more open economy, considerable liberalisation of imports and a concerted effort to boost exports. Starting in 1991, the decade of 1990s ushered in further policy initiatives aimed at integrating the Indian economy with the international economy. The policy stance in the new millennium also stresses more openness and networking with the global economy.

Table 1.1 Growth of World Exports 1971-2012 (Billions of US Dollars)

Year	*World*	*Advanced Economies*	*Emerging & Developing Economies*	
			Asia	**Other**
1971	334.5	249.1	19.19	66.25
2000	6365.0	4720.9	608.40	1042.60
2001	6131.6	3874.4	597.40	1028.60
2002	6425.4	4671.9	680.50	1081.70
2003	7472.0	5356.7	833.00	1293.60
2004	9111.1	6341.4	1072.30	1714.70
2005	10418.9	6927.6	1320.50	2196.10
2006	12066.0	7803.6	1627.80	2667.60
2007	13765.6	8859.0	1972.70	2972.40
2008	15991.4	9833.4	2314.90	3895.80
2009	12382.4	7818.4	1952.30	2649.10
2010	15106.6	9231.5	2555.00	3371.10
2011	18037.3	10701.2	3093.90	4408.80
2012	17986.3	10509.7	3222.40	4374.30

Source: International Financial Statistics; Yearbook 2013, ***International Monetary Fund***.

Table 1.2 Annual Growth Rates of Real GDP and Exports (% p.a.)

	1994-2003		*2009*		*2010*		*2011*		*2012*	
	GDP	*EXP*	*GDP*	*EXP*	*GDP*	*EXP*	*GDP*	*EXP*	*GDP*	*EXP*
Advanced Economies	2.8	6.2	–3.5	–11.3	3.0	12.0	1.6	5.3	1.3	2.2
Developing Countries	4.4	8.4	2.7	–7.6	12.0	13.7	6.2	6.5	2.2	4.0

Note: For the decade 1994-2003, the growth rates are averages over the period.
Figures for 2012 are projections.
Source: ***World Economic Outlook,*** October 2012, IMF.

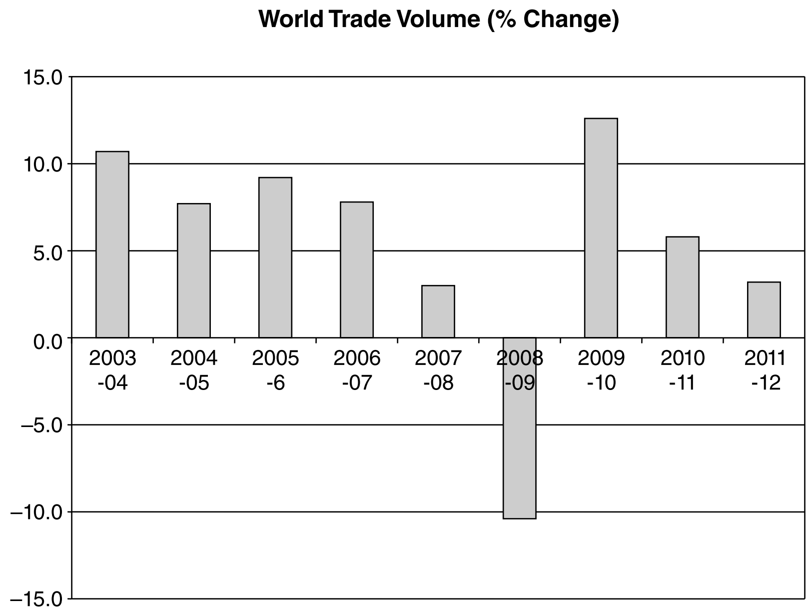


Fig. 1.1 Growth of World Trade Volume (% p.a.)
(***Source: World Economic Outlook,*** October 2012, IMF)

Quantitative restrictions on imports have been mostly phased out as part of WTO commitments, and import duties are being lowered. Foreign investments – direct and portfolio – are on the rise and the policy framework controlling them is being steadily liberalised. A unified market determined exchange rate, current account convertibility and a slow but definite trend in the direction of liberalising the capital account have opened up the Indian economy to a great extent. In keeping with the commitments made to WTO, all quantitative restrictions on trade were abolished at the end of March 2001. Further lowering of tariff barriers, greater access to foreign capital and finally capital account convertibility are certainly on the reform agenda of the Indian government. There has also been significant growth in both inward and outward foreign direct investment as well as considerable opening up of the financial markets to foreign institutional investors (FIIs). Also, resident Indians are allowed to invest in shares of foreign companies listed on foreign exchanges with an upper limit of 2,00,000 US dollars. In 2004, the Indian government notified the rules for foreign companies to raise equity capital in India by issuing an instrument called Indian Depository Receipts or IDRs. These rules and guidelines have been amended since then. The latest amendments were made in July 2009. The Depository Receipts method of raising equity capital will be dealt with in Chapter 18.

The apparently inexorable trend towards opening up of national economies and financial markets and their integration into a gigantic global market appeared to have suffered a serious setback in 1997 and 1998 following the East Asian crisis and the Russian debacle. In particular, doubts were raised regarding the advisability of developing countries opting for an open capital account. It was suggested that opening up the capital account might render them more vulnerable to the kind of currency crises which rocked some of the Asian tigers in the summer of 1997. Some economists argued that the benefits of unfettered cross-border capital flows had been overestimated while the enormous damage that even a short-lived currency crisis can cause had not been adequately emphasised in policy discussions. Extensive debates were conducted in various international forums on the subject of a new architecture for the global financial system. While everyone agrees that the system needs closer monitoring and some built-in safeguards against systemic crises, what form they should take remains an open question.

By 1999, some of the East Asian economies had recovered from the crisis and a sort of stable order appeared to be emerging in Russia. Multilateral negotiations regarding phased removal of trade barriers had made considerable progress and WTO had emerged as a meaningful platform to carry these matters further. No serious reversal of the trend towards more open financial markets appears to have taken place.

In 2008, there was a brief crisis in global financial markets as a result of some financial institutions taking excessive risk to obtain higher returns on their portfolios. Also, some institutions dealt with exotic structured financial products without adequately analysing the risks attached to these products. Some major investment banking firms and commercial banks in USA and UK had to be bailed out of the crisis by government grants. An extensive debate took place as to whether regulators should play a more proactive role in monitoring the business strategies and portfolios of banks and non-banking financial institutions and whether commercial banks should be subject to much stricter financial prudence norms. There have also been discussions on the subject of greater collaboration and co-ordination between regulatory authorities for different segments of financial markets. Towards the end of 2010, Government of India set up a regulatory body designated as Financial Stability and Development Council or FSDC to strengthen the mechanism for maintaining financial stability, financial sector development and inter-regulatory coordination. The council is headed by the Finance Minister and has Governor of RBI (Reserve Bank of India), Chairman of SEBI (Securities Exchange Board of India), Chairman of IRDA (Insurance Regulatory and Development Authority), and Chairman of PFRDA (Pension Fund Development and Regulatory Authority) as members in addition to officers from the Ministry of Finance.

In March 2011, Ministry of Finance constituted an expert group designated as Financial Sector Legislative Reforms Commission to review the legal and institutional structure of the financial sector. One of the topics they have handled is the legislative and procedural aspects of capital account controls. Some of the issues dealt with by this group will be discussed in Chapter 4.

In early 2010, another crisis threatened the European Union and the survival of the European common currency Euro. Four member countries in the European Union, viz. Greece, Ireland, Portugal and Spain had serious fiscal problems and the stronger European economies in collaboration with IMF had to work out a bailout package for them to prevent a crisis.

Along with the growth in trade, cross-border capital flows and, in particular, direct investments have also grown enormously. The world has witnessed the emergence of gigantic multinational corporations with production facilities spread across the world. Singer et al. (1991) conjecture that it is just possible that within the next generation about 400 to 500 of these corporations would own about two-thirds of fixed assets of the world economy. Table 1.3 and Figure 1.2 present selected data and forecast on the inflows of foreign investment into developing countries. According to IMF, net private financial flows to developing and emerging economies increased from US \$254 billion in 2006 to US \$689 billion in 2007 and then declined, due to the global financial crisis, to US \$179 billion in 2008 and US \$180 billion in 2009. Figure 1.3 clearly shows the upward trend in the net FDI into India in recent years. Figure 1.4 depicts the investment in Indian equity and debt markets by Foreign Institutional Investors (FFIs).

Foreign direct investments (FDI) are a major driving force behind the growth of Indian financial markets. Post liberalisation in 1990s, the country is being viewed as a strategic destination by foreign

Table 1.3 Emerging Markets and Developing Countries – Net Capital Flows

(US Dollars Billion)

	Average 1998-2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
Emerging and developing economies											
Private capital flows, net[2]	64.3	73.5	54.0	154.2	222.0	226.8	202.8	617.5	109.3	–190.3	–6.5
Private direct investment, net	164.2	180.5	144.4	161.3	183.9	243.7	241.4	359.0	459.3	312.8	303.1
Private portfolio flows, net	41.4	–76.9	–86.4	–3.8	10.0	–5.6	–100.7	39.5	–155.2	–234.5	–195.3
Other private capital flows, net	–141.2	–30.1	–4.1	–3.3	28.0	–11.3	62.2	219.2	–194.6	–268.5	–114.2
Official flows, net[3]	7.1	2.3	14.8	–43.3	–64.9	–98.5	–154.1	–100.5	–60.0	57.6	–28.1
Change in reserves[4]	–89.5	–132.7	–191.3	–360.6	–501.9	–585.7	–751.7	–1257.8	–865.7	–266.5	–512.2
Memorandum											
Current accounts[5]	41.7	93.3	138.0	233.6	312.3	532.0	728.7	741.5	793.0	355.7	473.8
Africa											
Private capital flows, net[2]	3.8	1.3	2.0	4.9	13.0	26.0	35.2	33.4	24.2	30.2	44.7
Private direct investment, net	7.4	23.1	14.3	17.1	15.8	23.3	23.4	32.1	32.4	27.6	31.7
Private portfolio flows, net	3.8	–7.9	–1.6	–0.4	5.6	4.2	17.6	9.9	–15.8	0.9	4.1
Other private capital flows, net	–7.3	–14.0	–10.7	–11.8	–8.4	–1.5	–5.7	–8.3	7.9	1.8	9.0
Official flows, net[3]	5.3	6.5	8.8	6.2	4.2	0.5	–10.0	5.0	11.1	15.1	12.8
Change in reserves[4]	–3.9	–10.2	–5.7	–11.5	–31.7	–43.3	–54.3	–61.6	–53.8	21.7	–3.6
Central and Eastern Europe											
Private capital flows, net[2]	30.8	5.6	25.9	42.3	61.3	99.9	12.0	173.6	147.1	–38.3	13.4
Private direct investment, net	15.4	17.4	12.2	13.3	30.0	37.4	58.9	72.0	64.1	30.1	32.5
Private portfolio flows, net	4.1	0.2	3.1	9.7	25.3	25.9	9.4	–7.4	–13.2	–6.1	4.6
Other private capital flows, net	11.3	–12.0	10.6	19.2	6.1	36.6	51.7	108.9	96.2	–52.4	–23.6
Official flows, net[3]	–0.7	5.2	4.5	–2.4	–4.1	0.0	–7.9	–6.0	7.3	26.8	9.6
Change in reserves[4]	–8.4	–11.0	–14.2	–9.3	–8.1	–36.1	–20.3	–31.2	–9.7	36.6	6.1

(Contd.)

(US Dollars Billion)

	Average 1998-2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
Commonwealth of Independent States											
Private capital flows, net[2]	–16.3	6.9	15.7	19.0	2.6	30.4	55.1	127.2	–127.4	–119.0	–40.0
Private direct investment, net	4.2	4.9	5.2	5.4	13.1	11.6	20.7	26.6	44.4	17.3	22.9
Private portfolio flows, net	–3.5	–1.2	0.4	–0.4	4.3	–4.9	12.9	14.5	–36.8	1.6	3.4
Other private capital flows, net	–17.0	3.1	10.1	14.1	–14.8	23.7	21.5	86.1	–135.1	–137.9	–66.4
Official flows, net[3]	–2.2	–5.1	–10.8	–9.4	–7.6	–19.6	–29.8	–5.9	–0.7	25.1	6.2
Change in reserves[4]	–4.8	–14.4	–15.1	–32.7	–54.9	–77.1	–127.8	–168.1	33.1	94.3	8.0
Emerging Asia[5]											
Private capital flows, net[2]	–13.4	24.3	23.9	66.9	145.6	85.3	31.8	164.8	127.9	–46.9	–35.6
Private direct investment, net	64.0	53.5	52.4	70.6	64.7	100.5	94.3	138.5	222.6	161.6	138.8
Private portfolio flows, net	27.6	–50.7	–60.2	10.3	10.2	–5.3	–107.2	11.2	–65.9	–192.1	–204.5
Other private capital flows, net	–105.0	21.4	31.7	–13.9	70.7	–10.0	44.6	15.2	–28.7	–16.3	30.1
Official flows, net[3]	2.4	–13.1	2.6	–18.4	–13.4	–21.7	–21.7	–36.6	–13.1	–11.3	–40.0
Change in reserves[4]	–67.2	–87.7	–154.9	–236.7	–338.7	–288.3	–372.2	–673.1	–634.3	–514.5	–526.9
Middle East[2]											
Private capital flows, net[2]	0.5	–7.6	–19.2	1.4	–17.7	–53.7	–60.0	11.0	–120.9	–29.5	–24.1
Private direct investment, net	6.5	12.3	9.1	17.0	10.4	17.6	14.9	4.0	11.4	17.6	15.7
Private portfolio flows, net	–3.5	–11.8	–16.1	–18.0	–21.7	–36.2	–25.7	–31.0	–12.3	–14.4	–6.4
Other private capital flows, net	–2.6	–8.1	–12.3	2.3	–6.4	–35.1	–39.2	38.0	–120.1	–32.7	–33.4
Official flows, net[3]	–5.3	–12.8	–8.2	–24.4	–33.9	–27.3	–67.0	–58.9	–75.6	–9.4	–22.1
Change in reserves[4]	–7.8	–11.1	–2.9	–36.7	–46.3	–107.2	–126.2	–191.5	–151.3	46.6	–10.6

Note: Figures for 2009 and 2010 are projections.
Source: ***World Economic Outlook,*** April 2009, IMF.

majors to park their investments and benefit from the economic growth. India remains the world's third most attractive destination for investment by transnational corporations (TNCs) during 2013-15, stated a recent survey by UNCTAD. The country was ranked after China and the US in the survey based on responses of 159 companies.

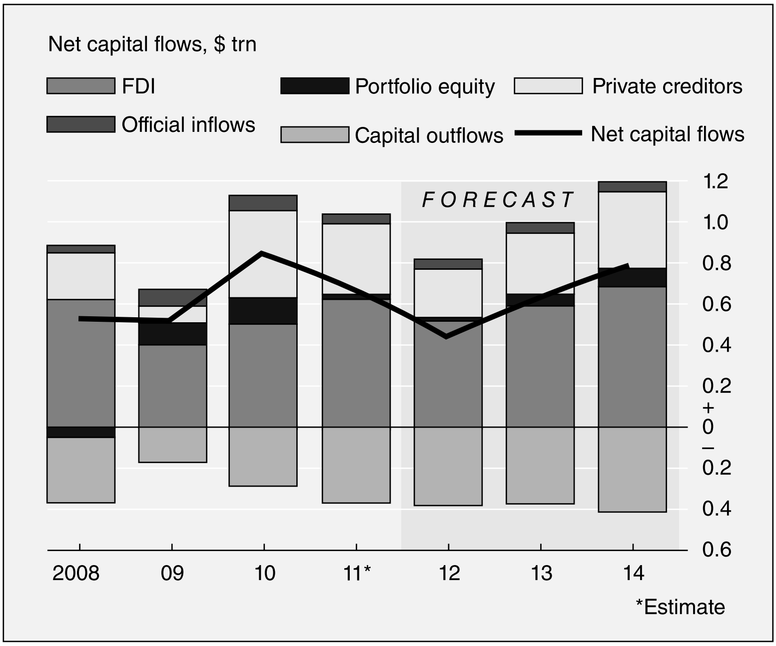


Fig. 1.2 Capital flows to developing countries
Source: World Bank.

According to the World Bank, net private-capital inflows to developing countries will fall by 22 per cent to $775 billion in 2013, a far cry from $1.06 trillion in 2010. Foreign direct investment (FDI), the biggest part of the flow, will fall after medium and long-term investors held onto their cash last year. (FDI has a time-lag; the money flows some time after the decision to invest.) Private creditor flows (bonds, bank loans, short-term debt) will decline by 29 per cent this year. Tighter rules increased funding costs and de-leveraging by euro-area banks have all squeezed lending. Thanks to rich-country fiscal deficits and loose monetary policies, the Bank reckons capital flows will remain volatile, but will pick up next year.

In more recent times, India has also been witnessing a surge in outward direct investment by Indian companies via the mergers and acquisitions route.

Outward FDI by Indian companies had been continuously rising since 1999 and rose to a historical high of 18 billion dollars in 2007. There has been a slowdown in 2008 and early 2009 as a consequence of the global financial turmoil.

During the quarter July-September 2009, 1127 proposals amounting to US $4.8 billion were cleared for investments by Indian companies in foreign joint ventures and wholly owned subsidiaries. Actual outward FDI during the period April-October 2011 was estimated to be $25 billion. The chart below illustrates some of the major acquisition deals done by Indian companies. Figure 1.5 provides a view of the rapid growth in outward investment by India companies. The policy governing outward

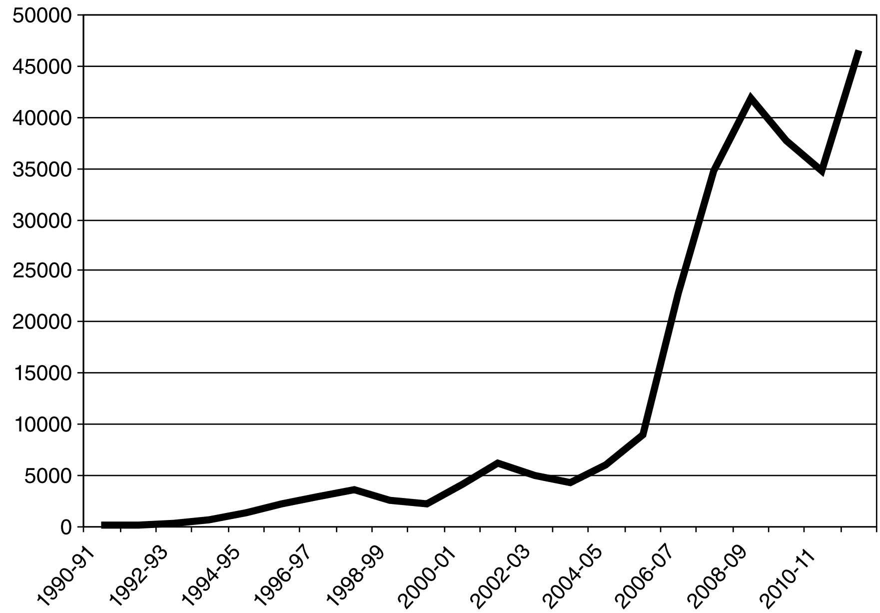
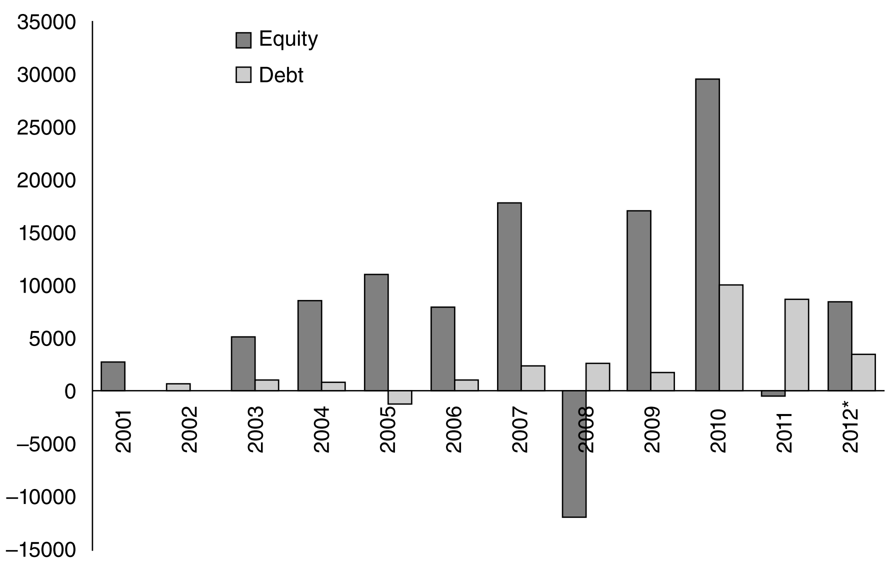


Fig. 1.3 Foreign Direct Investment in India (US $ Miilion)

Source: Handbook of Statistics on the Indian Economy 2011-12, Reserve Bank of India.



* The 2012 data are provisional estimates.

Fig. 1.4 Significant FII inflows in equity and debt

FDI by Indian companies was quite conservative till 2003. Significant liberalisation took place in 2004 and 2005 and there was a sharp rise in cross-border acquisitions by Indian multinationals.

Foreign Acquisitions by Indian Companies

Acquirer	*Target Company*	*Country targeted*	*Deal value ($ ml)*	*Industry*
Tata Steel	Corus Group plc	UK	12,000	Steel
Hindalco	Novelis	Canada	5,982	Steel
Videocon	Daewoo Electronics Corp.	Korea	729	Electronics
Dr. Reddy's Labs	Betapharm	Germany	597	Pharmaceutical
Suzlon Energy	Hansen Group	Belgium	565	Energy
HPCL	Kenya Petroleum Refinery Ltd.	Kenya	500	Oil and Gas
Ranbaxy Labs	Terapia SA	Romania	324	Pharmaceutical
Tata Steel	Natsteel	Singapore	293	Steel
Videocon	Thomson SA	France	290	Electronics
VSNL	Teleglobe	Canada	239	Telecom

In calendar year 2012, the IT and IT-enabled services sector saw cross-border merger and acquisition transactions worth $1.4 billion (around ₹7,630 crore today) with a bulk of the deals happening in Europe ($640.4 million) and North America ($591 million), according to transaction advisory services firm Grant Thornton India LLP report Dealtracker annual edition 2012.

"Indian IT companies have thoroughly realized the value of making strategic cross-border acquisitions as demonstrated by **Infosys Ltd**'s acquisition of Lodestone, **MphasiS Ltd**'s acquisition of Digital Risk LLC and **Wipro Ltd**'s acquisitions of Promax, and we believe the cross-border activity is expected to increase in 2013," said Arunkumar Krishnamurthy, partner (transaction advisory services) at Grant Thornton India.

A recent report by the US India Business Council (USIBC) has stated that Indian investments in the country has reached US $11 billion and has generated over 100,000 jobs there. Similarly, a report by the Europe India Chamber of Commerce (EICC), a body that promotes bilateral trade between the European Union and India, has stated that Indian companies have invested US $56 billion across the continent during 2003-2012. In the appendix, there is a list of ten most globalised Indian companies.

In addition to the significant growth in bi-directional foreign direct investment, there has also been substantial increase in non-resident portfolio investors participating in the capital markets of emerging economies. India has opened up its equity and debt markets to non-resident investors. Figure 1.6 illustrates Foreign Institutional Investors' (FIIs) participation in India's equity markets during the decade 1999-2009. The cumulative total of FII equity investment in India for the period November 1992 to May 2010 is a little over seventy nine billion dollars.

Over the same period, they have also put in a little over twelve billion dollars in Indian debt markets. Recent data also show that FII's daily buy-sell transactions constitute a little over 30% of the total value traded every day on BSE and NSE taken together.

Indian firms have been tapping foreign equity markets for more than a decade with issues of Global Depository Receipts (GDRs) and American Depository Receipts (ADRs). As mentioned above, very recent development in this area has been the use of the same mechanism by foreign firms to tap the Indian equity market with Indian Depository Receipts (IDRs).

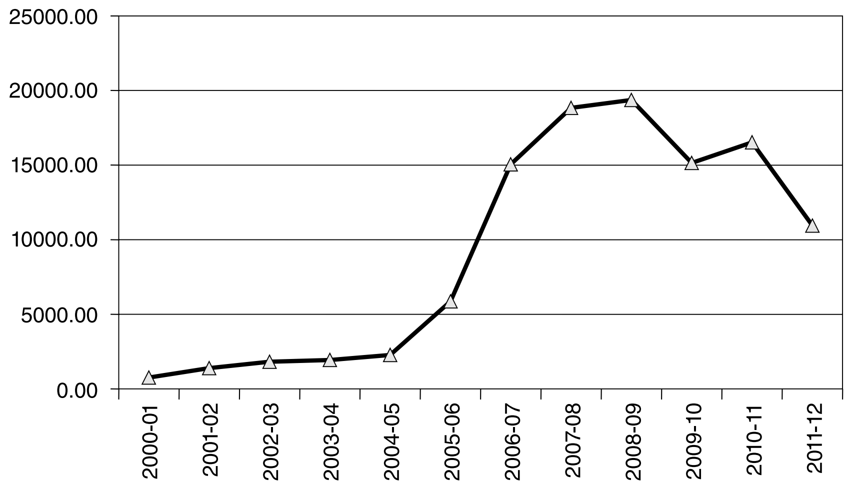


Fig. 1.5 Foreign Direct Investment by Indian Multinationals (US $ million)

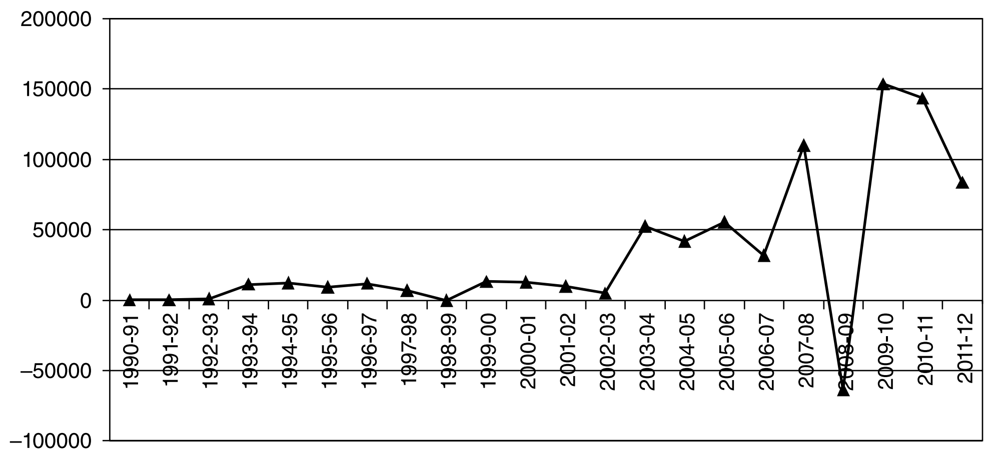


Fig. 1.6 Foreign Portfolio Investment in India (Rupees Crore)

Such an enormous growth in international trade and investment would not have been possible without simultaneous growth and increased sophistication of the international monetary and financial system. Adequate growth in international reserves, i.e. means of payment in international transactions, an elaborate network of banks and other financial institutions to provide credit, various forms of guarantees and insurance, innovative risk management products, a sophisticated payments system and an efficient mechanism for dealing with short-term imbalances are all pre-requisites for a healthy growth in cross-border trade and investment. A number of significant innovations have taken place in the international payments and credit mechanisms that have facilitated the free exchange of goods and services. Any company that wishes to participate in global trade on a significant scale must master the intricacies of international financial system.

Of greater relevance to the finance manager, are the developments that have taken place in the international financial markets during the last 20-25 years. A veritable revolution has been taking place in the money and capital markets around the world. Liberalisation, integration and innovation have created a giant international financial market that is extremely dynamic and complex.

The market presents a finance manager with a bewildering menu of funding techniques, investment vehicles, risk management products and speculative opportunities. Financial engineering is no more a fancy jargon, but a reality. For those who are willing to master its complexities, the market provides endless opportunities for creative financial management; for the unwary, it is a minefield.

As more and more companies venture into the international financial market, their finance managers will be forced to come to grips with the theoretical and analytical issues underlying the workings of the market, the funding and investment channels it offers, the risks and rewards of a wide variety of instruments and the risk management techniques available to achieve the desired risk-reward profile.

Till as late as early 1990s, international finance as a specialised discipline would probably not have been of great relevance to the typical finance manager in India. What has changed since then? If one looks at the macro picture, the role of the external sector in the Indian economy has not been increased significantly. Figures 1.7 and 1.8 present a comparative picture of the relative importance of exports and imports in some of the developed and developing countries. If the 'openness' of an economy is measured by these criteria, the Indian economy is much less 'open' compared to many European countries as well as the Asian dragons. India's share in world trade has been continuously falling. Domestic industry is in transitional phase; learning to cope with an environment of greater competition from imports and multinationals as barriers imposed by import quotas and high tariffs are being gradually dismantled though even now trade barriers in India are still quite high.

It would however be a serious error, if one were to conclude from this that developments in the international economy are at the best of marginal interest to India's policy makers and businessmen. There are several reasons why this is so. First, to maintain the tempo of economic growth achieved during the eighties, Indian economy needs substantial amounts of foreign capital to augment domestic savings. Second, technology upgradation will require continuing import of foreign technology, hardware and software. Third, concessional aid which contributed substantially to capital formation during the sixties and early seventies became totally inadequate during the eighties and not likely to increase significantly, which implies increasing recourse to commercial borrowings and direct and portfolio investments by nonresidents[1]. As seen above, the recent trends in inward capital flows – both FDI and portfolio investments by FIIS – are strongly upward. Fourth, the efforts of Indian companies to diversify into exports of engineering equipment and turnkey projects will have to be supported by the ability to offer long-term financing to buyers. Fifth, a number of companies, particularly in the IT sector, have begun venturing abroad for strategic reasons either as partners in joint ventures or by establishing foreign subsidiaries. Also, as seen above, Indian manufacturing and intermediate goods companies have already started to establish their footprints abroad through joint ventures and wholly owned subsidiaries. They will have to adapt themselves to operating in a global context. In the information technology sector, India has made great strides and has become an important source of software development and other IT services to multinational firms around the world.

[1] The rate of growth of commercial borrowings slowed down in late eighties due to the massive build up of debt in early eighties and the severe foreign exchange crisis which emerged towards the end of the decade. The Indian stock market was opened up to foreign institutional investors in September 1992. Restrictions on foreign direct investment have also been significantly relaxed.

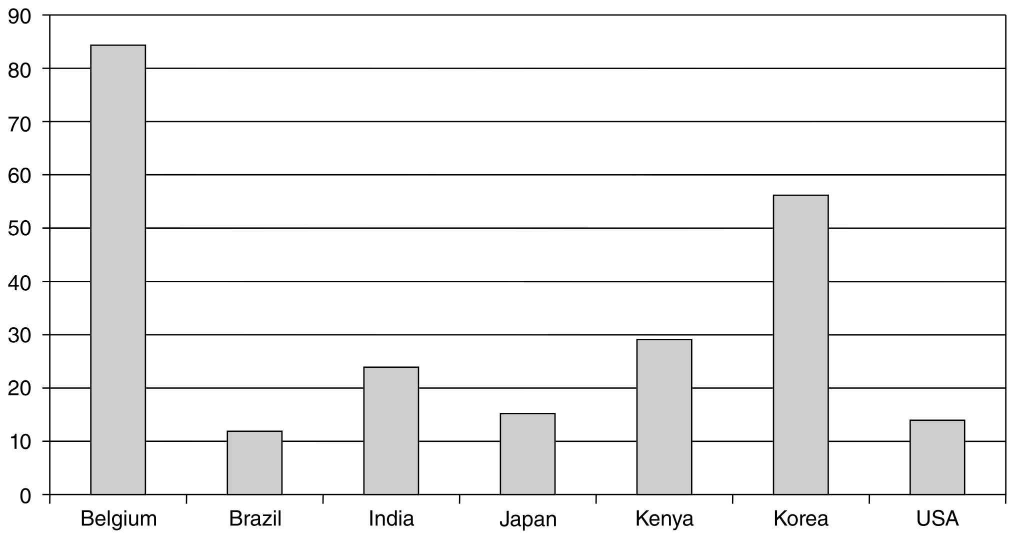


Fig. 1.7 Export/GDP Ratio 2011 (%)
Source: International Financial Statistics Yearbook 2012, IMF.

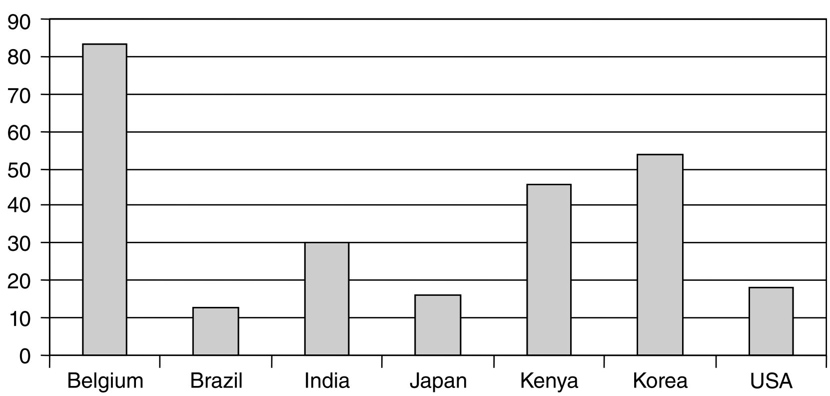


Fig. 1.8 Imports as % of GDP (2011)
Source: World Bank.

Indian IT firms have begun tapping global capital markets to fund foreign acquisitions and provide incentives like Employee Stock Options to their employees based outside India.

Last and the most important, the policy stance has clearly shifted in favour of more openness, greater competition – internal and external, and greater participation in the international exchange of goods, services, technology and capital. In short, the country and the companies can ignore the developments in the world economy only at the risk of being left behind in the global race.

Table 1.4 presents some data on India's growing dependence on international financial markets. While the rate of growth of total external debt has moderated during the latter half of nineties, there has been a significant increase in the share of commercial borrowing and the share of non-government borrowing, facts not revealed by the summary data in Table 1.4. By the end of March 2009, India's total external debt stood at a little over 220 billion dollars of which 180 billion was long term and the rest was short term. In addition, as mentioned above, a substantial amount of equity capital has been mobilised by Indian corporates both via investment by foreign financial institutions directly in the Indian stock market and via the Global and American Depository Receipts (GDR and ADR) route. The cumulative stock of FII investment in Indian equity markets since 1992 was a little over seventy nine billion dollars as of early May 2010. There was some decline between early 2008 and early 2009 as a result of the financial markets turmoil in USA, but the rising trend picked up again later in 2009. Also, on a particular day in May 2010, the value of total transactions by FIIs in NSE and BSE taken together were a little over 30 per cent of the overall traded value on these two exchanges. FIIs have also been putting their funds in the Indian debt markets. As of early May 2010, their cumulative investment in Indian debt securities was a little over twelve billion dollars. In the budget presented in February 2001, the government raised the ceiling on FII ownership stake in Indian companies from 40 to 50 per cent. Also, the guidelines for Indian companies investing abroad, acquiring foreign companies were significantly liberalised. Starting in May 1992, nearly 300 companies have made GDR and ADR issues. Of these, 123 companies have not raised any fresh capital, while the remaining 176 companies have raised over 21 billion dollars from US and non-US markets. During the closing decades of the last millennium, large IT companies have taken the ADR route to raise capital from the vast American capital markets. A large number of investment banking firms from the OECD countries have become active in India either on their own or in association with Indian firms.

Table 1.4 India's External Debt (Billions of US Dollars)

	End March					
Item	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***
Total Debt	172.36	224.41	224.49	260.94	305.93	332.75
Long-term Debt	144.23	178.67	181.18	208.61	240.94	267.62
Short-term Debt	28.13	45.74	43.31	52.33	64.99	65.13

Source: Handbook of Statistics on the Indian Economy 2011-12, Reserve Bank of India.

Of course by global standards, these are small amounts but Indian presence abroad is bound to grow at an accelerated pace. The budget presented in February 2001 significantly eased the restrictions on investments in joint ventures and acquisitions abroad by Indian companies and some of the Indian IT giants are poised to gear up their acquisition activity abroad.

In the light of these developments, corporate finance managers, financial analysts bankers and other finance professionals must acquire an in-depth knowledge and expertise in international finance.

In view of the rapid integration of economies and global spread of activities of MNCs, not just financial managers but executives in other functional areas such as production and operations management, marketing management, human resource management also need to acquire some familiarity with the working of the global financial markets and systems. They have to compare and evaluate various alternatives for acquiring raw materials and equipment, locating production facilities in different countries, focusing on different parts of global markets to enhance quantum of sales and revenue, impact of financial regulations in different countries on decisions pertaining to procurement of materials, human resource allocation and so forth. As we will see many strategic decisions pertaining to foreign project appraisal, international acquisitions, accessing new markets, etc. require joint expertise of and inputs from all functional executives and not just finance managers.

The globalisation of financial markets and evolution of new financial products implies widening of decision frameworks for commercial and investment bankers, fund managers, financial risk managers and financial consultants. Given the cross-border mobility of financial services providers and advisors, it is essential for finance professionals to acquire adequate understanding of all the financial products, processes, markets and regulatory aspects which are continuously evolving across the international financial markets.

1.2 THE FINANCE FUNCTION

The finance function in a firm can be conveniently divided into two sub-functions, viz. ***accounting and control*** and ***treasury management***. The two groups of tasks are by no means independent. Decisions taken by the ***treasurer*** have implications for the ***controller*** and vice versa with a continuous exchange of information between them. Figure 1.9 is a schematic presentation of the responsibilities of the treasurer and the controller.

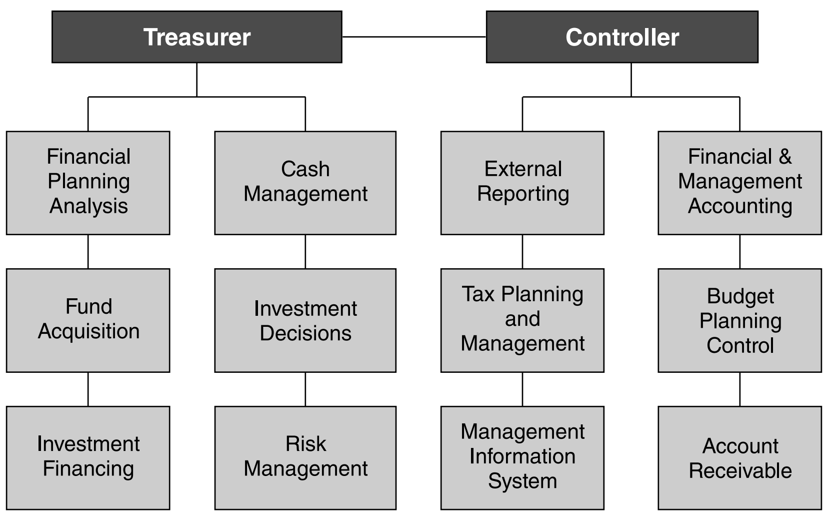


Fig. 1.9 The Finance Function

As is evident from Figure 1.9, tasks relating to accounting, reporting and internal control are the domain of the controller while financial analysis, planning, acquisition of funds and deployment of funds are the responsibilities of the treasurer. A related aspect is the management of risk in consonance with the company's preferred risk-reward profile.

While both the control and treasury management aspects of the finance function are important and complementary, in this book we have chosen to focus primarily on the latter. Accounting and taxation issues are dealt with rather briefly in two chapters towards the end of the book. A deeper treatment of these topics is best left to specialised works on the subject.

Acquisition and allocation of financial resources so as to minimise the cost and maximise the return, consistent with the level of financial risk acceptable to the firm is the core of treasury management. Much of the book will be concerned with the problem of managing the portfolios of the firm's financial assets and liabilities both short run as well as long run to optimise the risk-return and risk-cost tradeoffs. In non-financial companies, financial management can be confined to the short- and long-term flows of funds arising out of operational requirements. The management may decide as a matter of policy not to take on positions in the financial markets unrelated to the main business of the firm purely to profit from fluctuations in financial prices. Alternatively, it may want the treasury to actively exploit market imperfections and the firm's superior forecasting ability to generate purely financial gains. The latter strategy naturally has greater risks associated with it. The complexity and challenge of international finance are due to the fact that a wide variety of instruments, products, funding options and investment vehicles are available for both reactive and proactive management of corporate finance.

It must be pointed out at this stage that the finance manager is also concerned with operating decisions such as choice of markets, sourcing of inputs, etc. This is more so in the multinational context than in a purely domestic context. Decisions which would normally be left to the marketing and purchase departments, have significant implications for the company's exposure to changes in exchange rates and interest rates in a multinational context. The finance manager would be expected to make substantive contributions to these decisions.

In the final analysis, the finance function, like any other in the company, is expected to assist the top management in the formulation of strategic goals and then support the corporate effort to attain these goals. In the process, it must not lose sight of the operational requirements of day-to-day management, continuous monitoring, information flow and control.

1.3 THE EMERGING CHALLENGES

A firm as a dynamic entity has to continuously adapt itself to changes in its operating environment as well as in its own goals and strategy. The decades of 1980s and 1990s were characterised by unprecedented pace of environmental changes for most Indian firms. Political uncertainties at home and abroad, economic liberalisation at home, greater exposure to international markets, marked increase in the volatility of critical economic and financial variables such as exchange rates and interest rates, increased competition, threats of hostile takeovers were among the factors that had forced many firms to thoroughly rethink their strategic posture.

The start of the 21st century was marked by an even greater acceleration of environmental changes and significant increase in uncertainties facing the firm. As we approach the WTO deadlines pertaining to removal of trade barriers, companies will have to face even greater competition at home and abroad. Capital account convertibility of the rupee is expected to be put in place any time. Ceilings on foreign portfolio investment are being revised upwards and barriers to foreign direct investment in India are being steadily lowered. Indian banking sector is being opened up to significant increase in foreign stake. During 2007 and till about August 2008, the rupee showed a upward trend against the US dollar at times rising to a rate below ₹40 per dollar. This did put a squeeze on margins of exporting industries. The trend was reversed in 2009, but there has been some strengthening of the rupee again in early 2010. On the whole, the process of integration of India in the global economy is expected to accelerate and hence, exposure of Indian companies to global financial markets is certainly going to increase significantly during years to come.

Responsibilities of Finance Managers

The responsibilities of today's finance managers can be understood by examining the principal challenges they are required to cope with. Five key categories of emerging challenges can be identified:

1. **To keep up-to-date with significant environmental changes and analyse their implications for the firm.** Among the variables to be monitored are exchange rates, interest rates and credit conditions at home and abroad, changes in industrial, tax and foreign trade policies, stock market trends, fiscal and monetary developments, emergence of new financial instruments and products, etc.
2. **To understand and analyse the complex interrelationships between relevant environmental variables and corporate responses – own and competitive – to the changes in them.** Numerous examples can be cited.
   What would be the impact of a stock market crash on credit conditions in the international financial markets? What opportunities will emerge, if infrastructure sectors are opened up to private investment? What are the potential threats from liberalisation of foreign investment? How will a default by a major debtor country affect funding prospects in international capital markets? How will a takeover of a major competitor by an outsider affect competition within the industry? If a hitherto publicly owned financial institution is privatised, how will its policies change and how will that change affect the firm?
3. To **be able to adapt the finance function to significant changes in the firm's own strategic posture.** A major change in the firm's product-market mix, opening up of a sector or an industry so far prohibited to the firm, increased pace of diversification, a significant change in operating results, substantial reorientation in a major competitor's strategic stance are some of the factors that will call for a major financial restructuring, exploration of innovative funding strategies, changes in dividend policies, asset sales to overcome temporary cash shortages and a variety of other responses.
4. **To take in stride past failures and mistakes to minimise their adverse impact.** A wrong takeover decision, a large foreign loan in a currency that has since started appreciating much faster than expected, a floating rate financing obtained when the interest rates were low and have since been rising rapidly, a fix-price supply contract which becomes insufficiently remunerative under current conditions and a host of other errors of judgement which are inevitable in the face of the enormous uncertainties. Ways must be found to contain the damage.
5. **To design and implement effective solutions to take advantage of the opportunities offered by the markets and advances in financial theory.** Among the specific solutions, we will discuss in detail later the uses of options, swaps and futures for effective risk management, securitisation of assets to increase liquidity, innovative funding techniques, etc. More generally, the increased complexity and pace of environmental changes calls for greater reliance on financial analysis, forecasting and planning, greater coordination between the treasury management and control functions and extensive use of computers and other advances in information technology.

1.4 RECENT CHANGES IN GLOBAL FINANCIAL MARKETS

The decade of eighties witnessed unprecedented changes in financial markets around the world. The seeds of these changes were, however, sown in the 1960s with the emergence of Euromarkets which were a sort of parallel money markets, virtually free from any regulation. This led to internationalisation of the banking business. These markets grew vigorously during the seventies and pioneered a number of innovative funding techniques.

The outstanding feature of the changes during the eighties was ***integration***. The boundaries between national markets as well as those between national and offshore markets are rapidly becoming blurred leading to the emergence of a global unified financial market. The financial system has grown much faster than real output since the late seventies[2]. Banks in major industrialised countries increased their presence in each other's countries considerably[3]. Major national markets such as the US, Europe and Japan, are being tapped by non-resident borrowers on an extensive scale. Non-resident investment banks are allowed access to national bond and stock markets. The integrative forces at work through the eighties have more or less obliterated the distinction between national and international financial markets[4]. Today both the potential borrower and the potential investor have a wide range of choice of markets.

In addition to the geographical integration across markets, there has been a strong trend towards ***functional unification*** across the various types of financial institutions within individual markets. The traditional segmentation between commercial banking, investment banking, consumer finance, etc., has disappeared with the result that nowadays "everybody does everything". Universal banking institutions/bank holding companies provide worldwide, a wide range of financial services including traditional commercial banking. However, as mentioned above, after the recent financial turmoil in US and UK, a school of thought is emerging which strongly recommends that commercial banks should not be permitted to engage in investment banking, hedge funds, etc.

The driving forces behind this spatial and functional integration were first, liberalisation with regard to cross border financial transactions and, second, deregulation within the financial systems of the major industrial nations. The most significant liberalisation measure was the lifting of exchange controls in France, U.K. and Japan. (The markets in US, Germany, Switzerland, Holland were already free from most of the exchange controls). Withholding taxes on interest paid to non-residents were removed, domestic financial markets were opened up to foreign borrowers and domestic borrowers were allowed access to foreign financial markets. Thus, in the portfolios of investors around the world, assets denominated in various currencies became more nearly substitutable—investors could optimise their portfolios taking into consideration their estimates of returns, risks and their own risk preferences. On the other hand, borrowers could optimise their liability portfolios in the light of their estimates of funding costs, interest rate and exchange rate risks and their risk preferences.

Deregulation involved action on two fronts. One was eliminating the segmentation of the markets for financial services with specialised institutions catering exclusively to a particular segment and measures designed to foster greater competition such as abolition of fixed brokerage fees, breaking up bank cartels and so forth. The other was permitting foreign financial institutions to enter the national markets and compete on an equal footing with the domestic institutions in offering financial services to borrowers and investors.

The fever of liberalisation and deregulation has also swept the various national stock markets. This is the least integrated segment of financial markets, though in recent years, the number of non-resident firms being listed on major stock exchanges like New York and London has increased significantly.

Liberalisation and deregulation have led to a significant increase in competition within the financial services industry. Spreads on loans, underwriting commissions and fees of various kinds have become rather thin. Another factor responsible for this is the tendency on the part of prime borrowers to approach the investors directly by issuing their own primary securities thus, depriving

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[2] The stocks of eurocurrency bank loans and bonds have increased at the rate of 14% and 21% per annum respectively since 1975. See Anagol (1990).

[3] Even in a market as large as the U.S., foreign banks hold about a quarter of the banking assets.

[4] This does not mean that national markets have all become alike in terms of the kinds of instruments available, market practices and regulatory procedures.

the banks of their role and profits as intermediaries. This is a part of the overall trend towards ***securitisation and disintermediation***.

The attainment of the Economic and Monetary Union (EMU) and the birth of Euro in the closing years of the decade of 1990s have led to the emergence of a very large capital market which has the potential to rival the US financial markets as provider of capital to firms and governments around the world.

The pace of financial innovation has also accelerated during the last ten to fifteen years. The motive force behind innovations like options, swaps, futures and their innumerable permutations and combinations comes both from the demand side and the supply side. On the one hand, with the floating of exchange rates in 1973, a new factor was introduced in international finance; exchange rate volatility and the substantially higher interest rate volatility witnessed during the eighties led to demand for newer kinds of risk management products which would enable investors and borrowers to minimise, if not eliminate totally, exchange rate and interest rate risks. On the supply side, as the traditional sources of income for banks and investment banks such as interest, commissions, fees, etc., were subjected to a squeeze, they started offering complex, innovative deals and products, often tailored to the specific needs of a borrower or an investor, in the hope of skimming off fat fees before the competitors wised up to the fact and started offering similar products. Thus, there is a race on to cope up with increasingly complex and often esoteric products which, it is sometimes said, the bankers themselves do not fully understand. It has been argued that banks are overselling these so-called structured products to their corporate clients without adequately explaining the risks associated with them. Many non-financial companies, particularly small and medium enterprises, do not have the in-house expertise to analyse the risks associated with these products and while they are given detailed documentation pertaining to these products, they cannot fully understand the details. In recent times, there have been some allegations that banks have misled their corporate clients to purchase these products. The innovation mania has been made possible and sustained by the tremendous advances in telecommunications and computing technology. Financial markets even in developing countries like India have started trading these derivative instruments and many exotic combinations thereof.

Liberalisation and deregulation of financial markets is an ongoing process. From time to time, events and circumstances give rise to calls for re-imposition of some controls and barriers to cross-border capital movements. Some governments resort to such measures to contain or prevent a crisis. Many economists have proposed taxation of certain capital account transactions – particularly short-term movements of funds – to "throw sand in the excessively oiled machinery of global capital markets". The quality and rigour of banking supervision in many developing countries needs considerable improvement.

In the Western hemisphere, US and most of Europe have more or less free financial markets. Japan started the process around mid-eighties and most of the barriers have been dismantled, though some restrictions still remain. In other parts of the world, countries like Singapore and Hongkong already have very active and quite free financial markets. Australia has taken great strides in the same direction. Eastern Europe and the third world have begun their economic reforms including freeing their financial sectors. Recent years have seen a surge in portfolio investments by institutional investors in developed countries in the emerging capital markets in Eastern Europe and Asia. A large number of companies from developing countries have successfully tapped domestic markets of developed countries as well as offshore markets to raise equity and debt finance.

The explosive pace of deregulation and innovation has given rise to serious concerns about the viability and stability of the system. Events such as the LDC debt crisis and the 1987 stock market crash in the 1980s (and the speed with which it spread around the world's major capital markets), the East Asian currency crisis, the events following the Russian debacle including the fall of LTCM (a giant hedge fund) in the 1990s, the fall of Lehman (a giant investment banking firm) and the problems of AIG (an insurance firm) in 2008-09 have underscored the need to redesign the regulatory and control apparatus which will protect investors' interests, make the system less vulnerable to shocks originating in the real economy, will enable localisation and containment of crises when they do occur without unduly stifling competition and making the markets less efficient in their role as optimal allocators of financial resources. Increasing interdependence implies convergence of business cycles and, hence, less resilience in the global economy. Disturbances following a local financial crisis tend to spread throughout the global system at the "speed of thought" making the policy makers' task extremely difficult.

International bodies such as the IMF have already begun drawing up blueprints for a new architecture for the global financial system. Extensive debates will follow among economists, finance experts and policy makers before the blueprints are translated into new structures.

Summary

The finance manager of the new century cannot afford to remain ignorant about international financial markets and instruments and their relevance for the treasury function. The financial markets around the world are fast integrating and evolving a whole new range of products and instruments. As national economies are becoming closely knit through cross-border trade and investment, the global financial system must innovate to cater to the ever changing needs of the real economy. The job of the finance manager will increasingly become more challenging, demanding and exciting.

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APPENDIX

A.1.1 WHY DO NATIONS TRADE?

Most of us take the fact of international exchange of goods and services for granted. If we ponder over the question "why does a nation not produce whatever it needs instead of engaging in international trade?" the answers are not intuitively obvious except in specific cases of natural resource based products. For instance, Japan must import crude oil because it is not endowed with any oil deposits of its own. The vast volume of trade in manufactured products cannot be explained so simply.

A variety of explanations or "theories" of international trade have been proposed. The most appealing explanation is contained in the doctrine of ***comparative advantage*** attributed to the English classical economist David Ricardo.

To understand this theory, let us begin with a simple example that has nothing to do with international trade. In a town there are two gentlemen Mr X and Mr Y. Mr X is an excellent carpenter as well as a good plumber. Mr Y is a fairly competent plumber and also possesses some carpentry skills. Can some exchange between them be mutually beneficial or should each be self-sufficient as far as his carpentry and plumbing needs are concerned? In particular, it looks unlikely that Mr X can benefit from the exchange since he is both a better carpenter and a better plumber. However, it turns out that this is not correct. Both of them will benefit, if Mr X specialises in carpentry, Mr Y in plumbing and each imports the other's output, i.e. Mr X should "import" plumbing services from Mr Y and Mr Y should "import" carpentry services from Mr X. The key lies in the fact that Mr X's margin of superiority over Mr Y is much greater in carpentry than in plumbing. Mr X has a ***comparative advantage*** in carpentry and Mr Y in plumbing though Mr X has an ***absolute advantage*** in both.

Now let us extend the same logic to trade between two nations. We will convey the central ideas by means of a numerical example. Table A.1.1 presents some ***hypothetical*** data relating to production of silk fabrics and personal computers (PCs) in India and the US respectively, in the absence of any trade. It is assumed that labour is the only input in production of these goods[5]. Units of measurement are meters for silk and numbers for PCs.

The top part of the table gives the labour requirements per unit of output. Notice that the US is more efficient in the production of both the goods. The next part shows the same information in a different way. The opportunity cost of a unit of silk is the amount of PCs that have to be given up in order to have one more unit of silk. (Labour has to be transferred out of PC production into silk production.)

Notice that the ***opportunity cost*** of a metre of silk is lower in India than in the US – India has to give up only 1/6$^{\text{th}}$ of a PC to have an additional metre of silk while the US must give up 2/5$^{\text{th}}$ of a PC. It is the reverse for PCs – the sacrifice of silk involved per additional PC is greater in India than in the US. In the absence of trade, the price of a PC will be 6 m in India and 2.5 m in the US.

Table A.1.1 Autarkic Situation

Labour Requirement per Unit of Output		
	India	US
Silk	5	2
PCs	30	5
Opportunity Cost		
	India	US
Silk	1/6 PC	2/5 PC
PCs	6 m	5/2 m
Labour Employed (in millions)		
	India	US
Silk	180	40
PCs	120	60
Output (millions)		
	India	US
Silk	36	20
PCs	4	12

Each country can consume the quantities of the two goods that it produces.

Now suppose trade is opened up between India and the US. Since silk is cheaper in India, India will export silk to the US while the US will export PCs to India. Labour will be transferred out of

[5] This assumption is not essential. It is made only to simplify the exposition of the basic ideas.

PC production into silk production in India and in the reverse direction in the US. One possible outcome is illustrated in Table A.1.2.

Table A.1.2 Situation with Trade

Labour Employed (in millions)		
	India	US
Silk	240	20
PCs	60	80
Output (in millions)		
	India	US
Silk	48 m	10 m
PCs	2	16
Exports(+) Imports(–) (in millions)		
	India	US
Silk	+12 m	–12 m
PCs	–3	+ 3
Consumption (in millions)		
	India	US
Silk	36 m	22 m
PCs	5	13

The world output of both the goods has increased and each country is better off in the sense that the quantities of the two goods it consumes is at least as much, and in some cases more than before.

Thus, the possibility of trade enables each country to concentrate on the activity in which it has a comparative advantage, thereby increasing the world output of both the goods and living standards in both the countries. The astute reader will have guessed that a still better outcome can be obtained, if each country ***exclusively specialises*** in the activity where it has a comparative advantage. In that case, India will produce 60 million metres of silk and no PCs while the US will produce 20 million PCs. The price ratio between PCs and silk will depend upon relative consumption preferences in the two countries (and their populations) but will be somewhere between the autarkic opportunity cost ratios.

Contrived as it is, this example serves to bring out an important explanation of trade between nations, viz., differences in productive efficiency. The model can be extended to many goods and inputs.

Another explanation of trade patterns, the Heckscher-Ohlin theory, focuses on factor endowments and the fact that production of different goods requires the various inputs in different proportions. Thus, countries like India are well endowed with human capital including knowledge workers, but are poorly endowed with physical capital whereas countries like the US have plenty of physical capital but scarcity of skilled human capital, particularly in the IT and related sectors. Goods like textiles and services like software can be produced with human capital intensive methods while manufacture of aeroplanes is highly physical capital intensive. India should concentrate on and export human capital intensive products while importing physical capital intensive products.

However, keep in mind that comparative advantage of a country vis-à-vis its trading partners is a very dynamic phenomenon. As technology and quality of human capital change, relative costs of production will keep on changing and so will comparative advantage and hence, composition of exports and imports. Countries such as India and China are rapidly moving towards becoming competitive in consumer durables such as cars and industrial products.

Still other explanations of trade can be offered. Among them are differences in consumer tastes, differences in scale of production, differences in the state of technological advancement and so forth[6].

While the proposition that trade benefits both parties to it is well established, the case for ***free trade***, i.e. trade without the barriers of tariffs, quotas, etc., is still being debated. In other words, the question "will a country be necessarily better off with totally free trade than with some form of managed trade?" is still a matter of debate. Under special conditions, a case can be made for tariffs and recent theoretical advances in the area of "strategic trade theory" cast some doubts on the superiority of free trade. For a textbook exposition, see Krugman and Obstfeld (2000), Carbaugh (2000). A more advanced treatment is in Helpman and Krugman (1989).

A.1.2 GAINS FROM INTERNATIONAL CAPITAL FLOWS

Trade in goods and services enables countries to concentrate resources in those activities where they have a comparative advantage. Specialisation and division of labour increases world output and welfare of trading partners. What are the advantages of cross-border flows of financial and physical capital?

Within an economy, typically, units which have surplus resources (net savers, e.g. the household sector) have limited opportunities to invest them productively. On the other hand, units which are in a position to spot and exploit high-yielding investment opportunities (e.g. the business sector) do not have enough investible surpluses of their own. Capital markets and financial intermediaries perform the function of transferring the surpluses of the former to the latter, thereby enabling the surplus units to earn a higher rate of return on their savings and the deficit units to earn a profit by exploiting the investment opportunities.

International capital flows serve essentially the same purpose, viz. transfer the savings to investors worldwide so as to maximise the incremental productivity of investment. Savers in capital-rich countries, if confined to investment opportunities within their countries, cannot hope to achieve a very high rate of return since typically the productivity of investment in such countries tends to be low. On the other hand, if investment projects in capital-poor countries must be financed only out of domestic savings, many high yielding projects would have to be shelved due to shortage of funds. If funds are allowed to flow across national borders, savers in rich countries can earn a better rate of return and the volume of investment in poor countries would increase.

International capital flows also yield another benefit. A particular country may face a temporary shortfall in national income due to some special adverse circumstance. If it cannot borrow internationally and is unwilling to curtail investment, it must sharply cut down consumption expenditures. During the years of extraordinary prosperity, if it cannot invest abroad, it must have a splurge. International lending and borrowing permit people to achieve a smoother consumption profile. Overall welfare would be greater with cross-border capital flows than without.

[6] For a simple but cogent exposition of determinants of trade patterns see Findlay (1970). The traditional theories cannot explain intra-industry trade in differentiated products—for instance, the fact that the US both exports cars to Japan and imports cars from Japan. More recent research has used the monopolistic competition framework to explain this phenomenon. See Helpman (1984).

Does this mean that a country should always permit free flows of capital, in and out, across its borders? Once again, an unqualified answer is not possible. The effects of foreign capital on domestic entrepreneurial spirit, technology development, questions of political interference and national sovereignty are important considerations. Further, short-term capital flows can be very volatile and destabilising for the domestic monetary system and exchange rate[7]. The Asian currency crisis of 1997, the Russian collapse of 1998 and the almost-crisis in Brazil have brought home the perils of large capital flows, particularly for developing economies that have weak regulatory and supervisory apparatus. The proposition about the gains from international capital flows, like the one about free trade must be applied with care and may have to be qualified in individual cases.

Probably the most important vehicle for cross-border capital flows has been foreign direct investment (FDI). Production and distribution of goods and services has spread across the globe on an unprecedented scale during the preceding four decades. Along with the emergence of the multinational corporation (MNC), other contractual arrangements such as joint ventures, technology licensing, franchising, management contracts, production sharing contracts and R&D alliances have made this possible.

There have been numerous studies aiming to elucidate the economic theory of the MNC[8]. These studies attempt to combine the theory of the firm, industrial organisation, international trade theory and international finance to answer a variety of questions about the MNC. The motives behind going multinational have been thoroughly investigated. Explanations have been advanced as to why in some industries MNCs have become dominant while in others arrangements such as licensing prevail. Numerous empirical studies of comparative conduct of MNCs and their local competitors have been carried out.

We will briefly survey the motives underlying foreign direct investment. A number of factors have been cited in the literature.

- Vertical integration to ensure availability and quality of raw materials and intermediate inputs. Also, in sectors like mining, firms have little choice but to locate near the source of ores.

  This is probably the oldest motive behind going multinational and explains the emergence of European MNCs in the former colonies of European countries as well as US multinationals in Latin America.
- Exploit the differences in factor prices across countries. A large number of firms in advanced countries have located parts or whole of their operations in developing countries to take advantage of low labour costs. Japanese investments in many South East Asian countries for instance are motivated by low wages there to produce for third country markets. Multinationals like Texas Instruments have started 100 per cent owned subsidiaries in India to take advantage of cheap but skilled manpower in computer software to produce for developed country markets.
- Large domestic markets coupled with stiff import barriers have attracted MNCs to countries like India and Brazil. The aim is to produce products for the local market taking advantage of superior technology already developed in the parent country, greater management expertise, famous brand names, etc. When the host country has high tariffs and other controls on imports, huge local markets cannot be exploited without producing locally.
- The technological and other know-how, often proprietary, cannot sometimes be efficiently transferred by means of devices such as licensing agreements. The knowledge may be

[7] Massive capital inflows as witnessed in the Indian economy during some periods can have adverse consequences for money supply, inflation and the real exchange rate which determines the competitiveness of Indian exports.

[8] Among others see Caves (1982) and Casson (1987).

nontransferable or the costs of doing so may be very high. A firm can make much larger profits by starting operations itself in a foreign country rather than transfer the know-how to a local entrepreneur and collect royalties.

- A firm with widely known brands and reputation for quality, technological excellence, etc., may not wish to entrust production in the hands of a local firm. A related point is that the subsidiary of a large multinational has easier access to capital than a small local licensee firm who, therefore, may not be able to effectively exploit the technology transferred by the licensor.
- Firms such as Coca-Cola which have become household names around the world, well-known banking firms, etc., can exploit the brand image or the corporate image by starting operations abroad to serve the local markets.
- When a product reaches the maturity stage in its life cycle in the home market, the firm producing it has to shift to markets which have less intense competition and are at a lower stage of development. This is related to the third point mentioned above.
- A firm might find that the various regulations in its home country such as environment protection legislation, safety regulations, etc., are too costly to comply with and it is better to shift production to a country with looser regulatory framework.
- Real exchange rate changes can alter the relative profitabilities of producing in different locations[9]. The steady real appreciation of the US dollar during the first half of the eighties induced a number of American firms to shift part of their operations abroad to retain their competitive advantage. This is possible when the technology permits quick reshuffling of production, e.g. consumer electronics, computers, etc. It has been argued that one of the factors responsible for globalisation of production and distribution is the increased volatility of real exchange rates. Firms have responded to it by diversifying the currency composition of their revenues and costs.
- Firms in service industries such as advertising, accounting and auditing firms, consultancy firms and IT services providers may follow their clients abroad. In fact, for most of the service firms, a global presence becomes mandatory at some stage of their natural growth.
- Many researchers have argued that more than any of the factors cited so far, going multinational is motivated by strategic considerations in an oligopolistic industry. A firm must move abroad if its competition does so as not to lose any advantages conferred by lower costs, proximity to consumers, and so on.

Actual Foreign Direct Investment Outflows from India

In the financial year 2008-09 (April 08-March 09), actual outflow on account of overseas direct investments was US $22.1 billion as compared to US $23.07 billion in the corresponding period of 2007-08. The trend of investment outflows over the period 2000-2001 to 2011-2012 is shown below in Table A.1.3.

[9] The meaning of this will be clarified in Chapter 13. Roughly, a real appreciation of the currency of a country means appreciation in excess of what is justified by the lower inflation rate in the country compared to its trading partners.

Table A.1.3 Year–wise Position of Actual Outflows in Respect of Outward FDI & Guarantees Issued (US $ Million)

Period	*Equity*	*Loan*	*Guarantee Invoked*	*Total*	*Guarantee Issued*
2000-2001	602.12	70.58	4.97	677.67	112.55
2001-2002	878.83	120.82	0.42	1000.07	155.86
2002-2003	1746.28	102.10	0.00	1848.38	139.63
2003-2004	1250.01	316.57	0.00	1566.58	440.53
2004-2005	1481.97	513.19	0.00	1995.16	315.96
2005-2006	6657.82	1195.33	3.34	7856.49	546.78
2006-2007	12062.92	1246.98	0.00	13309.90	2260.96
2007-2008	15431.51	3074.97	0.00	18506.48	6553.47
2008-2009	12477.14	6101.56	0.00	18578.70	3322.45
2009-2010	9392.98	4296.91	24.18	13714.07	7603.04
2010-2011	9234.58	7556.30	52.49	16843.37	27059.02
2011-2012*	4031.45	4830.01	0.00	8861.46	14993.80
Total	**75247.61**	**29425.32**	**85.40**	**104758.30**	**63504.05**

* (The 2011-12 figure is a provisional estimate)
Source: RBI Bulletin, various issues

As seen from these data, the amount of outward investment from India has gone up substantially between 2004 and 2011.

Table A.1.4 presents data on sector-wise distribution of India's FDI outflows. Manufacturing sector far outweighs other sectors and outward investments in manufacturing have not declined despite the financial crisis in the global markets in 2008.

Table A.1.4 Major Sector-wise Overseas Investments by Indian Companies (US $ Million)

Period	*2008-09*	*2009-10*	*2010-11*	*2011-12*	*Total*
Manufacturing	10.18	5.35	5.04	2.74	23.31
Financial Insurance, Real Estate Business & Business Services	3.55	4.41	6.53	2.53	17.02
Wholesale & Retail Trade, Restaurants & Hotels	1.17	1.13	1.89	1.00	5.19
Agriculture & Allied Activities	2.38	0.95	1.21	0.41	4.95
Transport, Communication & Storage Services	0.31	0.38	0.82	1.34	2.85
Construction	0.35	0.36	0.38	0.37	1.46
Community, Social & Personal Services	0.39	0.18	0.70	0.18	1.45
Electricity, Gas & Water	0.14	0.84	0.10	0.04	1.12
Miscellaneous	0.12	0.11	0.18	0.10	0.51
Total	18.59	13.71	16.85	8.71	57.86

Table A.1.5 and Figure A.1.1 depict the amounts and shares of various destinations for India's outbound FDI. Singapore had the largest share of 20% in 2009. Indian companies have started investing in joint ventures and making acquisitions in advanced countries like UK, USA and Netherlands.

Table A.1.5 Top ten country-wise overseas investments by Indian companies (US $ Billion)

Country	*2008-09*	*2009-10*	*2010-11*	*2011-12*	*Total*
Singapore	4.06	4.20	3.99	1.86	14.11
Mauritius	2.08	2.15	5.08	2.27	11.58
Netherlands	2.79	1.53	1.52	0.70	6.54
United States of America	1.02	0.87	1.21	0.87	3.97
United Arab Emirates	0.63	0.64	0.86	0.38	2.51
British Virgin Islands	0.00	0.75	0.28	0.52	1.55
United Kingdom	0.35	0.34	0.40	0.44	1.53
Cayman Islands	0.00	0.04	0.44	0.14	0.62
Hong Kong	0.00	0.00	0.16	0.31	0.47
Switzerland	0.00	0.00	0.25	0.16	0.41
Other countries	7.65	3.19	2.65	1.23	14.72
Total	18.58	13.71	16.84	8.88	58.01

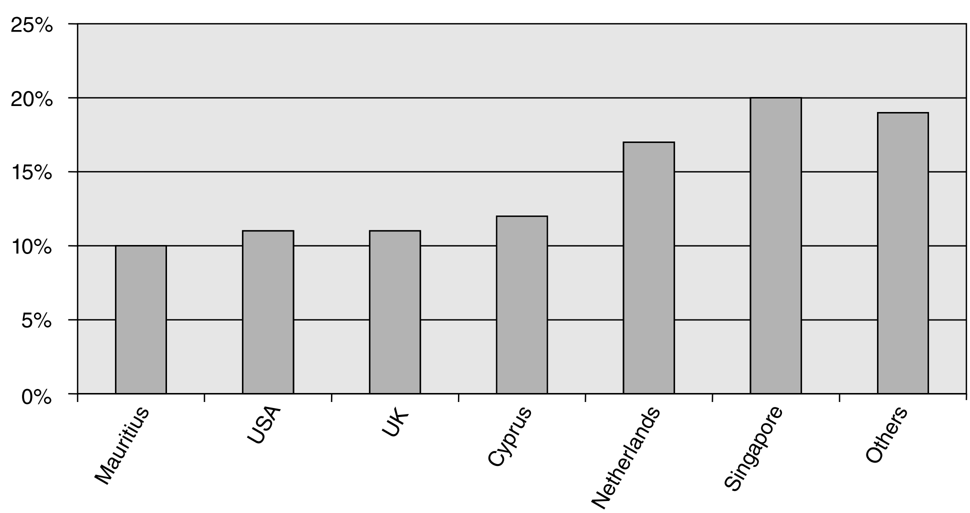

Fig. A.1.1 Destinations of Indian Outward FDI in 2008-09 (% Shares)
Source: RBI Bulletin, July 2009.

Ten Most Global Indian Companies

The **Transnationality Index** (**TNI**) is a measure of the extent of globalisation of multinational corporations developed by the United Nations Conference on Trade and Development.

It is calculated as the arithmetic mean of the following three ratios (where "foreign" means outside of the corporation's home country)

- The ratio of foreign assets to total assets
- The ratio of foreign sales to total sales
- The ratio of foreign employment to total employment

The following table shows the TNI of India's ten most global companies.

Company Name	**Transnationality Index (%) (TNI)**
ONGC Videsh	**77**
Tata Steel	**63**
Tata Global Beverages	**60**
Motherson Sumi Systems	**60**
HCL Technologies	**57**
Tata Communications	**56**
Hindalco Industries	**55**
Suzlon Energy	**55**
Tata Motors	**53**
Dr Reddy's Laboratories	**49**

Chapter 2

Objectives of the Firm and the Impact of Risk

2.1 OBJECTIVES OF THE FIRM

In the last chapter it was said that the finance manager must help in formulating the firm's objectives and then design and implement financial strategies to help achieve them. It is important to agree on the definition of the firm's objectives before a framework can be set up for financial decisions.

In microeconomic and organisational theories of the firm, there has been a longstanding controversy as to what is the appropriate description of the objectives of a firm. Among the issues that have been vigorously debated are single versus multiple objectives, managers' versus shareholders' objectives, optimising versus satisficing, firm as a single monolithic decision making entity versus firm as a coalition of groups with possibly conflicting objectives, and so on. Related to these issues is the question of descriptive realism versus predictive power of a theory of the firm[1].

We will steer clear of these controversies and specify a firm's objectives in terms of a definition which has been accepted in the modern theory of finance, viz. "*the objective of the management of a firm is to maximise the current value of the shareholders' wealth, i.e. the current market value of the firm's outstanding equity shares.*"

Let us examine this a little more closely. In particular, we want to be sure about two things: (i) the current value maximisation objective does not ignore the multi-period character of financial (and other) decisions; and (ii) it incorporates uncertainty in some way.

Shareholders' wealth is the discounted value of after-tax cash flows paid out by the firm. Since after-tax cash flows available for payout can be shown to be the same as the stream of dividends (over the infinite future), the current value of shareholders' wealth is given by

$$S_0 = \sum_{0}^{\infty} \frac{D_t}{(1 + k_s)^t} \tag{2.1}$$

[1] A compact but excellent review of these issues can be found in Hay and Morris (1991).

Here S_0 is the current value of the shareholders' wealth, D_t is the dividend paid at the end of period t and k_s is the rate of discount used by the shareholders to discount income streams which are considered to be equivalent (in terms of risk) to the firm's dividend stream.

The reader might wonder as to why capital gains do not appear in the valuation equation. After all, a shareholder invests in a share both for the dividend income *and* hopes of capital gains. The answer is, capital gains ***are*** taken care of in the above formula. To see this, consider an example. Suppose a firm pays a dividend D_1 of ₹15 at the end of the current year and thereafter, dividends will grow at the rate of 10 per cent per annum. Suppose the investor's discount rate is 15 per cent. The present value of this stream is given by[2]

$$S_0 = \frac{D_1}{k_s - g} = \frac{15}{0.15 - 0.10} = ₹300 \tag{2.2}$$

(In the above formula, g denotes the annual growth rate of dividends which in the present example is 10% or 0.10).

Suppose the investor buys this share for ₹300 today and holds it for 3 years. Its value at the end of the third year is

$$S_3 = \frac{D_4}{k_s - g} \tag{2.3}$$

The dividend D_4 at the end of the fourth year is

$$D_4 = D_1(1 + g)^3 = 15(1.1)^3 = 19.965$$

Hence, $\quad S_3 = 19.965/(0.05) = 399.30$

The value of the share at the end of the third year is the discounted value of all the dividend payments from that time on. Thus, the investor who holds the share for three years and then sells it receives three dividend payments and the sales proceeds at the end of the third year. The present value (today) of these payments is

$$S_0 = \sum_{1}^{3} \frac{D_1(1+g)^{t-1}}{(1+k_s)} + \frac{S_3}{(1+k_s)^3} \tag{2.4}$$

For the example at hand, this works out to

$$S_0 = 15/(1.15) + 15(1.1)/(1.15)^2 + 15(1.21)/(1.15)^3 + 399.30/(1.15)^3$$
$$= 13.0435 + 12.4764 + 11.9337 + 262.5419 = 299.9945$$

This equals the value obtained for S_0 earlier, viz. 300 except for rounding off errors.

Thus, the concept of wealth maximisation incorporates a multi-period horizon with any combination of dividends and capital gains. The next question is how it is affected by uncertainty.

Uncertainty makes equity shares risky assets. Since future after-tax cash flows are uncertain so are dividend payments and capital gains. The modern theory of finance as represented by the famous Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT) rests on the following three propositions:

1. Investors are "risk-averse", i.e. they demand compensation for investing in risky assets. More specifically, if one asset (say a share of company A) is perceived to be riskier than another

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[2] The following formula for the present value of a steadily growing annuity sometimes called the Gordon growth model can be found in any standard text on capital budgeting such as Bierman and Schmidt (1990).

(say a share of company B) they would demand a higher *expected* return from asset A. Risk is to be understood as some measure of variability of cash flows. Thus, suppose A and B have identical expected (in some sense "average") dividend streams but A's cash-flows are perceived to be liable to greater fluctuations than B's, asset A will be priced lower than B. In terms of our valuation equation, investors would use a ***higher rate of discount*** to discount cash flows from A than from B.

2. A risky asset has two types of risks associated with it. One is the ***unsystematic,*** asset-specific risk and the other is ***systematic*** risk. In the context of share valuation, risks arising out of firm-specific factors are unsystematic risks whereas risks arising out of movements of general economic and industry variables are systematic risks. Thus, a firm in, say, textile industry will perform badly when the entire economy is passing through a severe recession or when the entire textile industry is facing problems due to shortage of cotton; so will most firms in most industries or in the latter case most firms in the textile industry. On the other hand, this firm may sometimes perform badly even when the economy is booming and the textile industry is also doing well because of some adverse circumstances peculiar to the firm – say a long drawn-out strike. The former is systematic risk while the latter is unsystematic. The total variability in the firm's cash flows can be broken down into two components, one attributable to factors peculiar to the firm while the other is due to the general economic and market conditions.
3. Risk-averse investors will not worry about firm-specific, unsystematic risks since these risks are diversifiable. Investors will invest in a number of companies covering a broad range of industries and also in real assets such as houses and stocks of commodities. My stocks in a textile firm may perform badly because of factors peculiar to that firm, but at the same time, my stock in an IT firm may be doing extremely well. My portfolio as a whole would not be very sensitive to such firm-specific factors. Hence, no additional compensation will be demanded for these risks. Thus, the only risk that matters is the systematic risk arising out of the fact that the firm's fortunes may be linked to the general economic conditions.

The Capital Asset Pricing Model thus arrives at the famous result known as the ***Security Market Line*** which says that the expected return on a risky asset consists of the risk-free return plus a risk premium which depends only on the ***covariance*** of the firm's cash flows with general economic and market conditions[3] :

$$E(R_i) = R_f + [E(R_m) - R_f]\left(\frac{\sigma_{im}}{\sigma_m^2}\right) \tag{2.5}$$

R_i denotes the rate of return on the risky asset i, R_m is the rate of return on the "market portfolio", R_f is the rate of return on a risk-free asset (such as a treasury bill) and $\sigma_{\mathbf{im}}$ and $\sigma^2_{\mathbf{m}}$ are the covariance between the returns on asset i and the market portfolio, and the variance of the return on market portfolio, respectively. E is the expectation operator. The ratio $[\sigma_{\mathbf{im}}/(\sigma^2)_{\mathbf{m}}]$ is called the "Beta" of asset i. Investors would use the expected value of R_i as the rate of discount to find the present value of the income stream associated with asset i. Thus, the wealth maximisation hypothesis allows for uncertainty through its impact on the rate of discount k_s in equations (2.1) and (2.2).

[3] Elementary discussions of CAPM, APT and security market line can be found in any intermediate corporate finance text. A more advanced treatment is contained in Copeland and Weston (1988).

2.2 RISK MANAGEMENT AND WEALTH MAXIMISATION

A large part of this book will be devoted to techniques for managing financial risks, in particular those which arise more prominently in the context of international finance. The above discussion of the impact of risk on the value of the firm gives rise to a very important and interesting question: what should be the attitude of the firm's management regarding firm-specific risks? It appears that since these risks are diversifiable, they are not "priced" by the investors, i.e. they do not affect the expected rate of return demanded by the investors – the discount rate k_s. Why then should the firm spend resources to insure against these risks? Even if certain risks are systematic in the sense that they affect almost all firms adversely, it is not clear that hedging such risks necessarily adds to shareholder value. As Fite and Pfleiderer (1995) have argued such risks can be hedged only at a cost since the party to whom the risk is transferred will demand compensation for bearing the risk. Thus, for instance, while it is true that increase in energy costs will have an adverse impact on almost all firms, in an efficient market, the compensation that has to be paid for bearing this risk would just equal the increase in the value of the firm resulting from eliminating this risk; on balance the firm's shareholders will neither gain nor lose.

Risks arising out of fluctuations in exchange rates, interest rates and commodity prices are pervasive, i.e. affect most firms; however they affect different firms in different ways and are, therefore, firm-specific or idiosyncratic. For instance, strengthening of the dollar against the rupee will improve the prospects for exporting firms while the fortunes of those firms which have a heavy import content in their production will be affected adversely. The theory underlying the CAPM tells us that hedging such risks is irrelevant, i.e. adds no shareholder value[4].

Finally, even if the irrelevance argument is not found to be convincing, the well-known Modigliani-Miller analysis of a firm's optimal capital structure offers another argument against hedging. *In a world of no taxes, no transactions costs and no information asymmetries, they demonstrated that a firm's financing policy does not matter as long as it does not affect its investment policy.* If some shareholders are unhappy with the particular debt-equity structure adopted by the firm, they can achieve whatever leverage they desire by trading on their own account. The same argument can be extended to hedging risks such as exchange rate risks. A firm which exports to the United States and has dollar receivables can hedge these with forward sales of dollars against rupees; but if its shareholders can achieve the same result on their own (by taking similar but smaller positions in the dollar-rupee forward market), hedging by the firm will add no shareholder value[5]. If capital markets are perfect, individual investors, in particular a firm's shareholders, can replicate any financial strategy adopted by the firm. In such a world, active risk management policy cannot add value.

In practice, we find that firms do expend considerable amount of resources – managerial time and money – in an attempt to hedge firm-specific risks. For instance, they avoid highly risky investment projects, purchase insurance against product liability suits, enter into forward contracts in foreign exchange and specific commodities (which may be critical inputs) and so forth. Is there a rationale for these actions?

In addition to the "irrelevance of unsystematic risks" or "shareholders can do it themselves" arguments against hedging, it has also been argued that since financial markets are efficient, it makes

[4] There is also another consideration. In a well-diversified portfolio, the share of any single stock would be quite small. Even if a particular risk has significant impact on a particular firm's cash flows, its impact on the performance of a diversified portfolio is likely to be insignificant.

[5] If some of the shareholders are importers of American products, the exporter firm's exposure actually provides a natural hedge against their own exposure. They would rather not have the firm hedge it.

little difference in the long run whether and what kind of risk management posture a firm adopts. This means that with efficient markets, it would not matter in the long run whether a firm follows an active hedging policy, a purely passive strategy of hedging all risks at all times or a policy of no hedging at all. Note, however, that the hypothesis of efficiency of financial markets is far from firmly established.

If active risk management by a firm adds shareholder value, it must be (i) because it alters the firm's cash flows in a way which is beneficial to the shareholders even after meeting the cost of hedging and (ii) the firm can achieve this at a lower cost than what the shareholders would have to incur, if they did it on their own. This is possible in the presence of some capital market imperfections which are assumed away by the Modigliani-Miller theorem.

With reference to the valuation equation, hedging can increase shareholder wealth both by influencing future cash flows and by reducing the discount rate at which these cash flows are discounted. In general, it is true that the former effect is stronger though there can be circumstances under which hedging can reduce the expected return investors demand from a particular firm[6].

One of the most cogent arguments for hedging by the firm has been presented by Froot *et al.* (1994)[7]. They not only provide a rationale for hedging as such but also put forward an explanation as to why selective or discretionary hedging, rather than hundred per cent hedging, might be an optimal policy under certain conditions. The main thrust of their argument can be summarised as follows:

1. Firms enhance shareholder wealth – create "corporate value" – by making good investments. "Investments" here means not only physical plant and equipment but also R&D, product development, market investments such as advertising and promotion and so forth.
2. The firm's ability to take advantage of all the available good investment opportunities depends crucially on the availability of internally generated cash. While in a world of no taxes, no bankruptcy costs and perfect capital markets, the financing of investments may be irrelevant[8], in practice, firms typically prefer to finance projects with internal funds as much as possible. External finance – debt and new equity in that order – are less preferred alternatives. When a firm finds itself short of internal funds, it cuts back on its investment expenditures[9].
3. Careful hedging can minimise the probability of the firm finding itself short of internal cash at a time when the environment presents good investment opportunities.

This inter-linkage of investment and financing decisions also helps explain why it may not be necessary to hedge all environmental exposures or at least not hundred per cent. For an oil producer, further investments in exploration and development become attractive when oil prices are ruling high; but this is precisely when internal cash generation is also high. Hence, the firm may not have

[6]This can happen for shareholders whose portfolios are heavily weighted in favour of a particular firm's stock. Also, if the firm can pass on a particular risk "out of the system", its required rate of return can decrease. For a discussion of these points, see Fite and Pfleiderer (1995).

[7]A more formal version of their argument is presented in Froot ***et al***. (1993).

[8]This is the famous Modigliani-Miller result which says that value creation takes place on the "left-hand side" of the balance sheet—firms making investments which ultimately increase their operating cash flows. How these investments are financed on the "right-hand side", whether through internal sources, debt or new equity is largely irrelevant.

[9]Froot ***et al.*** (1993) demonstrate that when there are deadweight costs attached to creditors monitoring a firm's cash flows, and presence of taxes makes debt desirable in the capital structure, an expected value maximising firm will underinvest. As to new equity, it is very difficult for stock markets to correctly assess the value of a firm including potential value addition from new projects. Hence, the market may undervalue the firm – as perceived by managers. Therefore, managers are reluctant to issue new equity. In fact, the very act of issuing new equity might lead the market to think that the managers believe the stock of their firm to be overvalued.

to hedge against oil price fluctuations. On the other hand, a multinational pharmaceutical firm would find that its cash flows are very sensitive to exchange rates while emergence of profitable investment opportunities in R&D, new product development and so forth is largely independent of movements in exchange rates. Hedging against exchange rate fluctuations would minimise the probability of its having to sacrifice these opportunities on account of shortage of internally generated cash. The investment-financing inter-linkage predicts that firms with more growth opportunities are more likely to be hedgers than those with more stable businesses.

Shapiro and Titman (1985) point out that unsystematic risks like exchange rate risk, if left unmanaged, increase the probability of the firm getting into financial distress. There are both direct and indirect costs of financial distress. Direct costs refer to the costs incurred during bankruptcy, liquidation or reorganisation process. Even if exchange rate and interest rate exposure does not lead to bankruptcy, there are indirect costs of financial distress due to loss of credibility in the eyes of the firm's customers, suppliers and workers. This can lead to an adverse impact on the firm's revenue or an increase in its operating costs. If its bankers, suppliers, customers and employees think that the firm is in a liquidity crunch, they may react in a manner that can sometimes threaten the very survival of the firm, but will most probably affect its future operating cash flows[10]. Shapiro and Titman offer five reasons why this could happen. We will take a brief look at them.

1. *Financial distress and the possibility of bankruptcy can affect managerial incentives.* Managers are more likely to choose high-risk investments that benefit shareholders at the expense of the firm's creditors. They are likely to cut corners on product quality and the safety of workers. Finally, there will be an incentive to get out of the business which they would otherwise have continued.
2. *The suspicion that the firm may be slackening on quality and the fear* (in the case of firms which sell consumer durables, capital equipment, etc.) that if the firm goes out of business, after-sales service and spares will be difficult to obtain, may scare away customers and thus affect sales volumes adversely.
3. *A firm which is perceived to be struggling for survival will find its operating costs going up.* Suppliers will tighten credit terms (they may even demand advance payments), will be reluctant to undertake long-term commitments to supply highly specialised components and sub-assemblies (because these require investment in fixed assets on their part which are not readily transferable to other uses). The firm may find it difficult to attract and retain good personnel[11] thus raising its labour costs and/or reducing productivity.
4. *When day-to-day survival is in doubt, the firm is likely to become less careful about its creditworthiness.* Creditors, realising this, are likely to stiffen their terms. Trade credit, bank advances and term loans will become more expensive or even totally unavailable.
5. *The firm will have to incur higher costs just to maintain the organisation.* Employees, suppliers, creditors and other stakeholders will demand compensation for bearing added risks involved in dealing with a firm perceived to be in financial distress.

In essence, what this argument says is that while financial markets may be efficient and hedging or no hedging may not make a difference in the "long run", the firm may not have the luxury of a

[10] A classic case is that of Metallgeselschaft whose American subsidiary was forced into bankruptcy because of the liquidity crisis it faced when its large positions in oil futures incurred losses and huge amount of cash had to be found to honour the margin calls. In the debate that ensued in the academic circles one view was that a temporary liquidity problem was converted into financial disaster because the company's bankers refused to extend credit. See Miller and Culp (1994).

[11] Unlike the shareholders, the firm's employees may not have a "portfolio" of sources of income; if a large part of their income is derived from their employment with the firm, they would take an unfavourable view of the unsystematic risks.

long run; serious damage may have been done before the dice turns in its favour. The assertion that in the long run things would even out is little comfort to a treasurer who is faced with the prospect of a huge cash loss in the next quarter on account of unfavourable exchange rate movements.

Another argument in favour of hedging has to do with the nature of tax schedules faced by the firm. In many countries, tax schedules exhibit "convexity", i.e. the marginal tax rate rises as taxable income rises. A consequence of this is that the tax paid when taxable profits are high, are more than the tax saved when an equal loss occurs. Thus, suppose that due to exchange rate uncertainty, a firm's taxable income could be either +1000 or –200 with equal probability. Taxable income up to 500 is taxed at a rate of 40 per cent while income in excess of 500 is taxed at a rate of 50 per cent. Its expected tax liability would be

$$0.5(0) + 0.5\,[0.4 \times 500 + 0.5 \times 500] = 225$$

Suppose with hedging of currency exposure, it can lock in taxable income of

$[0.5(-200) + 0.5(1000)]$ or 400. Its tax liability would be (0.4×400) or 160, a tax saving of 65. Another point to note is that even when marginal tax rates are constant, tax laws generally allow losses to be set off against taxable income in the future. With positive interest rates, this reduces the present value of such tax savings. Also, when a firm makes losses and has no taxable income, it cannot take advantage of tax write-offs for depreciation, interest and incentives such as investment tax credits. Thus, reducing the variability of pre-tax income enables the firm to save on taxes in a number of ways. Graham and Smith (1999) have estimated that for a typical US firm, 5 per cent reduction in the variability of before-tax income results in a saving of 3 per cent in taxes.

While this appears to provide an important reason for hedging currency and other macroeconomic risks, surveys of managers' motivations do not bring it out as an important factor.

Agency-theoretic explanations for hedging focus on the conflict between stockholders and bondholders. There is the well-known problem of "under-investment" described by Myers and Majluf (1984). If stockholders think that a large part of the cash-flows from a new project will accrue to bondholders, they will not undertake some positive-NPV projects when they have to issue risky debt. Hedging can reduce or eliminate the probability of default and induce firms to undertake more investment. Once again, this rationale for hedging predicts that firms with greater growth opportunities (and hence, more room for discretionary investment decisions) are more likely to be hedgers.

Many other explanations have been advanced to account for the observed fact that firms do expend considerable resources managing their exposures to macroeconomic risk factors like exchange rates, interest rates and commodity prices[12].

The argument that shareholders can hedge their own risks by diversifying their portfolios[13] as well as using hedging instruments like forward contracts assumes that shareholders have the same access to hedging instruments as the firm. Also, some risks can be hedged internally without recourse to any hedging products. Such possibilities will be better known to the management of the firm rather than its shareholders. There is also the problem of information. To do it themselves, shareholders would need information on the timing and amount of currency and other exposures faced by the firms in their portfolios; gathering such information would prove to be a costly activity for most shareholders whereas for firms there is no additional cost involved.

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[12] For references to the relevant literature, see Froot *et al*. (1993), Fite and Pfleiderer (1995).

[13] For instance, both an oil producer and a user of oil are exposed to oil price fluctuations, but the impact on their businesses is opposite in direction. An investor can buy shares in both the firms and insulate his portfolio against oil price uncertainty. Similarly, an investor can hold stock in both an exporting firm and an importing firm to minimise the impact of exchange rate fluctuations.

It has also been pointed out that criteria used for appraising managerial performance may encourage hedging. In a multi-division firm, if each unit is judged on the basis of its own cash flows or profits, unit managers may engage in hedging to reduce the unit-level risk even when the firm as a whole may have a natural hedge. Thus, if one division is a net exporter to the US while another is a net importer, the firm as a whole may not have to hedge against rupee-dollar fluctuations, but individual divisions may still engage in active hedging of exchange rate exposure.

To sum up, there are good reasons why firms should and do pay attention to financial and operating risks which are specific to their own operations along with risks arising out of changes in the general economic conditions[14].

However, one point must be noted. In the case of a multinational firm whose shareholders are scattered around the world, it is not clear exactly how hedging serves shareholders' interests. Suppose an American firm has German and Japanese shareholders. If the firm follows the policy of stabilising its cash flows measured in US dollars, it may very well be ***destabilising*** the values of the portfolios of its foreign shareholders measured in their respective currencies. On the other hand, the presence of capital market imperfections is likely to be much more pervasive across national boundaries than within a country. This would induce greater concern about macroeconomic exposures on the part of multinationals compared to single-country firms.

Mian (1996) has provided some empirical evidence on the relationship between a firm's financial characteristics and hedging decisions. Surprisingly enough, he finds little or no relationship between hedging and growth opportunities, hedging and tax rate structure and between hedging and costs of financial distress. He does find a significant relationship between hedging and firm size indicating that perhaps there are significant economies of scale in hedging activity.

Summary

The above discussion leads us to a framework or paradigm for financial decision making. The two important considerations are return and risk.

In decisions involving deployment of the firm's financial resources, the treasurer must strive to maximise the expected return subject to the constraint that the associated risk does not exceed the level acceptable to the management. Alternatively, he should minimise the risk subject to the requirement that rate of return is above a specified level[15]. In more operational terms, the manager must strive to maximise the return while minimising the probability of financial distress. When it comes to the question of raising resources, the criterion would be to minimise the cost of funds subject to some ceiling on risk or minimise risk subject to some ceiling on the cost of funds.

Effective management of risks requires that the nature of these risks be properly understood. We must have operational definitions and some means of quantifying – however approximately – the magnitude of these risks. This will be the topic of the next chapter.

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[14] In early 1993, ***The Economist*** reported a court case in which shareholders of an agricultural cooperative in the US sued the management for failing to hedge price risk with the use of futures markets. After a long drawn out legal battle, the court upheld the shareholders' claim and found the management guilty of negligence.

[15] Theoretically, the "top management" can be supposed to have a "utility function" defined over return and risk. This function is to be maximised given the various investment opportunities.

Questions and Problems

1. A company's security is selling at ₹100, in the beginning of 19X1. The dividend payments for 19X1 are expected to be ₹5 per share. The retention ratio of the company is 60%. The earnings on book value per share is 20%. Compute the following:
(a) Payout ratio
(b) Dividend yield
(c) Dividend growth rate
(d) Market capitalisation rate

(***Hint:*** Retention ratio = 1 – Payout ratio
Payout ratio = DIV_1 EPS_1
Return on equity = ROE = EPS_1 Book equity per share
Dividend growth rate = g = Retention ratio *ROE)

2. Find the price of the security, given that the government bills give 8% returns and the market gives 25% returns. The dividend expected at the end of the year is Rs 5. The retention ratio is 60% and the earnings on book value per share is 20%. (Refer Question 1). The Beta of the security is 2.0.

3. The returns and standard deviation of common stock of IBM and NYSE market are:

$$E(R_j) = 0.0310 \qquad \sigma_j = 0.11785$$
$$E(R_m) = 0.04064 \qquad \sigma_M = 0.08654$$

The correlation of IBM's common stock to the NYSE market is:

$$\sigma_{j,M} = 0.7495$$

Give the characteristic line of IBM's common stock (estimated) and compute the undiversifiable and diversifiable components of the total risk of IBM's common stock.

(***Hint:*** Characteristic line is $R_{j,\,t} = \alpha_j + \beta_j\, R_{M,\,t} + e_{j,\,t}$
Also, Var $(R_j) = \beta_j^2$ Var (R_M) + Var $(\alpha_j + e_{j,t})$)

4. Enumerate the categories of risk factors that may contribute to an asset's total risk.

(***Hint:*** Macroeconomic factors, market factors, etc.)

5. Assume that a security has a beta of 1.05 and a residual standard error of 2%. If the market portfolio's standard deviation is 5%, what is the security's variance?

6. The covariance of return between two securities is +10, with the variance of returns being 12 and 8 on these two securities. Compute the correlation between these two securities. Compute assuming one of the security is the market.

7. Which of the following choices would you prefer and give your rationale?

(***Hint:*** Plot the return-standard deviation space)

(a) R_j = 10% and σ_j = 5% (say point A)
(b) R_j = 20% and σ_j = 5% (say point B)
(c) R_j = 10% and σ_j = 10% (say point C)
(d) (a) and (b)
(e) (a) and (c)

8. Why must a firm while managing the total risk of its cash flows take into consideration the performance of the economy as a whole?

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Chapter 3

The Nature and Measurement of Exposure and Risk

3.1 INTRODUCTION

The main purpose of this chapter is to understand the nature of currency exposure and risk and how it can be quantified. The values of a firm's assets and liabilities and its operating income vary continually in response to changes in a myriad of economic and financial variables such as exchange rates, interest rates, inflation rates, relative prices and so forth. We can label these uncertainties as **macroeconomic environmental** risks. In addition, uncertainties related to its operating business such as interruptions in raw materials supplies, labour troubles, success or failure of a new product or technology and so forth obviously have an impact on the firm's performance. These can be grouped under the heading of **core business risks**.

While core business risks are specific to a firm, macroeconomic uncertainty affects all firms in the economy. However, as we shall see later, the extent and nature of impact of even macroeconomic risks crucially depend upon the nature of a firm's business. For instance, fluctuations of exchange rate will affect net importers and net exporters quite differently; the impact of interest rate fluctuations will be very different on a bank compared to the effect it will have on a manufacturing firm; oil price gyrations will affect an airline in one way and an oil producer in a quite different way.

The nature of macroeconomic uncertainty can be illustrated by a number of commonly encountered situations. An appreciation of a foreign currency (or equivalently, a depreciation of the domestic currency) increases the **domestic currency** value of a firm's assets and liabilities denominated in the foreign currency – foreign currency receivables and payables, bank deposits and loans, etc. It will also change domestic currency cash flows from exports and imports. An increase in interest rates reduces the market value of a portfolio of fixed-rate bonds and may increase the cash outflow on account of interest payments. Acceleration in the rate of inflation may increase the value of unsold stocks, the revenue from future sales as well as the future costs of production. Thus, the firm is "exposed" to uncertain changes in a number of variables in its environment. These variables are sometimes called **Risk Factors**.

Uncertainties arising out of fluctuations in exchange rates, interest rates and relative prices of key commodities such as oil, copper, etc., create **strategic exposure and risk** for a firm. As we will see below, the long-run response of the firm to these risks can involve significant changes in the firm's strategic posture – choice of product-market combinations, sourcing of inputs, choice of technology, location of manufacturing activities, strategic alliances and so forth.

The primary focus of this book is on the firm's exposure to changes in exchange rates and interest rates. However, as we will see later, exchange rates, interest rates and inflation rates are intimately interrelated and are, in turn, related to a whole complex of macroeconomic variables. In many cases, it may be very difficult to isolate the effect of changes in any one of them on the firm's assets, liabilities and cash flows.

It is not uncommon to find the terms **exposure** and **risk** being used interchangeably. However, as several authors have pointed out[1], the two are not identical. Exposure is a measure of the **sensitivity** of the value of a financial item (asset, liability or cash flow) to changes in the relevant risk factor while risk is a measure of the **variability** of the value of the item attributable to the risk factor. Let us understand this distinction clearly. During April 1993 to about July 1995, the exchange rate between rupee and US dollar was almost rock-steady. Consider a firm whose business involved both exports to and imports from the US. During this period, the firm would have readily agreed that its operating cash flows were very sensitive to the rupee-dollar exchange rate, i.e. it had significant **exposure** to this exchange rate; at the same time, it would have said that it did not perceive significant **risk** on this account because given the stability of the rupee exchange rate, the probability of large fluctuations in its operating cash flows on account of rupee-dollar fluctuations would have been perceived to be minimal. **Thus, the magnitude of risk is determined by the magnitude of exposure and the degree of variability in the relevant risk factor.**

3.2 EXCHANGE RATE AND INTEREST RATE VOLATILITY RECENT EXPERIENCE

Corporate treasurers have become increasingly concerned about exchange rate and interest rate exposure and risk during the last ten to fifteen years or so. In the case of exchange rate risk, the increased awareness is firstly due to the tremendous increase in the volume of cross-border financial transactions (which create exposure)[2] and secondly due to the significant increase in the degree of volatility in exchange rates (which, given the exposure, creates risk). For non-financial corporations, the risks due to increased volatility of interest rates are heightened as a result of the substantial increase in the volume of floating rate borrowing in recent years.

A perspective on the magnitude of these risks can be obtained by looking at some recent data on exchange rates and interest rates. Table 3.1 presents some data on the exchange rates of some of the major convertible currencies against the US. dollar while Tables 3.2 and 3.3 give the exchange rates of the Indian Rupee.

Figure 3.1 shows how the US dollar has moved against the Swiss franc, the British pound and the Euro from January 2001 to early 2010. Figure 3.2 shows the path of the Yen/Dollar exchange rate.

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[1] See, for instance, Adler and Dumas (1984), Flood (1986), Oxelheim and Wihlborg (1987) and Levi (1990). We follow Levi in our treatment of these concepts.

[2] However, even a firm **without any cross-border transactions** can nevertheless have a significant degree of exchange rate exposure. We will see this more clearly later in this chapter.

While Figure 3.3 shows daily data on rupee exchange rates against five major currencies covering the period January 1, 2009 to May 7, 2010. Figure 3.4 shows monthly data on rupee exchange rates from October 2011 to July 2013. Table 3.4 and Figures 3.5 and 3.6 give some idea of the variability in Euromarket short-term interest rate known as LIBOR (London Inter-Bank Offer Rate).

In view of these data, it is hardly surprising that companies have devoted considerable efforts to the task of identification, measurement and hedging of foreign exchange and interest rate exposures and risks. Our task in this chapter is to understand the nature of these risks and the issues involved in their measurement. We will first deal with foreign exchange exposure and risk, and then go on to analyse interest rate risk.

Table 3.1 Exchange Rates of the US Dollar

Start of	*Yen/$*	*SFr/$*	*$/Pound*	*$/Euro*	*₹/$*
2003	118.81	1.3765	1.6175	1.0622	47.96
2004	106.27	1.2391	1.8255	1.2638	45.46
2005	103.34	1.1792	1.8797	1.3123	43.62
2006	115.48	1.2773	1.7686	1.2126	44.20
2007	120.45	1.2431	1.9587	1.2993	44.21
2008	107.82	1.1006	1.9702	1.4728	39.27
2009	90.12	1.1267	1.4462	1.3244	48.70
2010	91.10	1.0345	1.6158	1.4266	45.89
2011	81.56	0.9329	1.5490	1.3348	44.59
2012	76.67	0.9319	1.5655	1.2935	53.11
2013	87.10	0.9262	1.6255	1.3262	54.23

Source: Federal Reserve Bank of St. Louis.

Table 3.2 Exchange Rates of the Indian Rupee

End of	*₹/Dollar*	*₹/Pound*	*₹/Euro*	*₹/100 Yen*
Dec 2003	45.61	81.19	57.34	42.68
Dec 2004	43.59	84.12	59.42	42.50
Dec 2005	45.67	77.91	53.57	38.44
Dec 2006	44.25	86.96	58.30	37.23
Dec 2007	39.42	78.79	58.14	35.23
Dec 2008	48.46	70.00	68.25	53.70
Dec 2009	46.69	75.11	67.14	50.54
Dec 2010	44.81	69.27	59.85	55.07
Dec 2011	53.25	82.10	68.96	68.66
Jul 2012	55.81	87.67	68.45	71.35

Source: ***RBI Monthly Bulletin,*** Various Issues.

Table 3.3 Rupee Exchange Rates October 2011–August 2013

Date	USD/INR	EUR/INR	GBP/INR	JPY/INR
Oct-11	49.5209	67.83685	78.02253	64.64869
Nov-11	50.7983	69.01943	80.41523	65.54619
Dec-11	53.0675	69.97297	82.78861	68.18386
Jan-12	51.909	66.93617	80.49155	67.46686
Feb-12	49.4113	65.33294	78.07126	63.04874
Mar-12	50.6989	67.00000	80.23247	61.52033
Apr-12	52.1835	68.73485	83.50696	64.09962
May-12	54.4692	69.93093	86.88658	68.31707
Jun-12	55.8476	70.01956	86.81424	70.49684
Jul-12	55.1853	67.92873	86.10594	69.81063
Aug-12	55.3555	68.56019	86.95492	70.35524
Sep-12	54.2308	69.7054	87.27197	69.35772
Oct-12	52.8582	68.55798	84.99469	66.98543
Nov-12	54.6891	70.1592	87.32093	67.63431
Dec-12	54.5574	71.5038	87.99581	65.23664
Jan-13	54.2248	72.00212	86.70419	60.9747
Feb-13	53.7386	71.91997	83.43208	57.7586
Mar-13	54.3651	70.54905	82.03576	57.41377
Apr-13	54.1933	70.53664	82.95316	55.43505
May-13	54.6595	70.97715	83.67958	54.19344
Jun-13	58.1846	76.66965	89.98546	59.6337
Jul-13	59.7605	78.13873	90.71114	59.9283
Aug-13	62.7872	83.6382	97.23897	64.18646

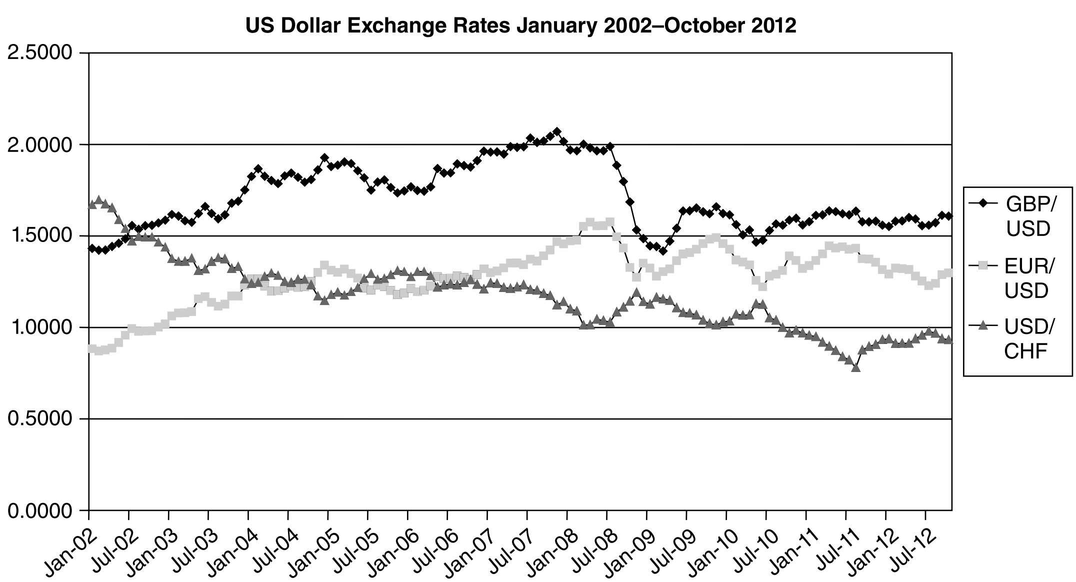

Fig. 3.1 USD/CHF: SWISS FRANCS per US DOLLAR
GBP/USD: US DOLLARS per BRITISH POUND
EUR/USD: US DOLLARS per EURO

Source: Federal Reserve Bank of St. Louis.

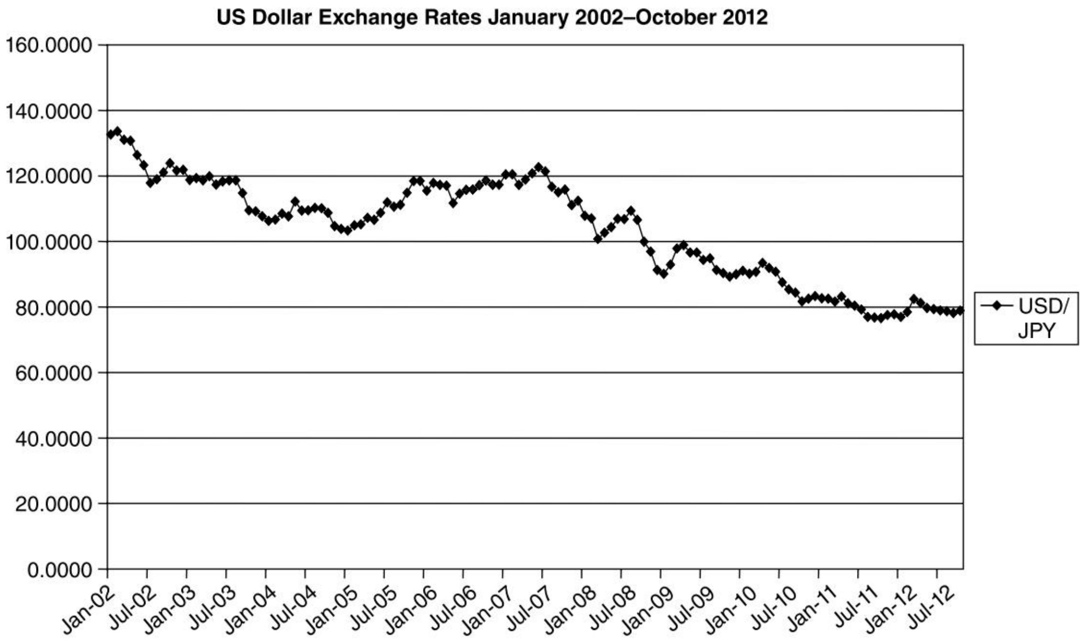

Fig. 3.2
Source: Federal Reserve Bank of St. Louis.

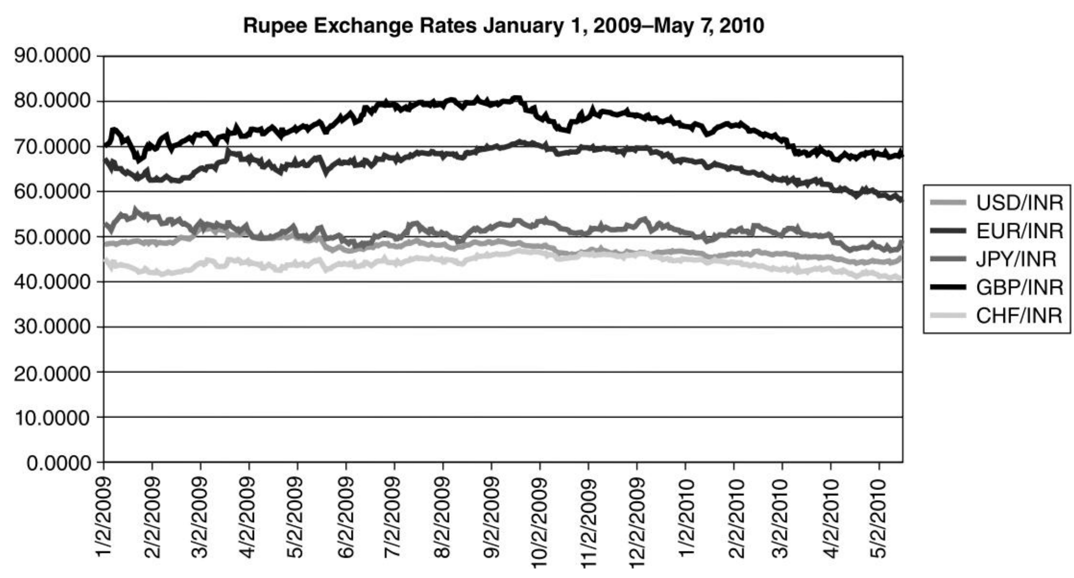

Fig. 3.3

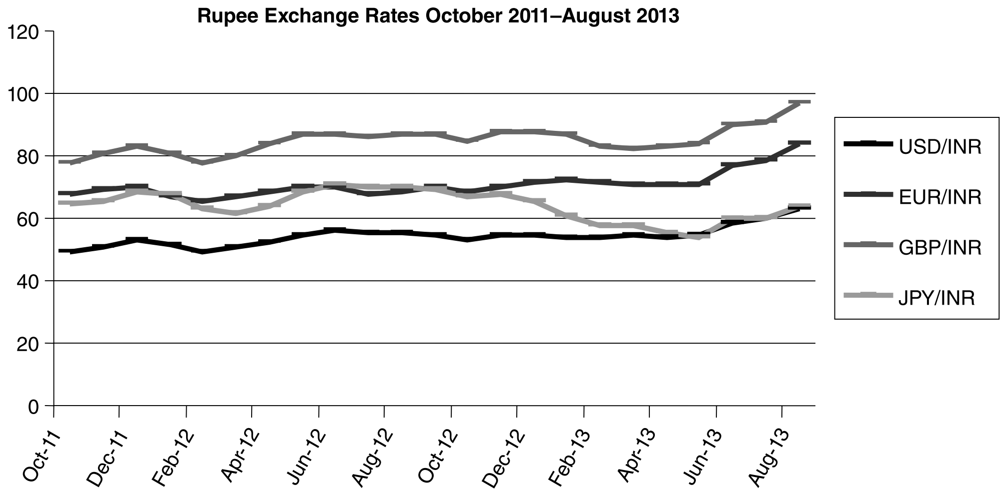

Fig. 3.4

Table 3.4 3-Month LIBOR Rates (% P.A.)

	CHF	*EUR*	*JPY*	*GBP*	*USD*
2008 Jan	2.71	4.5	0.9	5.66	4.02
2008 Feb	2.74	4.36	0.9	5.65	3.08
2008 Mar	2.84	4.63	0.96	5.93	2.75
2008 Apr	2.85	4.78	0.92	5.92	2.82
2008 May	2.78	4.86	0.92	5.83	2.7
2008 Jun	2.84	4.96	0.93	5.94	2.78
2008 Jul	2.79	4.96	0.92	5.83	2.79
2008 Aug	2.75	4.96	0.89	5.77	2.81
2008 Sep	2.78	5.01	0.91	5.92	3.15
2008 Oct	2.98	5.08	1.02	6.11	4.02
2008 Nov	1.74	4.14	0.91	4.16	2.23
2008 Dec	0.86	3.23	0.92	3.1	1.77
2009 Jan	0.57	2.45	0.74	2.34	1.23
2009 Feb	0.5	1.92	0.64	2.08	1.25
2009 Mar	0.43	1.62	0.62	1.81	1.26
2009 Apr	0.4	1.43	0.57	1.54	1.12
2009 May	0.4	1.29	0.53	1.36	0.82
2009 Jun	0.4	1.22	0.49	1.24	0.62
2009 Jul	0.37	0.94	0.43	0.99	0.51
2009 Aug	0.34	0.82	0.4	0.76	0.41
2009 Sep	0.3	0.73	0.36	0.61	0.3
2009 Oct	0.27	0.69	0.33	0.57	0.28
2009 Nov	0.25	0.68	0.31	0.61	0.27
2009 Dec	0.25	0.67	0.28	0.61	0.25
2010 Jan	0.25	0.63	0.26	0.61	0.25
2010 Feb	0.25	0.6	0.25	0.64	0.25
2010 Mar	0.25	0.59	0.25	0.65	0.27
2010 Apr	0.25	0.59	0.24	0.66	0.31

CHF: SWISS FRANC USD : US DOLLAR GBP: BRITISH POUND
JPY : JAPANESE YEN EUR : EURO

Source: Wall Street Journal and British Bankers' Association.

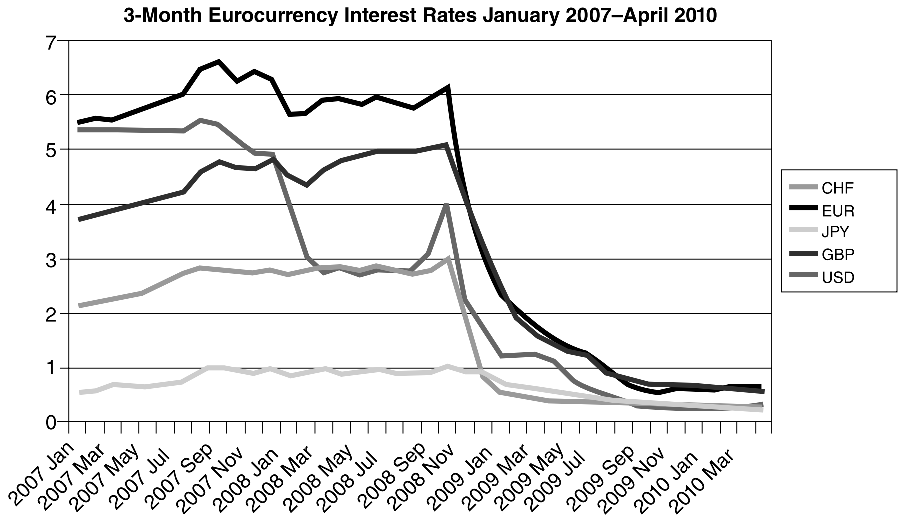

Fig. 3.5

Figure 3.5 shows daily data on 3-month LIBORS for the period January 2, 2013 to August 28, 2013 for US dollar, British pound, Japanese Yen and Euro. As shown in this chart, interest rates had fallen to very low levels – below 1 per cent – for all these currencies.

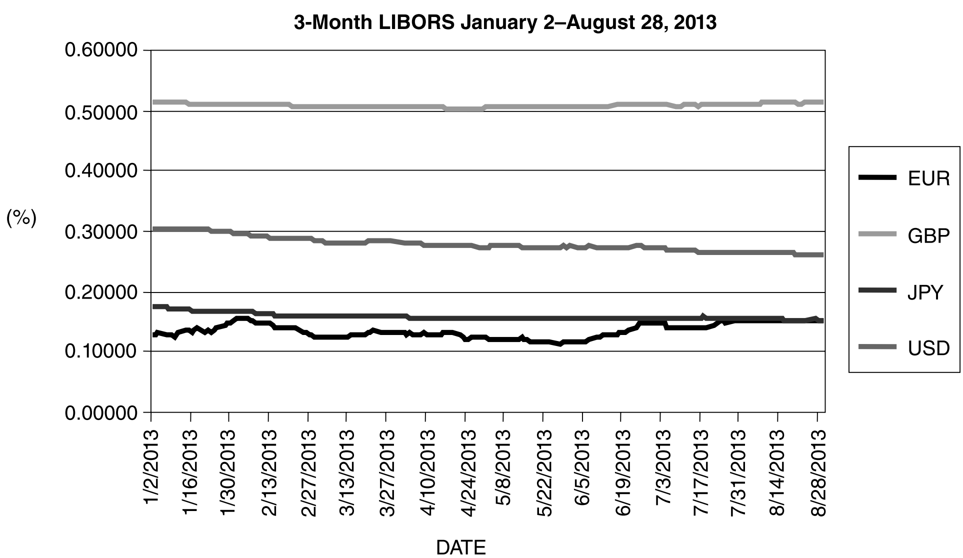

Fig. 3.6

3.3 EXPOSURE AND RISK: A FORMAL APPROACH

Exposure of a firm to a risk factor is the sensitivity of the real value of a firm's assets, liabilities or operating income, expressed in its functional currency, to unanticipated changes in the risk factor.

Let us begin with the definition of exposure.

Note the following important points about this definition:

1. Values of assets, liabilities or operating income are to be denominated in the **functional currency** of the firm. This is the primary currency of the firm and in which its financial statements are published. For most firms, it is the domestic currency of their country.
2. Exposure is defined with respect to **the real values**, i.e. values adjusted for inflation. While theoretically this is the correct way of assessing exposure, in practice, due to the difficulty of dealing with an uncertain inflation rate, this adjustment is often ignored, i.e. exposure is estimated with reference to changes in nominal values.
3. The definition stresses that only **unanticipated** changes in the relevant risk factor are to be considered. The reason is that markets would have already made an allowance for **anticipated** changes. For instance, suppose an exporter firm invoicing a foreign customer in the customer's currency is expecting that currency to depreciate against its own home currency. It will build an allowance for the expected depreciation of that currency into the price it quotes. A lender will adjust the rate of interest charged on the loan to incorporate an allowance for the expected depreciation. From an operational point of view, the question is how do we separate a given change in exchange rate or interest rate into its anticipated and unanticipated components since only the actual change is observable? One possible answer is to use the relevant **forward rate** as the expected value of the underlying risk factor. For instance, one possible estimate of what the exchange rate will be three months from now is today's three-month forward rate[3]. Suppose that the price of a pound sterling in terms of rupees for immediate delivery (the so called **spot rate**) is ₹90.00 while the 6-month forward rate is ₹91.20. We can say that the **anticipated** depreciation of the rupee is ₹1.20 per pound in six months. If six months later, the spot rate turns out to be ₹91.50, there has been an **unanticipated** depreciation of 30 paise per pound[4].

Box 3.1 presents an excerpt from **The Economist** which illustrates the notion of currency exposure.

Let us formalise the definition of exposure given above. The context will be that of currency exposure. Suppose a firm has dollar denominated assets and liabilities (e.g. export receivables, import payables, bank loans, bank deposits, etc.) as well as cash flows. We will use the following notation:

ΔV: Change in the real domestic-currency value of an item

S: The current value of the risk factor, e.g. spot exchange rate ₹/US $ expressed as number of rupees per dollar.

ΔS^u: Unanticipated change in the value of the risk factor. In this case unanticipated depreciation or appreciation of the rupee.

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[3] Like in other forward contracts, the forward exchange rate is the price of a currency, in terms of another, which is agreed upon today between the buyer and the seller for delivery at a specified future date. See Chapter 7.

[4] Whether the forward exchange rate can indeed be taken as an unbiased predictor (in a statistical sense) of the future spot exchange rate is a question, we will examine later. It can, however, be interpreted as market's "certainty equivalent" of the uncertain future spot rate.

Box 3.1 Companies and Currencies

Payment by Lottery

Volkswagen recently held only a muted ceremony to mark the making of its 50 millionth car. Its party spirit was an indirect victim of floating exchange rates. The company had just found itself apparently defrauded of DEM 480m ($266 m) by individuals whose job was to reduce Volkswagen's foreign exchange risk.

Consider some other, less criminal, prizes from the great exchange rate lottery:

- Eastman-Kodak reckons its pre-tax earnings were depressed by $3.5 billion between 1980 and 1985 because of the rising dollar. The dollar's subsequent fall revived its fortunes by adding 60 cents a share in 1986, but its market share abroad will take time to recover.
- Cadbury-Schweppes, a British drinks and confectionery firm, lost £10 m in pre-tax profits in 1985 through sterling's appreciation against the dollar.
- Canon, Japan's largest camera firm, reported a 69 per cent reduction in pre-tax profits for 1986, blamed largely on the climbing yen.
- BOC, a British industrial gases producer, banked a £16.8 m windfall profit in 1985 from selling forward all its dollar revenues for the year at $1.09 to the pound sterling.

Currency volatility saddles exporters and importers with short-term trading risks – exchange rates may move against them between doing a deal and getting paid or paying the supplier. They know, once a foreign deal is done, what their exposure (and hence, their risk) in a currency will be. There are three things they can do about it. First, do nothing; they risk a real loss if exchange rates move against them. Second, hedge all exposures fully; they risk an opportunity loss (i.e. the money they could have made by doing nothing), if the exchange rate moves in their favour. Or, third, try to predict exchange rates by hedging selectively. How do they choose?

Trading risks are short-term risks. But most companies must also worry about what happens to currencies in the long-term, beyond their immediate planning horizon. How do they cope with market-stealing bursts of competition from foreign firms whose costs are cheapened by a fall in their currency? Is a shift in business strategy the only answer to these long-term economic risks? Or can hedging help here too?

In Figure 3.7, we have plotted the change in the real rupee value of an item, ΔV, on the vertical axis and the unanticipated change in the Rupee-Dollar spot exchange rate, ΔS^u, on the horizontal axis. Positive values of ΔS^u indicate depreciation of the rupee and negative values indicate depreciation of the dollar. ΔV is measured in million rupees while ΔS^u is in rupees per dollar. The change in value could refer to a specific item such as a receivable or to a collection of items.

As shown in Figure 3.7, an unanticipated depreciation of the rupee results in a loss. This would be the case for a **liability** denominated in dollars such as a payable. In Figure 3.8, the reverse case is shown. For a dollar denominated **asset** such as a bank deposit or a receivable, rupee depreciation results in a gain while dollar depreciation results in a loss.

Suppose the linear relation between ΔV and ΔS^u can be represented by the following equation:

$$\Delta V = \beta_0 + \beta_1(\Delta S^u) \tag{3.1}$$

We will define exposure as the value of the slope coefficient β_1. As explained in the definition above, it is a measure of the sensitivity of V to unanticipated changes in S.

What can we say about the units of β_1? First, since ΔV is in million rupees and ΔS^u is in rupees per dollar, the units of measurement for the exposure, β_1, are millions of dollars. This is as it should be since a measure of exposure is supposed to tell us the amount in foreign currency that is exposed.

In Figures 3.7, 3.8 and equation (3.1) we have implicitly assumed that the change in exchange rate is the only risk factor affecting the value of the exposed item. This will indeed be the case, if the foreign currency value of the item is fixed.

Consider the case of a firm which has a 90-day receivable amounting to US $500,000 arising out of an export sale. The current spot rate is ₹53.20 per dollar and the three-month forward rate is ₹ 53.40. Three months later, the spot rate turns out to be ₹53.45; thus, unanticipated depreciation of the rupee is ₹0.05 per dollar. The gain in the rupee value of the receivable is ₹25,000. The exposure is[5]:

$$\Delta V/\Delta S^u = (25000)/(0.05) = \$500,000$$

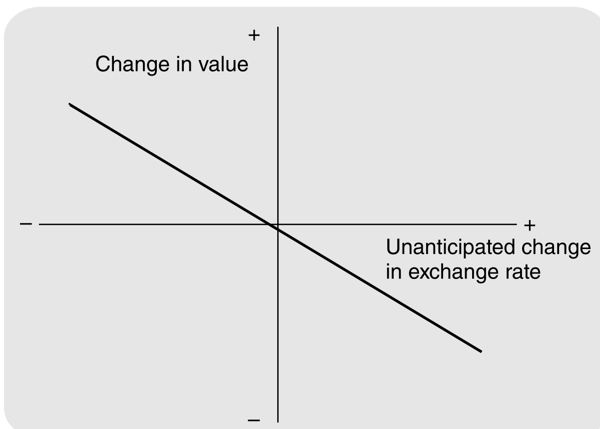

Figure 3.7 Exposure Line for a Foreign Currency Liability
Source: The Economist, April 4, 1987, London.

The reader can satisfy himself that the answer would be identical whatever be the value of ΔS^u. **When the foreign currency value of the exposed item is fixed, exposure identically equals that value.** Further, since the foreign currency value is fixed, the rupee value is exposed only to exchange rate changes[6].

Consider now a firm which exports denim jeans to the US. Currently it sells a pair of jeans for a price of $30. The exchange rate is ₹54.00. Its operating costs are entirely rupee denominated and equal ₹800 per pair of jeans. Thus, its operating margin on export sales is ₹820 per pair. Over the next year, US inflation is at 5 per cent per annum, Indian inflation is at 10 per cent per annum and by the year-end, the exchange rate depreciates to ₹56.70. Assume that it can raise its price in the US market by 5 per cent, the US rate of inflation, to $31.50 and its operating costs go up by 10 per cent, the Indian rate of inflation, to ₹880. Its operating margin now is

$$(31.50 \times 56.70) - 880 = 906.05 \approx 1.10(820)$$

[5] Note here that the "change" in the value is being measured with reference to the value at the current spot rate. As we will see in a later chapter, this amounts to using the current spot rate as a sort of "budget rate" for measuring losses and gains, not a recommended practice.

[6] Note, however, that the exchange rate change itself could be caused by changes in interest rates, inflation rates, etc. In that sense, the firm is exposed to these risk factors too.

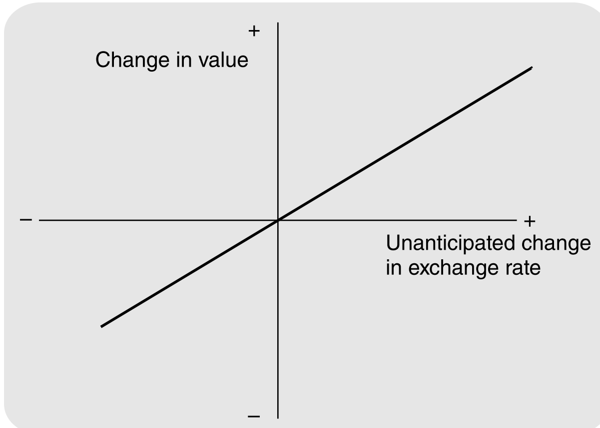

Fig. 3.8 Exposure Line for a Foreign Currency Asset

Thus, there has been no change in the **real** value of its operating margin; its exposure is zero.

Of course this result is derived with special assumptions. The three crucial assumptions we made were:

(a) The foreign currency price moves in line with the rate of inflation in the foreign country without any loss of sales for the firm.
(b) Operating costs keep pace with domestic inflation.
(c) The percentage depreciation of the rupee equals the excess of the home country's rate of inflation over that of the foreign country[7].

None of these assumptions is usually satisfied in practice. The extent to which foreign currency price can be changed and its impact on export sales depend upon the structure of the market in which the firm sells, extent of competition, changes in competitors' costs and the prices they charge, customer loyalty to the firm's brand name, etc. Changes in operating costs again depend upon the structure of markets for inputs, behaviour of wages and so forth. Things get more complicated, if some of the inputs are imported. Finally, movements in exchange rates generally do not compensate for differences in inflation rates between countries at least in the short run[8].

Suppose, for instance, that the firm could not raise prices in the US market by more than 3 per cent without losing market share and, further, the rupee depreciated only to 55.50. The firm's operating margin now is only ₹834.95 which after adjusting for 10 per cent inflation works out to ₹ 759.04 compared to ₹820 at the beginning of the year. The firm's competitiveness has been eroded. Conversely, suppose the rupee depreciates to 57.50. Now the inflation adjusted margin with a 5 per cent increase in foreign price and 10 per cent increase in costs would be ₹931.25, an improvement.

Unlike the case of a foreign currency denominated receivable or payable, we are here dealing with a case when the firm's future revenues, costs and profits are exposed to exchange rate fluctuations.

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[7] Strictly speaking we require the following relation to hold :

$$(1 + \hat{s}) = (1 + \pi)/(1 + \pi^*)$$

where $\hat{s}$ denotes the proportionate change in the exchange rate, and π and π^* are, respectively, proportionate rates of inflation in the home country and the foreign country. This is the famous Purchasing Power Parity relationship. More on this later. In the above example, π is 0.1, π^* is 0.05 and hence $\hat{s}$ should be 0.0476.

[8] This issue relates to the validity of the famous Purchasing Power Parity doctrine and behaviour of ***real*** exchange rates. We will discuss this in greater depth later.

The moral is that in the case of items whose values are not contractually fixed in foreign currency and are subject to influences other than exchange rate an exact relation like equation (3.1) cannot be valid. Instead, we must have a **stochastic** relation

$$\Delta V = \beta_0 + \beta_1(\Delta S^u) + \varepsilon \tag{3.2}$$

where the symbol ε denotes a random variable which represents the combined influence on ΔV of factors other than unanticipated exchange rate changes.

Those familiar with some elementary statistical methods will recognise (3.2) as a **regression equation.** The first two terms on the right, viz. $[\beta_0 + \beta_1(\Delta S^u)]$ constitute the **systematic component** of the relationship which in this case captures the systematic relation between exchange rate changes and the changes in the values of exposed items; the random element ε accounts for the joint influence of other factors. The slope coefficient β_1 is the measure of foreign exchange exposure.

Estimation of the Exposure Line

The interpretation of the exposure relationship as a regression equation suggests that an estimate of β_1 can be obtained by the method of ordinary least squares[9]. We can collect historical data on ΔV and ΔS^u and fit a straight line to the data by the least squares method. The slope of the fitted line then is the measure of exposure.

As we have seen above, in the case of items with contractually fixed foreign currency values, there is an exact systematic relation between ΔV and ΔS^u and all our data points will fall precisely on the line. In the case of items whose foreign currency values can change, there will be "noise" in the relationship due to the random element ε. The data points will not fall exactly on a straight line; we can statistically estimate the parameter β_1. However, in this case, the reliability of the estimated equation will depend upon the relative strengths of the systematic and random components of equation 3.2.

More pertinent, however, is the fact that the exposure relation in equation 3.2 may not be **stable**, i.e. the underlying "true" values of the parameters β_0 and β_1 may be changing over time, particularly if the relationship is being estimated for the entire collection of a firm's assets or liabilities and the composition of these collections changes over time. Further, in practice, it may be quite difficult to obtain estimates of changes in **real domestic currency values** of exposed items. (As seen above, the unanticipated change in exchange rate can be proxied by the difference between actual change and the change implied in the forward rate.)

In practice, therefore, estimation of exposure requires that the finance manager should construct alternative scenarios of exchange rates, interest rates and inflation rates and examine the impact of each combination on the various items in the firm's balance sheet and projected income statement. This will be discussed in more detail in later chapters.

The idea of foreign exchange exposure as the systematic relation between the change in real domestic currency value of an item and the unanticipated change in exchange rate can be extended to multiple exposures, for example, when the firm has receivables in many foreign currencies. The relationship can be written as:

$$\Delta V = \beta_0 + \beta_1(\Delta S_1^u) + \beta_2(\Delta S_2^u) + \ldots + \beta_n(\Delta S_n^u) + \varepsilon \tag{3.3}$$

[9] Ordinary least squares is a statistical technique used to fit a relationship to historical data. Suppose we have data on two variables x and y and want to fit the line $y = a + bx$. The least squares method involves choosing values for a and b so as to minimise the sum of squares of discrepancies between the actual values of y and values calculated from the fitted equation.

The slope coefficients $\beta_1, \beta_2, \ldots \beta_n$ measure the exposure with respect to the corresponding exchange rate. One can also include other risk factors in the above equation to estimate the exposure to them.

Finally, it must be recognised that exchange rate changes can affect a firm even if all or most of its assets, liabilities and cash flows are denominated in its home currency. This is because of the intimate connection between exchange rates and other macroeconomic variables like interest rates and price level. For instance, in response to an actual or incipient depreciation of the home currency, the monetary authorities might resort to raising interest rates at home in order to attract short-term foreign capital or make it difficult for domestic residents to borrow home currency to buy and hold foreign currency. This, in turn, will adversely affect the market value of a portfolio of fixed interest securities held by the firm. For a non-financial firm selling consumer durables like cars, higher interest rates may be bad news. As another example, changes in exchange rates will affect the relative competitiveness of a firm which produces an import substitute and hence, will affect its future sales and cash flows. An appreciation of the home currency reduces home currency price of imports; if a firm produces an import-competing product, such an event would have a depressing effect on its sales. Thus, even a "purely domestic" firm is exposed to exchange rate changes. We will discuss this sort of "indirect" exposure in greater detail in a later chapter.

In contrast to exposure which is a measure of the response of value to changes in the relevant risk factor, **risk** is a measure of variability of the value of an item attributable to variations in the risk factor. There are many ways to quantify this concept of variability. The one used most often by statisticians is the so-called **variance** or its square-root known as **standard deviation**. The variance of a random variable is a probability-weighted measure of departures from its average value. Using this measure of variability, foreign exchange risk can be defined as

> **The variance of the real domestic currency value of assets, liabilities or operating income attributable to unanticipated changes in exchange rates.**

Recall the exposure equation (3.2). The total change in value ΔV can be broken down into that attributable to exchange rate changes and the rest attributable to other factors captured in ε.

$$\Delta V = \Delta V^s + \Delta V^o$$
$$\Delta V^s = \beta_0 + \beta_1(\Delta S^u)$$

where ΔV^s is the change in value attributable to unanticipated change in the exchange rate. Foreign exchange risk is defined as the variance of ΔV^s. From elementary statistics[10]

$$\text{var}(\Delta V^s) = \beta_1^2[\text{var}(\Delta S^u)]$$

Risk as defined here depends upon the exposure as β_1 appears in this relation. It also depends upon the variance of the unanticipated changes in exchange rates.

Consider an example. A firm has a 90-day payable of 100,000 Swiss francs. The current spot rate is ₹42.00/SFr. The 90-day forward rate is ₹42.50. The spot rate 90-day hence is assumed to have a normal distribution with a mean of ₹42.50 and a standard deviation of ₹0.05[11]. Denote the current spot rate by S_0, and the spot rate that will rule 90-day from today by S_3.

[10] Things are a little more complicated than they appear. Risk should really refer to the variance of ΔV. It can be decomposed into a part due to exchange rate changes and another due to other factors captured in ε only if the systematic part ΔV is uncorrelated with ε. This is a dubious assumption.

[11] A normal distribution describes probabilities of the random variable assuming values within certain limits. It is a symmetric, bell-shaped distribution. If a variable X has a normal distribution with mean μ and standard deviation σ, then about 67% of the values of X lie between $\mu \pm \sigma$, about 95% between $\mu \pm 2\sigma$ and approximately 99% between $\mu \pm 3\sigma$.

As of today, S_3 is a random variable with expected value $E(S_3)$.

The total change in exchange rate from today to 90-day is $(S_3 - S_0)$. This can be broken down into

$$S_3 - S_0 = [S_3 - E(S_3)] + [E(S_3) - S_0] = \Delta S^u + \Delta S^a$$

where $E(S_3)$ means "expected value of S_3", ΔS^u is the unanticipated component of the change and ΔS^a is the anticipated component. Thus, suppose the spot rate 90 days hence is ₹42.90. The total change is ₹0.90 (= $S_3 - S_0$), anticipated change is 0.50 [= $E(S_3) - S_0$] and unanticipated change is 0.40 [= $S_3 - E(S_3)$]. Since S_3 has a normal distribution with mean 42.50 and standard deviation ₹0.05, $[S_3 - E(S_3)]$ will have a normal distribution with mean zero and identical standard deviation of ₹0.05. Since the unanticipated change in the rupee value of the payable is given by $100000(\Delta S^u)$, it will also have a normal distribution with mean zero and standard deviation of ₹5,000. Using the properties of the normal distribution (see footnote 9), one can say with 95% confidence that the unanticipated change in the value of the payable will lie between –10000 and +10000. Since the anticipated change is ₹50,000 (= 0.50 × 100000) the total change will be between ₹40,000 to ₹60,000.

Thus, the measure of risk tells us how volatile the values of the firm's assets, liabilities or operating income are in the face of fluctuations in the underlying risk factor, in this case, the exchange rate.

Instead of variance, one can estimate the possible range, i.e. the difference between the highest and lowest values of the item given certain assumptions about the possible range of variation in the exchange rate. In a similar vein, one can construct alternative scenarios of exchange rate movements (or movements in any other risk factor). The "best case" and the "worst case" scenarios correspond to the most favourable and the least favourable circumstances. For instance, for a company with a payable in foreign currency, "best case" would correspond to the largest depreciation (or smallest appreciation) of the foreign currency considered likely and the "worst case" would consider the maximum appreciation. Several alternative scenarios in-between can be considered. One could go further and assign some probabilities to these alternative possibilities. We will consider some examples of such an approach in a later chapter.

3.4 CLASSIFICATION OF FOREIGN EXCHANGE EXPOSURE AND RISK

Since the advent of floating exchange rates in 1973, firms around the world have become acutely aware of the fact that fluctuations in exchange rates expose their revenues, costs, operating cash flows and hence, their market value to substantial fluctuations. Firms which have cross-border transactions – exports and imports of goods and services, foreign borrowing and lending, foreign portfolio and direct investment, etc. – are directly exposed; but even "purely domestic" firms which have absolutely no cross-border transactions are also exposed because their customers, suppliers and competitors are exposed. Considerable effort has since been devoted to identifying and categorising currency exposure and developing more and more sophisticated methods to quantify it.

Figure 3.9 presents a schematic picture of currency exposure. In the short term, the firm is faced with two kinds of exposures. It has certain contractually fixed payments and receipts in foreign currency such as export receivables, import payables, interest payable on foreign currency loans and so forth. Most of these items are expected to be settled within the upcoming financial year.

An unanticipated change in the exchange rate has an impact – favourable or adverse – on its cash flows denominated in its home currency on account of these items. Such exposures are known as **Transactions Exposures.** In essence, it is a measure of the sensitivity of the home currency value of assets and liabilities which are denominated in foreign currency, to unanticipated changes in exchange rates, **when the assets or liabilities are liquidated.** The foreign currency values of these

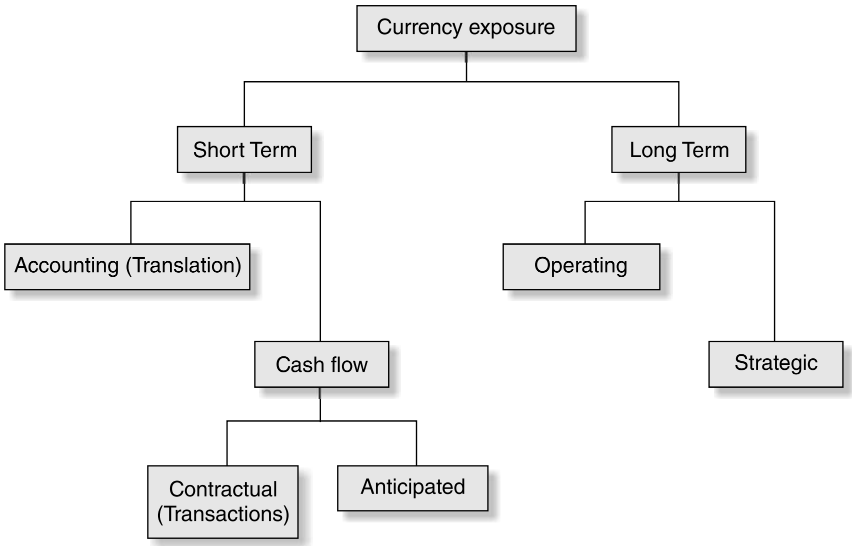

Fig. 3.9 The Taxonomy of Currency Exposure

items and the settlement dates are contractually fixed, i.e. do not vary with exchange rate. Hence, it is also known as **contractual exposure**.

Some typical situations which give rise to transactions exposure are:

(a) A currency has to be converted in order to make or receive payment for goods and services – import payables or export receivables denominated in a foreign currency.
(b) A currency has to be converted to repay a foreign currency loan or make an interest payment on the loan (or, conversely, receive a repayment or an interest payment); or
(c) A currency has to be converted to make a dividend payment, royalty payment, etc.

Note that in each case, the foreign currency value of the item is fixed and so is the time of payment or receipt; the uncertainty pertains to the home currency value. Typical examples of transactions exposure are captured in Boxes 3.2 and 3.3.

Box 3.2

It is May 7, 2012. An Indian company has cleared an import shipment of specialty chemicals. The invoice is for US $250,000 payable on August 10, 2012. The current exchange rate is ₹52.25 per dollar. The recent history of the exchange rate depicted in Figure 3.10 shows some volatility. During the last six months or so, dollar has shown both up and down movements against all currencies including the rupee. An adverse movement in exchange rate, viz. a sharp rise in dollar, will reduce the firm's cash flows. There is also the problem of how to value the imports for the purpose of product costing and pricing decisions.

- ***What should the firm do?***

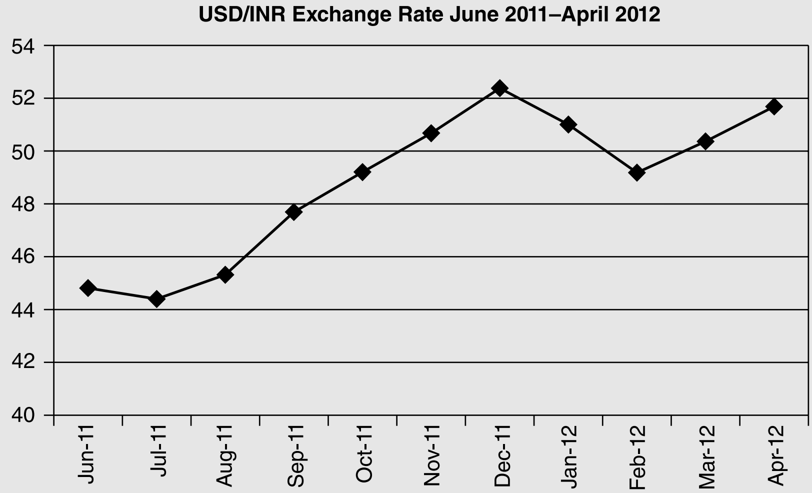

Fig. 3.10

Source: ***RBI Monthly Bulletin*** Various Issues

Box 3.3

It is early June 2010. A US firm has exported some computer peripherals to a German buyer. For customer relationship reasons the sale has been invoiced in buyer's currency, viz. Euro. The invoice is for €1,000,000 to be settled 60 days from now. The current exchange rate is $1.2721 per Euro. The recent history of the dollar-euro rate shown in Figure 3.11

Fig. 3.11

Source: Federal Reserve Bank of St. Louis

indicates a downward trend with some fluctuations. The firm's bankers are fairly bearish about the Euro because of some recent fiscal problems in some European economies, viz. Greece, Portugal, Ireland and Spain. However, the European Central Bank has expressed concern about the weak Euro.

- ***What should the firm do?***

Suppose a firm receives an export order. It fixes a price, manufactures the product, makes the shipment and gives 90 days credit to the buyer who will pay in his currency. A company has acquired a foreign currency receivable which will be liquidated before the next balance sheet date. The company has a transaction exposure from the time it accepts the order till the time the payment is received and converted into domestic currency. The exposure affects cash flows during the current accounting period. If the foreign currency has appreciated between the day the receivable was booked and the day the payment was received, the company makes an **exchange gain** which may have tax implications. In a similar fashion, interest payments and principal repayments due during the accounting period create transaction exposure. **Transaction risk** can be defined as a measure of variability in the value of assets and liabilities when they are liquidated.

The important points to be noted are (1) transaction exposures usually have short-time horizons and (2) operating cash flows are affected.

Sometimes, a transaction is being negotiated, all the terms have been more or less finalised, but a contractual arrangement is yet to be entered into. In such cases the firm has an ***anticipated cash flow exposure.***

The other kind of short-term exposure is known as **Translation Exposure** also called **Accounting Exposure.** A firm may have assets and liabilities denominated in a foreign currency. These are not going to be liquidated in the foreseeable future, but accounting standards which govern the reporting and disclosure practices require that at the end of the fiscal year, the firm must translate the values of these foreign currency-denominated items into its home currency and report these in its balance sheet. **Translation risk** is the related measure of variability. Consider the case described in Box 3.4:

Box 3.4

- **A Swiss pharmaceutical firm has a US subsidiary. The subsidiary's financial statements are denominated in US dollars.**
- **The financial year of the Swiss parent firm is about to close. On the balance sheet date it must translate the balance sheet of its US subsidiary from dollars to Swiss francs.**
- **During the last few months the US dollar has been weakening against the Swiss franc (Figure 3.12). On translation, the value of assets and liabilities would show a decline compared to the values reported last year; if assets exceed liabilities, there would be a net translation loss.**
- **Can anything be done about it? Should anything be done? How should the gains/losses be accounted for?**

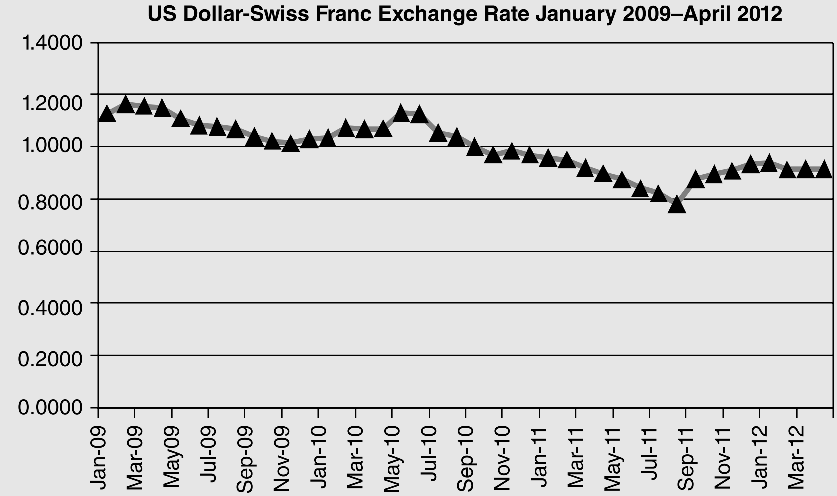

Fig. 3.12
Source: Federal Reserve Bank of St. Louis

The key difference between transaction and translation exposure is that the former has impact on cash flows while the latter has no direct effect on cash flows. (This is true only if there are no tax effects arising out of translation gains and losses.)

Translation exposure typically arises when a parent multinational company is required to consolidate a foreign subsidiary's financial statements with the parent's own statements after translating the subsidiary's statements from its functional currency into the parent's home currency. Thus, suppose an Indian company has a UK subsidiary. At the beginning of the parent's financial year the subsidiary has real estate, inventories and cash valued at £1,000,000, £200,000 and £150,000, respectively. The spot rate is ₹80 per pound sterling. By the close of the financial year, these have changed to £950000, £205,000 and £160,000, respectively. However, during the year, there has been a drastic depreciation of the pound to ₹75. If the parent is required to translate the subsidiary's balance sheet from pound sterling into rupees at the current exchange rate, it has "suffered" a translation loss. The translated value of its assets has declined from ₹10.80 crores to ₹9.8625 crores. Note that no cash movement is involved since the subsidiary is not to be liquidated. Also note that there must have been a translation gain on the subsidiary's liabilities, e.g. debt denominated in pound sterling.

There is broad agreement among finance theorists that translation losses and gains are only notional accounting losses and gains. The actual numbers will differ according to the accounting practices followed and, depending upon the tax laws, there may or may not be tax implications and, therefore, real gains or losses. Accountants and corporate treasurers however do not fully accept this view. They argue that even though no cash losses or gains are involved, translation does affect the **published financial statements** and hence, may affect market valuation of the parent company's stock. Whether investors indeed suffer from "translation illusion" is an empirical question. Some evidence from studies of the valuation of American multinationals seems to indicate that investors are quite aware of the notional character of these losses and gains and discount them in valuing the stock. For Indian multinationals, till a few years ago, translation exposure was a relatively less important consideration since at that time the company law did not require translation and consolidation of foreign subsidiaries' financial statements with those of the parent companies[12]. However, listing requirements of stock exchanges did require translation and consolidation. Now the legal framework is in line with international practices and the law requires translation and consolidation. Also, as India adopts the International Financial Reporting Standards, all the accounting and reporting practices will be identical to global practices.

The second group of exposures classified as long-term exposures consist of **operating exposure[13] and strategic exposures**. The principal focus here is on items which will have impact on the cash flows of the firm in years to come and which may have a serious impact on the competitive status of the firm forcing it to restructure its business and redefine its long-term strategy. Horizons are long, nothing is contractually fixed and the impact of exchange rate fluctuations can have substantial, sustained implications for the firm's bottom-line and whose values are not (yet) contractually fixed in foreign currency terms.

Of the two kinds of long-term exposures, operating exposures capture the impact of unanticipated exchange rate changes on the firm's revenues, operating costs and operating net cash flows over a medium term horizon – say up to three years.

We have already met this kind of exposure in our example of the denim jeans exporter discussed above. Consider the situations described in Boxes 3.5 and 3.6.

Box 3.5

Caterpillar is an American firm which manufactures heavy construction equipment. At the start of the 1980s, all its manufacturing operations were located in the US while it sold its products around the world priced in local currencies. Its nearest competitor was Komatsu of Japan. Around mid-1981, the US dollar started rising against all currencies and continued rising month after month. Caterpillar found that its revenues measured in dollars were shrinking while costs kept pace with US inflation. Margins shrank. It could not compensate by raising local currency prices in export markets because Komatsu was holding the price line. How could Caterpillar cope with this?

Box 3.6

Gems and jewellery exporters from India face stiff competition from firms in Thailand, Indonesia and Malaysia. After the East Asian currency crisis in the summer of 1997, some of these currencies crashed against the US dollar by almost 100 per cent. Figure 3.13 below shows the Baht/Dollar exchange rate. While rupee also fell, its fall was much smaller. Indian exporters lost market share as the East Asian exporters reduced prices substantially in the light of falling currencies. From time to time, Indian exporters and their federations like FIEO clamor for steeper fall in the rupee to maintain their competitive position. How can firms cope with this?

[12] Translation and consolidation are required if the foreign operation is an "integral part" of the parent business, e.g. a branch.
[13] Many authors use the term "economic exposure" to refer to the same concept.

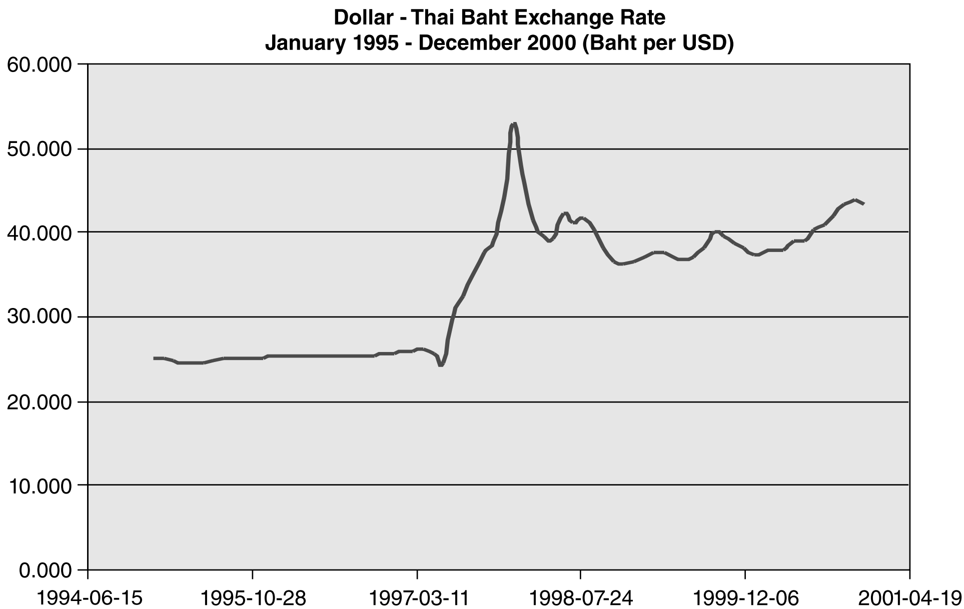

Fig. 3.13
Source: Federal Reserve Bank of St. Louis

Consider a firm which is involved in producing goods for export and/or import substitutes. It may also import a part of its raw materials, components, etc. A change in exchange rate(s) gives rise to a number of concerns for such a firm:

1. What will be the effect on sales volume, if prices are maintained? If prices are changed? Should prices be changed? For instance, a firm exporting to a foreign market might benefit from reducing its foreign currency price to the foreign customers following an appreciation of the foreign currency; a firm which produces import substitutes may contemplate an increase in its domestic currency price to its domestic customers without hurting its sales. A firm supplying inputs to customers who, in turn, are exporters will find that the demand for its product is sensitive to exchange rates.
2. Since a part of the inputs are imported, material costs will increase following a depreciation of the home currency. Even if all inputs are locally purchased, if their production requires imported inputs, the firm's material costs will be affected following a change in exchange rate.
3. Labour costs may also increase, if cost of living increases and wages and salaries have to be raised. This effect may be particularly strong, if typical consumption baskets contain significant amount of imported products as they do in some European countries.
4. Interest costs on working capital may rise, if in response to a depreciation of the home currency the central bank resorts to monetary tightening which drives up interest rates.
5. Exchange rate changes are usually accompanied by, if not caused by, differences in inflation across countries. Domestic inflation will increase the firm's material and labour costs quite independently of exchange rate changes. This will affect its competitiveness in all the markets, but particularly so in markets where it is competing with firms from other countries.
6. Real exchange rate changes also alter income distribution across countries. A real appreciation of the US dollar vis-à-vis say the Euro implies an increase in real incomes of US residents

and a fall in real incomes of Euroland. For an American firm which sells both at home and exports to Europe, the net impact depends upon the relative income elasticities of demand of domestic and European customers in addition to any effect of relative price changes.

Thus, the total impact of a real exchange rate change on a firm's sales, costs and margins depends upon the response of consumers, suppliers, competitors and the government to this macroeconomic shock.

In general, an exchange rate change will affect both future revenues as well as operating costs and hence, the operating income. As we will see later, the net effect depends upon the complex interaction of exchange rate changes, relative inflation rates at home and abroad, extent of competition in the product and input markets, currency composition of the firm's costs as compared to its competitors' costs, price elasticities of export and import demand and supply and so forth.

In the long run, exchange rate effects can undermine a firm's competitive advantage by raising its costs above those of its competitors or affecting its ability to service its market in other ways. Such competitive exposure is often referred to as "**Strategic Exposure**" because it has significant implications for some strategic business decisions. It influences the firm's choice of product-market combinations, sources of inputs, location of manufacturing activity, decisions as to whether foreign operations should be started[14] and so forth.

A number of examples from recent and not so recent history clearly bring out the nature of operating and strategic exposure:

1. In the late 70s, Laker Airways started offering low-price, trans-Atlantic air travel to British tourists wanting to travel to US during their vacations. The dollar was weak and tourist traffic was strong. Laker then expanded its fleet by buying aircraft financed the purchase with dollar borrowing. In late 1981, the dollar started rising against all currencies and continued to climb for nearly four years. On the one hand, the transactions exposure on servicing the dollar liabilities and on the other the operating exposure due to falling tourist traffic created severe cash crunch for Laker. The strong dollar meant that US vacations were an expensive proposition for British tourists. Ultimately, Laker Airways went bankrupt.
2. The relentless rise of the dollar during the first half of eighties eroded the competitive position of many American firms. Firms like Kodak found that most of their costs were dollar denominated while their sales were in all parts of the world, denominated in a number of foreign currencies which were falling against the dollar. They faced stiff competition from Japanese firms such as Fuji both in the US market and third country markets. Kodak could not raise its prices without significant loss of sales. Companies like International Harvester found themselves in a similar position and even moved some of their manufacturing operations out of US.
3. Conversely, when the dollar started falling against the yen and deutschemark around mid-1985 and continued to fall for over two years, Japanese and German car makers found their operating margins being squeezed. They responded partly by starting manufacturing operations in US and partly by moving up – market into premium – priced luxury cars where consumer sensitivity to rising price is relatively less and they could raise dollar prices without significant loss of market.
4. Closer home, Indian manufacturers of cars and two-wheelers with significant import content denominated in yen have found that strong and rising yen means cost increases which they

[14] Some authors have argued that at least a part of the explanation of increased globalisation of business during the last twenty years lies in firms' response to exchange rate uncertainty. As an example see Logue, D.E. (1995): "When Theory Fails: Globalisation as a Response to the (Hostile) Market for Foreign Exchange" ***Journal of Applied Corporate Finance*** Vol. 8, No. 3(Fall), 39-48.

are not always able to pass on to the consumer because of depressed demand conditions and competitive considerations.

5. American pharmaceutical multinationals like Merck have found that during periods of strong dollar, their cash flows denominated in dollars tend to shrink while bulk of their R&D expenditures are denominated in dollars. Shortage of internally generated cash tends to have adverse impact on their R&D budgets which are a crucial factor in their long-run competitiveness.
6. During 2007 and 2008, the rupee appreciated against the US dollar and for a while stayed below ₹40 per dollar. This had significant adverse impact on the competitive position of Indian exporters of garments, jewellery and other export-oriented industries.

In all these cases, exchange rate changes coupled with concomitant changes in relative costs have had significant impact on the firm's ability to compete effectively in particular product-market segments, to undertake good investment projects and thus, to enhance their long-run growth potential. This is the essence of operating and strategic exposure.

We alluded above to the fact that even if a firm has no direct involvement in any cross-border transactions, it is not immune to exchange rate exposure. This "indirect" exposure is also in the nature of operating exposure faced by the firm. Changes in exchange rates will most likely have an impact on its customers, suppliers and competitors which, in turn, will force the firm to alter its operations and strategies. Thus, a firm which produces an import substitute for purely domestic consumption with inputs denominated exclusively in home currency is nonetheless exposed to competitive exposure. An appreciation of the home currency puts it at a disadvantage relative to its competitors who sell the imported product. Similarly, a firm which buys its inputs from local firms who, in turn, have significant import content is as surely affected by exchange rate changes as a firm which directly imports some of its inputs. A firm which supplies intermediates to an exporter faces operating exposure even though it has no direct involvement in exports or imports. Finally, changes in exchange rates may trigger policy responses by the governments which in turn affect all the firms in the economy.

An alternative but similar in spirit approach to classification of currency exposure focuses on the length of the time horizon and whether or not the exposure impacts on the end-of-the horizon financial statements. For detailed discussions of this approach the reader should consult Antl (1989) and Hekman (1989). In this approach the term accounting exposure is used for short-term exposures which will have an impact on the financial results – income statement and balance sheet – for the immediate upcoming financial reporting period. It includes contractual transactions exposures as defined above, exposures on anticipated cash-flows denominated in foreign currency and balance sheet exposures of foreign operations – what we have referred to as translation exposures. Depending upon the time profile of the anticipated cash-flows and the changes in exchange rate, the cash-flow impact would show up partly as operating variance and partly as a translation adjustment. Operating exposure is defined as above as the sensitivity of future operating profits to unanticipated changes in the exchange rate. Here the horizon is medium-term – say about 3 years – and the firm is expected to have some operational flexibility such as varying prices, sourcing and so forth. Balance sheet impact of translation gains or losses is left out of consideration. Strategic exposure refers to a still longer horizon and contemplates longer-term operational flexibility such as changing product-market mix, shifting location of operations and adopting new technologies. Finally, a comprehensive concept – which is very difficult to operationalise – is "value-based" exposure which focuses on the impact of currency fluctuations on market value of the firm. It must take into account both short-term accounting exposures as well as operating and strategic flexibility in responding to currency movements.

In Chapter 13, we will provide a more detailed discussion of the determinants of operating exposure and some methods which might be used to assess its magnitude.

3.5 ACCOUNTING TREATMENT OF TRANSACTION AND TRANSLATION EXPOSURE

We have seen above that transactions and translation exposures give rise to exchange gains and losses, real or notional. In recording and reporting these effects, the accountant is essentially confronted with three important questions:

A. Which exchange rate should be used to translate asset and liability items? Historical, current or some average rate? (Historical rate here refers to the exchange rate ruling at the time the asset or liability came into existence.)
B. Where should the gains/losses be shown in financial statements? Should they be merged with the income statement or should a separate account be kept to be subsequently merged with the firm's net worth?
C. What are the tax implications of the various choices made regarding 1 and 2 above?

These questions are dealt with at some length in Chapter 19. Here we present a brief summary of the various alternatives.

1. Asset and liability items are recorded at the rate prevailing at the time they are acquired.
2. Items which are settled during the current accounting period are revalued at the rate prevailing at the time of settlement. This gives rise to exchange gains or losses which are taken to the income statement.
3. For items not settled within the accounting period, they are taken to the balance sheet either at the historical rate or at the closing rate. In the latter case, a loss or a gain is made, the treatment of which depends on the nature of the item and whether it is a gain or a loss. Losses are normally shown in income immediately while gains may be shown in current and future income according to some set procedure.
4. When items such as receivables, payables, etc., in foreign currency are hedged by means of a forward contract, the forward rate applicable in the contract is used to measure and report such items. The difference between the spot rate at the inception of the contract and the forward rate is recognised as income.
5. Suppose an asset was acquired at home, financed out of a foreign currency borrowing. A substantial depreciation of the home currency takes place. Further, there is no practical means of hedging the liability. In such cases, the exchange loss is sometimes regarded as an adjustment to the cost of the asset and the asset is carried at the adjusted value.
6. For translating a foreign entity's balance sheet into the parent's currency of reporting various methods can be followed. The **closing rate** method uses the rate prevailing on the parent's balance sheet date. The **current-non current** method uses the closing rate for current assets and liabilities and historical rates for non-current assets and liabilities. The **temporal** method translates cash, receivables and payables at the closing rate while other items are translated at historical rates. The **monetary-non monetary** method translates monetary assets and liabilities, e.g. receivables and payables, cash, bank deposits and loans, etc., at the closing rate while non-monetary assets and liabilities such as inventories are translated at historical rates. In contrast to the current-non current method, the major difference arises in translating long-term debt for which the monetary-non monetary method uses the closing rate. This can give rise to large translation losses or gains. For revenue and expense items from the income statement, there is a choice between using the rate prevailing at the time the transaction was booked or a weighted average rate for the period covered by the statement.

Apart from the transparency and information content of the financial statements, the key consideration in choosing the accounting treatment of transaction and translation exposures is its tax implications for the company as a whole. For a large multinational with subsidiaries spread around the world and exposures in multiple currencies, the accounting treatment of exposures becomes quite complex. Readers who would like to pursue these issues in greater depth should read Chapter 19 at this stage and consult the references cited there.

3.6 EXCHANGE RATES, INTEREST RATES, INFLATION RATES AND EXPOSURE

The reader must have noted that at several places in the above discussion of exposure and risk, we have stressed the idea that except in the case of contractually fixed items, the nature and amount of foreign exchange exposure and risk depends not only upon exchange rate movements but also upon movements in price levels and interest rates. As we shall see later, all these variables are closely interrelated and, under certain conditions, are subject to a set of "parity relationships". We will briefly return to the topic of exposure after analysing these relationships.

3.7 INTEREST RATE EXPOSURE AND RISK

We saw in the introductory section that the decade of eighties has seen a significant increase in interest rate volatility. At the macro level, several developing countries have suffered from the increase in real rates of interest as the interest payments on their floating rate borrowings have eaten away a progressively increasing part of their real export earnings.

Interest rate uncertainty exposes a firm to the following kinds of risks:

1. If the firm has borrowed on a floating rate basis, at every reset date, the rate for the following period would be set in line with the market rate. The firm's future interest payments are, therefore, uncertain. An increase in rates will adversely affect the cash flows.
2. Consider a firm which wants to undertake a fixed investment project. Suppose it requires foreign currency financing and is forced to borrow on a floating rate basis. Since its cost of capital is uncertain, an additional element of risk is introduced in the project appraisal[15].
3. On the other hand, consider a firm which has borrowed on a fixed rate basis to finance a fixed investment project. Subsequently, inflation rate in the economy slows down and the market rate of interest declines. The cash flows from the project may decline as a result of the fall in the rate of inflation, but the firm is locked into a high cost borrowing.
4. A fund manager expects to receive a sizeable inflow of funds in three months to be invested in five-year fixed rate assets on behalf of a client. He is worried that by the time he receives the funds, the five-year interest rate will have declined, thus reducing the return on his investment.
5. A bank has extended a six-month loan at 8 per cent to one of its corporate customer and financed it by means of a three-month deposit at 6.5 per cent. At the end of three months, it must refinance its investment. If deposit rates go up in the meanwhile its margin will be reduced or even turn negative.
6. A fund manager is holding a portfolio of fixed-income securities such as government and corporate bonds. Fluctuations in interest rates expose him to two kinds of risks. The first is that

[15] This risk will be over and above the exchange rate risk.

the market value of his portfolio varies inversely with interest rates. This is the risk of capital gains or losses. Secondly, he receives periodic interest payments on his holdings which have to be reinvested. The return he can obtain on these reinvestments is uncertain.

In each of these cases, an adverse movement in interest rates hurts the firm by either increasing the cost of borrowing or by reducing the return on investment or producing capital losses on its asset portfolio. During the early eighties, investor preferences shifted towards floating rate instruments, thus exposing borrowers to substantial interest rate risks.

For most Indian companies, the idea of interest rate risks is relatively new. In an environment of administered rates and fragmented, compartmentalised capital markets, neither investors nor borrowers did feel the need to worry about **fluctuations** in interest rates[16].

With increasing recourse to external commercial borrowings, Indian companies have had to recognise and learn to manage interest rate risk. Also, the Indian financial system has been moving in the direction of market determined interest rates. During the last few years, the environment has changed drastically. In particular, the steep rise in interest rates during 1995-96 led to the painful realisation that careful management of interest rate risk is crucial to a firm's financial health. More recently, RBI has used tight money policies – increase in CRR and discount rate – to counter weakness of the rupee, thus underlining the fact that financial risk factors are often correlated.

In Chapter 14, we will discuss several examples of interest rate risk and the instruments available to hedge the risk.

Summary

The purpose of this chapter is to provide an understanding of what is exchange rate exposure and risk, how the two concepts are different and how both can be measured in practice. The discussion focuses on the three main types of exposures and risk, viz. transactions exposure, translation exposure and operating exposure as also introduces the concept of strategic exposure. Measurement of transactions exposure is discussed in detail while measurement of translation exposure will be discussed in the appendix. The difficulties involved in quantifying operating and strategic exposure are brought out. The chapter concludes with a brief exposition of interest rate exposure.

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[16] This feeling of relative certainty was however only apparent. Since inflation rates were unpredictable, the **real interest rates** did fluctuate.

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APPENDIX

A.3.1 ACCOUNTING TREATMENT OF TRANSACTIONS EXPOSURE[17]

A ***Foreign Currency Transaction*** is a transaction whose terms are denominated in a currency other than the entity's functional currency. Such transactions arise when:

1. The firm sells or buys goods or services on credit the prices of which are denominated in a foreign currency.
2. The firm lends or borrows and the amounts receivable or payable on account of interest and repayments are denominated in a foreign currency.
3. The firm is a party to a forward contract in a foreign currency.
4. The firm for whatever reasons, acquires or disposes of assets, incurs or settles liabilities denominated in a foreign currency.

In accounting, for a foreign currency transaction, four key points are involved, viz.

1. Initial recording of the transaction
2. Recording of outstanding foreign currency balances on subsequent balance sheet dates
3. Treatment of exchange gains and losses
4. Recording of the settlement of foreign currency receivables and payables

We will highlight some of the issues involved by means of hypothetical numerical examples.

[17] This and the next section of this appendix draw on Arpan and Radebaugh (1985) and Choi and Mueller (1984).

One-Transaction Perspective

In this approach, the transaction is not deemed to be complete till the cash required to settle the payable or receivable exchanges hands. In other words, the transaction of purchase or sale of goods is not distinguished from the payment or receipt of cash. Any exchange gain or loss is considered as an adjustment to the value of the goods involved.

Consider an example. An Indian firm exports goods worth Euro (EUR) 100,000 to Germany on March 1. The firm's financial year is April-March so that the next balance sheet date is March 31. The goods are sold on 2 months credit so that the payment is due on April 30. On March 1 the EUR/INR exchange rate is ₹73.00. By March 31, the EUR has depreciated to ₹72.80 while by April 30, it appreciates to ₹73.10. Under the one-transaction perspective, this will be recorded as follows:

	March 1	
1.	Sales	73,00,000
2.	Receivables	73,00,000
	March 31	
3.	Sales	20,000
4.	Receivables	20,000
	April 30	
5.	Sales	30,000
6.	Receivables	72,80,000
7.	Cash	73,10,000

Lines 1 and 2 show the initial transaction which creates a receivable. By the balance sheet date, the foreign currency has depreciated reducing the rupee value of the receivable. As lines 3 and 4 show, this exchange loss of ₹20,000 is treated as a reduction in the value of goods sold. By the settlement date, the exchange rate has appreciated to ₹73.10; the firm receives cash in the amount ₹73,10,000. The difference between this and the value of the receivable on March 31, viz.

(73,10,000 – 72,80,000) is shown as an upward adjustment in the value of sales. Lines 5-7 show these entries.

In the chapter, we mentioned this type of an adjustment in the case of imported capital goods. When the foreign currency appreciates between the transaction date and the settlement date, the cost of the equipment is adjusted upward and, correspondingly the depreciation allowances on it increase throughout its life. The impact of the exchange rate change shows up in this manner.

Two-Transaction Perspective

In this approach, the foreign currency receivable or payable is treated separately from the sale or purchase transaction that gave rise to it. The exchange gain or loss is not treated as an adjustment to the value of the goods involved.

As to the treatment of the gains or losses, two approaches can be distinguished. One is to take the gain or loss to the income statement for the period in which it is incurred; the other is to defer the gain or loss till it is actually realised on settlement of the receivable or payable. We will illustrate both the possibilities using the same data as in the previous example.

(i) Immediate recognition in income:

	March 1	
1.	Sales	73,00,000
2.	Receivables	73,00,000

	March 31	
3.	Receivables	20,000
4,	Loss	20,000
	April 30	
5.	Receivables	72,80,000
6.	Gain	30,000
7.	Cash	73,10,000

(ii) Gains/Losses Deferred

	March 1	
1.	Sales	73,00,000
2.	Receivables	73,00,000
	March 31	
3.	Receivables	20,000
4.	Deferred Loss	20,000
	April 30	
5.	Receivables	72,80,000
6.	Deferred Loss	20,000
7.	Gain	10,000
8.	Cash	73,10,000

Note that on April 30, a gain of ₹30,000 is made since the value of the receivable went up from ₹72,80,000 to ₹73,10,000. However, that entry is not made. This gain offsets the deferred loss of ₹20,000. Thus, losses of the earlier period are offset by the gains of the following period and the net gain is recognised only at settlement.

International Accounting Standard 21 (IAS 21) which is discussed in Chapter 19 recommends the two-transaction perspective and immediate recognition of gains or losses in most situations. However, it permits the following two departures:

1. For long-term foreign currency items such as a long-term debt, the gains or losses can be deferred and written off systematically over the life of the loan.
2. As mentioned above, when an asset is acquired with foreign currency financing, and subsequently there are large gains or losses as a result of severe devaluations, the value of the asset can be adjusted (subject to certain limits) and written off over the life of the asset.

A.3.2 ACCOUNTING TREATMENT OF FORWARD CONTRACTS

The concept of forward exchange rate was alluded to in footnote 3 in the chapter. A forward contract in foreign exchange is a commitment to deliver one currency in exchange for another at a specified future date at a rate of exchange fixed at the time the contract is entered into. The exchange rate so fixed is the ***forward exchange rate.*** If the forward exchange rate is higher[18] than the spot rate on the date of the contract, the foreign currency is said to be at a ***forward premium***. Conversely, if it is lower, the foreign currency is said to be at a ***forward discount***. Companies involved in imports and exports often enter into such contracts with commercial banks in order to eliminate the uncertainty about the home currency value of their foreign currency receivables and payables.

[18]As long as we are talking about the "home currency" and the "foreign currency", exchange rates will be understood as number of units of home currency per unit of the foreign currency. Thus, a "higher" exchange rate will imply that the foreign currency is more expensive.

At the time the contract is entered into, no transaction is recorded in the books since delivery and payment are yet to take place. It is an ***executory contract***. Memorandum entries are made to keep track of such a contract. Only when the transaction is actually effected, it enters the books.

The following example illustrates the treatment of a forward contract which is entered into as a hedge to protect the home currency value of a foreign currency payable against unexpectedly large depreciation of the home currency.

An Indian firm imported goods worth 250,000 Swiss francs from a Swiss supplier on March 1, 2010. Payment in Swiss francs was due on April 30, 2010. The firm entered into a forward contract on March 1, to buy 250,000 Swiss francs against rupees, delivery April 30. The following were the rates:

Spot Rate on March 1:	₹28.00/SFr
2-month Forward Rate on March 1:	₹28.30/SFr

Thus, on April 30, the firm is committed to receive SFr 250,000 in exchange for ₹70,75,000 (= 250,000 × 28.30). Further, we will assume that the following rates were obtained on March 31, the balance sheet date of the firm, and April 30, the date of settlement of the forward contract and the payable:

Spot Rate on March 31:	₹28.25/SFr
Spot Rate on April 30:	₹28.20/SFr

The following entries show the recording of this set of transactions:

March 1

1.	Inventory :	70,00,000
2.	A/C Payable :	70,00,000

The initial transaction recorded at the spot rate prevailing on the date of the transaction.

3.	Contract Receivable (SFr) :	70,00,000
4.	Premium Expense :	75,000
5.	Contract Payable (₹) :	70,75,000

Memorandum entries for the forward contract. The foreign currency (receivable under the contract) is recorded at the spot rate; the domestic currency (payable) is recorded at the forward rate. The difference is the *premium* the company has to pay.

6.	Deferred Premium Expense :	75,000
7.	Deferred Charge :	75,000

These entries set up the premium expense in the books so that it can be written off over the life of the forward contract.

March 31

8.	Loss:	62,500
9.	A/c Payable:	62,500

These entries reflect the fact that at the spot rate on March 31, the outstanding payable has increased in value, thus resulting in an exchange loss which must be recognised in income.

10.	Deferred Charge:	62,500
11.	Gain:	62,500

The receivable under the forward contract, viz. SFr 250,000 increased in value as the spot rate had gone up.

12.	Premium Expense:	37,500
13.	Deferred Premium Expense:	37,500

Half of the premium expense is written off.

April 30

14. Premium Expense: 37,500
15. Deferred Premium Expense: 37,500

The remaining premium expense is amortised.

19. A/c Payable : 70,62,500
20. Deferred Charge: 12,500
21. Cash: 7075,000

On settlement of the forward contract there was a cash outflow of ₹45,75,000. This was offset by the value of the payable as of the last balance sheet date and the balance in the deferred charge account. The latter accounts for the premium expense of ₹75,000 partly offset by the increase in the value of the receivable under the forward contract.

A.3.3 TRANSLATION EXPOSURE

Table A.3.1 summarises the exchange rates used for translating a foreign entity's balance sheet into the parent's reporting currency.

Table A.3.1 Exchange Rates Used in Various Translation Methods

—	*Current Non-Current*	*Temporal*	*Monetary Non-Monetary*	*Current Rate*
Cash, Current Receivables & Payables	C	C	C	C
Inventory	C	C or H	H	C
Fixed Assets	H	H	H	C
Long-Term Receivables & Payables	H	C	C	C
Note: "C" denotes current rate, "H" denotes historical rate.				

In Table A.3.2 a small numerical example is worked out which illustrates these methods.

In the illustration, it is assumed that an Indian company is translating the balance sheet of a foreign entity into rupees. The "current rate", which is the rate on the balance sheet date of the parent is assumed to be LC 1 = ₹1.50 while the "historical rate" is assumed to be LC 1 = ₹1.00. Here "LC" stands for "Local Currency", the currency in which the foreign entity's accounts are denominated. Thus, between two balance sheet dates, the foreign entity's functional currency has appreciated.

Table A.3.2

	LC	*Current Non-Current (₹)*	*Monetary Non-Monetary (₹)*	*Current Rate (₹)*	*Temporal Method (₹)*
Cash	200	300	300	300	300
Inventory	300	450	300	450	450
Fixed Assets	800	800	800	1200	800
	1300	**1550**	**1400**	**1950**	**1550**

(Contd.)

Current Liabilities	200	300	300	300	300
Long-term Debt	300	300	450	450	450
	500	**600**	**750**	**750**	**750**
Net Worth	800	950	650	1200	800

In the above table, column 1 refers to the foreign entity's balance sheet in its own currency. The remaining four columns have been computed using the conventions summarised in Table A.3.1. Under the temporal method, inventory has been translated at the current rate. The last row of the table shows that the net worth reported by the parent is quite sensitive to the translation method used. With the foreign currency appreciating, in this case the current rate method appears to present the best picture. Suppose instead that the local currency of the subsidiary had depreciated to ₹0.80 from the historical rate of 1.0. Table A.3.3 shows the results under the various conventions. Now the monetary-non monetary method yields the highest translated value for the subsidiary's net worth. There is no theoretical argument to support any one of the conventions listed in Table A.3.1. The firm must make it totally transparent to the shareholders which convention it has adopted.

Table A.3.3

	LC	*Current Non-Current (₹)*	*Monetary Non-Monetary (₹)*	*Current Rate (₹)*	*Temporal Method (₹)*
Cash	200	160	160	160	160
Inventory	300	240	300	240	240
Fixed Assets	800	800	800	640	800
	1300	**1200**	**1260**	**1040**	**1200**
Current Liabilities	200	160	160	160	160
Long-term Debt	300	300	240	240	240
	500	**460**	**400**	**400**	**400**
Net Worth	800	740	860	640	800

A.3.4 TAX EFFECTS AND EXPOSURES IN A MULTINATIONAL CONTEXT[19]

The purpose of this section is to illustrate calculation of before-tax and after-tax exposures in a multi-currency, multinational context. We will employ the following abbreviations:

PC: Parent's Currency SC: Subsidiary's Currency
TC: Third Currency (other than PC or SC)
ER: Exchange Rate AT: After-Tax
A/R: Accounts Receivable A/P: Accounts Payable
TP: Tax Payable RE: Retained Earnings

We will make the following assumptions about the exchange rates:

At time t_0, the beginning of the accounting period,

$$\text{SC } 1 = \text{PC } 1 = \text{TC } 1$$

[19] This treatment draws on Antl, B. (1989).

At time t_1, the end of the accounting period,

SC 1 = PC 1.1 = TC 1.2

Hence, PC 1 = TC 1.0909 (= 1.2/1.1)

Thus, over the accounting period, SC appreciates against PC by 10% and against TC by 20%. PC, in turn, appreciates against TC by 9.09%.

Before-Tax Exposures

1. Transaction Exposure Suppose the subsidiary books an A/R of TC 100 at time t_0. It is valued at SC 100 at the time. At time t_1, its value in terms of SC has fallen to (100/1.2) = SC 83.33 thus giving rise to a before-tax loss of SC 16.67.

t_0 .... TC 1 = SC 1	TC 100 = SC 100
t_1 .... TC 1.2 = SC 1	TC 100 = SC 83.33
	Transaction loss (SC 16.67)

2. Translation Exposure As we have seen, translation exposure does not involve actual cash flows. The magnitudes of notional losses and gains depend upon the method used. For the sake of completeness, we will review a few examples of translation exposure.

(a) Translation of Local Currency Exposure

Suppose the subsidiary has an A/R of SC 100, denominated in its own currency.

At t_0 ..... SC 1 = PC 1	SC 100 = PC 100
At t_1 ..... SC 1 = PC 1.1	SC 100 = PC 110
	Translation Gain 10

(b) Translation of Third Currency Exposure

Suppose the subsidiary has an A/R of TC 100 denominated in the third currency.

At t_0 .. SC 1 = TC 1 = PC 1	TC 100 = SC 100 = PC 100
At t_1 .. SC 1 = TC 1.2 = PC 1.1	TC 100 = SC 83.33 = PC 91.6674
	Translation Loss (SC 16.67) (PC 8.3326)

(c) Translation of Intra-Corporate Exposure

For transactions within the corporation, e.g. between the parent and the subsidiary, intra-corporate translation exposure *before tax* is zero irrespective of the currency of denomination (because on consolidation the opposite items cancel out).

Suppose the subsidiary has on its books a payable to the parent, denominated in the parent's currency of PC 400.

At time t_0,

	Parent		Subsidiary
A/R	PC 400	A/P	LC 400 (= PC 400)

At time t_1,

	Parent		Subsidiary
A/R	PC 400	A/P	LC 363.6364 (= PC 400)

From a consolidated point of view, the A/R of the parent offsets the A/P of the subsidiary. However, as we will see below, the subsidiary makes a transaction gain when it settles the payable since its currency has appreciated against the PC. This gain results in additional tax liability.

After-Tax Exposures

1. Local Currency Exposure As we saw above, when the subsidiary has an asset or liability denominated in its own currency, it leads to translation exposure for the parent. We will assume that pure translation gains or losses have no tax effects. Hence, this exposure is same on after-tax basis as before-tax basis calculated above.

2. Third Currency Exposure Now suppose that the only exposure the subsidiary has is a receivable of TC 100 denominated in the third currency.

At time t_0,

$$\text{TC } 100 = \text{SC } 100 = \text{PC } 100$$

At time t_1,

$$\text{TC } 100 = \text{SC } 83.33 = \text{PC } 91.6674$$

The parent incurs a translation loss of PC 8.3326; however, since the subsidiary has made a *transaction loss* of SC 16.67, it gets a tax credit. Assuming the tax rate to be 50%, the tax saving is worth SC 8.34, which when translated at the closing rate is worth PC 8.9870. Thus, on an after-tax basis, the parent has gained (8.9870 – 8.3326) = PC 0.6544.

This "gain" can be interpreted as follows. If the subsidiary collects the receivable at t_1 and remits it to the parent, it would be worth PC 100.6544, consisting of the PC value of the receivable, 91.6674, and the PC value of the tax saving, 8.9870.

3. Intra-Corporate Exposures As before, let the subsidiary have a payable of PC 400 to the parent. As we saw above, there is no translation exposure on a before-tax basis. However, when tax effects are taken into account, the situation is different. Now when the PC depreciates against the SC, the subsidiary makes a *transaction gain* worth

$$\text{SC } [400 - (400/1.1)] = \text{SC } 36.3636$$

This entails an additional tax liability of SC 18.1818 which when translated into PC at the rate of SC 1 = PC 1.1, generates a loss of PC 20 for the parent.

A.3.5 EXPOSURES, ACCOUNTING AND TAX EFFECTS: A SUMMARY

The examples in this appendix are meant to convey some of the basic ideas in measurement and accounting of foreign exchange exposure. The importance of accounting conventions and tax laws has been brought out. It does not purport to be an exhaustive treatment of all the issues involved. Some of these issues will be revisited in later chapters when we discuss the ways and means of managing foreign exchange exposure. The point to grasp is that exchange rate movements, apart from their effects on operating cash flows, give rise to purely financial cash flows through their tax effects. The magnitude of these effects depends partly upon the accounting practices and partly on how the tax authorities treat the financial gains and losses.

A.3.6 ON THE CHOICE OF THE FUNCTIONAL CURRENCY

In the text we have used the term ***"functional currency"*** of an enterprise. The term is understood to mean the currency of the "primary economic environment in which the firm operates" [see Arpan and Radebaugh op.cit.]. It would almost always be also the currency in which the firm reports its financial statements.

The International Accounting Standard 21 uses the terms ***"reporting currency"*** and ***"foreign currency"***. The former is the currency of financial statements while the latter is any other currency.

Sometimes it may happen that a foreign subsidiary (or a branch) is engaged only in the business of importing goods from the parent and selling them in the local and third country markets. Bulk of its costs are denominated in the parent's currency. Its sales contracts may be mostly denominated in parent's currency and so may be its short-term and long-term borrowings. Its operations may be characterised by a high degree of intra-corporate transactions and extensive interaction with the parent. In such cases, it may be better to regard the parent's currency as its functional currency. For local purposes, it may maintain a set of books in local currency, but for the purpose of exposure analysis, the parent's currency should be taken as its functional currency.

In some countries, e.g. the US, foreign subsidiaries of US multinationals are required to specify a functional currency and, if it is different from the parent's currency, accounting standards specify how translation from one to the other is to be done. IAS 21 assumes that the reporting currency and functional currency would be identical.

A.3.7 EXPORT CREDIT INSURANCE

Exporters most often have to give some credit to their foreign buyers for settling the payments. The tenor of these credits may vary from as short as one month to a few years in case of large export deals involving capital goods and project exports. Payments for exports are open to risks even at the best of times. The risks have assumed large proportions today due to the far-reaching political and economic changes that are sweeping the world. An outbreak of war or a civil war in a country may block or delay payment for goods exported to a customer in that country. A coup or an insurrection may also bring about the same result. Economic difficulties or balance of payment problems may lead a country to impose restrictions on either import of certain goods or on settlement of payments for goods imported. Apart from such macro-risks, there are the usual commercial risks of insolvency or protracted default of particular buyers. The commercial risks of the foreign buyer going bankrupt or losing his capacity to pay are heightened due to the political and economic uncertainties.

Credit risk associated with a large export receivable can sometimes be more important than the exchange rate risk. A foreign customer's failure to pay may spell disaster for any exporter whatever his prudence and competence. On the other hand, being too conservative and trying to minimise or avoid all credit risk may result in loss of hard-to-get business opportunities. Export credit insurance is designed to protect exporters from the consequences of the payment risks, both political and commercial, and to enable them to expand their overseas business without fear of loss. Export credit insurance also provides guarantees to banks to protect them from the risk of loss inherent in granting various types of finance facilities to exporters.

The biggest export insurer in India is the Export Credit Guarantee Corporation (ECGC). ECGC also provides Overseas Investment Insurance (OII). OII provides cover for the investments made by Indian companies abroad in a joint venture or their wholly owned subsidiary (WOS) either in the form of equity or loan. The JV or WOS should have been approved by the Government of India or RBI. The basic principle is that the investment should emanate from India and benefit of dividend/interest arising from such investment should accrue to India.

More information regarding the various types of export credit and investment insurance covers provided by ECGC and the insurance premia can be obtained from the ECGC website.

Case Study

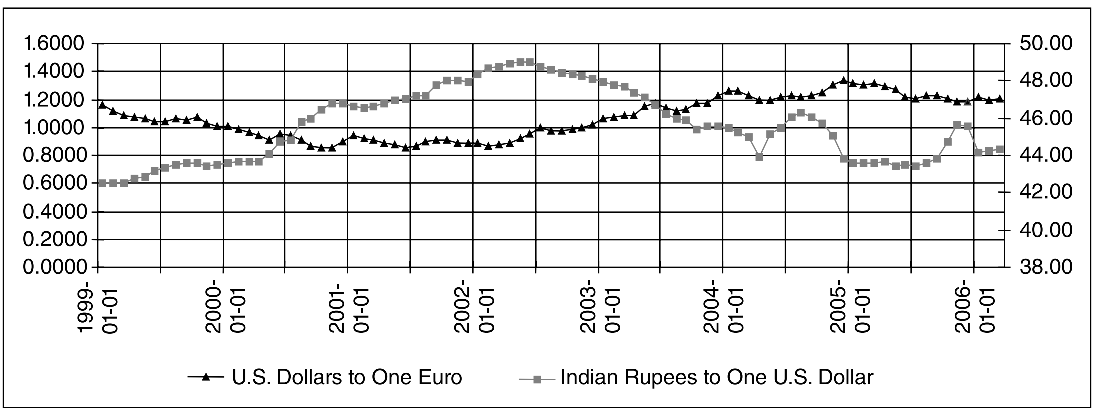
You are the CFO of a large Indian pharmaceutical company. Over the last five years your company has grown, primarily through overseas acquisitions. You started acquiring companies in Europe and North America in 2000.

Your balance sheet on March 2005 has assets equivalent of US $200 million, including those of your subsidiaries.

In the last board meeting, a presentation made by your major European subsidiary painted a worrisome picture. This bulk drug manufacturing facility sources its raw materials from a small South African country, which is facing political unrest. This means that the reliability of this source of raw material, in the days to come, is poor. Your subsidiary is keen to source this material from a small Taiwanese firm. This Taiwanese firm is willing to supply the raw material but wants payment in US dollars for the January to June 2006 period; in euros for the July to December 2006 period through its Cayman Island bank account.

If this supply contract clicks, it could mean at least two things: one, getting a reliable supplier, and two, opening a link in the Far East market.

You are preparing to present a case for this supply contract to the top management. You search the web to get some data on USD/INR and EUR/INR behaviour.



Source: http://research.stlouisfed.org/fred2/series/EXUSEU/15

Question: What are the issues that you will take into account and what is the likely response from the board members?

Chapter 4

The Balance of Payments

4.1 INTRODUCTION

All modern economies prepare and publish detailed statistics about their transactions with the rest of the world. A systematic accounting record of a country's economic transactions with the rest of the world forms a part of its National Accounts. It can also be looked upon as a record of all the factors, which create the demand for, and the supply of the country's currency. A precise definition of the **Balance of Payments (BOP)** of a country can be stated as follows:

The Balance of Payments of a country is a systematic accounting record of all economic transactions during a given period of time between the residents of the country and residents of foreign countries.

The phrase "residents of foreign countries" may often be replaced by "non-residents", "foreigners" or "rest of the world (ROW)".

A few clarifications are in order. The definition refers to *economic transactions*. By this, we mean transfer of economic value from one economic agent (individual, business, government, etc.) to another. The transfer may be a **requited** transfer, i.e. the transferee or the receiver gives something of equivalent economic value to the transferor or the giver, in return or an **unrequited** transfer, i.e. a unilateral gift. The following basic types of economic transactions can be identified:

1. Purchase or sale of goods or services with a financial **quid pro quo** – or a promise to pay. One real and one financial transfer.
2. Purchase or sale of goods or services in return for goods or services or a **barter** transaction. Two real transfers.
3. An exchange of financial items, e.g. purchase of foreign securities with payment in cash or by a cheque drawn on a foreign deposit. Two financial transfers.
4. A unilateral gift in kind. One real transfer.
5. A unilateral financial gift. One financial transfer.

Of course there is nothing specifically "international" about any of the above transactions: they become so when they take place between a resident and a non-resident. (There are however some exceptions. See below).

The other clarification relates to the term "resident". This term certainly is not identical with the term "citizens" though there is normally a substantial overlap. As regards individuals, "residents" mean those individuals whose general centre of interest can be said to rest in the given economy. They consume goods and services, participate in the productive process or otherwise carry out economic activity within the territory of the country on other than a temporary basis. This definition may turn out to be ambiguous in some cases. The **Balance of Payments Manual** published by the International Monetary Fund (IMF) provides a set of rules to resolve such ambiguities. As regards non-individuals, a set of conventions has been evolved. For example, governments and non-profit bodies serving resident individuals are residents of the respective countries; for enterprises, the rules are somewhat complex, particularly those concerning unincorporated branches of foreign multinationals. According to the IMF rules, these are considered to be residents of countries where they operate; though they are not a separate legal entity from the parent located abroad. International organisations like the UN, the World Bank, and the IMF are not considered to be residents of any national economy even though their offices may be located within the territories of any number of countries.

4.2 ACCOUNTING PRINCIPLES IN BALANCE OF PAYMENTS

The BOP is a standard double-entry accounting record and as such is subject to all the rules of double-entry book-keeping, viz. for every transaction two entries must be made, one credit (+) and one debit (–) and leaving aside errors and omissions, the total of credits must exactly match the total of debits, i.e. the balance of payments must always "balance".[1]

Some simple rules of thumb will enable the reader to understand (and remember) the application of the above accounting principles in recording transactions which enter the BOP of a country–

(a) All transactions which lead to an immediate or prospective payment from the rest of the world (ROW), i.e. non-residents, to the country in question i.e. residents of that country, should be recorded as credit entries in the BOP of that country. The payments themselves, actual or prospective, should be recorded as the offsetting debit entries. Conversely, all transactions which result in an actual or prospective payment from the country to the ROW should be recorded as debits and the corresponding payments as credits.

    Note carefully the obvious corollary of this rule; a payment received from the ROW increases the country's foreign assets – either the payment will be credited to a bank account held abroad by a resident entity or a claim is acquired on a foreign entity. Thus, an increase in foreign assets (or a decrease in foreign liabilities) must appear as a debit entry. Conversely, a payment to the ROW, reduces the country's foreign assets or increases its liabilities owed to foreigners; a reduction in foreign assets or an increase in foreign liabilities must therefore appear as a credit entry. This may appear somewhat paradoxical, but the second thumb rule below will make it clear.

(b) A transaction which results in an increase in demand for foreign exchange or decrease in supply of foreign exchange is to be recorded as a debit entry while a transaction which results

[1] The meaning of the commonly encountered terms "balance of payments deficit" or "surplus" will become clear below.

in an increase in the supply of or decrease in demand for foreign exchange is to be recorded as a credit entry.

Thus, an increase in foreign assets or reduction in foreign liabilities because it uses up foreign exchange now – reduces the supply – is a debit entry while a reduction in foreign assets or an increase in foreign liabilities because it is a source of foreign exchange now – increases the supply – is a credit entry. Capital outflow, e.g. when a resident purchases foreign securities or pays off a foreign bank loan, uses up foreign exchange and hence, is a debit entry while a capital inflow, e.g. disbursement of loan by a foreign bank to a resident firm, increases availability of foreign exchange and, therefore, is a credit entry.

We will look at a few simple examples to illustrate the application of these rules for the five basic types of transactions identified above.

1. Country A exports goods worth 500 to country B. The goods have been invoiced in and will be paid for in country B's currency. Payment will be effected by crediting the bank account which country A exporter holds with a bank in country B. The balance in such an account is a foreign asset for country A and a foreign liability for country B. In country A's BOP, this will be recorded as follows:

	Current Account	
	Credit	Debit
Merchandise Exports	500	

	Capital Account	
	Credit	Debit
Increase in Claims on a Foreign Bank		500

   In accordance with the thumb rule (a), exports result in a payment from a non-resident to a resident and hence appear as a credit entry in the current account (more accurately in the merchandise trade account) while the payment appears as a debit entry in the capital account – an increase in foreign assets, a use of foreign exchange hence a debit according to rule (b). Country B will record its imports as a debit in its current account and the payment for them as a credit in its capital account – one of its bank's liabilities to foreigners has increased.

2. Country A agrees to supply leather goods worth 300 to country B in return for crude oil worth 300 both valued in country B's currency. Country A's BOP will have the following entries:

	Current Account	
	Credit	Debit
Merchandise Exports	300	
Merchandise Imports		300

   Country B's BOP will show identical entries except that A's exports will be B's imports and vice versa.

3. A bank in country A purchases securities issued by the Government of country B, valued at 200 in B's currency and pays for them by drawing on an account it has with its correspondent bank in country B. Here country A has exchanged one financial asset (the bank deposit) for another (the bonds). This will show up in its capital account as follows:

	Capital Account	
	Credit	Debit
Increase in Foreign Bond Holdings		200
Decrease in Foreign Bank Deposits	200	

   Country B's BOP will show similar entries in its capital account.

4. Country A gifts medical supplies, blankets, etc., worth 150 to country B. This is shown as exports, a credit entry in the current account of country A. The contra entry, a debit, appears under "unrequited transfers" also in the current account. Country B would have a debit entry under merchandise trade and a credit entry under unrequited transfers both in its current account. The entries for country A are:

	Current Account	
	Credit	Debit
Merchandise Exports	150	
Unrequited Transfers		150

5. A resident of country A makes a gift worth 50 in A's currency to a charitable organisation in country B. The transfer is effected by crediting the recipient organisation's account with a bank in country A. The entries would be as follows:

	Current Account			**Capital Account**	
	Credit	Debit		Credit	Debit
Unrequited transfer		50	Increase in Foreign Liabilities	50	

In country B's BOP, a credit entry will appear under unrequited transfers and a debit in the capital account since its foreign assets have increased.

The reader should convince himself or herself that these examples conform to the rules of double-entry book-keeping as well as the thumb rules stated above.

4.3 VALUATION AND TIMING

In addition to the accounting conventions, two further considerations are important. One is the procedure adopted for valuation of goods and services and the other is the timing of recording a transaction.

Let us take the valuation problem first. Unless a uniform system of pricing is adopted for all transactions, a number of problems can arise. The credit and debit sides of a transaction, if not valued on the same basis, will not equal each other. Cross-country comparisons of balance of payments data would be meaningful only when a common system of pricing is used by all countries. The IMF recommends the use of "market prices" this being defined as the price paid by a "willing buyer" to a "willing seller", where the seller and the buyer are "independent parties" and the transaction is governed solely by commercial considerations. While this principle is adhered to wherever possible, in some cases departure is inevitable[2]. Another aspect of valuation is the choice between f.o.b. and c.i.f. valuations[3]. IMF recommends the former as the latter includes value of transportation and insurance in addition to the value of the goods. In India's BOP statistics, while exports are valued on f.o.b. basis, imports are at c.i.f. valuation. [See RBI (1987)] Still another difficulty concerns translation of foreign currency values into domestic currency. Theoretically, it should be done at the exchange rate prevailing at the time of the transaction. In practice, in most cases, for transactions during a particular month, the average exchange rate for the month is used.[4]

[2] For instance, a case where machinery or technical know-how is imported in exchange for shares in the importing enterprise or the case of a transaction between a foreign parent company and its local subsidiary.
[3] These abbreviations stand for "free on board" and "cost insurance freight", respectively.
[4] See Appendix II of RBI (1987) op.cit. for details.

For reasons similar to those in case of valuation, a uniform system of timing of recording is also desirable. The two sides of transaction should be recorded in the same time period. Various conventions have been evolved for this purpose, e.g. exports are recorded when cleared by customs, imports when payment is made, and so forth.

4.4 COMPONENTS OF THE BALANCE OF PAYMENTS

The BOP is a collection of accounts conventionally grouped into three main categories with subdivisions in each category. The three main categories are:

(a) **The Current Account:** Under this are included imports and exports of goods and services and unilateral transfers of goods and services.
(b) **The Capital Account:** Under this are grouped transactions leading to changes in foreign assets and liabilities of the country.
(c) **The Reserve Account:** In principle, this is no different from the capital account in as much as it also relates to assets and liabilities. However, in this category only "reserve assets" are included. These are the assets which the monetary authority of the country uses to settle the deficits and surpluses that arise on the other two categories taken together.[5]

In what follows we will examine in some detail each of the above main categories and their subdivisions. Our aim is to understand the overall structure of the BOP account and the nature of relationships between the different sub-groups. We will not be concerned with details of the valuation methodology, data sources and the various statistical compromises that have to be made to overcome data inadequacy. We draw extensively on the Reserve Bank of India monograph ***Balance of Payments Compilation Manual*** [RBI (1987)]. Readers interested in exploring methodological details should consult this source.

4.4.1 The Current Account

The structure of the current account in India's BOP statement is shown in Box 4.1.

We will briefly discuss each of the above heads and subheads.

I. Merchandise In principle, merchandise trade should cover all transactions relating to movable goods, with a few exceptions[6], where the ownership of goods changes from residents to non-residents (exports) and from non-residents to residents (imports). The valuation should be on f.o.b. basis so that international freight and insurance are treated as distinct services being exported and their value should not be merged with the value of the goods themselves.

[5] Reserve assets are financial assets, which are acceptable as means of payment in international transactions and are held by and exchanged between the monetary authorities of the trading countries. They consist of monetary gold, assets denominated in foreign currencies, special drawing rights and reserve positions in the IMF. The last two of these are explained in the next chapter. Deficits and surpluses on the other two categories lead to decumulation and accumulation of reserves, respectively.

[6] Among the exceptions are goods such as ships, airline stores, etc., purchased by non-resident transport operators in the given country and similar goods purchased overseas by that country's operators, purchases of foreign travellers, purchases by diplomatic missions.

Box 4.1 Structure of the Current Account in India's BOP Statement

A. Current Account	Credits	Debits	Net
I. Merchandise			
II. Invisibles ($a + b + c$)			
(a) Services			
1. Travel			
2. Transportation			
3. Insurance			
4. Government not elsewhere Classified			
5. Miscellaneous			
(b) Transfers			
6. Official			
7. Private			
(c) Income			
8. Investment Income			
9. Compensation to Employees			
Total Current Account (I + II)			

Exports, valued on f.o.b. basis, are credit entries. Data for these items are obtained from the various forms exporters have to fill and submit to designated authorities.

Imports valued at c.i.f. are the debit entries. Three categories of imports are distinguished according to the mode of payment and financing. [see RBI (1987) pp 27-30 for details]. Valuation at c.i.f., though inappropriate, is a forced choice due to data inadequacies.

The difference between the total of credits and debits appears in the "Net" column. This is **the Balance on Merchandise Trade Account**, a deficit if negative and a surplus if positive.

II. Invisibles Conventionally, trade in physical goods is distinguished from trade in services. The invisibles account includes services such as transportation and insurance, income payments and receipts for factor services – labour and capital – and unilateral transfers.

Credits under invisibles consist of services rendered by residents to non-residents, income earned by residents from their ownership of foreign financial assets (interest, dividends), income earned from the use, by non-residents, of non-financial assets such as patents and copyrights owned by residents and the offset entries to the cash and in-kind gifts received by residents from non-residents. Debits consist of same items with the roles of residents and non-residents reversed. A few examples will be useful:

1. Receipts in foreign exchange, reported by authorised dealers in foreign exchange, remitted to them by organisers of foreign tourist parties located abroad for meeting hotel and other local expenses of the tourists. This will be a credit under "travel".
2. Freight charges paid to non-resident steamship or airline companies directly when imports are invoiced on f.o.b. basis by the foreign exporter will appear as debits under "transportation".
3. Premiums on all kinds of insurance and re-insurance provided by Indian insurance companies to non-resident clients is a credit entry under "insurance".

4. Profits remitted by the foreign subsidiary of an Indian company to the parent represent a receipt of "investment income". It will be recorded as a credit under "investment income". Interest paid by a resident entity on a foreign borrowing will appear as a debit.
5. Funds received from a foreign government for the maintenance of their embassy, consulates, etc., in India will constitute a credit entry under "government not included elsewhere".
6. Payment to a foreign resident employed by an Indian company will appear as a debit under "compensation to employees".
7. Revenue contributions by the Government of India to international institutions such as the UN or a gift of commodities by the Government of India to non-residents will constitute a debit entry under "official transfers". Cash remittances for family maintenance from Indian nationals residing abroad will be a credit entry under "private transfers".

The net balance between the credit and debit entries under the heads merchandise, non-monetary gold movements and invisibles taken together is the **Current Account Balance**. The net balance is taken as deficit if negative (debits exceed credits), a surplus if positive (credits exceed debits).

4.4.2 The Capital Account

The capital account in India's BOP is laid out in Box 4.2.

Global capital flows occur in the form of:

1. Equity investment in the form of Foreign Direct Investment (FDI), portfolio investment by non-residents in the equity of domestic companies including Foreign Institutional Investors (FIIs) and individuals and investment by non-resident entities in depository receipts. Both capital inflows and outflows can occur in this form.
2. Non-resident investment in the debt instruments issued by domestic government and domestic firms.
3. External commercial borrowing by domestic firms.
4. External government borrowing including concessional loans granted by foreign governments and institutions such as World Bank and IMF.
5. Trade credits.
6. Capital flows through the banking channels.

Depending upon the exchange control and other regulations in the investors' home country and the country to which the investment is targeted, some of these forms of capital flows may not be permitted.

In the Indian context, RBI has adopted the IMF definition of FDI. (See RBI Monthly Bulletin dated August 13 2007, the section titled "The External Economy"). According to the IMF definition, FDI is the category of international investment that reflects the objective of obtaining a lasting interest by a resident entity in one economy in an enterprise resident in another economy. The lasting interest implies the existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence by the investor on the management of the enterprise. In line with international best practices, FDI includes both equity capital, reinvested earnings (retained earnings of FDI companies) and 'other direct capital' (inter-corporate debt transactions between related entities).

In dealing with FII investment also, RBI follows the IMF definition of foreign portfolio investment. According to the IMF definition, portfolio investment refers to cross-border transactions and positions involving debt or equity securities, other than those included in direct investment or reserve assets. Generally, FIIs include hedge funds, insurance companies, pension funds and mutual funds. In India, FIIs include overseas pension funds, mutual funds, investment trusts, asset management companies, nominee companies, banks, institutional portfolio managers, university funds, endowments, foundations, charitable trusts, charitable societies, a trustee or power of attorney holder incorporated or established outside India proposing to make proprietary investments or investments on behalf of a broad-based fund (*i.e.* fund having more than 20 investors with no single investor holding more than 10 per cent of the shares or units of the fund). India is among the largest recipients of portfolio inflows among EMEs.

The currency risk associated with incomes arising from both FDI and portfolio investments is borne by the investor and not by the company in whose capital these investments are made. Similarly, investment by non-resident investors in the depository receipts issued by a domestic firm exposes the investors to currency risk.

Medium- and long-term debts can be in the form of external syndicated loans, foreign currency bonds issued by domestic entities and non-resident investments in debt instruments issued by domestic entities in their own currency. The first two of these subject the borrowing entity to exchange rate risk. Short-term capital flows can be in the form of trade credits and short-term deposits by non-residents with domestic banks.

We will deal with long-term borrowing in global markets in Chapter 19 while the depository receipts mechanism – GDRs and ADRs – will be dealt with in Chapter 18.

Box 4.2 Structure of the Capital Account

B. Capital Account (1 to 5)	**Credit**	**Debit**	**Net**
1. Foreign Investment ($a + b$)			
(a) In India			
i. Direct			
ii. Portfolio			
(b) Abroad			
2. Loans ($a + b - c$)			
(a) External Assistance			
i. By India			
ii. To India			
(b) Commercial Borrowings (MT and LT)			
i. By India			
ii. To India			
(c) Short Term			
To India			
3. Banking Capital ($a + b$)			
(a) Commercial Banks			
i. Assets			
ii. Liabilities			
iii. Non-resident Deposits			
(b) Others			
4. Rupee debt Service			
5. Other Capital			
Total Capital Account (1 to 5)			

Net capital flows to India increased from US $24.2 billion during 2005-06 to US $106.6 billion during 2007-08, led by foreign direct investment (FDI) and FII investment inflows. There was a considerable amount of external commercial borrowings (ECBs). There was a sharp fall in net capital inflows in 2008-09 mainly due to FIIs exiting the Indian equity markets. The overall net inflows were US $7.2 billion. The optimism and strong positive view of the Indian economy have revived in 2009-10 with net inflows of over forty billion dollars during the period April to December 2009. The amount of FDI inflows was US $19.5 billion during 2006-07 and has gone up significantly after that. Even during the year 2008-09 when foreign portfolio investment dropped considerably, FDI was US $35 billion which was slightly higher than that in 2007-08. Foreign investors continue to find India as a good investment destination and there is a growing investor interest in the Indian economy with continuing liberalisation of the policy regime with regard to FDI.

Foreign institutional investors (FIIs) returned to India to invest in the Indian capital market during 2009-10, with inflows of nearly 24 billion dollars during the period April to December 2009. With corporates resorting to greater issue of American Depository Receipts (ADRs)/Global Depository Receipts (GDRs) abroad, capital inflows through this route were a little over 6.5 billion dollars in 2007-08. The volume fell sharply in 2008-09, but has recovered in 2009-10. Along with the jump in inward FDI inflows, there was a large increase in outward foreign direct investment from US $2.9 billion during 2005-06 to US $17.5 billion during 2008-09, reflecting large overseas acquisitions by the Indian corporates to gain market shares and reap economies of scale, amidst the progressive liberalisation of the external payments regime.

The net capital flow into India during 2011-12 amounted to about thirty nine billion dollars.

4.4.3 The Other Accounts

The remaining accounts in India's BOP are set out in Box 4.3.

Box 4.3

	Credits	Debits	Net
C. Errors and Omissions			
D. Overall Balance (Total of Capital and Current Accounts and Errors and Omissions)			
E. Monetary Movements			
(i) IMF			
(ii) Foreign Exchange Reserves (Increase –/Decrease +)			

The IMF account contains, as mentioned above, purchases (credits) and repurchases (debits) from the IMF. The Foreign Exchange Reserves account records increases (debits) and decreases (credits) in reserve assets. Reserve assets consist of RBI's holdings of gold and foreign exchange (in the form of balances with foreign central banks and investments in foreign government securities) and holdings of SDRs. SDRs – Special Drawing Rights – are a reserve asset created by the IMF and allocated from time to time to member countries[7]. Within certain limitations it can be used to settle international payments between monetary authorities of member countries. An allocation is a credit while retirement is a debit.

[7] More on the nature of this asset, allocation mechanism, etc., in the next chapter.

This completes our examination of the structure of India's BOP. In the next section, we will learn the meaning of the terms "deficit" and "surplus" in the balance of payments and the relationship between the three major categories of accounts.

4.5 MEANING OF "DEFICIT" AND "SURPLUS" IN THE BALANCE OF PAYMENTS

If the BOP is a double-entry accounting record, then apart from errors and omissions, it must always balance. Obviously, the terms "deficit" or "surplus" cannot then refer to the entire BOP, but must indicate imbalance on a subset of accounts included in the BOP. The "imbalance" must be interpreted in some sense as an economic disequilibrium.

Since the notion of disequilibrium is usually associated with a situation that calls for policy intervention of some sort, it is important to decide the optimal way of grouping the various accounts within the BOP so that an imbalance in one set of accounts will give the appropriate signals to policy makers. In the language of an accountant, we divide the entire BOP into a set of accounts "above the line" and another set "below the line". If the net balance (credits – debits) is positive above the line, we will say that there is a "balance of payments surplus; if it is negative, we will say there is a "balance of payments deficit". The net balance below the line should be equal in magnitude and opposite in sign to the net balance above the line. The items below the line can be said to be of a "compensatory" nature – they "finance" or "settle" the imbalance above the line.

The critical question is how to make this division so that BOP statistics, in particular the deficit and surplus figures, will be economically meaningful. Suggestions made by economists and incorporated into the IMF guidelines emphasise the purpose or motive behind a transaction as the criterion to decide whether the transaction should go above or below the line. The principal distinction is between **autonomous** transactions and ***accommodating or compensatory*** transactions. An autonomous transaction is one undertaken for its own sake, in response to the given configuration of prices, exchange rates, interest rates, etc., usually in order to realise a profit or reduce costs. It does not take into account the situation elsewhere in the BOP. An accommodating transaction on the other hand is undertaken with the motive of settling the imbalance arising out of other transactions, e.g. financing the deficits arising out of autonomous transactions. All autonomous transactions should then be grouped together "above the line" and all accommodating transactions should go "below the line". The terms **balance of payments deficit** and **balance of payments surplus** will then be understood to mean deficit or surplus on all autonomous transactions taken together.

Such a distinction, while easy to propose in theory (and economically sensible) is difficult to implement in practice in some cases. For some transactions, there is no difficulty in deciding the underlying motive, e.g. exports and imports of goods and services, private sector capital flows, migrant workers' remittances, unilateral gifts are all clearly autonomous transactions. Monetary authority's sales or purchases of foreign exchange in order to engineer certain movements in exchange rate is clearly an accommodating transaction. But consider the case of the government to finance deficits on other transactions or to finance a public sector project or both. In the first case, it is an accommodating transaction; in the second case, it is an autonomous transaction while in the third case, it is a mixture of both.

The IMF at one stage suggested the concept of **compensatory official financing.** This was to be interpreted as "financing undertaken by the monetary authority to provide (foreign) exchange to cover a surplus or deficit in the rest of the BOP". This was to include use of reserve assets as well as transactions undertaken by authorities for the specific purpose of making up a surplus or a deficit in the rest of the balance of payments. However, this concept did not really solve the problem of ambiguity mentioned above.

Later, the IMF introduced the notion of overall balance in which all transactions other than those involving reserve assets were to be "above the line". This is a measure of residual imbalance, which is settled by drawing down or adding to reserve assets.

In practice, depending upon the context and purpose for which it is used, several concepts of "balance" have evolved. We will take a look at some of them.

1. **Trade Balance**: This is the balance on the merchandise trade account, i.e. item I in the current account.
2. **Balance on Goods and Services**: This is the balance between exports and imports of goods and services. In terms of our presentation, it is the net balance on item I and sub-items 1-6 of item III taken together.
3. **Current Account Balance**: This is the net balance on the entire current account, items I + II + III. When this is negative, we have a current account deficit; when positive, a current account surplus; and when zero, a balanced current account.
4. **Balance on Current Account and Long-term Capital**: This is sometimes called **basic balance**. This is supposed to indicate long-term trends in the BOP, the idea being that while short-term capital flows are highly volatile, long-term capital flows are of a more permanent nature and indicative of the underlying strengths or weaknesses of the economy[8].

In discussing the BOP, we have left out an item, which inevitably appears in all BOP statements in practice, viz. "Errors and Omissions". While changes in reserve assets are accurately measured, recording of other items is subject to errors arising out of data inadequacy, discrepancies of valuation and timing, erroneous reporting, etc. These have to be reconciled by introducing a fictitious head of account called errors and omissions.

4.6 WHY ARE BOP STATISTICS IMPORTANT?

Balance of Payments statistics (at least estimates of major items) are regularly compiled, published and are continuously monitored by companies, banks, and government agencies. Often, we find a news headline like "announcement of provisional U.S. balance of payment figures have sent the dollar tumbling down". Obviously, the BOP statement contains useful information for financial decision matters.

In the short run, BOP deficits or surpluses may have an immediate impact on the exchange rate. Basically, BOP records all transactions that create demand for and supply of a currency. When exchange rates are market determined, BOP figures indicate excess demand or supply for the currency and the possible impact on the exchange rate. Taken in conjunction with recent past data, they may confirm or indicate a reversal of perceived trends. Further, as we will see later, they may signal a policy shift on the part of the monetary authorities of the country, unilaterally or in concert with its trading partners. For instance, a country facing a current account deficit may raise interest rates to attract short-term capital inflows to prevent depreciation of its currency. Or it may otherwise

[8] Recall, however, that the distinction between long- and short-term capital is made on the basis of the original maturity of the asset. A five-year original maturity bond with three months left to maturity is no more permanent than a three-month deposit. Also, while investment in equity shares is considered to be long term, it is one of the most easily marketable assets.

tighten credit and money supply to make it difficult for domestic banks and firms to borrow the home currency to make investments abroad. It may force exporters to realise their export earnings quickly and bring the foreign currency home. Movements in a country's foreign exchange reserves have implications for the stock of money and credit circulating in the economy. Central bank's purchases of foreign exchange in the market will add to the money supply and vice versa unless the central bank "sterilises" the impact by compensatory actions such as open market sales or purchases. Countries suffering from chronic deficits may find their credit ratings being downgraded because the markets interpret the data as evidence that the country may have difficulties in servicing its debt.

Finally, BOP accounts are intimately connected with the overall saving-investment balance in a country's national accounts. Continuing deficits or surpluses may lead to fiscal and monetary actions designed to correct the imbalance, which, in turn, will affect exchange rates and interest rates in the country.

Summary

The balance of payments of a county records its economic transactions with the rest of the world using a well-defined set of accounting conventions. These transactions can be grouped in different ways to create sub-groups such as current account, capital account, autonomous transactions, etc., depending upon the nature of the transaction or its economic significance. The phrase balance of payments deficit or surplus normally refers to the balance between credits and debits on the current account.

Corporate finance managers must monitor the BOP data being put out by government agencies on a regular basis because they have both short-term and long-term implications for a host of economic and financial variables affecting the fortunes of the company.

Questions and Problems

1. Explain how the following transactions will be recorded in Germany's balance of payments accounts:
   - **(a)** A German supermarket chain imports tea from Sri Lanka. Payment is made in EUR into the exporter's account in Frankfurt.
   - **(b)** A German bank makes a 1 million dollar loan to a Swedish firm. The firm wants the proceeds to be credited to its dollar account with a London bank.
   - **(c)** An American tour operator arranges a conducted tour of Germany for a group of Americans and sends a cheque for EUR 250,000 to a German travel agent to meet the tourists' local expenses.
   - **(d)** A German conservationist group does a land-for-loan deal with the Brazilian government. Brazil agrees to sell 500,000 hectares of Amazonian tropical forest to the group; in return it wants the group to pay off a EUR 400 million loan it owes to a German bank.
   - **(e)** A German charity sends a cheque for EUR 5,00,000 to Sisters of Charity as a donation to the organisation.

2. Why should a corporate finance manager monitor balance of payments' developments?
3. What is the basis of the distinction between the capital account and the reserve account?
4. Gold is a part of a country's foreign exchange reserves. How does the BOP record the sale of domestically mined gold to the central bank of the country?
5. Sometime ago the Government of India carried out a "temporary" sale of gold from the RBI to the Bank of England. How would such a transaction affect the BOP?
6. SDRs are reserve assets created by the IMF. How is a fresh allocation of SDRs recorded in the BOP?
7. Can all countries collectively show a surplus or deficit, or must surpluses cancel deficits? What does gold mining or creation of SDRs by the IMF imply for the world's balance?
8. "A country which persistently runs a current account surplus is living below its means while if it runs a persistent deficit it is living beyond its means". Explain this statement.
9. India used to trade with erstwhile communist countries where the payments were in rupees. Would these transactions appear in balance of payments? How would they be recorded?
10. Government of India makes a gift ₹50 million to a neighbouring country. Subsequently, the recoup country use the money to buy medicines, food, etc. from Indian suppliers. How would these transactions affect India's BOP?

References and Bibliography

1. Awasthi, G.D. (1997): ***Trade Payments*** Academy of Business Studies, New Delhi.
2. EXIM Bank of India (1992): ***Export-Import Bank of India: Objectives, Operations, Organisation***, September, Bombay.
3. Reserve Bank of India (1987): ***Balance of Payments Compilation Manual***, RBI, Bombay.
4. Willsher, R. (1995): ***Export Finance—Risks, Structures and Documentation***, Macmillan, London.

A fairly adequate discussion of trade finance with some procedural detail can be found in:

Eng, M. (1988): "Financing International Trade", Section 16 in Walter, I. and T. Murray (Eds.), ***HandBook of International Business***, 2nd edition, John Wiley and Sons, New York.

Publications of the International Chambers of Commerce provide details on the various procedural aspects. On documentary letters of credit, see ***Uniform Customs and Practice for Documentary Credits***, 1994 revision, ICC Publication No. 500.

Descriptions of activities of export finance institutions in a number of countries can be found in ***Guide to Export Finance***, Euromoney Publications, London, 1990.

APPENDIX

A.4.1 INDIA'S OVERALL BALANCE OF PAYMENTS

Data on India's balance of payments for the fiscal year 2008-09 are provided in Tables A.4.1.

Table A.4.1 India's Overall Balance of Payments

Sl. No.	*Item*	*2007–08*	*2008–09*	*2009–10*	*2010–11*[PR]	*2011–12*[P]	*2011–12 H1 (April-Sept. 2011)*[PR]	*2012-13 H1 (April-Sept. 2012)*[P]
1	2	3	4	5	6	7	8	9
I	**Current Account**							
1	Exports	166,162	189,001	182,442	258,159	309,774	158,202	146,549
2	Imports	257,629	308,520	300,644	383,481	499,533	247,739	237,221
3	Trade Balance	–91,467	–119,519	–118,203	–127,322	–189,759	–89,537	–90,672
4	Invisibles (net)	75,731	91,604	80,022	79,269	111,604	53,103	51,699
	A Non-factor Services	38,853	53,916	36,016	44,081	64,098	30,409	29,572
	B Income	–5,068	–7,110	–8,038	–17,952	–15,988	–7,587	–10,510
	C Transfers	41,945	44,798	52,045	53,140	63,494	30,281	32,637
5	Goods and Services Balance	–52,614	–65,603	–82,187	–83,241	–125,661	–59,128	–61,100
6	Current Account Balance	–15,737	–27,914	–38,181	–48,053	–78,155	–36,433	–38,973
II	**Capital Account**							
	Capital Accounts Balance	106,585	7,395	51,634	63,740	67,755	43,490	39,989
	i. External Assistance (net)	2,114	2,439	2,890	4,941	2,296	640	15
	ii. External Commercial Borrowings (net)	22,609	7,861	2,000	12,160	10,344	8,388	1,726
	iii. Short-term debt	15,930	–1,985	7,558	12,034	6,668	5,940	9,511
	iv. Banking Capital (net) of which:	11,759	–3,245	2,083	4,962	16,226	19,714	14,899

(Contd.)

	Non-Resident Deposits (net)	179	4,290	2,922	3,238	11,918	3,937	9,397
	v. Foreign Investment (net) of which:	43,326	8,342	50,362	42,127	39,231	17,087	18,608
	A FDI (net)	15,893	22,372	17,966	11,834	22,061	15,741	12,812
	B Portfolio (net)	27,443	–14,030	32,396	30,293	17,170	1,346	5,796
	vi. Other Flows (net)	10,847	–6,016	–13,259	–12,484	–7,008	–8,278	–4,769
III	**Errors and Omission**	1,316	440	–12	–2,636	–2,432	–1,338	–653
IV	**Overall Balance**	92,164	–20,080	13,441	13,050	–12,831	5,719	363
V	**Reserves change [increase (–) / decrease (+)]**	**–92,614**	**20,080**	**–13,441**	**–13,050**	**12,831**	**–5,719**	**–363**

Source: RBI. PR : Partially Revised. P : Preliminary.

A.4.2 FINANCING INTERNATIONAL TRADE

The massive growth of international trade in goods and services would not have been possible without the supporting framework of efficient payments and financing mechanisms. The purpose of this section of the appendix is to briefly explain some of the features of the payment process and the financing alternatives available to exporters and importers. The emphasis is on explaining the essential character of the important mechanisms rather than specific procedural details. The interested reader can consult specialised works on the subject some of which are cited at the end of this appendix.

Following are among the important considerations in the choice of a strategy for trade financing:

- **The nature of the goods in question**. Capital goods usually require medium to long-term financing while consumer goods, perishable products, etc., require short-term finance.
- **The nature of the market**. A buyers' market favours the importer and the exporter may have to offer longer credit terms, bear the currency risk and possibly some credit risk. A sellers' market on the other hand favours the exporter.
- **The nature of the relationship between the exporter and the importer.** For example, if both are members of the same corporate family (affiliates of the same MNC) or have had a long-standing relation with each other, the exporter may agree to sell on open account credit while absence of confidence may require a letter of credit.
- **The availability of various forms of financing**, government regulations pertaining to the sale transaction, etc.

The crucial question is who will bear the credit risk? When an exporter sells on open account or consignment basis, the exporter bears the entire credit risk. On the other hand, in cases when the importer makes advance payment at the time of placing the order, he bears the credit risk. Most often, given the complexities in cross-border transactions and the absence of detailed knowledge regarding the financial status of the two parties, credit risk will be shifted to an intermediary who specialises in evaluating and undertaking such risks. This may be a government institution such as an EXIM bank or commercial banks, factors or others.

There is also the question of exchange risk. If the invoice is in exporter's currency, the importer bears exchange risk and vice versa. Often, it may be neither the exporter's nor the importer's currency, but some international vehicle currencies, e.g. US dollar in which case both bear exchange risk. With the availability of sufficiently deep forward markets, and other currency risk management products, the question of currency of invoicing is not critically important.

Methods of Payment

The payment process and the implicit provision of financing basically involve at least four parties, viz. the exporter, the importer and their respective banks. In some cases, other parties may enter the picture as we will see below.

Open Account This means the exporter sells on credit terms arranged between the exporter and the importer. There is no third-party involvement. In case of default, legal remedies to enforce payment by the foreign importer can be quite difficult. This mode of payment is, therefore, used mostly when the two parties are members of the same corporate family or have had very long-standing relationship with each other.

Consignment Under this arrangement, the exporter ships goods to the importer, but retains title to them till such time when the goods are sold and the ***consignee*** (importer) pays the ***consigner*** (exporter). The method is used mostly when the importer is a foreign branch of the exporter. Legal resort in case of default is difficult.

Advance Payment The importer or the importer's bank may pay the exporter in advance. In the former case, the importer pays the full amount at the time of placing the order. This is found very rarely in international trade unless the importer's credit standing is very low or completely unknown. In the latter case, importer's bank pays the exporter in advance in accordance with a letter of credit requested by the importer. The exporter can draw drafts on a specified bank in his country the amounts being adjusted when the goods are shipped and documents are presented to the importer's bank. Finally, the exporter may obtain financing from his bank by presenting documents evidencing shipment and the bank will discount the draft drawn by the exporter with recourse to the exporter.

Documentary Drafts Under this payment procedure, the exporter after completing the shipment presents a draft (drawn on the importer) and documents[9] to his bank who, in turn, forward them to the importer's bank. If the draft is a **Documents against Payment (D/P)** draft, the importer must pay before the documents are handed over to him; if it is a **Documents against Acceptance (D/A)** draft[10], the importer must "accept" the draft before acquiring the documents[11]. The title to the goods remains with the exporter till the draft is paid or accepted. When the importer makes payment, his bank remits the same to the exporter's bank who pay the exporter. The banks **do not**

[9] "Documents" here refers to various shipping and other documents which are required to be prepared for effecting a shipment and subsequently for the buyer to take possession of the goods. On average about 25 documents are associated with an export transaction prior to shipment. There are both "commercial documents" and "regulatory documents". Among the former are commercial invoice, bill of lading, drafts, packing list, certificate of origin, etc. while the latter consist of various documents required by customs, exchange control, port authorities, etc.

[10] A draft is also called a "bill of exchange" or simply a "bill". Thus, an "Export Bill" is a draft drawn by an exporter on the importer or the importer's bank.

[11] "Accepting" a draft means acknowledging one's obligation to pay by signing the draft with appropriate phrases such as "accepted".

provide any financing but only document processing and forwarding services as well as handling the payment and remittance[12].

Letters of Credit A **Letter of Credit (L/C)** is a written guarantee given by the importer's bank to honour an exporter's draft or any other claims for payment provided the exporter has fulfilled all the conditions specified in the L/C. The L/C is **opened** by the importer's bank at the request of the importer. It is the **issuing or opening bank**. The issuing bank forwards the L/C to a correspondent bank (or its own branch) in the exporter's country (the **Advising Bank**) who, in turn, forwards it to the exporter who is the **beneficiary** under the L/C. Since the documentation is quite elaborate and the written clauses require careful interpretation, the International Chambers of Commerce have evolved a standard code called **Uniform Customs and Practices for Documentary Credits** to deal with documentary disputes in international trade. Its current version is ICC Publication No. 500 of 1994. Note that the L/C by itself is **not** a financing instrument; it is only a bank's commitment to pay. Financing depends upon how the related draft is disposed off. Exhibit A.4.1 shows a specimen irrevocable (see below) letter of credit.

Note that the LC is in essence a list of documents. It is entirely separate from any underlying commercial contract between the buyer and the seller. The banks involved in handling the LC will concern themselves only with the documents as specified in the LC. They are not concerned with the goods being sold, e.g. their specifications, quality, etc. Provided the documents presented by the seller or exporter conform in every detail to what is specified in the LC, payment would be made. Figures A.4.1 and A.4.2 show the basic structure of the LC mechanism.

Payment under a L/C is either against a **Sight or Demand Draft** or a **Time or Usance Draft**. In the former case, the exporter presents a sight draft along with other documents to the opening bank who must pay the exporter immediately, provided all documents are in order and all the conditions specified in the L/C have been complied with. With a time or usance draft, the payment is at a later date, 30, 60, 90, etc., days after presentation of the draft (or the date of the draft) depending upon the agreement specified in the L/C. In such a case, the opening bank "accepts" the draft and it becomes **A Banker's Acceptance**[13]. The exporter can get immediate payment by **discounting**[14] the accepted draft either with the opening bank, or with his own bank or (in some cases) by selling the acceptance in the market[15,16]. Financing is, thus, provided by the bank which discounts the draft or by a money market investor who buys the acceptance. (With sight drafts, the importer's bank may provide credit to the importer as a part of their ongoing business relationship).

Exhibit A.4.2 shows a specimen sight draft. To cater to the wide variety of transactions and customers, different types of letters of credit have evolved. **A Revocable L/C** is issued by the issuing bank and contains a provision that the bank may amend or cancel the credit without the approval

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[12] Of course the buyer's bank may accept the time draft and create a banker's acceptance which the exporter can then discount. The buyer would have made arrangements for financing with its bank.

[13] Actually, the opening bank will empower its correspondent bank located in the country of the exporter to examine the documents and make payment or accept the draft. This bank is then the "Negotiating Bank". It has recourse to the beneficiary unless it is also acting as the "Confirming Bank" in the case of a confirmed letter of credit explained below.

[14] Who will bear the discount depends upon the agreement between the exporter and the importer.

[15] Because of the high credit standing of the opening bank (an exporter would normally accept an L/C issued only by a reputed bank in the importer's country), the banker's acceptance is a money market instrument with an active market in some countries such as the US.

[16] There is also the possibility of "deferred payment" when some time elapses between the exporter presenting the draft and documents and getting paid because compliance with all conditions has to be inspected. For instance, the goods may have to be inspected by an agency of the importer's government (e.g. Food and Drug Administration in the U.S.).

Exhibit A.4.1 Sample Irrevocable Letter of Credit

International Banking Group — Original

Megabank Corporation
P.O. Box 1000, Atlanta Georgia 30302-1000
Cable Address: MegaB
Telex No. 1234567
Swift No. MBBABC 72

Our Advice Number: EA0000091
Advice Date: 08MAR97
Issue Bank REF: 3312/HBI/22341
Expiry Date: 23JUN97

****Amount****
USD****25,000.00

Beneficiary:
The Walton Supply Co.
2356 South N.W. Street
Atlanta, Georgia 30345

Applicant:
HHB Hong Kong
34 Industrial Drive
Central, Hong Kong

We have been requested to advice to you the following Letter of Credit as issued by:
Third Hong Kong Bank
1 Central Tower
Hong Kong

Please be guided by its Terms and Conditions and by the following:
Credit is available by negotiation of your draft(s) in duplicate at sight for 100 percent of invoice value drawn on us accompanied by the following documents:

1. Signed commercial invoice in 1 original and 3 copies.
2. Full step 3/3 ocean bills of landing consigned to the order of Third Hong Kong Bank, Hong Kong notify applicant and marked freight collect.
3. Packing list in 2 copies.

Evidencing shipment of: 5000 pine logs—whole—8 to 12 feet FOB Savannah, Georgia

Shipment from: Savannah, Georgia — To: Hong Kong
Latest Shipping Date: 02Jun97

Partial shipments not allowed — Transshipment not allowed

All banking charges outside Hong Kong are for beneficiarys account. Documents must be presented within 20 days from B/L date.

At the request of our correspondent, we confirm this credit and also engage with you that all drafts drawn under and in compliance with the terms of this credit will be duly honoured by us.

Please examine this instrument carefully. If you are unable to comply with the terms or conditions, please communicate with your buyer to arrange for an amendment.

of the beneficiary. It provides least protection to the exporter. **An Irrevocable L/C** cannot be so amended or cancelled without the exporter's prior approval. **A Confirmed, Irrevocable L/C** contains an extra protection; in addition to the issuing bank's commitment, a **Confirming Bank** adds its own undertaking to pay, provided all conditions are met. The confirming bank (which may be, but need not be the same as the advising bank) will pay even if the issuing bank cannot or will not honour

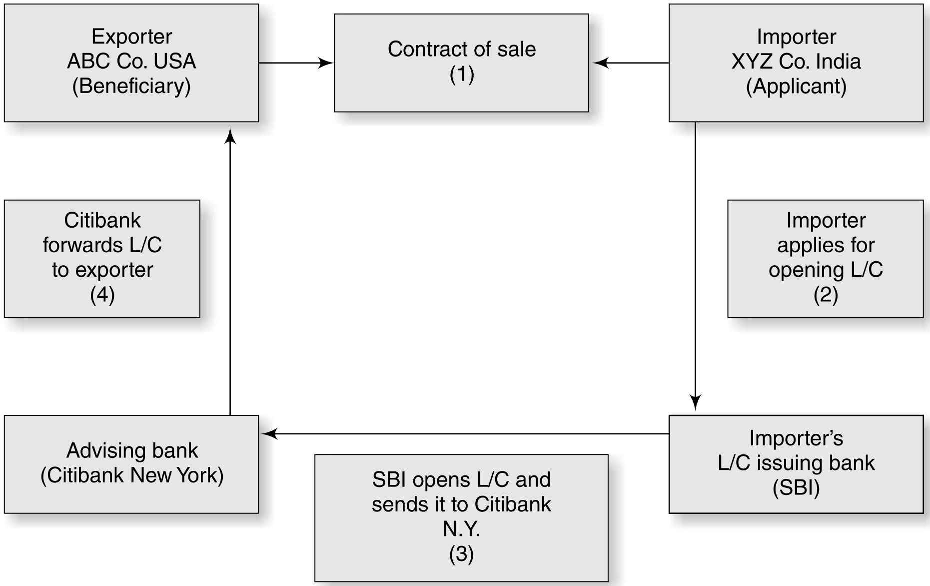


Fig. A.4.1 Opening a Letter of Credit (L/C)

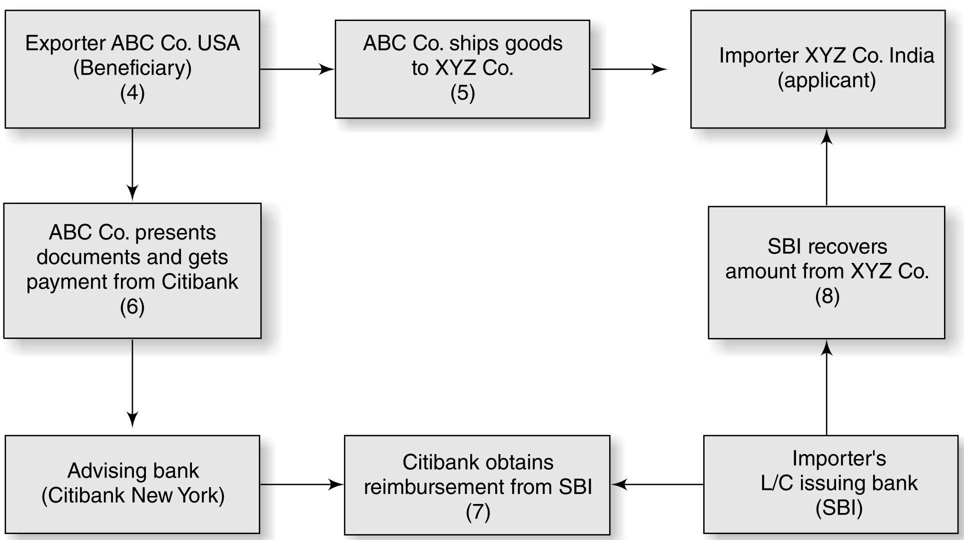
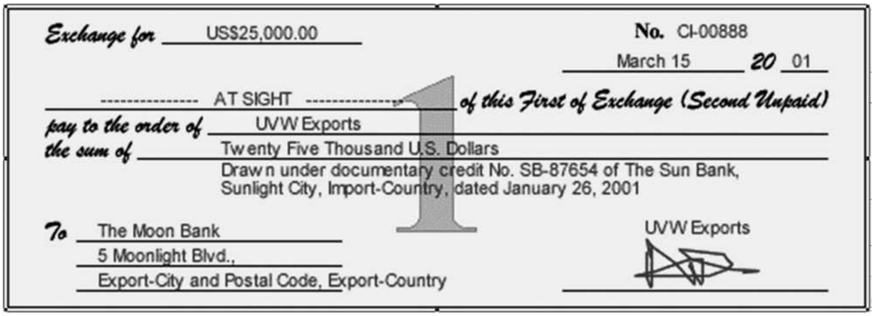


Fig. A.4.2 Utilisation of Letter of Credit (L/C)

the exporter's draft[17]. **A Revolving L/C** is used when the exporter is going to make shipments on a continuing basis and a single L/C will cover several shipments. **A Transferable L/C** permits the beneficiary to transfer a part or whole of the credit in favour of one or more secondary beneficiaries. This type of L/C is used by trader exporters who act as middlemen between the importer and the

[17] The confirming bank may also be the advising and negotiating bank.

Exhibit A.4.2 A Sight Draft


Exchange for US$25,000.00 No. CI-00888
March 15 20 01
-------------- AT SIGHT -------------- of this First of Exchange (Second Unpaid)
pay to the order of UVW Exports
the sum of Twenty Five Thousand U.S. Dollars
Drawn under documentary credit No. SB-87654 of The Sun Bank,
Sunlight City, Import-Country, dated January 26, 2001
To The Moon Bank
5 Moonlight Blvd.,
Export-City and Postal Code, Export-Country
UVW Exports

manufacturer(s) of the goods[18]. The trader intends to profit from the difference between the original amount of credit and the amount transferred to the secondary beneficiaries. In a **Back-to-Back L/C**, the beneficiary of the original L/C requests a bank (usually the advising bank to the original L/C) to open an irrevocable L/C in favour of another party who may be the ultimate manufacturer or supplier of the goods. The original L/C is a guarantee against the second L/C. In a **Red-Clause L/C**, a clause is printed in red ink on a normal L/C authorising the advising bank to make clean advances to the exporter which are offset against the export proceeds when the documents are finally presented. In effect the importer makes unsecured loans to the exporter in the latter's currency. This type of L/C is used when there exists a close relationship between the importer and the exporter. When the currency of invoice in a transaction is neither the exporter's nor the importer's home currency, a bank in the importer's country may request a third-country bank to advise the exporter that the exports will be paid for in the third country's currency by that bank.

Thus, a Dutch importer of cocoa from Ghana would ask his bank to request an American bank to advise the exporter that the draft will be settled in dollars at the American bank. **A Standby L/C**, actually a term covering a wide variety of arrangements, provides a fallback guarantee to the supplier in case the primary obligor fails to pay.

Both the exporter and the importer must take care that all the relevant and significant details pertaining to the transaction are clearly spelt out in the L/C and all the documents including the draft are prepared exactly as specified in the L/C since the banks will be guided strictly by what is stated in the L/C. In particular, the exporter must make sure that it is in a position to supply all the documents demanded by the L/C and exactly as specified in the L/C.

There are a number of other special types of L/Cs. The reader can consult Wilsher (1995) or the relevant ICC publication for further details.

Other Methods

Cross-border leasing represents an alternative to imports and trade finance. Equipment such as aircraft, ships, oil drilling rigs, etc., can be leased from international leasing firms. Some international merchant banks specialise in cross-border leasing. Foreign banks in the importer's country may also have the expertise to structure complex leasing deals.

Forfaiting is a specialised form of trade finance that allows the exporter to offer extended credit to the importer. Under this mechanism, the importer gives the exporter a bundle of bills of exchange or promissory notes covering the principal amount as well as the interest. Each tranche of the notes

[18] It may also be used by a manufacturer exporter who does not have sufficient quantity to deliver and has to transfer a portion to another manufacturer.

fall due at different points of time in the future, e.g. every six months, extending upto several years[19]. The notes are backed by a guarantee or **Aval** provided by a reputed bank in the importer's country. The exporter can then discount these notes **without recourse** with banks who specialise in the forfaiting business to generate immediate cash flow[20]. This means that if either the importer or the guaranteeing bank fails to pay when notes fall due, the forfaiter cannot ask the exporter for reimbursement. The credit risk is assumed entirely by the forfaiter. The forfaiter, in turn, may hold the notes in its own portfolio or sell different tranches in the secondary market (obviously at a discount smaller than what was charged to the exporter). Figure A.4.3 provides a schematic picture of the forfaiting mechanism.

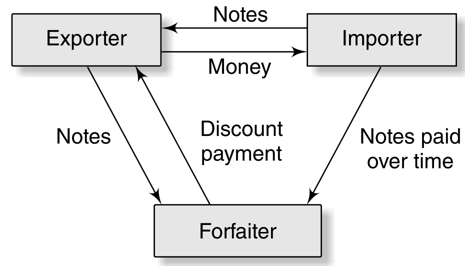


Fig. A.4.3 The Forfaiting Mechanism

Forfaiting tends to be a specialised business because each underlying export-import transaction generally has unique features. For a detailed treatment of this financing mechanism, see Wilsher (1995).

Buyers' Credits are a form of eurocurrency loans designed to finance a specific transaction involving import of goods and services. Under this arrangement, lending bank(s) pay the exporter on presentation of shipping documents. The importer works out a deferred payment arrangement with the lending bank which the bank treats as a loan. Large loans are club loans or syndicated loans. Many provisions in the loan agreement are quite similar to a general purpose syndicated credit. A number of formalities have to be completed before the exporter can draw funds. Interest rate is linked to a market index such as LIBOR. In some cases, a state Export Credit Agency from the exporter's country may pay a subsidy to the banks so that an attractive funding cost can be offered to the importer. For further details, see Wilsher (1995).

Lines of Credit are like buyers' credits, but much wider in scope. A typical buyer's credit involves one transaction between one supplier and one buyer. A line of credit covers several purchase transactions with the buyer importing different items from different suppliers. Many buyers can also be involved provided the ultimate credit risk is that of a single buyer or guarantor.

In a **Supplier's Credit**, the exporter extends credit to the importer by allowing it to pay on a deferred payment basis. Promissory notes issued by the importer evidence the credit. Like in forfaiting, the supplier can discount the paper with a bank[21]. The payments made by the buyer under the promissory notes are assigned to the lenders and may be routed to them directly or through the supplier. The supplier may have to share the responsibility of pursuing payment on the banks' behalf in the case of default on the part of the buyer.

The Export-Import Bank of India (EXIM Bank) The EXIM bank of India set up in 1982 is the principal institution in the country for coordinating the working of institutions engaged in trade finance. It has a variety of programmes designed to provide long-term and short-term finance to foreign buyers of Indian goods and services that enable Indian exporters to extend credit to their overseas customers. It also assists commercial banks in providing export finance and finance for imports of bulk goods and imports of raw materials for export production. Apart from finance, it also provides information and advisory services to exporters to assess international opportunities and

[19] For instance, importers in India may be able to avail credit extending up to seven years. See Wilsher (1995).
[20] The institution which buys the notes directly from the exporter is called "primary forfaiter".
[21] Alternatively, there can be a Supplier's Credit Loan. The difference is that under this, the supplier receives the full value of the loan rather than the discounted value of the promissory notes. See Wilsher (1995).

risks. A brief description of its lending programmes and other activities can be found in one of its periodic publications [e.g. EXIM Bank (1992)].

Counterparts of EXIM India in other countries such as EXIM USA are an important source of finance including term credits for importers in India.

Case Study

"Government of India closely watching rise in FOREX reserves".
"BOP situation for India worsens over last few months due to bird flu scare."
"RBI considering possible hike in CRR, thereby signalling possible tight monetary policy."
"Political parties demanding compensation in dollar terms, for farmers for chickens culled."

These were some of the headlines screaming for your attention before the annual board meeting. You—the CEO of a mega-property developing corporation—call up the chief economist to take her views into consideration. Your company has heavily invested in many mega projects and you are planning to ride the retail boom. The organisation has ambitious plans to make foray into airport and seaport privatisation process. This will mean hand-holding with international agencies and taking loans and, possibly, equity partnership. These inflows will have the usual condition of repayment of interest and minimum guaranteed dividends in dollar terms.

Your phone rings and chief economist explains, "On one hand, India has a promising future in retail market, as it is evident from the shopping malls boom in all metros and mini-metros. Therefore, our investments are well protected. GDP is projected to grow at about 8% over next five years. This will mean a much larger foreign trade component, giving fillip to requirement of airport and seaport infrastructure. In such a scenario, we should be able to establish ourself in this sector as well. However, on the other hand, there is a definite possibility that in case this GDP growth is not achieved, unemployment will rear its head once again, causing supply side shortages and unabated demand in some sectors—thereby meaning inflation will soar, and, in turn, interest rates will go up; and finally this will put downward pressure on rupee against all major currencies. This will erode our credibility and profitability in the market. The signs of impact could be visible in six months from now and among the first indicators of this shift looming over the horizon will be change in India's BOP account." You listen to her silently on your intercom.

You give a sigh of relief as soon as her prognosis is over. You call up your treasurer for a small chat. After all, he is the person who deals in foreign exchange market on minute-to-minute basis.

He has a different story to tell, "Well, even if worst case scenario emerges, we stand to gain. See, hardening of interest rates with devaluation of currency will not have any material impact on us. In fact, with this India will become a preferred destination for further foreign investment. Our exports will become more competitive in the international market and it will give a boost for indigenous production of many things. This means more imports of plant and machinery, and of course, raw materials." He signs off by saying, "I see no reason for worry even if BOP situation worsens, we are well covered in currency and interest rate futures market." He adds further with smile, "We can actually make money on the basis of this forecast, subject to the permission from our board to take position in options markets."

You sit back in your chair and try to figure out what your presentation is going to be in front of the board.

Chapter 5

The International Monetary System

5.1 INTRODUCTION

Trade and exchange are probably older than the invention of money, but in the absence of this wonderful contrivance, the volume of trade and gains from specialisation would have been rather miniscule. What is true of trade and capital flows within a country is also true, perhaps more strongly, of international trade and capital flows. Both require an efficient global monetary order to flourish and yield their full benefits.

From the point of view of a firm with worldwide transactions in goods, services and finance, an efficient multilateral financial system is a prerequisite for efficient operation. By this, we mean a global monetary and financial organisation that facilitates transfer of funds between parties, conversion of national currencies into one another, acquisition and liquidation of financial assets, and international credit creation. The international monetary system is an important constituent of the global financial system.

The purpose of this chapter is to familiarise the reader with the organisation and functioning of the international monetary system. Our approach will be partly analytical and partly descriptive. The discussion will be structured around the following aspects of the system which we consider to be the key areas a finance manager must be acquainted with:

1. Exchange rate regimes, current and past.
2. International liquidity, i.e. the volume and composition of reserves, adequacy of reserves, etc.
3. The International Monetary Fund, its evolution, role and functioning.
4. The adjustment process, i.e. how the system facilitates the process of coping with payments imbalances between trading nations.
5. Currency blocks and unions such as the Economic and Monetary Union (EMU) and European Currency Union (ECU) in Europe.

A deeper analysis of these aspects belongs to the discipline of International Monetary Economics. Here, we wish to provide an introductory treatment to serve as background to the discussion in the rest of the book. For a more in-depth treatment, the reader should consult a standard text in International Economics such as Carbaugh (2000).

5.2 EXCHANGE RATE REGIMES

An exchange rate is the value of one currency in terms of another. What is the mechanism for determining this value at a point in time? How are exchange rates changed? The term *exchange rate regime* refers to the mechanism, procedures and institutional framework for determining exchange rates at a point in time and changes in them over time, including factors which induce the changes.

In theory, a very large number of exchange rate regimes are possible. At the two extremes are the perfectly ***rigid or fixed*** exchange rates and the perfectly ***flexible*** **or** ***floating*** exchange rates. Between them are hybrids with varying degrees of ***limited flexibility***. The regime in existence during the first four decades of the 20th century could be described as gold standard. This was followed by a system in which a large group of countries had fixed but adjustable exchange rates with each other. This system lasted till 1973. After a brief attempt to revive it, much of the world moved to a sort of "non-system" wherein each country chose an exchange rate regime from a wide menu depending on its own circumstances and policy preferences. We will provide a brief historical overview of the gold standard and adjustable peg regimes. This will be followed by a discussion of the broad spectrum of exchange rate arrangements in existence as of the beginning of the 21st century.

5.2.1 A Brief Historical Overview: The Gold Standard and the Bretton Woods System

5.2.1(a) The Gold Standard This is the oldest system which was in operation till the beginning of the First World War and for a few years after that. In the version called ***Gold Specie Standard,*** the actual currency in circulation consisted of gold coins with a fixed gold content. In a version called ***Gold Bullion Standard,*** the basis of money remains a fixed weight of gold but the currency in circulation consists of paper notes with the monetary authorities, i.e. the central bank of the country, standing ready to convert on demand, unlimited amounts of paper currency into gold and vice versa, at a fixed conversion ratio. Thus, a pound sterling note can be exchanged for say x ounces of gold while a dollar note can be converted into say y ounces of gold on demand. Finally, under the ***Gold Exchange Standard,*** the authorities stand ready to convert, at a fixed rate, the paper currency issued by them into the paper currency of another country which is operating a gold-specie or gold-bullion standard. Thus, if rupees are freely convertible into dollars and dollars, in turn, into gold, rupee can be said to be on a gold-exchange standard.

The exchange rate between any pair of currencies will be determined by their respective exchange rates against gold. This is the so-called "mint parity" rate of exchange. In practice, because of costs of storing and transporting gold, the actual exchange rate can depart from this mint parity by a small margin on either side.

Under the true gold standard, the monetary authorities must obey the following three rules of the game:

- They must fix once-for-all the rate of conversion of the paper money issued by them into gold.
- There must be free flows of gold between countries on gold standard.
- The money supply in the country must be tied to the amount of gold the monetary authorities have in reserve. If this amount decreases, money supply must contract and vice versa.

The gold standard regime imposes very rigid discipline on the policy makers. Often, domestic policy goals such as reducing the rate of unemployment may have to be sacrificed in order to continue operating the standard and the political cost of doing so can be quite high. For this reason, the system was rarely allowed to work in its pristine version. During the Great Depression, the gold standard was finally abandoned in form and substance.

In modern times, some economists and politicians have advocated return to gold standard[1], precisely because of the discipline it imposes on policy makers in the area of monetary and credit policy. As we will see later, such discipline can be achieved by adopting other types of exchange rate regimes.

5.2.1(b) The Bretton Woods System Following the Second World War, policy makers from the victorious allied powers, principally the US and the UK, took up the task of thoroughly revamping the world monetary system for the non-communist world. The outcome was the so called "Bretton Woods System"[2] and the birth of two new supranational institutions, the International Monetary Fund (the IMF or simply "the Fund") and the World Bank, the former being the linchpin of the proposed monetary system.

The exchange rate regime that was put in place can be characterized as the **Gold Exchange Standard**[3]. It had the following features:

- The US government undertook to convert the US dollar freely into gold at a fixed parity of $35 per ounce.
- Other member countries of the IMF agreed to fix the parities of their currencies vis-à-vis the dollar[4] with variation within 1 per cent on either side of the central parity being permissible. If the exchange rate hit either of the limits, the monetary authorities of the country were obliged to "defend" it by standing ready to buy or sell dollars against their domestic currency to any extent required to keep the exchange rate within the limits.

In return for undertaking this obligation, the member countries were entitled to have access to credit facilities from the IMF to carry out their intervention in the currency markets. We will examine later in this chapter the various facilities available to the member countries.

The novel feature of the regime which makes it ***an adjustable peg*** system rather than a fixed rate system like the gold standard was that the parity of a currency against the dollar could be changed in the face of a **fundamental disequilibrium**[5]. Changes of up to 10 per cent in either direction could be made without the consent of the Fund while larger changes could be effected after consulting the Fund and obtaining their approval. However, this degree of freedom was not available to the USA. US monetary authorities had to maintain the gold value of the dollar.

[1] See, for instance, Rueff (1962) and Heilperin (1961).

[2] Bretton Woods is the name of the town in the state of New Hampshire, USA, where the delegations from over forty countries met in 1944 to deliberate on proposals for a post-war international monetary system. The two main contending proposals were "the White plan" named after Harry Dexter White of the US Treasury and "the Keynes plan" whose architect was Lord Keynes of the UK.

[3] As we will see below, this characterisation was valid till 1968 when it became a limping gold exchange standard.

[4] Some countries, e.g. India chose to tie their currencies not directly to the dollar, but to another currency like the pound sterling which, in turn, was tied to the dollar.

[5] A fundamental disequilibrium is said to exist when at the given exchange rate, the country repeatedly faces balance of payments disequilibria and has to constantly intervene and sell foreign exchange (persistent deficits) or buy foreign exchange (persistent surpluses) against its own currency. As we will see below, the situation of persistent deficits is much more difficult to deal with and calls for a devaluation of the home currency.

Let us see how the Bretton Woods system worked. In Figure 5.1, we have drawn a supply curve S-S and a demand curve D_1D_1 for dollars[6]. On the vertical axis, we have plotted the price of dollars in terms of rupees, i.e. the exchange rate between rupees and dollars. On the horizontal axis, we have shown the quantity of dollars demanded and supplied. For the present, one can imagine that the demand for dollars arises from Indian residents wanting to import American goods and services while the supply of dollars arises from Americans wishing to import goods and services from India (and, therefore, wishing to exchange their dollars for rupees). Suppose the parity exchange rate is ₹12.00 per dollar. The ± 1% limits are, therefore, ₹12.12 and ₹11.88. These limits are called ***support points*** for reasons that will become clear shortly.

As long as the demand and supply curves intersect within the permissible band, the Indian authorities need do nothing; the exchange rate resulting from autonomous demand and supply factors falls within the permissible band. However, suppose the demand curve shifts upward to the right because Indians develop a greater liking for American goods and want to import a larger quantity. This is shown by the curve D_2D_2. Now the "market determined" exchange rate would fall outside the band. The Indian authorities are obliged to prevent this by supplying dollars from their reserves and buying rupees so that the exchange rate does not rise above the upper support point of ₹12.12 per dollar. The authorities are ***supporting*** the value of the rupee by ***intervening*** in the market for foreign exchange.

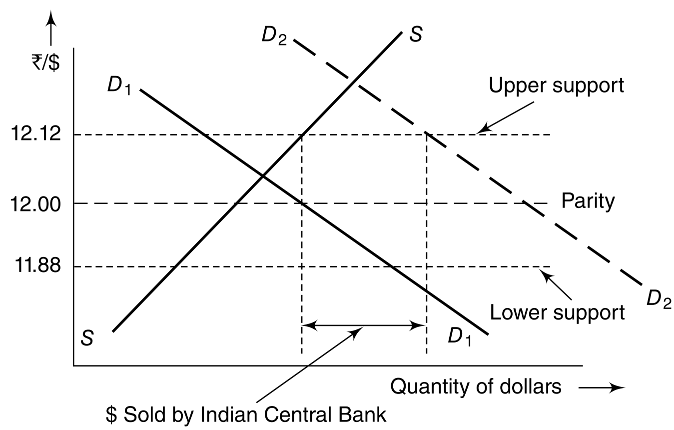


Fig. 5.1 Supply and demand curve under Bretton Woods system

Effectively, the supply curve of dollars becomes ***infinitely elastic*** at the upper support point. In the reverse case, if the supply curve of dollars shifts downward to the right so that the exchange rate would tend to cross the lower support point of ₹11.88 (US residents develop a strong liking for things Indian), the Indian authorities must stand ready to buy dollars and supply rupees to prevent it. The ***demand curve*** for dollars becomes infinitely elastic at the lower support point.

Thus, to maintain the exchange rate within the ± 1% limits, the central bank has to ***intervene*** in the foreign exchange market, i.e. carry out buy/sell operations against the home currency.

[6] We have drawn the supply curve upward sloping and the demand curve downward sloping. What ensures that they will indeed have these conventional shapes? Is it possible that either or both of them will exhibit "perverse" behaviour in certain ranges of values of the exchange rate? The answer in the case of the supply curve is "yes". It depends upon the price elasticity of foreigners' demand for our exports.

At least two questions need to be addressed in the context of such intervention operations. First, what are the effects of these intervention operations on the domestic money supply and then on the price level, GNP, etc? Second, in the first case when the authorities are required to supply dollars, what if they run out of dollars and exhaust all possibilities of borrowing dollars from other countries or the IMF? (In the other case, at least theoretically, the authorities can supply an infinite amount of rupees by simply "running the printing press"). We will clarify both the queries below when we discuss the process of adjustment to payments disequilibria.

Under the Bretton Woods System, the US dollar in effect became international money. Other countries accumulated and held dollar balances with which they could settle their international payments; the US could in principal buy goods and services from other countries simply by paying with its own money. This system could work as long as other countries had confidence in the stability of the US dollar and in the ability of the US treasury to convert dollars into gold on demand at the specified conversion rate. The system came under pressure and ultimately broke down when this confidence was shaken due to various political and some economic factors starting in mid 1960s. On August 15, 1971, the US government abandoned its commitment to convert dollars into gold at the fixed price of $35 per ounce and the major currencies went on a float. An attempt was made to resurrect the system by increasing the price of gold and widening the bands of permissible variation around the central parity. This was the so-called Smithsonian Agreement. That too failed to hold the system together and by early 1973, the world moved to a system of floating rates.

After a period of wild fluctuations in exchange rates – accentuated by real shocks such as the oil price crises in 1973 – policy makers in various countries started experimenting with exchange rate regimes which were hybrids between fixed and floating rates. A group of countries in Europe entered into a Bretton-Woods like arrangement of adjustable pegs within themselves. This was the European Monetary System. Other countries tried various mixed versions. At the beginning of the new millenium, the world has a potpourri of exchange rate arrangements.

We now turn to a brief description of the main variants.

5.2.2 Exchange Rate Regimes: The Current Scenario

The IMF classifies member countries into seven categories according to the exchange rate regime they have adopted. The exchange rate arrangements under these categories are briefly described below. The information is sourced from IMF's publication titled "Annual Report on Exchange Arrangements and Exchange Restrictions 2006". Figure 5.2 presents a graphic summary of number of countries following various regimes in 2008. A brief description of each of the regimes is shown in the figure as follows.

(1) Exchange Arrangements with no Separate Legal Tender Under this regime a country either adopts the currency of another country as its legal tender or a group of countries share a common currency. Examples of the former arrangement are countries like Ecuador and Panama which have adopted the US dollar as their legal tender. The most prominent example of the latter category is of course the European Union, the sixteen-member countries of which all have euro as their currency. In addition, a few countries which are not part of the European Union have also adopted euro as their currency. Countries belonging to the West African Economic and Monetary Union (WAEMU) such as Niger, Mali, Senegal and those belonging to the Central African Economic and Monetary Community (CAEMU) such as Cameroon, Chad, Republic of Congo share a common currency called CFA franc. Countries belonging to the Eastern Caribbean Currency Union (ECCU) such as Antigua and Barbuda, Grenada also have a common currency called East Caribbean dollar

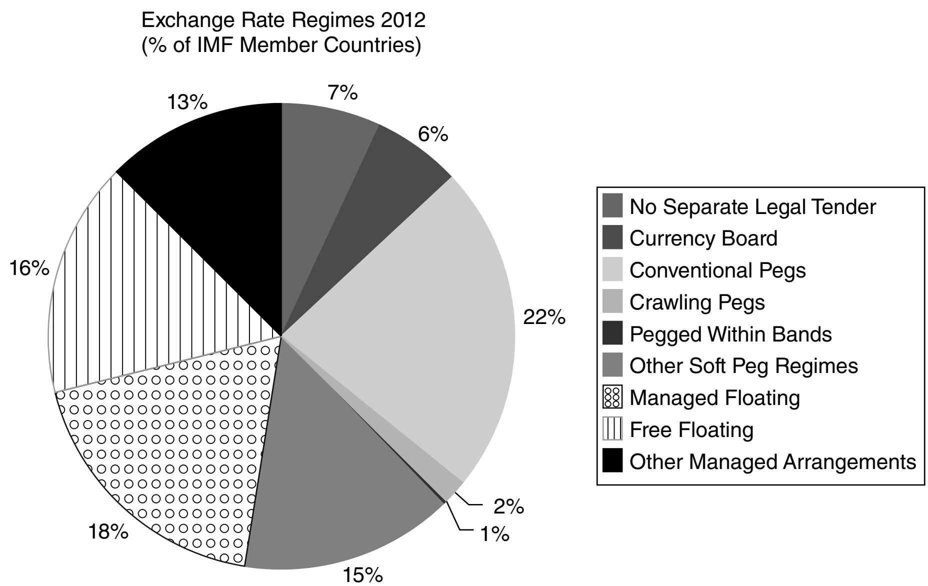


Fig. 5.2
Source: Annual Report on Exchange Arrangements and Exchange Restrictions 2012. IMF. Total number of member countries 185

which, in turn, is pegged to the US dollar in a currency board arrangement (see below). Obviously a country adopting such a regime cannot have an independent monetary policy since its money supply is tied to the money supply of the country whose currency it has adopted or controlled by a common central bank which regulates monetary policy in all the member countries belonging to the currency union.

(2) Currency Board Arrangements This is a regime under which there is a ***legislative commitment*** to exchange the domestic currency against a specified foreign currency at a fixed exchange rate coupled with restrictions on the monetary authority to ensure that this commitment will be honoured. This implies constraints on the ability of the monetary authority to manipulate domestic money supply. In its classification for 2006, IMF classified seven countries – Bosnia and Herzegovina, Brunei, Bulgaria, Djibouti, Estonia, Hong Kong and Lithuania – as having a currency board system. Of these, Estonia has recently joined the European Union and adopted euro as its currency. However, Hanke (2002) argues that none of these countries can be said to conform to all the criteria of an orthodox currency board system. According to him, legislative commitment to convert home currency into a foreign currency at a fixed rate is just one of the six characteristics of an orthodox currency board arrangement. Once again, a country with a currency board arrangement cannot have an independent monetary policy.

(3) Conventional Fixed Peg Arrangements This is identical to the Bretton Woods system where a country pegs its currency to another or to a basket of currencies with a band of variation not exceeding ±1% around the central parity. The peg is adjustable at the discretion of the domestic authorities. Forty-nine IMF members had this regime as of 2006. Of these, forty-four had pegged their currencies to a single currency and the rest to a basket. The mechanics of a basket peg is discussed in the appendix to this chapter.

(4) Pegged Exchange Rates within Horizontal Bands Here there is a peg, but variation is permitted within wider bands. It can be interpreted as a sort of compromise between a fixed peg and a floating exchange rate. Six countries had such wider band regimes in 2006. IMF has defined a regime titled as **"Stabilised Arrangement".** It entails a spot market exchange rate that remains within a margin of 2 per cent for six months or more (with the exception of a specified number of outliers or step adjustments) and is not floating. The margin of stability can be with respect to a single currency or a basket of currencies.

(5) Crawling Peg This is another variant of a limited flexibility regime. The currency is pegged to another currency or a basket, but the peg is periodically adjusted. The adjustments may be pre-announced and according to a well-specified criterion or discretionary in response to changes in selected quantitative indicators such as inflation rate differentials. Five countries were under such a regime in 2006. A **"Crawl-like Arrangement"** is where the exchange rate remains within a narrow margin of 2 per cent relative to a statistically defined trend for six months or longer. An annualised rate of change of at least 1 per cent is expected.

(6) Managed Floating with no Pre-announced Path for the Exchange Rate The central bank influences or attempts to influence the exchange rate by means of active intervention in the foreign exchange market – buying or selling foreign currency against the home currency – without any commitment to maintain the rate at any particular level or keep it on any pre-announced trajectory. Fifty-three countries including India were classified as belonging to this group in 2006.

(7) Independently Floating The exchange rate is market-determined with central bank intervening only to moderate the speed of change and to prevent excessive fluctuations, but not attempting to maintain or drive it towards any particular level. In 2008, a little over one-fifth of the member countries of IMF characterised themselves as independent floaters.

It is evident from this that unlike in the pre-1973 years, one cannot characterise the international monetary regime with a single label. A wide variety of arrangements exist and countries move from one category to another at their discretion. This has prompted some analysts to call it the international monetary "nonsystem".

5.2.3 Is there an Optimal Exchange Rate Regime?

The world has experienced three different exchange rate regimes in this century in addition to some of their variants tried out by some countries. Starting from the gold standard regime of fixed rates, passing through the adjustable peg system after the Second World War, it finally ended up with a system of managed floats after 1973. Since 1985, the pendulum has started swinging, though very slowly and erratically, in the direction of introducing some amount of fixity and rule based management of exchange rates.

The fixed versus floating exchange rates controversy is at least four decades old. Even a brief review requires some understanding of open economy macroeconomics which is outside the scope of this book. Suffice it to say that after the actual experience of floating rates for nearly two decades, the sober realisation has come that the claims made in their favour during the fifties and sixties were rather exaggerated.

The economic crises – in particular high inflation rates – which a number of developing countries in Latin America and elsewhere experienced during the late 1970s and 1980s and in Asia in 1990s led many economists to reconsider the merits of a floating exchange rate and monetary policy independence which it apparently bestows upon a country. By the end of 1980s, many economists had started recommending a hard peg via a currency board-like arrangement. The fact that the Hong Kong economy emerged out of the East Asian crisis of 1997 relatively unscathed was attributed to its currency board arrangement with the US dollar. The success of the Argentinian economy in achieving stability and bringing inflation under control in the 1990s was also attributed to the hard peg of the peso to the US dollar.

However, by 2001, things were not looking so rosy for Argentina. Its external account was in deep crisis and the cost of borrowing at home and abroad had gone up steeply because of fears of default. Thus, currency boards bring troubles of their own, as do other exchange rate arrangements. Systems with crawling pegs, crawling bands and other "mixed" varieties have not fared better either as shown by the experiences of Indonesia, Brazil and Turkey. It appears, therefore, that there is no such thing as "the ideal" exchange rate regime for all countries or even for a given country at all times.

Despite the empirical facts discussed above, there is a school of thought within the profession which argues that in the years to come, there will be only two types of exchange rate regimes: truly fixed rate arrangements like currency unions or currency boards or truly market determined, independently floating exchange rates. The "middle ground" – regimes such as adjustable pegs, crawling pegs, crawling bands and managed floating – will pass into history. Some analysts even predict that three currency blocks – the US dollar block, the euro block and the yen block – will emerge with currency union within each and free floating between them. However, in late 2009, problems developed within the European Union with four countries, viz. Portugal, Ireland, Greece and Spain facing serious fiscal problems due to large government deficits. The problem was particularly severe for Greece. Due to their membership of the Union, their ability to use monetary and exchange rate policies to counter these problems was restricted. In early 2010, there was a debate going on as to whether the European Union is likely to break up with countries like Greece and Ireland deciding to get out.

The argument for the impossibility of the middle ground refers to the "impossible trinity", i.e. it asserts that a country can achieve any two of the following three policy goals, but not all the three:

1. A stable exchange rate
2. A financial system integrated with the global financial system, i.e. an open capital account and
3. Freedom to conduct an independent monetary policy

Of these, (1) and (2) can be achieved with a currency union or board, (2) and (3) with an independently floating exchange rate and (1) and (3) with capital controls.

Figure 5.3 provides a graphical representation of the impossible trinity argument.

This assertion has been strongly contested by many economists. To get a flavour of the controversy, the reader should consult the references cited at the end of this chapter.

As of now, there is no consensus either among academic economists or among policy makers or among businessmen and bankers as to the ideal exchange rate regime. The debate is extremely complicated and made more so by the fact that it is very difficult if not impossible to sort out the effects of exchange rate fluctuations on the world

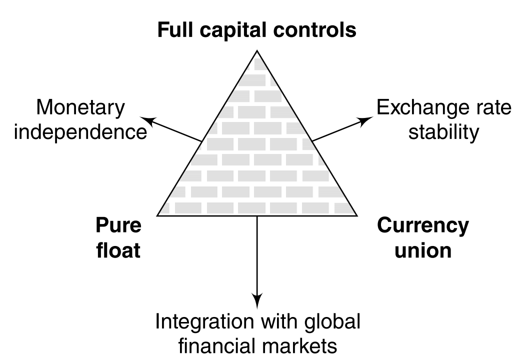


Fig. 5.3 The Impossible Trinity

economy from those of other shocks, real and monetary (oil price gyrations, Mid-East wars, political developments in East Europe, disagreements over trade liberalisation, developing country debt crisis, banking crises due to inadequate emphasis on market and credit risk management, etc.).

Macroeconomic policy making within an economy has become an extremely complex and demanding task. With open economies and integrated financial markets, a given monetary or fiscal policy action can have a variety of conflicting or complementary impacts on important policy targets like employment, inflation and external balance. Market overreaction and speculative asset price bubbles can do lasting damage as evidenced by the currency crises that ravaged the East Asian economies in 1997. Under these conditions, a policy combination of extensive capital controls and a pegged exchange rate – with of course an adjustable peg – is becoming attractive particularly for developing economies.

Attempts have been made to devise exchange rate policy guidelines based on the concept of ***Equilibrium Real Effective Exchange Rate***. This concept will be discussed at length in Chapter 11. In simple terms, effective exchange rate is a kind of purchasing power weighted average of a currency's exchange rates against a group of currencies. The idea is to set a target value for this weighted average such that it is "sustainable" in the long run, i.e. it would not lead to persistent large BOP disequilibrium. For more details on this, see Hinkle and Montiel (1998), Williamson (1994).

5.3 THE INTERNATIONAL MONETARY FUND (IMF)

5.3.1 The Role of IMF

The International Monetary Fund has been the centrepiece of the world monetary order since its creation in 1944 though its supervisory role in exchange rate arrangements has been considerably weakened after the advent of floating rates in 1973[7].

As mentioned above, restoration of monetary order after the Second World War was to be achieved within the framework of the Articles of Agreement adopted at Bretton Woods. These articles required the member countries to cooperate towards:

- Increasing international monetary cooperation
- Promoting the growth of trade
- Promoting exchange rate stability
- Establishing a system of multilateral payments, eliminating exchange restrictions which hamper the growth of world trade and encouraging progress towards convertibility of member currencies[8]
- Building a reserve base

The responsibility for collection and allocation of reserves was given to the IMF. It was also given the role of supervising the adjustable peg system, rendering advice to member countries on their international monetary affairs, promoting research in various areas of international economics and monetary economics and provide a forum for discussion and consultations among member nations.

[7] The IMF articles were amended to "legalise" the floating exchange rates. The amendment came into effect only in 1978.

[8] The IMF's definition of convertibility can be characterised as "current account convertibility". This concept has been clarified by McKinnon (1979) as follows: "Domestic [residents] wishing to buy foreign goods and services, not specifically restricted, can freely sell domestic for foreign currency at a single but possibly varying exchange rate covering *all current transactions* inclusive of normal trade credit, whereas nonresidents with domestic currency balances arising from *current transactions* can sell them at the same foreign exchange rate or purchase domestic goods freely at the prevailing domestic currency prices". Convertibility is a matter of degree. The use of tariffs, subsidies, quota restrictions and exchange controls implies reduction in convertibility.

The initial quantum of reserves was contributed by the members according to quotas fixed for each. The size of the quota for a country depends upon its GNP, its importance in international trade and related considerations. Each member country was required to contribute 25 per cent of its quota in gold and the rest in its own currency. Thus, the Fund began with a pool of currencies of its members. The quotas have been revised several times since then. The most recent revision happened around September 2006 when the quotas of China, Turkey, Mexico and South Korea were increased and it was also decided to review the formula for calculating the quota adjustments and voting power. The quotas decide the voting powers of the members within the policy-making bodies of IMF. The maximum amount of financing that a member country can obtain from the IMF is also determined by its quota. In April 2008, a significant quota reform package has been adopted by the Board of Governors of IMF. It aims to make quotas more responsive to economic realities by increasing the representation of fast-growing economies and at the same time giving low-income countries more say in the IMF's decision making. It will have to be approved by 85 per cent of the IMF members. As of early March 2010, 70 per cent of the members had approved it. For more details on quotas, the reader can consult the latest IMF Annual Report.

In addition to the quota resources, the Fund has from time to time borrowed from member (and non-member) countries additional resources to fund its various lending facilities[9]. Since 1980, the Fund has been authorised to borrow from commercial capital markets.

5.3.2 Funding Facilities

As we have seen above, operation of the adjustable peg requires a country to intervene in the foreign exchange markets to support its exchange rate when it threatens to move out of the permissible band. When a country faces a BOP deficit, it needs reserves to carry out the intervention it must sell foreign currencies and buy its own currency. When its own reserves are inadequate it must borrow from other countries or the IMF. (Note that a country which has a surplus does not face this problem.)

Any member can unconditionally borrow the part of its quota which it has contributed in the form of SDRs or foreign currencies. This is called the ***Reserve Tranche***. (The word "tranche" means a slice.) In addition, it can borrow up to 100 per cent of its quota in four further tranches called ***Credit Tranches***. There are increasingly stringent conditions attached to the credit tranches in terms of policies the country must agree to follow to overcome its BOP deficit problem.

In addition to this, the Fund over the years has considerably expanded the lending facilities available to the members. Some are meant to tide over short-term problems such as a temporary shortfall in exports or an unanticipated bulge in imports while others are medium-term facilities designed to help a country overcome some structural weaknesses, remove inefficiencies in its production structure and increase its international competitiveness. To be able to borrow from these facilities, the member country must agree to a policy package worked out in consultation with the Fund. Resources are made available in installments and the IMF monitors the country's performance with regard to the commitments it has given, the next installment being released only after the Fund is satisfied that the agreed upon policies are being implemented.

In the appendix to this chapter, we have provided a brief description of the various funding facilities in existence as of March 2006. Of these, the so-called Stand-by Arrangements and Extended Fund

[9] For instance, in 1962, a group of developed countries lent to IMF under the General Agreement to Borrow so that short-term financing needs of countries within the group could be met from these funds rather than drawing on quota resources. During 1974-75, IMF borrowed from some of the OPEC countries to create the Oil Facility to give BOP assistance to oil importing developing countries.

Facilities are "regular" facilities while there are various special facilities including the Supplemental Reserve Facility (SRF), the Compensatory and Contingency Financing Facility (CCFF), Systemic Transformation Facility (STF) as also facilities for low-income member countries and facilities to deal with specific shocks. In addition to these, the Fund has had in the past other facilities such as the Oil Facility, the Trust Fund, the Supplementary Financing Facility (also known as the Witteveen Facility, it replaced the Oil Facility) some of which have been discontinued.[10].

Borrowing under these facilities and its repayment are called "purchase and repurchase". The member country, when it borrows, purchases convertible foreign currencies from the Fund in exchange for its own currency; at the time of repayment, it repurchases its own currency against the foreign currencies.

The conditionalities attached to some of these facilities typically include measures like reduction in budget deficits of the recipient government, moderating growth in money supply, replacing quota-type trade restrictions by tariffs, scaling down and eventual elimination of subsidies (e.g. in India's case, fertilizer subsidies, food subsidies, etc.), realistic pricing of public sector outputs and, sometimes, devaluation of the exchange rate.

IMF's approach towards providing structural adjustment assistance and the associated conditionality have been the target of criticism from various quarters. One type of criticism, directed more at the governments of the recipient countries, comes from certain sections within those countries. One hears talk of "capitulation to the IMF", "selling out the country's interests", etc. In our view this sort of criticism is rather misplaced. It is to be noted that many countries resort to IMF assistance at a point when other avenues of borrowing are more or less closed and the country is already in dire straits. Under these conditions, it is natural that the lender would demand certain covenants from the borrower. There can certainly be a debate about whether the country should have opted for IMF assistance or could have extricated itself out of the difficult situation by other means. We will not pursue that controversy here.

The other type of criticism, in our view more thoughtful, concerns the appropriateness of IMF's policy package in the light of the specific circumstances prevailing in the recipient country. Particularly during the earlier years of operation of these facilities, the IMF was accused of forcing a uniform, straitjacketed policy prescription on all countries irrespective of their individual circumstances. Also, it was said, that the IMF did not take into account the social and political costs of enforcing the policies and hence, the ability of some governments to do so despite their best intentions. This line of criticism was voiced again after the Asian crisis when interest rates in some of the affected countries skyrocketed with considerable damage to their economies and no significant reversal of capital outflows. This debate too is outside the scope of this book[11].

5.3.3 International Liquidity and Special Drawing Rights (SDR)

International Liquidity and International Reserves International liquidity refers to the stock of means of international payments. ***International Reserves*** are assets which a country can use in settlement of payments imbalances that arise in its transactions with other countries. These are held by the monetary authority of a country and are used by them in carrying out interventions on the foreign exchange markets. In addition, private markets can provide liquidity by lending to deficit

[10] Details of these facilities can be found in IMF's Annual Reports. They are also available on IMF's website. India's 5 billion SDR assistance package in early eighties was under the EFF. The more recent loans are under the stand-by arrangements and ESAF.

[11] The interested reader can consult among others, Dell and Lawrence (1980), Donovan (1982).

countries out of funds deposited with them by the surplus countries. This sort of private financing of BOP deficits took place on a large scale during the post oil-crisis years and has come to be known as *recycling of petrodollars*[12].

Table 5.1 provides some data on official holdings of reserve assets while Table 5.2 shows the shares of the major convertible currencies in official holdings of foreign exchange assets. The unit of account in Table 5.1 is SDRs which are explained below.

Table 5.1 Official holdings of reserve assets (Billion of SDRs)

	2006	*2007*	*2008*	*2009*	*2010*	*2011*	*Mar. 2012*
All countries							
Total reserves excluding gold Fund-related assets Reserve positions in the fund	17.5	13.7	25.1	38.7	48.8	98.3	101.1
SDRs	18.2	18.4	18.9	200.7	199.4	193.6	192.7
Subtotal, Fund-related assets	**35.7**	**32.1**	**44.0**	**239.4**	**248.2**	**291.9**	**293.8**
Foreign exchange	3491.8	4242.6	4769.2	5207.8	6014.9	6645.5	6735.4
Total reserves excluding gold	**3527.9**	**4275.1**	**4813.5**	**5447.2**	**6263.4**	**6937.6**	**7029.4**
Gold[13] Quantity (millions of ounces)	870.7	855.6	856.6	879.3	884.6	897.1	900.0
Value at London market price	367.9	451.4	483.7	610.0	807.4	894.7	965.9
Total reserves including gold	**3895.8**	**4726.5**	**5297.2**	**6057.2**	**7070.7**	**7832.3**	**7995.4**

It is clear from these tables that reserve assets consist of gold, foreign exchange, SDRs and reserve positions in the IMF. After the demonetisation of gold in 1976[13], central banks have stopped using gold in settling international payments. However, it remains an important part of reserves as a sort of precautionary store of value. Among foreign exchange assets, US dollar continues to occupy the dominant position followed by Euro which replaced the legacy European currencies such as D-mark, French franc and the Dutch guilder.

[12] We have made a distinction between international liquidity and international reserves. The former includes the latter plus the borrowing capacity of central banks on the commercial capital markets. Many authors treat the two as synonymous in discussing adequacy of liquidity.

[13] In the Bretton Woods system, gold had a central role as the standard of value and unit of account. It was also the paramount means of international payments. The Jamaica Agreement of 1976 among the IMF members eliminated this special status of gold. Gold would henceforth be like any other commodity with a market determined price and central banks would not use it for settling international payments. Also, the IMF would gradually dispose of its stock of gold by open market sales and by returning a part of it to members at the official price.

Table 5.2 Currency Composition of Foreign Exchange Reserves

Currency	*Holding as of End of Year 2012*	
	Billion US Dollar	*Share (%)*
US Dollar	3761.31	61.87
Euro	1455.14	23.93
Pound Sterling	243.31	4.00
Japanese Yen	239.76	3.94
Swiss Franc	7.70	0.13
Other	372.43	6.13
Total	6079.65	

* For each currency, the amount is given in equivalent of US dollars. This table shows only "Allocated Reserves", i.e. reserves whose currency compositions could be identified. There is additional amount designated as "Unallocated Reserves". These are reserve holdings the currency composition of which could not be identified.

Source: Annual Report 2012, The IMF, Washington DC.

The dominant position of the dollar is due to its "vehicle currency" status in a large volume of trade and financial transactions[14].

The concept of "reserve position in the IMF" needs some clarification. It represents the amount that a country can draw from the IMF ***automatically (i.e. without prior assent on the part of the Fund) and unconditionally***. It consists of the un-drawn portion of the reserve tranche part of the country's quota plus the country's lending to the Fund if any. Recall that 25 per cent of the quota is contributed in foreign currencies and SDRs (earlier in gold) and can be drawn unconditionally. The rest 75 per cent is in member's own currency. However, at any time the Fund's holdings of a country's currency may be less than 75 per cent of its quota because some other member country has purchased the former's currency with its own. In this case, the country whose currency has been lent to another member acquires drawing rights over and above its reserve tranche. If on the other hand, a country has purchased foreign currency from the Fund, its reserve position falls below its reserve tranche. In other words, reserve position of a country can be defined as:

Reserve Position = Quota – Fund's Holding of its Currency.

Thus, suppose India's quota measured in its own currency is 100. It has contributed 25 of this in SDRs and 75 in rupees. It has made no drawings and a member country has borrowed ₹35 from the Fund. India's reserve position is then 100 – (75 – 35) = 60.

The last component of reserves consists of ***Special Drawing Rights or SDRs***. Though quantitatively rather small, it is conceptually important and represents the first attempt to create a truly international fiat money. For this reason, the following subsection is devoted to a brief discussion of SDRs.

Special Drawing Rights (SDRs)

We have seen above that the dominant constituents of international reserves are gold and foreign exchange. (We can ignore the reserve positions which are rather small.) How is the stock of these assets at a point in time determined? How is it related to the liquidity requirements of the world monetary system?

[14] A vehicle currency is simply the currency used to settle a payment. The transaction can involve the currency directly as when an exporter invoices the goods in that currency or indirectly as when in acquiring currency *i* for currency *j*, the latter is first converted into currency *k* which is then exchanged for currency *i*, thus making *k* a vehicle currency.

A short answer would be that they are determined arbitrarily by considerations unrelated to the needs of the system. The stock of gold depends upon new discoveries of gold deposits and additions due to mining of new gold net of its other uses. Its value is determined by market demand and supply with a large element of speculative forces.

As to foreign exchange, its largest component, viz. US dollar assets depend upon the BOP deficits of US. We have seen above how this peculiar role of the key currency leads to the Triffin Paradox.

During the sixties, several ideas were floated for the creation of an international fiat money, the stock of which can be monitored and controlled by some sort of a supra-national monetary authority. It was envisaged that this "international money" would then become the principal reserve asset. It was felt that the additions to the stock of such an asset can be tuned to the growing liquidity needs of the system as the volume of trade and global financial flows grows. International liquidity would not then have to depend upon the vagaries of gold mining or the vicissitudes of US balance of payments.

At the 1967 Rio de Janeiro Annual Meeting of the IMF, it was decided to create such an asset, to be called ***Special Drawing Rights or SDRs***. The required amendment to IMF's articles of agreement was effected in 1969. The IMF would "create" SDRs by simply opening an account in the name of each member country and crediting it with a certain amount of SDRs. The total volume created has to be ratified by the governing board and its allocation among the members is proportional to their quotas. The members can use it for settling payments among themselves (subject to certain limits) as well as for transactions with the Fund, e.g. paying the reserve tranche contribution of any increase in their quotas. The various limitations governing the use of SDRs and a few other matters are described in the appendix to this chapter.

The value of a SDR was initially fixed in terms of gold with the same gold content as the 1970 US dollar. In 1974, SDR became equivalent to a basket of 16 currencies, and then in 1981, to a basket of five currencies (dollar, sterling, deutschemark, yen and french franc). After the birth of euro, the SDR basket includes four major "freely usable" currencies, viz. US dollar, euro, British pound and Japanese yen. SDR valuation is explained in the appendix to this chapter.

The first allocation of 9.3 billion SDRs was made over the three-year period 1970, 1971 and 1972. A second allocation totaling 12.1 billion was made in 1979, 1980 and 1981. In September 1997, the IMF's Board of Governors adopted a resolution to amend the IMF's Articles of Agreement (the Fourth Amendment) to allow for a special one-time allocation of SDRs which would take the total cumulative allocations to 42.8 billion SDRs. In addition to the central banks of member countries who can receive allocations and transact in SDRs, the Fund has prescribed to date, sixteen official institutions who can hold SDRs.

In order to make SDRs an attractive asset to hold, the Fund pays interest on holdings in excess of a member's cumulative allocation. (It charges interest on any shortfalls.) Also, SDRs is the unit of account for par values of member currencies, denomination of quotas and payment of the 25 per cent reserve tranche portion of quotas.

Though the use of SDRs is confined to official transactions, SDR denominated bank deposits and loans have been offered in private financial markets. Despite IMF's best intentions and efforts, it has failed to become the dominant reserve asset as can be seen from Table 5.1.

5.3.4 Demand for Reserves and Composition of Reserves

The factors determining the size of a country's total reserves and the currency composition of the foreign exchange part have been studied extensively. The total demand for reserves has been analysed both in a positive as well as a normative framework. In the positive tradition, reserve stock is related to the volume of imports, marginal propensity to import, variability of export earnings and so forth. In the optimising approach, reserve holdings are arrived at by equating the marginal cost of holding reserves to the marginal benefit. Cost of holding reserves is the opportunity foregone to use the resources for productive purposes, e.g. capital investment at home. The benefit is that a balance of payments deficit can be financed by drawing down reserves and does not have to be "adjusted to" by curtailing imports or some other policy which would hurt the domestic economy.

The problem of currency composition of reserves has been posed as a problem in portfolio selection along the lines of the Markowitz-Sharpe portfolio choice models. Such efforts have been criticised on the grounds that central banks have to consider many other factors, e.g. currency composition of the country's trade and not just the risk-return profile of their portfolio.

References to the literature on both these aspects can be found in Chrystal (1990).

5.3.5 The Role of IMF in the Post-Bretton Woods World

Under the Bretton Woods system, the IMF was responsible for the functioning of the adjustable peg system. Under the current "non-system", that role has considerably been diminished, if not disappeared. There is still the surveillance function. The Fund is mandated to "exercise firm surveillance over the exchange rate policies of members" to help assure orderly exchange arrangements and to promote a stable exchange rate system [IMF Annual Report 1990, p.11]. It consists of an ongoing monitoring and analysis of a broad range of domestic and external policies affecting, in particular, members' price and growth performance, external payments balances, exchange rates and restrictive systems. [IMF, ibid.] This is done with the active participation and full cooperation of member country governments. Since 2000, the IMF has conducted safeguard assessments of member countries' central banks in connection with IMF lending operations. The assessments aim to provide reasonable assurance that a central bank's framework of financial reporting, audit and controls is adequate to manage its resources including IMF disbursements. In 2009, twenty eight such assessments were conducted.

The Fund has played an important role in tackling the debt crises of developing countries. In addition to its own facilities described above, the Fund is actively involved in designing debt reduction and financing packages involving the World Bank and private lenders for heavily indebted countries, provided they accept policies and programmes recommended by the Fund. The Fund's involvement serves to provide a kind of guarantee to private lenders that the country would follow a growth-oriented open policy and would be in a position to service its debt. This increases the country's creditworthiness and makes it possible for it to get new financing[15].

5.4 THE PROBLEM OF ADJUSTMENT

Every open economy, from time to time, faces the problem of imbalance on its external transactions. Current account deficits and surpluses, excessive or inadequate capital flows and unplanned changes in reserves are all inter-related manifestations of the problem of external imbalance.

The BOP disequilibria may be transitory or permanent in nature. The former could arise from temporary fall in exports (e.g. failure of a major export crop, cyclical fall in demand for some primary commodity, etc.) or a temporary rise in imports (e.g. a drought necessitating unusually large food imports or a severe winter necessitating large imports of fuel oil). The latter could be the consequence of several structural and policy related factors.

[15] For a description of the Fund's policies in this regard, see the Annual Report of 1989. A brief description of some of the packages worked out for Mexico, Philippines and Costa Rica can be found in the Annual Report of 1990.

In either case, the country must choose between financing the imbalance or undertaking a programme of adjustment. In most cases of transitory disequilibria, it would choose to tide over the problem by "financing the gap" from its own reserves, by borrowing from the IMF, by borrowing from other sources or a combination of these strategies. The international monetary and financial system can play a role in this process by enabling timely access to short-term borrowing facilities so that the country neither has to undergo painful adjustment nor has to resort to imposition of quantitative and other restrictions on international trade.

When financing is not feasible – the country may neither have adequate reserves nor residual borrowing capacity – or when the disequilibrium is persistent it must resort to adjustment. In the case of persistent deficits, it must take steps to curtail imports and/or promote exports or encourage capital inflows by offering attractive rate of return to foreign investors. The former can be achieved by policies designed to reduce the level of economic activity at home (so as to reduce imports), quantitative restrictions on imports, a variety of export promotion measures, import duties and export subsidies and finally, exchange rate devaluation. Increase in capital inflows can be achieved by raising interest rates at home and offering other incentives to foreign investors. Almost all of these measures are likely to have adverse consequences on the economy at least in the short run.

Note that by contrast, a country facing the "problem" of persistent surpluses need not undertake any adjustment at all. It can simply go on accumulating reserves at least till the point when its trading partners threaten to take retaliatory action. This asymmetry of sharing the adjustment burden is one of the outstanding problems of international monetary reform and policy coordination.

A detailed analysis of the adjustment process is outside the scope of this book. The interested reader can consult any one of the excellent texts in international economics such as Krugman and Obstfeld (2006). At present, it is enough to note that the adjustment can come via changes in income as well as relative prices. It can be automatic or discretionary or a combination of the two. Among the important factors involved are: (i) the exchange rate regime (ii) availability of short- and medium-term financing facilities from official and quasi-official sources (iii) creditworthiness of the country in international financial markets and its attitude towards foreign capital (iv) propensities to save and import (v) price elasticities of demand for and supply of exports and imports (vi) the structure of domestic costs and behaviour of wage rate. A particularly important question is whether the "automatic" adjustment that takes place via exchange rate changes under a regime of floating rates obviates the need for other policy measures thus reducing the need for policy coordination among governments.

5.5 THE ECONOMIC AND MONETARY UNION (EMU)

After more than a quarter century of managed floating rates, many countries appear to be headed back to some form of fixed exchange rate system.

Around the time, while attempts were being made to salvage the Bretton Woods system by redefining the parities and widening the bands of variation to 2.25%[16], another adjustable peg system was born among the countries belonging to the European Economic Community (EEC). This was the ***Snake,*** created in 1972, designed to keep the EEC countries' exchange rates within narrower bands of 1.125% around the central rates while they maintained the wider bands of 2.25% against the currencies of other countries. (Hence the designation ***Snake in the Tunnel***.) Subsequently, in

[16] This was the result of the so called Smithsonian Agreement hammered out at the Smithsonian Institution in Washington D.C. in December 1971.

1973, they decided to float jointly against the dollar as the Smithsonian Agreement[17] failed to revive the Bretton Woods system[18].

In 1979, the snake became the ***European Monetary System*** **(EMS)** with all EEC countries except Britain joining the club; a combination of adjustable peg with wider bands, the frequency of adjustment of pegs being more than that under the Bretton Woods system. The member countries declared their bilateral parities (the parity grid) with exchange rates allowed to oscillate within ±2.25% (except for the Italian Lira which had margins of ±6%)[19] around the central parities. The feature that distinguished EMS from the snake was the ***European Currency Unit*** **(ECU)**, a SDR-like basket of currencies which was to play the role of, among other things, the unit of account for transactions among the member central banks[20]. The ECU was the precursor of the common currency euro which the sixteen member countries of EMU now share. The EMS had operating mechanisms which guided member countries' intervention in the foreign exchange markets to maintain the bilateral rates within the permissible bands and financing arrangements which provided reserves to member countries whose currencies came under pressure from time to time.

Monetary Union had been envisaged as a part of the move towards creating a single economic zone in Europe with complete freedom of resource mobility within the zone, a single currency and a single central bank. In November 1990, central bankers of EEC countries finalised the draft statutes for a future European Central Bank. Earlier, 11 out of the 12 governments had agreed that the second stage of the transition to economic and monetary union would begin in January 1994.

Just when it appeared that Europe will steadily march towards an economic and monetary union as envisaged in the "Maastricht treaty", the system received severe jolts. First, in early 1992, Danish voters in a referendum rejected the Maastricht treaty. Second, in September 1992, severe strains developed in the ERM as UK and Italy found it increasingly difficult to defend their parities against the deutschemark without a drastic monetary contraction and steep increase in interest rates which were politically infeasible. The sterling and the lira left the exchange rate mechanism after massive intervention failed to shore up the currencies. The currency markets were plunged into a turmoil and next the French franc came under pressure. Despite these setbacks, Germany and France took the lead in preserving the momentum towards single currency and stick to the schedule.

Extensive debates followed regarding issues such as the speed of approach, preconditions for a

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[17] After protracted discussions and speculation in the financial markets Britain finally joined the exchange rate arrangement in October 1990 with a central parity of DM 2.95 per pound and limits of +6.18 and –5.82 per cent. It left the system in September 1992 after attempts to defend sterling's parity against the mark had failed.

[18] This was an attempt to move towards a *currency area.* A currency area is a group of countries which have a common currency (a full monetary union) or have permanently and rigidly fixed exchange rates amongst their currencies and full convertibility into each other. The problem of *Optimum Currency Areas* introduced by Mundell [Mundell (1961), also McKinnon (1963)], consists in determining the optimum domain of the currency area and deciding whether joining such an arrangement would be beneficial to a country.

[19] The wider band for Lira was abandoned in January 1990. It now has a ± 2.25% band like the others. Note an important technicality. The upper and lower intervention points cannot be obtained by simply adding to and subtracting from the central value, 2.25% of the central value. To see this, suppose the parity FRF/DEM rate is 4.0000. Then the parity DEM/FRF rate must be 0.2500. If you add and subtract 2.25% of the parity, you get 4.0900 and 3.9100 when FRF/DEM is considered and 0.255625 and 0.244375 when DEM/FRF is considered. Now when FRF/DEM is at its highest, DEM/FRF should be at its lowest. But 0.244375 is ***not*** the reciprocal of 4.0900 and, similarly, 0.255625 is not the reciprocal of 3.9100. To achieve the correct result, we must find a multiplier X such that if P is the parity, XP is the upper point, (P/X) is the lower point and

$$XP - (P/X) = 0.045P$$

This yields $X = 1.022753$.

[20] Even though Britain was not party to the exchange rate mechanism of EMS, pound sterling was included in the ECU in view of the importance of Britain in the EC. In 1984, Greek Drachma was also included even though Greece is not a member of EC.

country to join the monetary union, the nature and constitution of the European Central Bank, the degree of independence it will enjoy, policy freedom of member countries and related matters. A sort of compromise was worked out in Dublin in mid-December 1996 – the so-called "Growth and Stability Pact" – regarding issues such as permissible size of fiscal deficit for a member country, penalties for violating the ceilings, the extent of political control over operation of European monetary policy by the European Central Bank and so forth.

Finally, the single currency "euro" came into existence on January 1 1999 and vigorous trading in it began on January 4 after the weekend. During the transition period from 1999 to 2002, the euro co-existed with the national currencies of the eleven countries which have decided to join the single currency from the beginning. After 2002, their individual currencies ceased to exist. The parities of the eleven member currencies against the euro were irrevocably fixed on December 31, 1998 as follows (units of currency per one euro):

Austrian Schilling	13.760300
Belgian Franc	40.339900
Dutch Guilder	2.203710
Finnish Markka	5.945730
French Franc	6.559570
German Mark	1.955830
Irish Punt	0.787564
Italian Lira	1936.270000
Luxembourg Franc	40.339900
Portuguese Escudo	200.482000
Spanish Peseta	166.386000

Subsequently, on January 1, 2001, Greece joined the euro group with a conversion parity of 340.75 Greek drachmas against the euro. Then four more countries, viz. Cyprus, Malta, Slovakia and Slovenia have joined. Estonia is scheduled to join in January 2011. Euro is also the currency in five more European countries some with and some without formal agreements. Denmark, and Lithuania have linked their currency to the euro, but the exchange rate is not irrevocably fixed. Many other currencies are pegged to euro.

A brief chronological history of major landmarks in the evolution of the ECU is given in the appendix to this chapter.

As we will see in Chapters 7 and 8, these "lock-in" rates were used to compute exchange rates of non-EU currencies against the EU currencies which have become "legacy currencies", viz. rates are first computed against the euro and then against the legacy currencies using the above conversion rates.

In market dealing that took place on December 31, 1999, the euro traded at USD 1.17, JPY 133 and GBP 0.70. Subsequently, the euro showed prolonged weakness against the US dollar and was trading below par against the greenback as of the end of June 2000. During early 2002, it had reached as low as $0.87. Subsequently, it has appreciated significantly against the dollar. During the first quarter of 2010, it was trading around $1.35.

The EMU and the euro provide a model for other currency unions – a regime in which a group of sovereign nations share a single currency and vest the power to design and conduct monetary policy with a supra national central bank. The evolution and implications of EMU and euro are discussed in Owen and Cole (1999), Temperton (1999) and Subramanyam *et al*. (1998).

The euro crisis in April-May 2010 has led to a strong debate about the viability and desirability of a currency union, particularly when it involves countries with widely differing economic development levels. Large fiscal deficits in countries like Greece, Ireland, Portugal and Spain and the constraints imposed on their ability to use monetary policy to cope with severe recessionary pressures may lead to some of these countries leaving the currency union even though a substantial bailout package has been worked out by the European Union authorities. It appears that right from its origin, some economists and senior political leaders had strong views against the viability of Economic and Monetary Union (EMU) among countries which had widely different economic structures. Overtveldt (2011) provides a very insightful perspective on the evolution of EMU and the factors leading to its potential breakdown.

Following the financial crisis in 2007-08, there has also been a debate about the viability and propriety of the existing international monetary system. Dorruci and McKay (2011) discuss some of the important issues pertaining to this matter.

Summary

This chapter provides a brief overview of the international monetary system including the historical evolution of the various exchange rate regimes. It also discusses issues related to adequacy of international reserves and the problem of adjustment.

The post-1973 world is characterised by a variety of exchange rate regimes ranging from currency unions to independent floating. There are few, if any, rules governing the system. It is a matter of countries negotiating with each other to attain some shared goals. With increasing capital mobility and immense technological innovation, the system has acquired its own dynamic which occasionally leads to crises and panics. It remains to be seen whether countries would willingly enter into more rule-bound arrangements in the interest of minimising the probability of occurrence of such systemic disturbances.

Questions and Problems

1. Suppose the world is on gold standard. The price of gold in India is ₹580 per gram while in US it is \$12.00 per gram. The cost of transporting gold from India to the US is ₹0.50 per gram. Find the mint parity ₹per \$ exchange rate and the gold points.
2. What is the inherent paradox in having a particular currency as the reserve currency in the international monetary system?
3. The quota of an IMF member country *X* is 100 million SDRs. It has drawn 10 million SDRs from the Fund and a country *Y* has drawn *X*'s currency worth 15 million SDRs. What is *X*'s reserve position in the IMF?
4. Proponents of flexible exchange rate used to argue that under that system, there would be no need for central banks to hold foreign exchange reserves. In practice we observe that all central banks hold substantial amounts of reserves. What could be the explanation of this?

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APPENDIX

A.5.1 SPECIAL DRAWING RIGHTS: LIMITATIONS ON USE AND VALUATION

As mentioned in the text, member countries of the IMF and prescribed holders can use and receive SDRs in transactions and operations among themselves[21]. Members can also use SDRs for reserve tranche payments of increases in their quota and operations involving the General Resources Account such as payment of charges and repurchases (essentially repayments of loans taken from IMF). Also, the Fund ensures that by designating member countries to provide freely usable currencies in exchange for SDRs, a member can use its SDRs to obtain such currencies if it needs because of its balance of payments, reserve position or development in its reserves.

The use of SDRs for such purposes is subject to certain limitations. Till 1981, it was subject to a partial "reconstitution requirement", whereby members were obliged to maintain, over time, a minimum average level of SDR holdings specified as a percentage of their net cumulative allocations. Since then, this requirement has been dropped. No member is obliged to accept SDRs in return for convertible currency beyond the point where its holdings in excess of its net cumulative allocation is twice its net cumulative allocation. Of course, a member may *voluntarily* choose to accept SDRs beyond this point. [IMF Annual Report 1990].

[21] A variety of voluntary transfers among members involving SDRs are possible. Spot exchanges of SDRs against other monetary assets, swap arrangements (a reversible exchange of SDRs for currency or other monetary assets), forward sales and purchases of SDRs against currencies or other monetary assets, loans of SDRs at mutually agreed interest rates and maturities, settlements of financial obligations with SDRs used as collateral and inter-government grants and donations. For more details, see *Journal of Foreign Exchange and International Finance* **IV, No. 4,** pp. 305-309.

Detailed guidelines for the use of SDRs among member countries, between member countries and the IMF and in transactions with prescribed “other holders” are available on the IMF website ***www.imf.org***.

Interest is paid to holders on their holdings of SDRs. Interest is levied at the same rate on each member’s net cumulative allocation as well as any negative balance and unpaid charges. Effectively this means that if a member’s holding exceeds its net cumulative allocation, it earns interest on the excess while if it falls short, it pays interest on the shortfall. The rate of interest is a weighted average of yields or rates on short-term instruments in the capital markets of U.S., U.K., Japan and the inter-bank 3-month lending rate for the euro. The currencies of these three countries along with the euro constitute the SDR basket.

The basket of currencies constituting a SDR is reviewed every five years. The currencies to be included in the basket used to be currencies of those five countries which had the largest exports of goods and services during the five-year period ending one year before the date of revision. After the formation of EMU, it was decided that in applying this criterion, exports of countries belonging to an economic union to each other would not be counted; only exports of the entire union to rest of the world would be taken into account. Thus, two of the constituent currencies, viz. Deutschemark and French franc were replaced by euro. In addition to the size of exports, another criterion is also applied, viz. that the currency must be “freely usable”, that is in fact widely used to make payments for international transactions and widely traded in the principal foreign exchange markets. The weights assigned to the currencies in the SDR basket are based on (i) the value of the exports of goods and services of members or monetary unions and (ii) the amount of reserves denominated in the respective currencies which are held by other member countries of the IMF. The SDR is now a basket of four major currencies: U.S. dollar, Euro, British pound sterling and Japanese yen. The SDR basket and its valuation in terms of the U.S. dollar as on May 26, 2010 are shown below: (Taken from SDR Valuation prepared by the IMF Finance Department on a daily basis.)

SDR Valuation

The currency value of the SDR is determined by summing the values in U.S. dollars, based on market exchange rates, of a basket of major currencies (the U.S. dollar, euro, Japanese yen, and pound sterling). The SDR currency value is calculated daily and the valuation basket is reviewed and adjusted every five years. Its valuation as on May 6, 2013 is depicted in Exhibit A.5.1 below.

Exhibit A.5.1 Valuation of SDRs May 6, 2013

Currency	*Currency amount under Rule O-1*	*Exchange rate*	*U.S. dollar equivalent*
Euro	0.4230	1.30670	0.552734
Japanese yen	12.1000	99.35000	0.121792
Pound sterling	0.1110	1.55380	0.172472
U.S. dollar	0.6600	1.00000	0.660000
			1.506998
		U.S.$1.00 = SDR	0.663571
		SDR1 = US $	1.50700

(The exchange rates against euro and pound are stated as dollars per unit of those currencies; for the Japanese yen, it is yen per dollar).

***Source*: IMF website**

The weight attached to a particular constituent currency is given by the ratio of its dollar equivalent in SDR to the dollar equivalent of one SDR. Thus, the weight of Euro on May 6, 2013 was (0.552734/1.50700) = 0.3668 or 36.68% while that of Yen was (0.121792/1.50700) = 0.0808 or 8.08%. Notice that these weights will keep changing as the bilateral exchange rates change. Suppose on May 7, 2013 the Euro had appreciated to 1.3500 and the Yen had gone down to 102.50 with the pound remaining unchanged against the dollar. The dollar value of SDR would rise to 1.52152 and the weights of euro and yen would have been 37.53 per cent and 7.75 per cent, respectively. (Needless to say, the weights for the dollar and the pound would also change even though their exchange rates have not changed). The value of this basket in terms of any particular currency varies as bilateral exchange rates fluctuate. The Fund determines the SDR value each day by summing the dollar equivalents of the above amounts at market exchange rates. The above table reports that as on May 6, 2013, one SDR was equal to US dollars 1.50700 at market exchange rates between constituent currencies.

This calculation also illustrates the idea of a basket peg. Suppose a country wishes to maintain an exchange rate of its currency against the SDR at say 4.00 units of the currency per SDR. With an SDR valued at $1.50700, on May 6, 2013, it must set the exchange rate of its currency against the US dollar at (4.00/1.50700) or 2.6543 units of the currency per dollar. As the SDR changes against the US dollar, it must adjust the exchange rate of its currency against the US dollar so as to maintain a rate of 4.00 against the SDR.

Countries wishing to have a basket peg can choose a publicly known basket such as the SDR or construct their own basket. One possibility is to construct the basket with currencies of the country's major trading partners, the weight assigned to each reflecting the share of that partner in total trade. As seen above, these weights will change over time and the basket may have to be reconstituted to get the weights to reflect trade shares of the partner countries.[22]

Interest rate on SDRs is determined weekly as a weighted average of interest rates on specified short-term instruments in the domestic money markets of the four currencies which constitute the SDR basket. As of now these are: 3-month treasury bills in US and UK, 13-week treasury bills of the Japanese government and the 3-month EURIBOR – an inter-bank lending rate for euro.

A.5.2 FUNDING FACILITIES AVAILABLE TO IMF MEMBER COUNTRIES

IMF provides financial support to members through a variety of funding facilities depending upon the nature of the macroeconomic and structural problem they wish to address. Each facility has a different degree of "conditionality" attached to it. Box A.5.1 taken from the IMF's Annual Report for the year 2004 contains brief descriptions of the regular and special facilities available to member countries.

In 2006, a new facility was created to provide aid to countries that are facing balance of payments problems due to some exogenous shock. It provides annual aid up to 25 per cent of the country's quota with a cumulative limit of 50 per cent of the quota.

A facility titled Systemic Transformation Facility was available from April 1993 to April 1995 to assist countries which were facing severe disruption in their trade and payments arrangements. IMF allows a member country to set aside a part of a credit accessed under regular facilities to reduce debt principal and debt service payments.

[22] It can be proved mathematically that given a set of weights, the amounts of constituent currencies in the basket can be determined up to a multiplicative factor. See Gandolfo (1986).

Box A.5.1 IMF Financial Facilities

Credit facility	*Purpose*	*Conditions*	*Phasing and Monitoring*[1]	*Access Limits*[1]
Credit tranches and Extended Fund Facility				
Stand-By Arrangement (1952)	Medium-term assistance for countries with balance of payments difficulties of short-term character	Adopt provide that provide confidence that the member's balance of payments difficulties will be resolved	Quarterly purchase (disbursements) contingent on observance of performance criteria and other conditions within a reasonable period	Annual: 100% of quota; Cumulative: 300% of quota
Extended Fund Facility (1974) (Extended Arrangements)	Longer-term assistance to support members structural reforms to address balance of payments difficulties of a long-term character	Adopt-3 year program, with structural agents, with annual detailed statement of policies for the next 12 months	Quarterly or semiannual purchase (disbursements) contingent on observance of performance criteria and other conditions.	Annual: 100% quota; Cumulative: 300% of quota
Special facilities Supplemental Reserve Facility (1907)	Short-term assistance for balance of payments difficulties related to cases of market confidence	Available only in content of Stand-By or Extended Arrangements with associated program and with strengthened policies to address loss of market confidence.	Facility available for one year; frontloaded access with two or more purchases (disbursements)	No access limits; access under the facility one when across under associated regular arrangement would otherwise exceed either animal or cumulative limit
Compensatory Financing Facility (1988)	Medium-term assistance for temporary export shortfalls or cereal import excesses	Available only when the shortfall/excess is largely beyond the control of the authorities and a member has an arrangement with upper credit tranches conditionally, or when a member's balance of payments position excluding the shortfell/ excess is satisfactory	Stand-along disbursements or, if there is an arrangement, disbursement are in two phases	45% of quota each for export and cereal components. Combined limit of 55% of quota for both components

(Contd.)

Emergency assistance	Quick, medium-term assistance for balance of payments difficulties related to		None, although post-conflict assistance can be segmented into two or more purchases	Generally limited to 25% of quota, although larger amounts can be made available in exceptional cases
(1) Natural disasters (1962)	(1) Natural disasters	(1) Reasonable efforts to overcome balance of payments difficulties.		
(2) Post-conflict (1995)	(2) The alternate of civil unrest, political turnoff, or international armed conflict	(2) Focus on institutional and administrative capacity building to pass the way for an upper credit tranche arrangement of PRGE		
Facility for low-income members				
Poverty Reduction and Growth Facility (1999)	Longer-term assistance for deep-seated balance of payments difficulties of structural nature; aim is sustained poverty-reducing growth	Adopt 3-year PRGF program. PRGF-supported programs are based on a Powerty Reduction Strategy Paper (PRSP) prepared by the country in a participatory process and integrating macroeconomic, structural, and poverty reduction policies	Semiannual (or occasionally quarterly) disbursements contingent an observance of performance criteria and reviews	140% of quota; 185% of quota in exceptional circumstances.

Figures A.5.1 and A.5.2 depict IMF lending and regular loans outstanding to member countries.

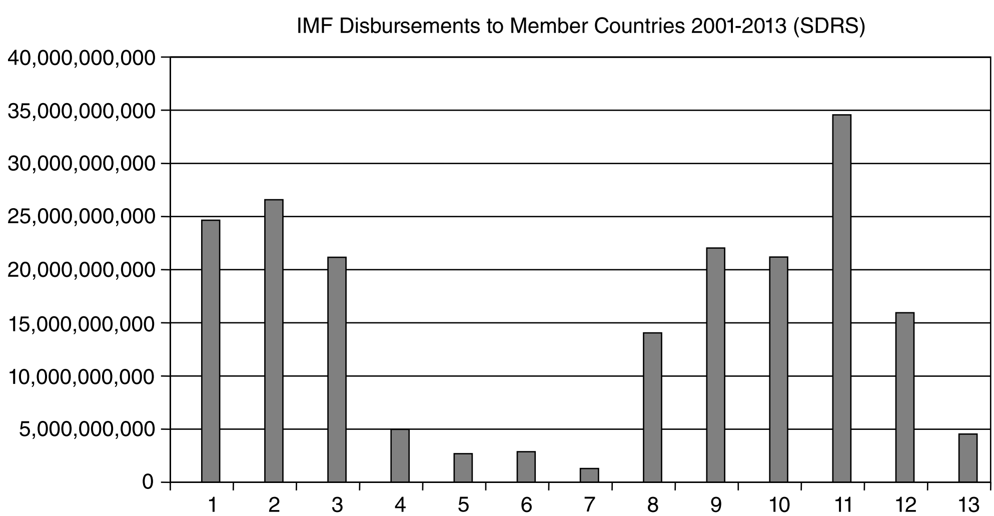

Fig. A.5.1 IMF Lending to Member Countries

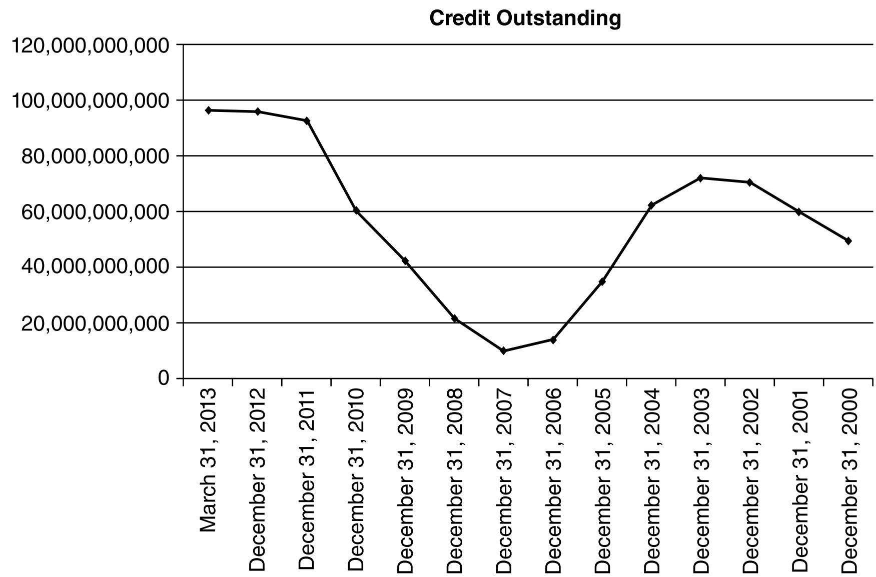

Fig. A.5.2 IMF Credit Outstanding to Member Countries

A.5.3 POST WORLD WAR II HISTORY OF THE INTERNATIONAL MONETARY SYSTEM

1944 Bretton Woods, New Hampshire conference established an adjustable peg system of quasi-fixed exchange rates with the U.S. dollar as the key currency. IMF and World Bank created. IMF authorised to supervise the International Monetary System.

1958 Birth of the European Economic Community (EEC).

1963 The U.S. government imposed an "Interest Equalisation Tax" on foreign issuers funding in U.S. capital markets.

1963 The U.S. government imposed voluntary foreign credit restraints on the U.S. banks and companies.

1968 Mandatory controls on foreign investment by the U.S. companies imposed by the US government.

1970 Special Drawing Rights created.

1971 On August 15, the U.S. $ floated; the convertibility of the U.S. $ into gold abandoned; On December 17, Smithsonian Agreement reached; the U.S. $ devalued from $35 per ounce of gold to $38.

1972 A snake (2.25%) within a tunnel (4.5%) established among major European currencies.

1973 The US $ devalued from $38 to $42.22 per ounce of gold in March.

1973 The oil price crisis. Oil prices quadruple.

1976 "Jamaica Agreement". IMF "recognises" the existing floating system.

1978 The European Monetary System (EMS) officially replaced the snake within a tunnel. European currencies jointly float against the U.S. dollar.

1980 Latin American debt crisis.

1985 Group of Five countries reached "Plaza Agreement" to drive down the U.S. dollar.

1987 Major industrialised countries reached "Louvre Accord" to support stability and exchange rates around their current levels. Aimed at checking further fall of the U.S. dollar.

1992 Tight monetary policy in Germany triggered a currency crisis in Europe in September. Italy and the United Kingdom withdrew from the European Monetary System.

1993 In July the allowable deviation band around EMS central parities widened to ±15 per cent.

1993 EEC changed to the European Union (EU).

1994 Mexican peso crisis. A 40 per cent devaluation and began floating.

1997 The East and South East Asian currency crisis. Started in Thailand and spread to Indonesia, Malaysia, South Korea, Philippines.

1999 January 1, 1999, the single European currency, the Euro launched with a common monetary policy formulated and implemented by an independent European Central Bank.

2002 Euro introduced in parallel with home currencies; transition period to last not more than six months.

2003 Traditional European currencies abandoned.

Key Dates of European Monetary Integration

1969: 2 December: The Council adopts the Werner Plan to strengthen coordination of economic policies.

1972: 10 April: Balse Agreement sets up the 'Snake': The Six (B, D, F, IT, L, NL) agreed to limit the margin of fluctuation between their currencies to 2.25 per cent.

19 & 20 October: The Paris meeting of Heads of State and Government reaffirms the 1980 deadline for the achievement of EMU.

1973: 3 April: Creation of the European Monetary Cooperation Fund (EMCF).

1978: 6 & 7 July: The European Council meeting at Bremen agrees with the French-German proposal to launch the European Monetary System (EMS)

5 December: The Brussels European Council decides to set up the EMS

1979: 13 March: The EMS comes into force; the eight participating Member States (the U.K. stays outside) are required to maintain their exchange rates within a fluctuation margin of ±2.25% (±6% for the lira). Creation of the European Currency Unit (ECU)

1987: 1 July: The Single European Act, which reforms the EEC Treaty, comes into force. Its objective is the completion of the Internal market by the end of 1992.

1988: 24 June: The Council Capital movements directive is adopted eliminating all restrictions by 1 July 1990, with temporary derogations for E, GR, IR and P.

1989: 19 June: The Peseta enters EMS exchange rate mechanism (ERM).
26 & 27 June: Madrid European Council decides to convene an Intergovernmental Conference before 1990 on Economic and Monetary Union.

1990: 1 July: The first phase of EMU comes into force. It involves the removal of most of remaining restrictions on capital movements, increased coordination of economic policies and more intensive cooperation between central banks.

6 October: The Pound sterling enters ERM with a 6 per cent fluctuation margin.

1991: 9 & 10 December: Maastricht European Council reaches agreement on draft Treaty on European Union: completion of EMU and introduction of the single European currency by 1999, at the latest.

1992: 4 April: The Escudo enters ERM with a 6 per cent fluctuation margin.

17 September: Intense speculative pressure forced the UK and the Italian authorities to suspend participation of pound and the lira in the ERM.

1993: 1 January: The Single Market enters into force.

2 August: Fluctuation margins of ERM currencies widened [temporarily] to 15 per cent.

1 November: The Treaty on European Union enters into force.

1994: 1 January: Stage II of EMU begins and European Monetary Institute is established.

1995: 9 January: The Austrian schilling enters the ERM.

28 15 & 16 December: Madrid European Council names the European currency unit 'Euro' and confirms the introduction of the single currency on 1 January 1999.

1996: 14 October: The Finnish markka enters the ERM.

25 November: The Italian Lira rejoins the ERM.

1998: 1 June: The European Central Bank (ECB) is established. The EMI, having completed its tasks, ceases to exist.

1999: 1 January: the Third and final stage of EMU enters into force with the irrevocable fixing of the exchange rates of the currencies of 11 Member States and the conduct of a single monetary policy under the responsibility of the ECB.

2001: January: Greece enters the third stage of EMU and adopts the euro.

2002:1 January: Introduction of euro notes and coins.

2010: Financial crisis in Greece, Portugal, Ireland and Spain. Bailout package worked out. Doubts arise about the survival of the European Union.

OFFICIALLY DOLLARISED ECONOMIES

[COUNTRIES WHICH USE OTHER COUNTRY'S CURRENCY (2012)]

U.S. Dollar

(A) Countries using the U.S. dollar exclusively

- *British Virgin Islands*
- *Caribbean Netherlands* (from 1 January 2011)
- *East Timor* (uses *its own coins*)
- *Ecuador* (uses *its own coins* in addition to U.S. coins; *Ecuador* adopted the U.S. dollar as its *legal tender* in 2000.)

- *El Salvador*
- *Marshall Islands*
- *Federated States of Micronesia* (Micronesia used the U.S. dollar since 1944)
- *Palau* (Palau adopted the U.S. dollar since 1944)
- *Panama* (uses *its own coins* in addition to the U.S. coins. This country has adopted the U.S. dollar as *legal tender* since 1904.)
- *Turks and Caicos Islands*

(B) Countries using the U.S. dollar alongside other currencies

- *Bahamas*
- *Belize* (Belizien Dollar pegged 2/1 but USD is accepted)
- *Uruguay*
- *Cambodia* (uses *Cambodian Riel* for many official transactions, yet most businesses deal exclusively in dollars for all but the cheapest items. Change is often given in a combination of US dollars and Cambodian Riel.)
- *Lebanon* (along with the *Lebanese pound*)
- *Liberia* (was fully dollarized until 1982, when the National Bank of Liberia began issuing five dollar coins; the U.S. dollar still in common usage alongside the *Liberian dollar*)
- *Zimbabwe*
- *Haiti* (uses the U.S Dollar alongside its domestic currency, the *Gourde*)
- *Vietnam* (along with the *Vietnamese Dong*)
- *Somalia* (along with the *Somali Shilling*)
- *North Korea* (along with the *Chinese yuan*, *Euro*, and *North Korean Won*)

Euro

- *Andorra* (formerly *French franc* and *Spanish peseta* since 1278)
- *Kosovo* (formerly *German mark* and *Yugoslav dinar*)
- *Monaco* (formerly *French franc* since 1865; issues its own euro coins)
- *Montenegro* (formerly *German mark* and *Yugoslav dinar*)
- *San Marino* (formerly *Italian lira*; issues its own euro coins)
- *Vatican City* (formerly *Italian lira*; issues its own euro coins)
- *Zimbabwe* (Alongside *USD*, *South African Rand* and *Botswana pula*)
- *North Korea* (along with the Chinese yuan, USD, and North Korean Won)[39]

New Zealand Dollar

- *Cook Islands (issues its own coins and some notes)*
- *Nauru* (alongside *Australian dollar* from 25 May 2013)
- *Niue*
- *Pitcairn Island*
- *Tokelau*

Australian Dollar

- *Kiribati* (issues *its own coins*; Kiribati has used Australian currency since 1943)
- *Nauru* (has fully used Australian currency since 1914)

- *Tuvalu* (issues *its own coins; Tuvalu* has used Australian currency alongside its domestic currency since 1892)

South African Rand

- *Lesotho*
- *Namibia*
- *Swaziland*
- *Zimbabwe* (Alongside the *American dollar*, *Euro* and *Botswana pula*)

Others

- **Armenian dram:** *Nagorno-Karabakh Republic*
- **Russian ruble:** *Abkhazia* and *South Ossetia* (*de facto* independent states, but recognized as part of *Georgia* by nearly all other states)
- **Indian rupee:**
  - *Bhutan* (Alongside *Bhutanese Ngultrum*, pegged at par with the rupee)
  - *Nepal* (Alongside the *Nepali rupee*, pegged at 0.625)
- **Swiss franc:** *Liechtenstein*
- **Israeli shekel:** *Palestinian territories*
- **Jordanian Dinar**: *West Bank* (Alongside *Israeli New Sheqel*)
- **Egyptian Pound**: *Gaza Strip* (Alongside *Israeli New Sheqel*)
- **Turkish lira**: *Turkish Republic of Northern Cyprus* (*de facto* independent state, but recognised as part of *Cyprus* by all states but Turkey)
- **Canadian Dollar**: *St Pierre and Miquelon* (Alongside *euro*)
- **Pound Sterling and Botswana pula**: *Zimbabwe* (Alongside *South African rand*, *Euro* and *USD*)

Chapter 6

Global Financial Markets and Interest Rates

6.1 INTRODUCTION

The last two decades have witnessed the emergence of a vast financial market straddling national boundaries enabling massive cross-border capital flows from those who have surplus funds and are in search of high returns to those seeking low-cost funding. The phenomenon of borrowers, including governments, in one country accessing the financial markets of another is not new; what is new is the degree of mobility of capital, the global dispersal of the finance industry and the enormous diversity of markets and instruments which a firm seeking funding can tap.

The decade of 1980s ushered in a new phase in the evolution of international financial markets and transactions. Major OECD countries had began deregulating and liberalising their financial markets towards the end of seventies. While the process was far from smooth, the overall trend was in the direction of relaxation of controls which till then had compartmentalised the global financial markets. Exchange and capital controls were gradually removed, non-residents were allowed freer access to national capital markets and foreign banks and financial institutions were permitted to establish their presence in the various national markets. The process of liberalization and integration continued into the 1990s with many of the developing countries carrying out substantive reforms in their economies and opening up their financial markets to non-resident investors. A series of crises – the Mexican crisis of 1995, the East Asian collapse in 1997 and the Russian meltdown the following year – threatened to stop the process in its tracks, but by the end of 1999, some of the damage has been repaired and the trend towards greater integration of financial markets appears to be continuing. Many developing economies are also opening up their financial markets and gradually relaxing restrictions on foreign investments coming into the home country as well as domestic firms investing abroad.

The crisis that erupted in the US following the failure of Lehman and problems faced by the insurance giant AIG in 2007-08 have given rise to a debate as to whether such gigantic global markets with large segments of it subject to little or no regulatory norms and the lack of transparency associated with many exotic structured financial products are a desirable development. Many economists have argued that much tighter and broader regulation is needed to minimise the probability of occurrence of such crises which lead to systemic failures.

While opening up of the domestic markets began only around the end of seventies, a truly international financial market had already been born in mid-fifties and gradually grown in size and scope during sixties and seventies. This is the well-known **Eurocurrencies Market** wherein a borrower (investor) from country A could raise (place) funds in currency of country B from (with) financial institutions located in country C. For instance, a Mexican firm could get a US dollar loan from a bank located in London. An Arab oil sheik can deposit his oil dollars with a bank in Paris. This market had performed a useful function during the years following the oil crisis of 1973, viz. recycling the "petrodollars" – accepting dollar deposits from oil exporters and channelling the funds to borrowers in other countries. During the eighties and the first half of nineties, this market grew further in size, geographical scope and diversity of funding instruments. It is no more a "euro" market, but a part of the general category called "offshore markets"[1].

Alongside liberalisation, other qualitative changes have been taking place in the global financial markets. Removal of restrictions led to geographical integration of the major financial markets in the OECD countries. Gradually this trend is spreading to developing countries many of whom have opened up their markets, at least partially, to non-resident investors, borrowers and financial institutions. Another noticeable trend is functional integration. The traditional distinctions between different kinds of financial institutions – commercial banks, investment banks, finance companies, etc. – are giving way to diversified entities that offer the full range of financial services. The early part of eighties saw the process of **disintermediation** get under way. Highly rated issuers began approaching the investors directly rather than going through the bank loan route. On the other side, the developing country debt crisis, adoption of capital adequacy norms proposed by the Basle Committee and intense competition, forced commercial banks to realise that their traditional business of accepting deposits and making loans was not enough to guarantee their long-term survival and growth. They began looking for new products and markets. Concurrently, the international financial environment was becoming more and more volatile – the amplitude of fluctuations in interest rates and exchange rates was on the rise. These forces gave rise to innovative forms of funding instruments and tremendous advances in the art and science of risk management. The decade saw increasing activity in and sophistication of financial derivatives markets which had begun emerging in the seventies.

Taken together, these developments have given rise to a globally integrated financial marketplace in which entities in need of short- or long-term funding have a much wider choice than before in terms of choice of market segment, maturity, currency of denomination, interest rate basis, and so forth. The same flexibility is available to investors to structure their portfolios in line with their risk-return tradeoffs and expectations regarding interest rates, exchange rates, stock markets and commodity prices. Financial services firms can now design customised financial products to suit the specific requirements of individual customers.

The purpose of this chapter is to provide an introduction to global financial markets and the linkages between domestic and international money markets. The focus will be on the short-maturity segment or the money market. Global capital markets – equities, bonds, notes, etc. – will be discussed in later chapters.

[1] This term should also include the so-called "international banking facilities" wherein a bank, e.g. in US is permitted to have a separate division located on US territory for carrying out business with non-resident entities and which is not subject to the usual domestic banking regulation.

6.2 DOMESTIC AND OFFSHORE MARKETS

Financial assets and liabilities denominated in a particular currency, say the US dollar, are traded primarily in the national financial markets of that country. In addition, in the case of many convertible currencies, they are traded outside the country of that currency. Thus, bank deposits, loans, promissory notes, bonds denominated in US dollars are bought and sold in the US money and capital markets such as New York as well as the financial markets in London, Paris, Singapore and other centres outside the USA. The former is the **domestic market** while the latter is the **offshore market** in that currency. Each of these, in turn, will have a menu of funding avenues.

While it is true that not both markets will offer all the financing options or that any entity can access all segments of a particular market, it is generally true that a given entity has access to both the markets both for placing as well as raising funds[2]. Are they then really two distinct markets or should we view the entire global financial market as a single market?

There is no unambiguous answer to this question. On the one hand, since as mentioned above, a given investor or borrower will normally have equal access to both the markets, arbitrage will ensure that they will be closely linked together in terms of costs of funding and returns on assets. On the other hand, they do differ significantly on the regulatory dimension. Major segments of the domestic markets are usually subject to strict supervision and regulation by relevant national authorities such as the SEC, Federal Reserve in the US, the Ministry of Finance in Japan and the Swiss National Bank in Switzerland. These authorities regulate non-resident entities' access to the public capital markets in their countries by laying down eligibility criteria, disclosure and accounting norms and registration and rating requirements. Domestic banks are also regulated by the concerned monetary authorities and may be subject to reserve requirements, capital adequacy norms and deposit insurance. The offshore markets, on the other hand, have minimal regulation[3], often no registration formalities and importance of rating varies. Also, it used to be the case that when a non-resident entity tapped a domestic market, tasks like managing the issue, underwriting, etc., were performed by syndicates of investment banks based in the country of issue and investors were mostly residents of that country while issues in offshore markets are often managed by global syndicates and investors also tend to come from different countries.

Finally, it must be pointed out that though nature of regulation continues to distinguish domestic from offshore markets, almost all domestic markets have segments like private placements, unlisted bonds and bank loans where regulation tends to be much less strict. Also, recent years have seen emergence of regulatory norms and mechanisms which transcend national boundaries. With removal of barriers and increasing integration, authorities have realised that regulation of financial markets and institutions cannot have a narrow national focus – the markets will simply move from one jurisdiction to another. To minimise the probability of systemic crises, banks and other financial institutions must be subjected to norms and regulatory provisions that are common across countries. One example of such transnational regulation is the Basle accord under which the advanced OECD economies have imposed uniform capital adequacy norms on banks operating within their jurisdictions. In the near future, other segments of the financial markets may also be subjected to common "global" regulation which will reduce, if not eliminate, the regulatory distinctions between domestic and offshore markets.

[2] This is not true when capital controls of different kinds are in force.

[3] For instance, the euroyen market is closely monitored by the Japanese MOF.

As mentioned above, the eurocurrencies market is the oldest and largest offshore market. We now proceed to describe the essential features of this market.

6.3 EUROMARKETS

6.3.1 What are They?

Prior to 1980, eurocurrencies market was the only truly international financial market of any significance. It is mainly an inter-bank market trading in time deposits and various debt instruments. A **"Eurocurrency Deposit"** is a deposit in the relevant currency with a bank outside the home country of that currency. Thus, a US dollar deposit with a bank in London is a eurodollar deposit, a sterling deposit with a bank in Luxembourg is a eurosterling deposit. Note that what matters is the location of the bank – neither the ownership of the bank nor ownership of the deposit. Thus, a dollar deposit belonging to an American company held with the Paris subsidiary of an American bank is still a eurodollar deposit. Similarly, a **Eurodollar Loan** is a dollar loan made by a bank outside the US to a customer or another bank. The prefix ***"euro"*** is now outdated[4] since such deposits and loans are regularly traded outside Europe, e.g. in Singapore and Hong Kong (These are sometimes called Asian dollar markets). While London continues to be the main euromarket centre, for tax reasons, loans negotiated in London are often booked in tax-haven centres such as Grand Cayman and Nassau [See Stigum (1990)].

Over the years, these markets have evolved a variety of instruments other than time deposits and short-term loans. Among them are Certificates of Deposit (CDs), Euro Commercial Paper (ECP), medium to long-term floating rate loans, eurobonds[5], Floating Rate Notes (FRNs) and Euro Medium Term Notes (EMTNs). Of these, the short-term instruments like ECP and CDs will be briefly discussed later in this chapter; the rest will be described in Chapter 19.

As mentioned above, the key difference between euromarkets and their domestic counterparts is one of regulation. For instance, eurobanks are free from regulatory provisions such as cash reserve ratio, deposit insurance, etc., which effectively reduces their cost of funds. Eurobonds are free from rating and disclosure requirements applicable to many domestic issues as well as registration with securities exchange authorities. This feature makes it an attractive source of funding for many borrowers and a preferred investment vehicle for some investors compared to a bond issue in the respective domestic markets.

6.3.2 Evolution of Euromarkets

Eurocurrency markets, specifically the eurodollar market, is said to have originated, ironically enough, with the Russian authorities seeking dollar-denominated deposits with banks in Britain and France. During the 1950s, the erstwhile USSR was earning dollars from the sale of gold and other commodities and wanted to use them to buy grain and other products from the West, mainly from the US. However, they did not want to keep these dollars on deposit with banks in New York as they were apprehensive that the US government might freeze the deposits if the cold war intensi-

[4]Also, with the birth of the new currency euro, the terminology gets confusing. Euro-denominated deposits outside the Euroland will have to be called "Euroeuro" deposits.

[5]In keeping with the definition of eurodeposits, a dollar commercial paper or a dollar bond issued, say in London, become eurodollar commercial paper and eurodollar bond, respectively.

fied. They approached banks in Britain and France who accepted these dollar deposits and invested them partly in US. The subsequent enormous growth of the eurodollar market was, however, due to a number of other factors.

On the supply side, the impetus for growth derived from the various restrictions imposed by the US authorities on domestic banks and capital markets. Throughout the 60s and 70s, American banks and other depository institutions had to observe ceilings on the rate of interest they could pay on deposits[6]. These restrictions did not apply to branches of American banks located outside the US, and a number of American banks began accepting dollar deposits in their foreign branches. The dollars so obtained were often reinvested in the US. Most of these restrictions had been lifted by mid-seventies. Secondly, domestic banks in the US (as in many other countries) were subjected to reserve requirements which meant that a part of their deposits were locked up in relatively low-yielding assets. The requirement did not apply to dollar deposits held in foreign branches of American banks (except between 1969 and 1978). The result was banks outside the US could offer better rates to depositors (slightly higher) and to borrowers (slightly lower) than their domestic counterparts. Absence of deposit insurance on deposits held outside was also an added factor. This absence of regulation continues to be a factor in favour of euromarkets.

A third reason is that due to the importance of the dollar as a vehicle currency in international trade and finance, many European corporations have cash flows in dollars and hence temporary dollar surpluses. Due to distance and time zone problems as well as their greater familiarity with European banks, these companies preferred to keep their surplus dollars in European banks, a choice made more attractive by the higher rates offered by eurobanks.

These supply side factors were reinforced by demand for eurodollar loans by non-US entities and by US multinationals to finance their foreign operations. During the sixties as the US balance of payments difficulties started growing, the US government imposed a series of restrictions which made it difficult and/or more expensive for foreign entities to borrow in the US. The voluntary foreign credit restraints of 1963, followed by mandatory controls on foreign lending and the interest equalisation tax (a tax on interest earned by the US residents from foreigners) induced channelling of funds through the eurodollar markets where these regulations did not apply.

To summarise, the main factors behind the emergence and strong growth of the eurodollar markets were the regulations on borrowers and lenders imposed by the US authorities which motivated both banks and borrowers to evolve eurodollar deposits and loans[7]. Added to this are the considerations mentioned above, viz. the ability of eurobanks to offer better rates both to depositors and borrowers (which again can be attributed to existence of regulations) and the convenience of dealing with a bank closer to home who is familiar with the business culture and practices in Europe[8].

The emergence of euromarkets in currencies other than US dollar can also be attributed to similar considerations though in these cases better rates and familiarity perhaps played a more important role. As exchange controls were eased and offshore banking was encouraged by authorities, offshore markets were developed in many other centers including the Far East.

It is difficult to obtain precise estimates of the size of the euromarket, particularly net figures, i.e. excluding inter-bank placement of funds. Table 6.1 below provides some recent data on the volume of international syndicated credit facilities and commercial paper.

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[6]The most important of these was the regulation Q which specified a maximum rate of interest payable on savings deposits.

[7]In a similar vein, the restriction imposed by the British government on British banks borrowing at home to finance third country trade also played a small role.

[8]In the case of banking centres in "tax haven" locations like Bahamas, Cayman islands, etc., low or non-existent corporate taxation was also a factor. Of course many of these operations were only "name plate" operations like Liberian or Panmaian shipping companies.

Table 6.1 International Syndicated Credits and Money Market Instruments (US $ Billion, by Nationality of Borrower)

	2010	*2011*	*2012*
Signed International Syndicated Credit Facilities			
All Countries	1723.7	2492.2	1840.5
Developing Countries	267.6	343.2	276.0
India	33.6	33.5	25.0
Money Market Instruments (Net Issues)			
All Countries	–24.1	41.9	20.0
Developing Countries	–1.9	2.4	3.6
India	0.1	0.0	0.0

Source: Bank for International Settlements Quarterly Report December 2012, March 2013.

6.3.3 Multiple Deposit Creation by Eurobanks

Like any other fractional reserve banking system, eurobanks can generate multiple expansion of eurodeposits on receiving a fresh injection of cash.

The traditional approach to this issue treats eurobanks analogously with banks within a domestic monetary system except that the cash reserve ratio of the former is voluntarily decided while for the latter it is often statutorily fixed. (Actually, even in the latter case, authorities specify only the **minimum** reserve ratio. Banks **can** hold excess reserves). Following the traditional reasoning, deposits give rise to loans which, in turn, give rise to deposits perhaps with some leakages, at each stage a fraction being added to reserves. This process is examined in more detail in the appendix to this chapter.

A competing "modern" approach rejects the idea of a fixed reserve ratio and emphasises the fact that supply of eurodeposits on one hand and the demand for euroloans on the other are both dependent upon the rate of interest. A fresh injection of cash will put downward pressure on the interest rate which will induce some marginal depositors to shift their deposits out of the eurobanks while it will increase the demand for loans. The total size of eurobanks' balance sheets will expand, but the extent of the increase cannot be determined by any fixed multiplier formula as in the traditional approach; it depends on the elasticities of the schedules of supply of and demand for funds in the euromarkets. An exhaustive survey of the theoretical debate can be found in Johnston (1983).

6.3.4 Economic Impact of Euro and other Offshore Markets

The emergence and vigorous growth of euromarkets and their (alleged) ability to create multiple deposit expansion without any apparent control mechanism have given rise to a number of concerns regarding their impact on international liquidity, on the ability of national monetary authorities to conduct an effective monetary policy and on the soundness of the international financial system. Among the worries expressed are:

1. The market facilitates short-term speculative capital flows – the so called "hot money" – creating enormous difficulties for central banks in their intervention operations designed to "stabilise" exchange rates.

2. National monetary authorities lose effective control over monetary policy since domestic residents can frustrate their efforts by borrowing or lending abroad. It is known that with fixed or managed exchange rates, perfect capital mobility makes monetary policy less effective. Euromarkets contribute to increasing the degree of international capital mobility.
3. The market is based on a tremendously large volume of interbank lending. Further, eurobanks are engaged in maturity transformation, borrowing short and lending long. In the absence of a "lender of last resort", a small crisis can easily turn into a major disaster in the financial markets.
4. Euromarkets create "private international liquidity" and in the absence of a central coordinating and regulatory authority – such as the central bank of a nation in the case of national banking systems – they might create too much liquidity contributing to inflationary tendencies in the world economy.
5. The markets allow central banks of deficit countries to borrow for balance of payments purposes, thus enabling them to put off needed adjustment measures.

Against these are to be set the obvious advantages of the markets such as (1) more efficient allocation of capital worldwide, (2) smoothing out the effects of sudden shifts in balance of payments imbalances (e.g. recycling of petrodollars mentioned above without which a large number of oil importing countries would have had to severely deflate their economies after the oil crisis), and (3) the spate of financial innovations that have been created by the market which have vastly enhanced the ability of companies and governments to better manage their financial risks, and so on.

On the question of whether the euromarkets are really unbridled creators of international liquidity, the argument, as we saw above, is not settled. The connection between international liquidity and world inflation is also open to debate. Concerns pertaining to increased fragility of the financial system are quite legitimate particularly since the advent of securitisation. Authorities in OECD countries have already taken certain steps towards tightening the regulatory provisions. Uniform capital adequacy norms and tightening of bank supervision is expected to render the financial system less vulnerable to systemic failures. The debate about the desirability of having completely open capital accounts and uncontrolled cross-border capital flows continues with a variety of proposals for redesigning the global financial system. We will briefly discuss some of these developments towards the end of this chapter.

6.4 INTEREST RATES IN THE GLOBAL MONEY MARKETS

The purpose of this section is to examine the linkages between interest rates in the domestic and offshore markets on the one hand, and amongst interest rates for different currencies in the offshore market on the other. The spectrum of interest rates existing in an economy at any point of time is the result of the complex interaction between several forces. Figure 6.1 provides a schematic picture of interest rate determination. As seen in the figure, the short-term money market rates in a domestic money market are linked to the so-called risk-free nominal interest rate, usually the yield offered by short-term government securities like treasury bills.

In the eurocurrency market, which is primarily an interbank deposit market, the benchmark is provided by the interbank borrowing and lending rates. The most widely known benchmark is the **LONDON INTER-BANK OFFER RATE** abbreviated **LIBOR.**[9] This is an index of the rate which

[9]For the euro, there is a euro LIBOR fixed in London and a euribor fixed in Brussels.

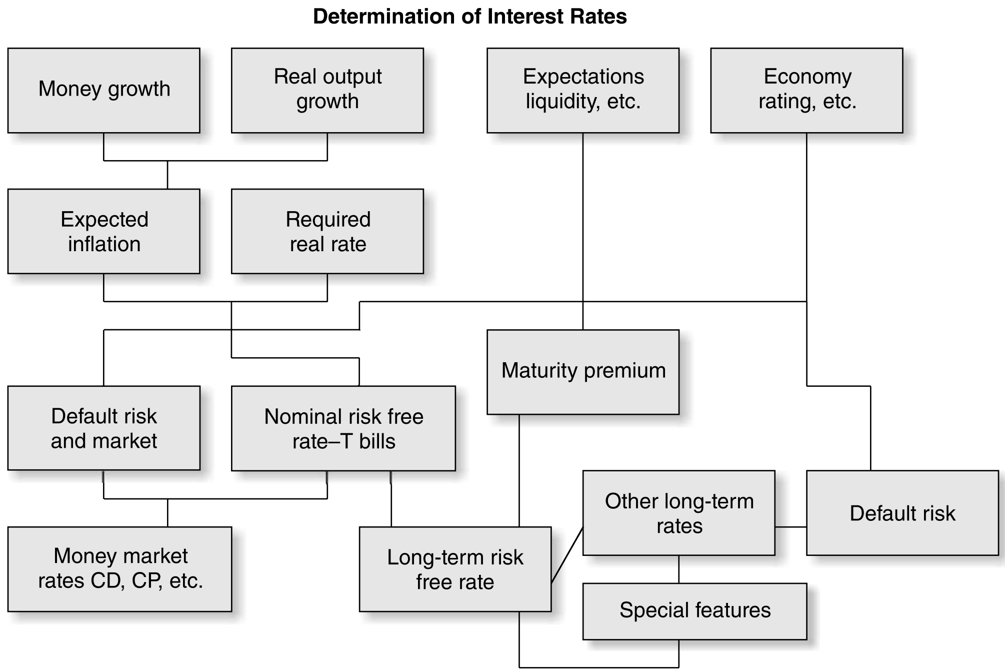

Fig. 6.1 Determinants of Interest Rates

a "first class" bank in London will charge another first class bank for a short-term loan. Note that LIBOR is not necessarily the rate charged by any particular bank; it is only an indicator of demand-supply conditions in the interbank deposit market in London[10]. Another rate often referred to is the **LIBID – London Inter-Bank Bid Rate**, the rate which a bank is willing to pay for deposits accepted from another bank[11].

Obviously, LIBOR would vary according to the term of the underlying deposit. Thus, financial press normally provides quotations for 3- and 6-month LIBORS. In the euromarket, deposits range in maturity from overnight up to one year. LIBOR also varies according to the currency in which the loan or deposit is denominated. We will discuss below the link between LIBORS for different currencies.

In July 2012, a crisis termed "Libor Scandal" emerged in the euromarket. It was revealed that banks were falsely inflating or deflating their reported lending and borrowing rates – LIBORS and LIBIDS – so as to profit from their trades or to give the impression that they were more creditworthy than they were. The banks are supposed to submit the actual inter-bank interest rates they are paying. It was discovered that the rates they were reporting to British Bankers' Association were not the rates they were actually paying. The reported rates form the basis for financial derivatives, mortgages, student loans, etc., and the valuation and pricing of these products based on submitted

[10]In many loan agreements as also in instruments like Floating Rate Notes (FRNs), the rate to be paid by the borrower is stated as (LIBOR + a spread). In such cases, the agreement clearly spells out how LIBOR is to be determined on the rate resetting date. For instance, it might say that on the resetting date, rate quotations will be obtained from 12 major banks in London at 11.00 a.m. London time, the two highest and the two lowest will be discarded and the arithmetic average of the remaining eight will become "the LIBOR" for rate setting purposes.

[11]LIMEAN is the average of LIBOR and LIBID.

rates rather than actual rates can have negative impact on consumers and financial markets. Banks used the misrepresentation of LIBOR to manipulate the financial derivatives market. It appears that LIBOR manipulation had been common since 1991. Many banks were sued in civil courts and had to pay substantial fines.

Boxes 6.1 and 6.2 present selected short-term interest rates for the United States and the United Kingdom money markets, respectively. Table 6.2 gives 6-month LIBORS for various currencies.

Box 6.1 Short-term Rates – US May 2013 (% per annum)

Federal Funds : 0.25
3-Month T-Bill : 0.06
1-Month AA Non-Fin CP : 0.06
Prime Rate : 3.25
1-Month CD Rate : 0.17

Note: The interbank rate is average for April 2013

Box 6.2 Short-term Rates – UK May 2013 (% per annum)

3-Month T-Bill : 0.36
BOE Base Rate : 0.50
3-Month Interbank : 0.48

Note: For different rates, the data pertain to different days in May 2013.

Table 6.2 3-Month and 6-Month LIBORs (May 2013, % per annum)

Currency	*3-Month LIBOR*	*6-Month LIBOR*
US Dollar	0.28	0.43
Japanese Yen	0.15	0.24
Pound Sterling	0.51	0.59
Swiss Franc	0.02	0.08
Euro	0.12	0.20
Australian Dollar	2.97	3.08
Canadian Dollar	1.18	1.38

Note: Rates for different currencies refer to different dates in May 2013

Sources: Box 6.1: Federal Reserve Bank of St. Louis
Box 6.2: Bank of England
Table 6.2: www.homefinance.nl

Let us now discuss the relationship between interest rates in the domestic and euro segments of the money market. Table 6.3 provides recent data on Commercial Paper (CP) and Certificates of Deposit (CD) rates in the domestic dollar segment and the 3-month eurodollar rate. As can be seen the rates are very close and generally move together. This is not surprising since as said above, arbitrage by borrowers and investors with access to both the markets should serve to keep the rates close together. Why are the rates not identical? Two explanations are offered. The first emphasises the demand side, viz. investors (depositors) may not regard dollar deposits with banks in the US and banks outside the US as perfect substitutes. If eurobanks are perceived to be more risky, depositors would demand a risk premium which would force eurobanks to pay somewhat higher deposit rates. On the other hand, if depositors who are not residents of US might perceive a degree – however small – of political risk in placing their funds in the US, eurobanks can attract deposits even if they pay a somewhat smaller rate of interest. The second explanation emphasises the supply side. Banks in the US are subject to reserve requirements and have to pay insurance premiums for Federal Deposit Insurance. This would mean a higher cost of funds for a given rate paid on deposits. Eurobanks are exempt from both these restrictions and can, therefore, afford to pay somewhat higher rates. Thus, suppose both pay interest at 10 per cent per annum; assume that reserve requirements in the US are 5 per cent and deposit insurance costs 0.1 per cent per annum. Then the effective cost of funds for the US bank would be

$$(10 + 0.1)/(1 - 0.05) = 10.63\%$$

while for the eurobank, it is 10 per cent[12]. The US bank can pay interest only at the rate of 9.4 per cent to achieve a cost of funds equal to 10 per cent. There may also be a third factor at work though its influence is likely to be small. Depositors outside the US may prefer offshore banks on account of the convenience of time zone and greater familiarity with banking practices.

The cost-of-funds arguments would also imply that eurobanks would charge slightly lower rates on loans than their domestic counterparts since their cost of fund is somewhat lower.

In practice, neither argument, risk premium or cost of funds, by itself is adequate to explain the interest differentials at all times. Both have to be invoked depending upon specific market conditions.

From time to time, for balance of payments reasons or to defend the exchange rate parity, national authorities may impose temporary controls which result in divided capital markets as arbitrage transactions are not permitted. Under these circumstances, the close linkage between domestic and offshore rates is snapped. The most dramatic instance of such segmented credit markets is what happened to the euro-French franc market in the early eighties when to prevent speculation against the French franc, the authorities imposed various controls on resident and non-resident borrowers and investors and banks. This led to the euro-French franc deposit rates being much higher than corresponding domestic deposit rates. For a brief history of this episode, see Giddy (1994).

Table 6.3 Us Dollar Domestic and Off-shore Interest Rates (3-Month Rates % p.a.)

Month-Year	*CP*	*CD*	*Libor*
2011-04	0.2	0.23	0.4
2011-05	0.16	0.21	0.38
2011-06	0.15	0.22	0.36
2011-07	0.14	0.24	0.32
2011-08	0.16	0.29	0.37
2011-09	0.14	0.33	0.42
2011-10	0.15	0.37	0.49
2011-11	0.14	0.41	0.49
2011-12	0.14	0.49	0.5
2012-01	0.14	0.4	0.49
2012-02	0.17	0.3	0.48
2012-03	0.18	0.29	0.45
2012-04	0.2	0.29	0.46
2012-05	0.19	0.29	0.43
2012-06	0.21	0.32	0.43
2012-07	0.22	0.3	0.43
2012-08	0.2	0.26	0.43
2012-09	0.2	0.24	0.41
2012-10	0.19	0.23	0.35
2012-11	0.2	0.23	0.31
2012-12	0.2	0.24	0.31
2013-01	0.16	0.23	0.3
2013-02	0.17	0.22	0.29
2013-03	0.15	0.21	0.28
2013-04	0.12	0.2	0.28

Source: Federal Reserve Board St. Louis and Bank of England.

[12]This is not strictly true. Even though eurobanks are not subject to legal reserve requirements, they will nevertheless keep some reserves for prudential reasons.

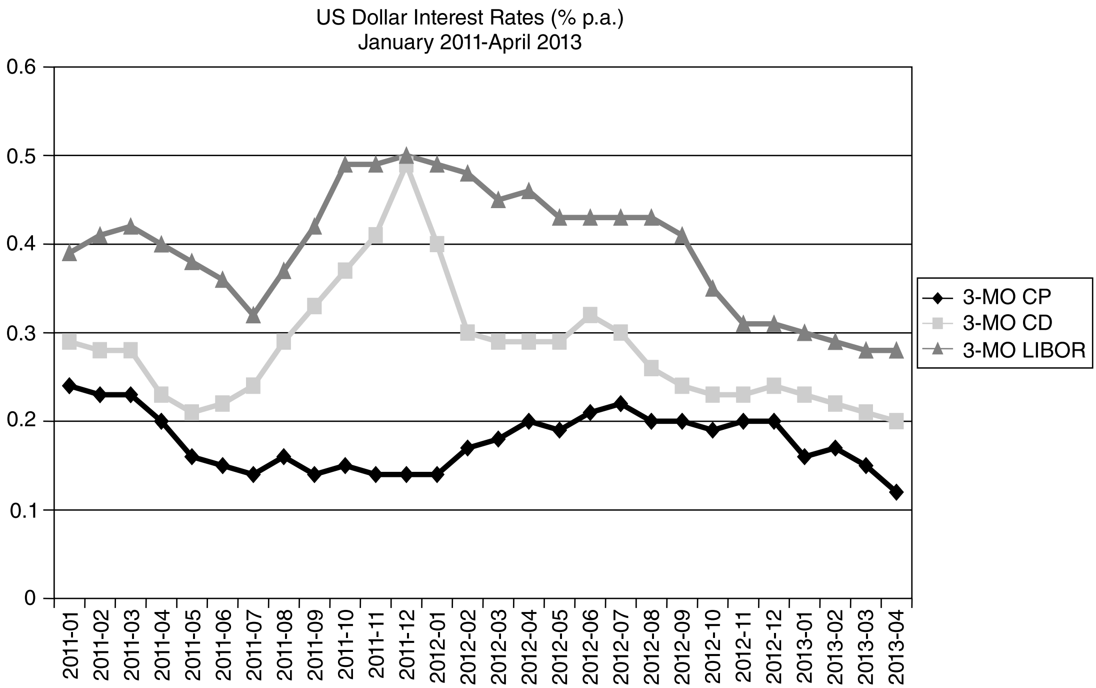

Fig. 6.2 US Dollar Domestic and Offshore Interest Rates

Next, let us examine the linkages between interest rates for different currencies in the euromarket. As seen in Table 6.2, at any point in time, LIBORS for different currencies differ substantially. Consider a depositor who on May 10, 2013 wished to place funds in the euromarket for six months. Why would such a depositor put money in say a Japanese yen deposit earning 0.24 per cent p.a. and not in a Australian dollar deposit earning 3.08 per cent? Obviously this must have something to do with the expected behaviour of exchange rates. For concreteness, assume that the depositor's functional currency is US dollar (USD). To make an investment in a Japanese yen (JPY) deposit, he converts his USD into JPY in the so-called spot foreign exchange market. When the deposit matures, he would like to get back into USD. Assume further that he wishes to avoid any exchange rate risk[13]. He can do this by entering into what is known as a **forward contract** at the time he deposits the funds. Under this contract, he agrees to deliver JPY six months later in return for USD, at an exchange rate specified now. This is the **forward exchange rate**. A similar route is followed when making an Australian dollar (AUD) investment. In choosing between a JPY and a GBP deposit, the depositor would compare the end-of-period USD cash inflows from both for a given USD outflow today. This comparison involves two factors viz. the interest rates to be earned and the forward exchange rate at which the currency of deposit can be converted into USD when the deposit matures. We will illustrate these calculations with an example. Suppose the following rates were available to an investor whose functional currency is USD:

Euro$ 6-month LIBOR: 3.75% p.a.
Euro£ 6-month LIBOR: 5.80% p.a.

[13]We say that the depositor wishes to make a "covered investment", i.e. hedged against exchange rate risk.

Euroyen 6-month LIBOR: 0.60% p.a.
Spot Exchange Rate GBP/USD: 1.8410 (Dollars per GBP)
(Rate for immediate conversion from USD to GBP)
6-month forward exchange rate GBP/USD: 1.8107
Spot Exchange Rate USD/JPY: 106.19 (Yen per US dollar)
6-month forward exchange rate USD/JPY: 104.75

Forward rates are rates fixed today for a transaction which will be executed at a specified future date. Thus, the 6-month forward GBP/USD rate of 1.8107 means that six months from today, pounds will be converted into dollars at a rate of \$1.8107 per pound.

(a) 100 USD put in a GBP deposit, maturity value of deposit sold forward. At the end of six months the depositor would have:

$$\text{USD}[(100/1.8410)(1.0 + 0.0580 \times 0.50)(1.8107)] = \text{USD}(101.21)$$ [14]

(b) 100 USD put in a JPY deposit, maturity value of deposit sold forward. At the end of six months the depositor would have:

$$\text{USD}\{[(100 \times 106.19)(1.0 + 0.0007 \times 0.5)]/(104.75)\} = \text{USD}(101.68)$$

Thus, despite the higher interest rate on sterling deposits, the depositor would have been better off putting money in a JPY deposit. Why was this so? The key lies in the loss or gain made when converting the deposit proceeds forward. With a JPY deposit the depositor gains. The percentage gain is:

$$[(106.19 - 104.75)/106.19] \times 100 = 1.3560\% \text{ for six months}$$

On annualised basis, this gain is 2.7121 per cent. Thus, the **effective return** is 3.3121 per cent per annum or 1.6560 per cent for six months[15]. With a sterling deposit, the depositor loses in currency conversion; the percentage loss is:

$[(1.8107 - 1.8410)/1.8410] \times 100 = -1.6458\%$ for six months or – 3.2917 per cent per annum. With annual interest at 5.79 per cent, the **effective return** is 2.4983 per cent per annum.

Thus, the investor should invest in JPY and cover the currency exposure with a forward contract.

It is also easily seen that holder of a sterling deposit would be better off liquidating it, convert the proceeds to JPY, invest in a JPY deposit and enter a forward contract to get back to sterling. Given the above rates, the implied GBP/JPY (yen per pound sterling) rates are:

$$195.50 = 1.8410 \times 106.19 \text{ for spot exchange and}$$
$$189.67 = 1.8107 \times 104.75 \text{ for 6-month forward exchange}$$

This implies a currency conversion gain of 5.96 per cent per annum. Thus, the transaction would yield a total return of 6.56 per cent p.a. against the 5.80 per cent offered by a pound sterling deposit.

Obviously, if all depositors – including those in UK – are free to place their funds in any currency, such a situation cannot last. As seen above, depositors who hold sterling deposits would liquidate

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[14]This calculation is as follows:
DM 100 converted to SFr at the spot rate gives SFr(100/1.1). This is deposited at an annual interest rate of 2.06%. Including interest, at maturity the deposit is worth: SFr(100/1.1)[1+(0.026/2)] = SFr[(100/1.1)(1.0103)].
This, converted to DM at the forward rate is worth:
DM[(100/1.1)(1.0103)(1.1107)].

[15]The slight discrepancy between this and the six-month return calculated above (2.0128%) is due to the fact that this calculation ignores the exchange gain on interest. The correct return is 2.0128%. Note also that the effective return on SFr deposits is same as the return offered by euroDEM deposits.

them, buy JPY in the spot market, put these on deposit and simultaneously enter into forward contracts to convert the deposit proceeds back into sterling. This activity is known as **Covered Interest Arbitrage**. We will examine it in much greater depth in Chapter 8. When all or even a large number of investors attempt to put through such transactions, the market rates would change. For instance, deposit rates on sterling would rise, those on JPY and USD would fall, spot price of sterling would fall and the forward price would rise. In equilibrium, the effective returns on all currencies, i.e. interest plus any locked-in exchange gain or loss, would be equalised. You can convince yourself that the fact that we have assumed the functional currency of the depositor to be USD is of no consequence.

Thus, the differences in interest rates between different currencies in the euromarket reflect the market's expectations regarding exchange rate movements as captured in the spot rate-forward rate differentials. On a **covered** basis all currencies should yield equal returns. As we will see in Chapter 8, empirically this proposition is found to be valid.

To summarise, the relationship between the domestic and offshore market interest rates for a currency are governed by risk premia, reserve requirements and other regulations that apply to domestic deposits and the presence of capital controls. The differences in interest rates between currencies in the euromarket and the spot-forward margins are inter-related through covered interest arbitrage. Note that we are not proposing at this stage any causality between interest rate differentials and the spot-forward margin. In equilibrium, effective returns on all currencies would be equal.

6.5 AN OVERVIEW OF MONEY MARKET INSTRUMENTS[16]

During the decade of the eighties, the markets have evolved a wide array of funding instruments. The spectrum ranges from the traditional bank loans to complex borrowing packages involving bonds with a variety of special features coupled with derivative products such as options and swaps. The driving forces behind these innovations have diverse origins. Some, such as floating rate loans and bonds, reflect investor preference towards short-term instruments in the light of interest rate volatility. Some, such as Note Issuance Facilities, permit the borrower to raise cheaper funds directly from the investor while having a fallback facility. Some, such as swaps, have their origins in the borrowers' desire to reshuffle the composition of their liabilities (as also investors' desire to reshuffle their asset portfolios). Some, such as medium term notes, were designed to fill the gap between very short-term instruments such as commercial paper and long-term instruments such as bonds. Some – an example is swaps again – have their genesis in market participants' drive to exploit capital market inefficiencies and arbitrage possibilities created by differences across countries in tax regulations.

In this section, we will briefly describe some of the common short-term funding instruments such as commercial paper (CP), bankers' acceptances (BAs) and Certificates of Deposit (CDs). In addition, there are banking products, viz. deposits and loans ranging in maturity from overnight to one year and some underwritten facilities like Note Issuance Facility (NIF) and Revolving Underwriting Facility (RUF). Medium-to-long-term debt instruments like bonds, notes, NIFs and RUFs are discussed in Chapter 19. International equity investment is discussed in Chapter 18. Financial swaps are the topic of Chapter 16. A comprehensive reference on money market instruments, players and regulatory aspects is Stigum (1990).

[16]This section draws on a number of sources. The important ones are Stigum (1990), Fabozzi (1991) and Joshi (1996).

6.5.1 Commercial Paper

Commercial paper is a corporate short-term, unsecured promissory note issued on a discount to yield basis[17]. It can be regarded as a corporate equivalent of CD (Certificate of Deposit) which is an interbank instrument.

Commercial paper maturities generally do not exceed 270 days. Issuers usually roll over the issue and use the proceeds from the new issue to retire the old issue. The issue is normally placed through CP dealers or, in a few cases, large corporations have their own sales force. Commercial paper represents a cheap and flexible source of funds, especially for highly rated borrowers, cheaper than bank loans[18]. For investors, it is an attractive short-term investment opportunity compared to a time deposit with a bank. In addition to the high credit reputation of the borrowers, most CP programmes also require a back-up credit line from a commercial bank covering at least 50 per cent, more often nearly 100 per cent of the issue. While CPs are negotiable, secondary markets tend to be not very active since most investors hold the paper to maturity.

The United States has the largest and long-established dollar CP market. In recent years, it has dwarfed the markets for Certificates of Deposit and Bankers' Acceptances. It is used extensively by the U.S. corporations as well as some non-U.S. corporations. Euro Commercial Paper (ECP) emerged in the 1980s. It evolved as a natural culmination of the Note Issuance Facility and developed rapidly in an environment of securitisation and disintermediation of traditional banking. Investors in CP consist of money market funds, insurance companies, pension funds, other financial institutions and corporations with short-term cash surpluses.

After the initial flurry of activity, the growth in the number of new issues and issue volumes slowed down in the ECP markets. Also, as a result of some defaults, investor concern about creditworthiness increased dramatically. CP has also developed in the domestic segments of some European countries offering attractive funding opportunities to resident entities.

6.5.2 Certificates of Deposit

A Certificate of Deposit (CD) is a negotiable instrument evidencing a deposit with a bank. Unlike a traditional bank deposit which is non-transferable, a CD is a marketable instrument so that the investor can dispose it off in the secondary market when cash is needed. The final holder is paid the face value on maturity along with the interest. CDs are issued in large denominations – $100,000 or equivalent or higher – and are used by commercial banks as short-term funding instruments. Occasionally, CDs with maturity exceeding one year are issued. When the maturity is less than a year, interest is paid along with redemption of principal; for maturity longer than a year, interest may be paid semiannually.

Euro CDs are issued mainly in London by banks. Interest on CDs with maturity exceeding a year is paid annually rather than semiannually. There are floating rate CDs with maturities normally ranging from 18 months to five years on which interest rate is periodically reset, indexed to LIBOR, Federal Reserve CD composite rate, Treasury Bill rate, and so forth.

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[17] A discount instrument is purchased at a price below its face value and redeemed at face value on maturity. There are no intermediate interest payments. With add-on interest, the investor invests a principal amount and on maturity collects this plus the interest on it. Commercial paper with add-on interest is also possible.

[18] "High-yield" commercial paper is issued by borrowers with lesser or no rating. This is similar to the "junk bonds" issued to finance leveraged buyouts in the US during the eighties. These were "high yield" bonds with low or no credit rating.

6.5.3 Bankers' Acceptances

This is an instrument widely used in the U.S. money market to finance domestic as well as international trade. In a typical international trade transaction, the seller (exporter) draws a time or "usance" draft on the buyer's (importer's) bank. On completing the shipment, the exporter hands over the shipping document and the letter of credit issued by the importer's bank to its bank. The exporter gets paid the discounted value of the draft. The exporter's bank presents the draft to the importer's bank which stamps it as "accepted". A banker's acceptance is created. The exporter's bank may hold the draft in its portfolio, ask the importer's bank to rediscount it or sell it as a money market instrument. The investor might be a money market mutual fund. It is possible to draw BAs without a formal pre-authorisation like a letter of credit as in this example.

In addition to these securitised instruments, short-term bank loans are also available. The eurocurrencies market is essentially an interbank deposit and loans market. Loans ranging in maturity from overnight to one year can be arranged with minimal formalities. Interest rates are indexed to LIBOR.

In the U.S. money market, Repurchase Obligations (REPOS) are used by securities dealers to finance their holdings of securities. This is a form of collateralised short-term borrowing in which the borrower "sells" securities to the lender with an agreement to "buy" them back at a later time. (Hence the name "Repurchase Obligations"). The repurchase price is the same as the original buying price, but the seller (borrower) pays interest in addition to buying back the securities[19]. The duration for the borrowing may be as short as overnight or as long as up to a year. The former are called "overnight repos"; longer duration repos are "term repos". The interest rate is determined by the demand-supply conditions.

This concludes our brief survey of major short-term funding instruments. It must be emphasised that what we have described are the basic prototypes. A bewildering variety of specific combinations of the basic types with exotic risk management products thrown in are seen in the market and new ones will continue to evolve.

Summary

This chapter is designed to introduce the reader to the basic features of the global financial markets. Its main purpose is to examine the interest rate linkages between the different segments of the global money markets. On the one hand, there is the close link between interest rates in the domestic and offshore markets in a particular currency. These are explained partly by risk premium demanded by the investors and partly by regulatory considerations. On the other hand, there are linkages between interest rates on deposits denominated in different currencies in the euromarket. This linkage is explained by the covered interest arbitrage activity which will be examined in greater depth in Chapter 8. The chapter concludes with a brief survey of common short-term funding instruments in global money markets.

[19]Both the lender and the borrower are exposed to credit and risk. If interest rates change, and in the meanwhile one of the parties goes bankrupt, the other might find itself holding securities whose market value is less than the amount of money lent (this will happen when interest rates increase and the borrower goes bust) or holding less money than the value of securities given as collateral. Though the risk is symmetrical, in practice the amount of money lent is slightly less than the market value of securities given as collateral. This difference is known as "haircut".

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APPENDIX

A.6.1 MULTIPLE DEPOSIT CREATION BY EUROBANKS

Suppose a bank in London receives a deposit of $1000 from a firm. The bank maintains reserves of 3 per cent against all eurodeposits, i.e. $30 is kept as reserves in the bank's account with its correspondent bank in New York and $970 is loaned to a customer. Consider the following possibilities:

(a) The borrower retains the loan proceeds as cash or deposits them with a bank in the U.S. There is no further expansion of eurodeposits.

(b) The borrower converts the dollars into his home currency, say euro, and deposits the euro in a German bank. The bank which sells him the euro, deposits the dollars received with a bank in the U.S. Once again, no further expansion.

(c) The borrower deposits the dollars with another eurobank, or converts the dollars into another currency which ends up as another eurodeposit. If this process continues, then assuming that each bank in the chain keeps 3 per cent reserves, the total amount of eurodeposits created will be

$$1000 + 1000(0.97) + 1000(0.97)^2 + 1000(0.97)^3 + \ldots\ldots$$

an infinite sum, which adds up to 1000/(1 – 0.97) or 33333.33.

This is the traditional deposit multiplier in a fractional reserve banking system. More complicated multipliers can be derived by assuming that at each stage of redeposit, there is a leakage, i.e. each borrower converts a part of the loan to his home currency and the concerned bank deposits the dollars in New York. This would be similar to the money multiplier analysis with leakage into currency hoards with public.

A.6.2 ORGANISATION OF INTERNATIONAL BANKING[20]

The banking industry has historically been more "multinational" in character than any other business. Today, the giant international banks like Citicorp, Barclays, Fuji Bank, etc., have presence in more countries than giant corporations in other industries such as IBM, Sony and Phillips.

Despite the tremendous advances in communications and information transmittal across the globe, ***physical presence*** in important financial centres continues to be important. Developments in money and exchange markets can be better anticipated, if the bank has its people on the spot than relying on information relayed through financial information networks such as Reuters even though the latter may be quite up-to-the-minute. In making loans to foreign borrowers, information gathered and evaluated by the bank's own staff is usually more reliable than that obtained from a correspondent bank (see below) or other local agencies. Finally, as a bank's clients' business becomes more multinational, it finds that it can serve its domestic clients better – making international payments, advising home clients on local business conditions, etc. – by being on the spot.

There are several forms and degrees of multinational presence that a bank can have. These are briefly discussed below.

1. **Correspondent Banking:** This is the oldest and the most informal form of international linkage among banks. Large banks, when they do not have offices or branches in foreign countries, maintain correspondent accounts with local banks in those countries. The purpose is to facilitate payments and collections on behalf of their clients who may have business dealings with parties in the foreign country. Thus, in our example of eurodeposit creation above, banks in Europe effected dollar payments and collections for their clients through accounts the banks maintain with their correspondent banks in the U.S. Communications and settlements are effected through global networks such as **SWIFT** and electronic funds transfer systems such as **CHIPS and CHAPS**[21].
2. **Resident Representatives**: Some banks open business offices in foreign countries whose function is to provide information on local business conditions including creditworthiness of local business entities to their customers. These offices do not engage in the usual banking business, viz. taking deposits and making loans. They are very small outfits. They keep in touch with the correspondent bank and render help when needed.
3. **Bank Agencies:** A bank agency is almost like a full-fledged bank except it does not deal with ordinary deposits. Other functions such as operating in the local money markets, foreign exchange markets, clearing drafts and even arranging loans are carried out on behalf of the home office.
4. **Foreign Branches:** A foreign branch is like a local bank, subject to local banking regulations but not incorporated under local laws. Its account books are consolidated with the parent bank though it keeps separate books for performance evaluation and tax purposes. It carries out the full range of banking business in the country where it operates. Legally it is not a separate entity, but a part of the parent bank. With foreign branches, international payments can be effected much faster than with a correspondent bank. Different countries place different restrictions on

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[20]We have drawn on Levi (1996) for this subsection.

[21]**SWIFT**: **S**ociety for **W**orldwide **I**nter-Bank **F**inancial **T**elecommunications
CHIPS: **C**learing**H**ouse **I**nterbank **P**ayments **S**ystem.
CHAPS: **C**learinghouse **A**utomated **P**ayments **S**ystem.

For more on correspondent banking see: "On Correspondent Banking" *Euromoney*, December 1988, p.115.
"Old Questions New Answers" *Euromoney*, March 1991. p.113-116.

opening of branches by foreign banks and, as in the case of the U.S., geographical expansion of branch banking within the country.

5. **Foreign Subsidiaries:** A bank that is locally incorporated but partially or wholly owned by a foreign parent bank is a subsidiary bank. It undertakes all types of banking business and for all practical purposes is indistinguishable from a local bank. Once again, countries differ in their degree of acceptance of foreign owned banking subsidiaries.
6. **Consortium Banks:** Joint ventures of a number of large international banks are concerned with investments, securities underwriting and large loans. They do not accept deposits or deal with individual investors. Apart from making corporate and sovereign loans, they also acquire equity and are involved in mergers and takeover activities.

A number of foreign banks have been allowed to open branches in India and carry on various types of banking business — accepting individual and corporate deposits, making consumer and corporate loans, dealing in foreign exchange, etc. In 2008-09, there were 31 foreign banks in India with nearly 280 offices across the country. As of the end of March 2009, their total assets amounted to ₹447149 crore and they had deposits of ₹214077 crore. Domestic public sector banks reported assets of ₹3766716 crore with deposits of ₹3112748 crore while private sector banks had assets of ₹1027645 crore and deposits of ₹736309 crore.

Table A.6.1 presents data on the shares of different groups of banks in total assets, deposits and advances.

Table A.6.1 Bank Group-wise Assets and Liabilities
Consolidated Balance Sheet of Scheduled Commercial Banks

(Amount in ₹ billion)

Item	*As at end-March 2012*							
	Public sector banks	*SBI group*	*Nationalised banks**	*Private sector banks*	*Old private sector banks*	*New private sector banks*	*Foreign banks*	*All scheduled commercial banks*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1. Capital	183	12	171	48	13	35	406	637
2. Reserves and Surplus	3,373	1,061	2,312	1,545	266	1,279	531	5,449
3. Deposits	50,020	14,050	35,970	11,746	3,159	8,587	2,771	64,537
3.1 Demand Deposits	3,844	1,197	2,647	1,659	258	1,401	801	6,303
3.2 Savings Bank Deposits	12,140	4,537	7,604	2,729	578	2,152	419	15,289
3.3 Term Deposits	34,036	8,317	25,719	7,358	2,323	5,035	1,551	42,945
4. Borrowings	4,618	1,588	3,030	2,584	198	2,386	1,199	8,401
5. Other Liabilities and Provisions	2,186	1,002	1,184	855	114	741	929	3,970
Total Liabilities/Assets	**60,380**	**17,712**	**42,668**	**16,778**	**3,750**	**13,028**	**5,836**	**82,994**

(Contd.)

1. Cash and Balances with RBI	2,800	791	2,009	706	167	538	232	3,737
2. Balances with Banks and Money at Call and Short Notice	1,760	482	1,278	366	71	295	312	2,437
3. Investments	15,041	4,173	10,868	5,260	1,093	4,166	2,005	22,305
3.1 Government Securities ($a + b$)	12,580	3,513	9,067	3,474	785	2,688	1,378	17,429
(a) In India	12,494	3,494	9,000	3,468	785	2,683	1,376	17,338
(b) Outside India	85	19	67	5.6	—	5.6	—	91
3.2 Other Approved Securities	10	0.2	9.7	0.2	0.2	0.01	—	10
3.3 Non-Approved Securities	2,451	660	1791	1,786	308	1,478	629	4,866
4. Loans and Advances	38,783	11,520	27,263	9,664	2,301	7,363	2,298	50,746
4.1 Bills Purchased and Discounted	2,307	888	1,419	357	113	244	257	2,922
4.2 Cash Credits, Overdrafts, etc.	16,085	4,958	11,127	2,860	1,120	1,740	1,099	20,044
4.3 Term Loans	20,391	5,674	14,717	6,447	1,068	5,380	942	27,780
5. Fixed Assets	383	74	309	134	27	107	50	567
6. Other Assets	1,613	672	941	649	91	558	939	3,201

Note: Nil/negligible. Components may not add up to their respective totals due to rounding off numbers to ₹ billion.
*: Includes IDBI Banks Ltd.
Source: Annual accounts of respective banks.
RBI, Report on Trend and Progress of Banking October 2012.

Starting in 2002, Indian banks have also significantly accelerated expansion of their foreign activities. At the end of November 2007, ten public sector banks and two private sector banks had established one hundred and twenty five branches in nearly thirty foreign countries. Another eight institutions had banking subsidiaries, fourteen banks had representative offices and there were a few joint ventures mostly in Africa and Nepal. These numbers have gone up significantly since then.

A.6.3 INTERNATIONAL REGULATION OF COMMERCIAL BANKS

Traditionally, banks have been regarded as the most sensitive part of the financial system and hence subject to stringent prudential control to ensure the integrity and soundness of the entire financial system. Controls are exercised in terms of the levels of liquidity banks must maintain, the character of assets in which they can deploy depositors' funds, kinds of provisions they must make against doubtful loans and how much own capital – paid up capital, reserves, preference shares, etc. – they must maintain for a given level of assets.

Till around mid-seventies, bank regulation was more or less the concern of individual monetary and regulatory authorities in each country. The failure of Bankhaus Herstatt in Germany and the much bigger Franklin National Bank in New York in 1974 (following the oil price rise, generalised floating of major currencies and the massive growth of funds recycled through the euromarket), led the central bank governors of the Group of Ten countries to start the process whereby a uniform global approach to bank regulation could be evolved. The rapid liberalisation and integration during the eighties meant that financial system of a country could not be immune to adverse developments in another part of the global system. Also, a single country could not unilaterally tighten its own regulatory framework because this would result in international banks simply shifting their operations elsewhere.

In 1975, the G-10 central bank governors set up the **Basle Committee on Banking Regulations and Supervisory Practices.** The Basle Committee, as it is more commonly known, approached its task in several phases to bring about a greater degree of dialogue, information exchange and co-operation amongst bank regulators around the World. A series of agreements called **"Basle Concordats"** have been arrived at[22]. The process is continuing.

Sometime in 1989, the Basle Committee published its guidelines on capital adequacy. It provided a scheme for categorising various bank assets according to their degree of risk and a procedure for computing a measure of risk-weighted total assets. It was recommended that a bank should achieve and maintain owned capital base of at least 8% of its risk adjusted total assets. These guidelines, known as BASEL I norms, were confined to the market risk faced by banks. Acceptance of this recommendation resulted in a scramble among international banks to raise more equity capital and get rid of more dubious assets (such as developing country loans) from their balance sheets.

During the 1990s, the scope of business of commercial banks expanded rapidly to include substantial activity in securities, derivatives and insurance. The complexity of banks' organisational forms and governance structure also increased markedly because of mergers and acquisitions. The Basle Committee decided to expand and refine the scope of its capital adequacy guidelines to include market risk and operational risks in addition to credit risk which was the sole focus of the 1988 guidelines. The revised guidelines were published in January 2001 and were debated in various fora. In June 2004, BIS published a document titled ***"International Convergence of Capital Measurement and Capital Standards"*** which sets out the framework for capital adequacy standards and guidelines for banking supervision. These are known as BASEL II norms and they take into account not just market risk but also credit risk and operational risk.

Reserve Bank of India initially decided that Indian banks should adopt BASEL II norms by the end of March 2007. However, the deadline was extended to March 2008 for a subgroup of banks and March 2009 for others. Finally, the Reserve Bank of India implemented the BASEL II standardised norms in March 2009.

The details of these guidelines can be obtained from Basle Committee publications which are accessible on the Bank for International Settlements website: ***www.bis.org***.

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[22]A brief history of the evolution of international bank regulation can be found in Cooke W.P.(1987): " The New Dimension of International Banking Regulation", *Journal of Foreign Exchange and International Finance,* Vol. No. 1 (January-March) 58-63, NIBM Pune.

Bank for International Settlements has put out several documents related to Basle Committee's work. These are available on its website www.bis.org.

Chapter 7

The Foreign Exchange Market

7.1 INTRODUCTION

The foreign exchange market is the market in which currencies are bought and sold against each other. It is the largest market in the world. The survey carried out by the Bank of International Settlement in April 2013 reported that the average trading volume per day was over US $5.3 trillion. This corresponds to 160(!) times the daily volume of the NYSE. Bulk of this is accounted for by a small number of currencies – US dollar, euro, yen, pound sterling, Swiss franc, Canadian dollar and Australian dollar. Prior to the introduction of euro in 1999, deutsche mark had an important position.

Table 7.1 shows data provided by BIS on the level of turnover in global currency markets. Between 1998 and 2013 the total turnover has gone up by about three and a half times. The three types of transactions in the forex market – spot, outright forwards and foreign exchange swaps – will be discussed later in this chapter. Currency swaps, options and other products will be discussed in separate chapters.

Table 7.1 Global Foreign Exchange Market Turnover (Daily Averages in April; Billions of US Dollar)

Instrument	*1998*	*2001*	*2004*	*2007*	*2010*	*2013*
Foreign exchange instruments	1,527	1,239	1,934	3,324	3,971	5,345
Spot transactions	568	386	631	1,005	1,488	2,046
Outright forwards	128	130	209	362	475	680
Foreign exchange swaps	734	656	954	1,714	1,759	2,228
Currency swaps	10	7	21	31	43	54
Options and other products	87	60	119	212	207	337
Exchange-traded derivatives	11	12	26	80	155	160

Table 7.2 provides data on the volume of transactions between US dollar and some of the major currencies and their shares in the total turnover. These currency pairs account for about 60 per cent of the total turnover.

Table 7.2 Global Foreign Exchange Market Turnover by Currency Pair

Daily averages in April, in billions of US dollars and percentages										
Currency pair	***2001***		***2004***		***2007***		***2010***		***2013***	
	Amount	***%***	***Amount***	***%***	***Amount***	***%***	***Amount***	***%***	***Amount***	***%***
USD / EUR	372	30.0	541	28.0	892	26.8	1,098	27.7	1,289	24.1
USD / JPY	250	20.2	328	17.0	438	13.2	567	14.3	978	18.3
USD / GBP	129	10.4	259	13.4	384	11.6	360	9.1	472	8.8
USD / AUD	51	4.1	107	5.5	185	5.6	248	6.3	364	6.8
USD / CAD	54	4.3	77	4.0	126	3.8	182	4.6	200	3.7
USD / CHF	59	4.8	83	4.3	151	4.5	166	4.2	184	3.4

After the Euro crisis in early 2010 there was an indication that the volume growth in global currency markets is slowing down. Figure 7.1 depicts the growth in the volume of turnover from 2001 to 2012.

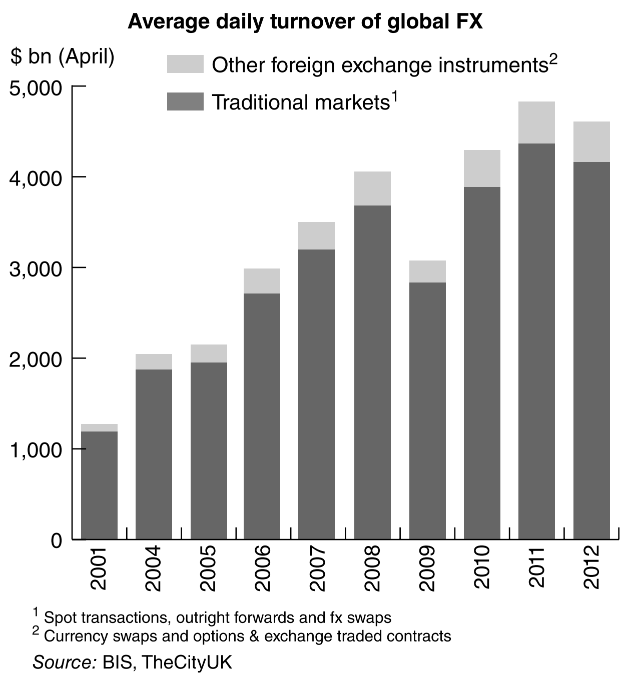
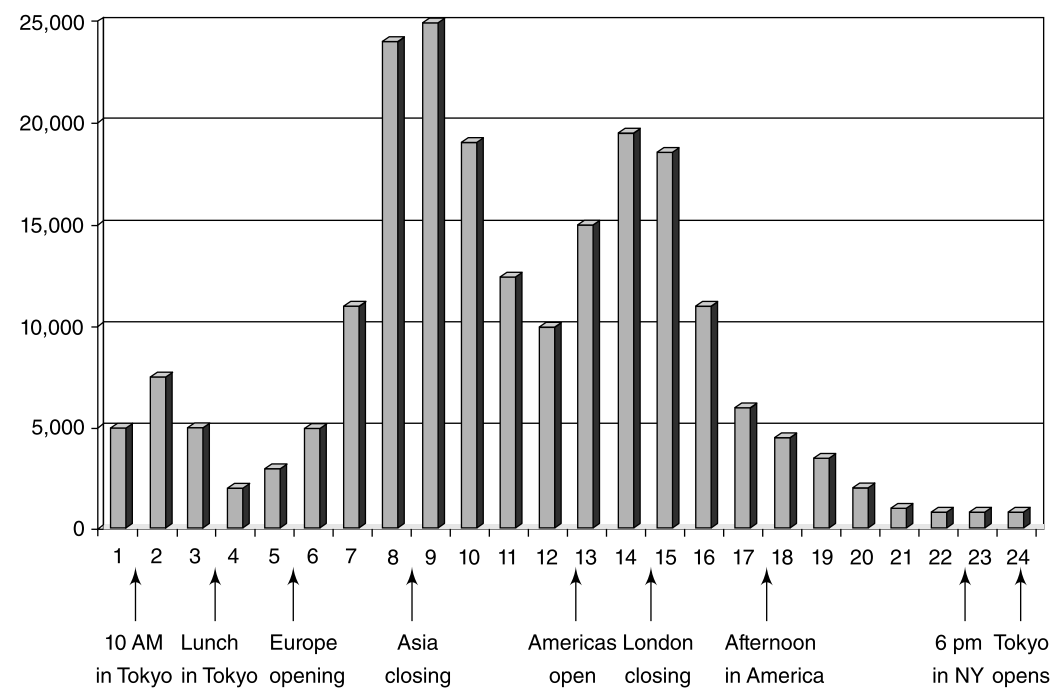


Fig. 7.1 Growth in the volume of turnover from 2001 to 2012

The foreign exchange market is an over-the-counter market. This means that there is no single physical or electronic market place or an organised exchange (like a stock exchange) with a central trade clearing mechanism where traders meet and exchange currencies. The market itself is actually a worldwide network of inter-bank traders, consisting primarily of banks, connected by telephone lines and computers. While a large part of inter-bank trading takes place with electronic trading systems such as Reuters Dealing 2001 and Electronic Broking Systems, banks and large commercials, i.e. corporate customers, still use the telephone to negotiate prices and consummate the deal. After the transaction, the resulting market bid/ask price is then fed into computer terminals provided by official market reporting service companies (networks such as Reuters®, Bridge Information Systems®, Telerate®). The prices displayed on official quote screens reflect one of maybe dozens of simultaneous deals that took place at any given moment. New technologies such as the Interpreter 6000 Voice Recognition System (VRS) which allows forex traders to enter orders using spoken commands are presently being tested and may be widely adopted by the inter-bank community in the years to come. Online trading systems have also been devised and may become the norm in the near future. However, for corporate customers of banks, dealing on the telephone will continue to be an important channel.

Geographically, the markets span all the time zones from New Zealand to the West Coast of the United States. When it is 3.00 p.m. in Tokyo, it is 2.00 p.m. in Hong Kong. When it is 3.00 p.m. in Hong Kong, it is 1.00 p.m. in Singapore. At 3.00 p.m. in Singapore, it is 12.00 noon in Bahrain. When it is 3.00 p.m. in Bahrain, it is noon in Frankfurt and Zurich and 11.00 a.m. in London. At 3.00 p.m. in London, it is 10.00 a.m. in New York. By the time New York is starting to wind down at 3.00 p.m., it is noon in Los Angeles. When it is 3.00 p.m. in Los Angeles, it is 9.00 a.m. of the next day in Sydney. The gap between New York closing and Tokyo opening is about $2^1/_2$ hours. Exhibit 7.1 provides a visual presentation of the timeline of the global currency market.

Exhibit 7.1 Forex Market Activity: Average Electronic Conversations per Hour



Thus, the market functions virtually 24-hours enabling a trader to offset a position created in one market using another market. The five major centres of inter-bank currency trading, which handle more than two thirds of all foreign exchange transactions, are London, New York, Tokyo, Zurich, and Frankfurt. Transactions in Hong Kong, Singapore, Paris and Sydney account for bulk of the rest of the market.

7.2 STRUCTURE OF THE FOREIGN EXCHANGE MARKET

Some of us are familiar with the ***retail market*** in foreign exchange. This is the market in which travellers and tourists exchange one currency for another in the form of currency notes or travellers' cheques. The total turnover and average transaction size are very small. The spread between buying and selling prices (see below) is large.

The market referred to in section I of this chapter is the ***wholesale market***, often called the ***inter-bank market***. The major categories of participants in this market are commercial banks, other financial institutions, non-financial corporations and central banks. The average transaction size is very large. For example, the average transaction in the US market was reported to be 4 million dollars with many transactions being of much larger size. This is the market we will be studying in this chapter.

Among the participants in this market, **primary price makers or professional dealers** make a two-way market to each other and to their clients, i.e. on request they will quote a two-way price – a price to buy currency X against Y and a price to sell X against Y – and be prepared to take either the buy or the sell side. This group includes mainly commercial banks, but some large investment dealers and a few large corporations have also assumed the role of primary dealers. Primary price makers perform an important role in taking positions off the hands of another dealer or corporate customer and then offsetting these by doing an opposite deal with another entity which has a matching requirement. Thus, a primary dealer will sell US dollars against rupees to one corporate customer, carry the position for a while and offset it buy buying US dollars against rupees from another customer or professional dealer. In the meanwhile if the price has moved against the dealer he bears the loss. For instance, he might have agreed to buy rupees, i.e. sell dollars at a rate of ₹53.85 per dollar; by the time he covers his position, the market may have moved so that he must acquire the dollars, i.e. sell rupees at a price of ₹54.05 per dollar. If the transaction is for one million dollars he loses 2,00,000 rupees. The difference between the buying and selling prices – the so called "bid-offer spread" – provides a cushion against such losses. During times of high volatility the spread tends to widen. In addition, of course the spread allows banks to recover the costs of the dealing function and make a profit. In fact, for many banks forex dealing makes a substantial contribution to their bottom lines.

Among the primary price makers there is a kind of layering or a pyramid. A few giant multinational banks deal in a large number of currencies, in large amounts and often deal directly with each other without using brokers. Their transactions can have significant influence on the market. In the second tier are large banks which deal in a smaller number of currencies and use the services of brokers more often. Lastly there are small local institutions which make market in a very small number of major currencies against their home currency. For instance, in Mumbai, the State Bank of India and large private sector banks such as HDFC bank, ICICI bank, etc., may make a market in, say, nine or ten currencies while most other banks will deal mostly only in US dollars and euro. Many of the latter may have almost 100 per cent of their deals in US dollars versus rupee.

In the retail market, there are entities which quote foreign exchange rates, but do not make a two way market. They are **secondary price makers**. Restaurants, hotels, shops catering to tourists buy foreign currency in payment of bills; some entities specialise in retail business for travellers and buy and sell foreign currencies and traveller's cheques. Typically, their bid-ask spreads are much wider than those of primary price makers.

Foreign currency brokers act as middlemen between two market-makers. Their main function is to provide information to market-making banks about prices at which there are firm buyers and sellers in a pair of currencies. A bank indicates its willingness to buy or sell a specific amount of currency X against currency Y at a specific price or gives a price limit. The broker transmits this information to a group of his clients via dedicated phone lines and collects a commission on consummation of the deal. Till a deal is struck, the identities of the various parties transmitting their orders to the broker are not revealed. Banks may also use brokers to acquire information about the general state of the market even when they do not have a specific deal in mind. Primary price makers may use brokers to "show" their prices to the market anonymously. By specialising in certain pairs of currencies and maintaining constant contact with market-makers, brokers tend to possess much more information than the dealers themselves. The important thing is brokers do not buy or sell on their own account. In recent years, electronic brokerage services have significantly replaced traditional brokers.

Finally, there are **price takers** who take the prices quoted by primary price makers as given and buy or sell currencies for their own purposes, but do not make a market themselves. Corporations use the foreign exchange market for a variety of purposes related to their operations. Among these are payments for imports, conversion of export receipts, hedging of receivables and payables in foreign currencies, payment of interest on foreign currency loans and repayment of principal amounts of the loans, placement of surplus funds and so forth. Many companies, as a matter of policy, restrict their participation in the market to transactions arising out of their business of producing and selling goods and services. They do not take active positions in the market to profit from exchange rate fluctuations. Others, mainly giant multinationals, utilise their considerable financial expertise to take positions purely with the intention of generating financial profits from exchange rate movements.

Central banks intervene in the market from time to time to attempt to move exchange rates in a particular direction or moderate excessive fluctuations in the exchange rate. In the case of limited flexibility systems like the EMS which existed before the EMU came into being, or a fixed exchange rate system, these interventions are obligatory and, when intervention limits are reached, potentially unlimited. In other cases, though there is no commitment to maintain any particular level of the rate, a central bank may still intervene to influence the market sentiment.

Of the total volume of transactions, about two-thirds are accounted for by inter-bank transactions and the rest by transactions between banks and their non-bank customers. This is implicit in the total turnover figure mentioned above which is nearly ten times the value of world trade in goods and services. Thus, foreign exchange flows arising out of cross-border exchanges of goods and services account for a very small proportion of the turnover in the foreign exchange market. A significant volume of currency transactions arises to cater to cross-border capital flows. In recent times, significant liquidity has been added to the market by hedge funds whose interest in currencies as an asset class has boomed.

There is no distinct class of "speculators" in the foreign exchange market. Price making banks often carry uncovered positions to profit from exchange rate movements; so do non-financial corporations who have extensive foreign currency dealings arising out of their operations. Financial and non-financial corporations, hedge fund managers and even governments through their central banks often seek to derive gains out of exchange rate movements by investing in assets denominated in currencies which they think are going to appreciate. It is very difficult to demarcate speculation from prudent business decisions. A non-financial corporation which does not hedge its foreign currency export receivable or import payable is as much a speculator as a fund manager who moves funds out of one currency into another to profit from appreciation of the latter currency.

Exhibit 7.2 shows the distribution of total turnover between different counterparties. Exhibit 7.3 provides data on the share of various trading locations in the total turnover.

7.3 TYPES OF TRANSACTIONS AND SETTLEMENT DATES

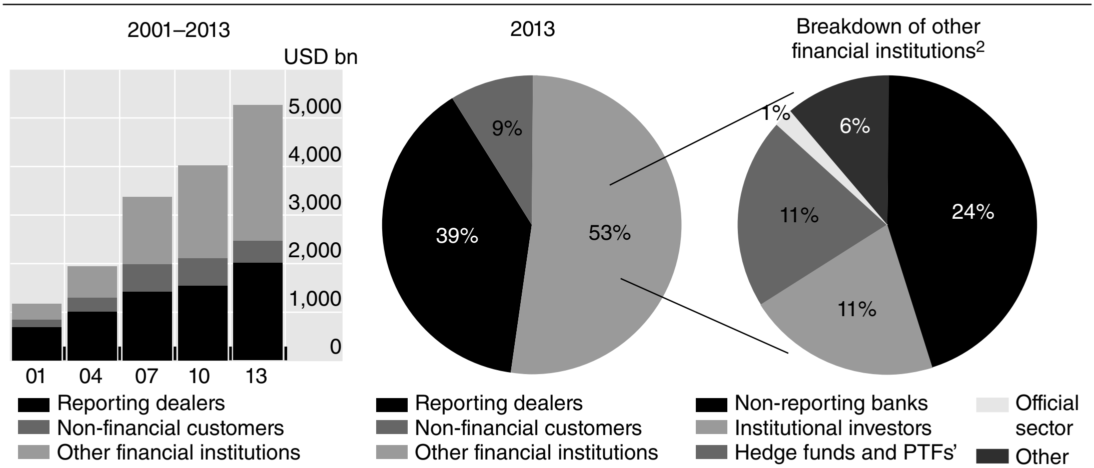
As we said above, settlement of a transaction takes place by transfers of deposits between the two parties. The day on which these transfers are carried out is called the ***settlement date*** or the ***value date***. Obviously, to implement the transfers, banks in the countries of the two currencies involved must be open for business. The relevant countries are called ***settlement locations***. The locations of the two banks involved in the trade are ***dealing locations*** which need not be the same as settlement locations. Thus, a London bank can sell Swiss francs against US dollar to a Paris bank. Settlement locations may be New York and Geneva, while dealing locations are London and Paris. The transaction can be settled only on a day on which both US and Swiss banks are open.

Exhibit 7.2 Distribution of total turnover between different counterparties

Foreign exchange market turnover by counterparty[1]

Net-net basis, daily averages in April

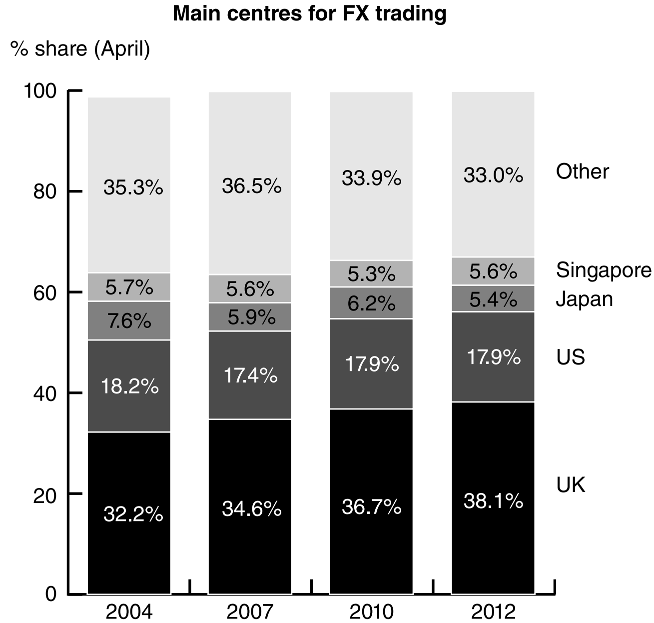
Graph 2



[1] Adjusted for local and cross-border inter-dealer double-counting, i.e. "net-net" basis.
[2] For definitions of counterparties, see page 19.
[3] Proprietary trading firms.

Source: BIS Triennial Survey April 2013

Exhibit 7.3 Average Daily Turnover by Geographic Location



Source: BIS, The CityUK

Note: The trading centres are: UK: London; USA: New York; Japan: Tokyo

Depending upon the time elapsed between the transaction date and the settlement date, foreign exchange transactions can be categorised into ***spot and forward*** transactions. A third category called ***swaps*** is a combination of a spot and a forward transaction (or a forward-forward swap, i.e. a combination of two forward transactions).

In a spot transaction, the settlement or value date is usually two business days ahead for European currencies and Asian currencies traded against the dollar. Thus, if a London bank sells yen against dollar to a Paris bank on a Monday, the London bank will turn over a yen deposit to the Paris bank on the following Wednesday and the Paris bank will transfer a dollar deposit to the London bank on the same day. If the State Bank of India sells dollars against rupees to HDFC bank on a Tuesday, on the following Thursday SBI will turn over a dollar deposit to HDFC and HDFC will turn over a rupee deposit to SBI. The time gap is necessary for confirming and clearing the deal through the communication network such as **SWIFT** (Society for Worldwide Inter-bank Financial Telecommunications). Note that by the two business days ahead rule, deals done on a Thursday will be cleared the following Monday while deals done on Friday will have Tuesday of the following week as the value date if Saturday and Sunday are bank holidays as they are in most financial centres. To reduce credit risk (i.e. one of the parties failing to deliver on its side of the trade), both transfers should take place on the same day[1]. In the dollar-yen trade between the London and Paris

[1]The exception to this general principle is in case of Middle Eastern currencies because of the fact that in these countries, Friday is a bank holiday while Saturday is not. Thus, for a US dollar-Saudi riyal deal done on a Wednesday, the dollar deposit will be transferred on Friday while the transfer of riyals will be on Saturday.

banks done on Monday, if the following Wednesday happens to be a bank holiday in either Japan or US, the value date is shifted to the next available business day, in this case Thursday. What about holidays in the dealing locations? If Wednesday is a holiday in either UK or France, settlement is again postponed to Thursday. What if Tuesday is a holiday in UK, but not in France? Then "two business days" would mean Wednesday for the Paris bank, but Thursday for the London bank. In such cases, the normal practice is if the Paris bank "made the market", i.e. the London bank called for a quote, the value date would be Wednesday while if London made the market, it would be Thursday. The settlement time is reduced to one business day for trades between currency pairs such as the US dollar and Canadian dollar and US dollar and Mexican peso since both the countries are in the same time zone.

Having understood value dates for spot transactions, let us look at value dates for forward transactions. In a 1-month (or 30-day) forward purchase of, say, pounds against rupees, the rate of exchange is fixed on the transaction date; the value date is arrived at as follows: first find the value date for a spot transaction between the same currencies done on the same day and then add one ***calendar month*** to arrive at the value date. Thus, for a one-month forward transaction entered into on, say, June 20, the corresponding spot value date is June 22 and one-month forward value date is July 22, two-month forward would be August 22, and so on. Standard forward contract maturities are 1week, 2 weeks, 1, 2, 3, 6, 9 and 12 months. The value dates are obtained by adding the relevant number of calendar months to the appropriate spot value date. If the value date arrived at in such a manner is ineligible because of bank holidays, then like in a spot deal, it is shifted forward to the next eligible business day. However, there is one important difference, viz. ***rolling forward must not take you into the next calendar month***, in which case you must shift backward. Thus, suppose a 2-month forward deal is done on December 26, 2012. The spot date is December 28, 2012. Adding two calendar months takes you to February 28, 2013. If February 28, 2013 happens to be a bank holiday in one or both settlement locations, you cannot shift forward because that goes into March 2013, as 2013 is not a leap year and hence there is no February 29. It must be rolled back to February 27, 2013.

Though standard forward maturities are in whole number of months, banks routinely offer forward contracts for maturities which are not whole months. Thus, a corporation can enter into a forward contract for delivery, say, 73 days from the date of transaction. Such contracts are called "**broken date**" or "**odd date**" contracts. For many currency pairs, long dated forward contracts with maturities extending out to five years are available.

A swap transaction in the foreign exchange market is a combination of a spot and a forward in the opposite direction or two forward transactions maturing at two different dates. Both the transactions are in the same pair of currencies and between the same two parties. Thus, a bank will buy euros spot against US dollar and simultaneously enter into a forward transaction with the same counterparty to sell euros against US dollar. A spot-60-day dollar-euro swap will consist of a spot purchase (sale) of dollars against the euro coupled with a 60-day forward sale (purchase) of dollar against euro[2]. When both the transactions are forward transactions, we have a forward-forward swap. Thus, a 1-3 month dollar-sterling swap will consist of purchase (sale) of sterling versus dollars one month forward coupled with a sale (purchase) of sterling versus dollars three-month forward. The uses of spot-forward and forward-forward swaps are discussed in the next chapter. As the term

[2]The amount of one of the two currencies is kept fixed. Thus, in a dollar-euro swap, say a million dollars will be bought spot and sold forward. The corresponding amounts of euro will depend upon the rates applicable to the spot and forward legs of the transaction.

"swap" implies, it is like a temporary exchange of one currency for another with an obligation to reverse it at a specific future date. Forward contracts without an accompanying spot deal are known as ***"outright forward contracts***" to distinguish them from swaps.

It has been estimated that about 38 per cent of the turnover in the market is in the spot segment, 42 per cent in swaps and the rest in outright forward contracts. Outright forwards are most often used by corporations to cover their transactions exposures. Exhibit 7.4 presents the shares of the three segments in total turnover and also the share of derivative products like options and currency swaps.

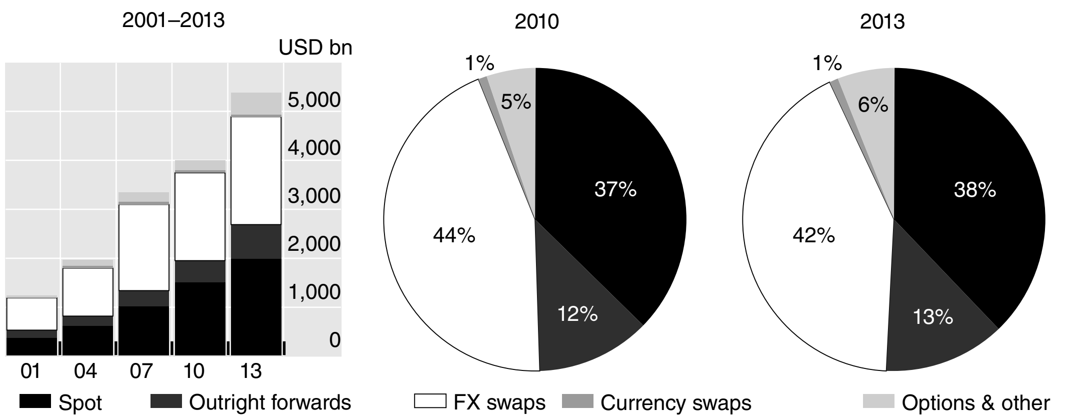
Short date transactions are transactions which call for settlement before the spot value date. "Cash" transactions are for settlement same day as the transactions date while some deals will involve settlements "tomorrow", i.e. one business day ahead when a spot deal would be settled two business days later.

Exhibit 7.4

Foreign exchange market turnover by instrument[1]

Net-net basis, daily averages in April

Graph 3



[1] Adjusted for local and cross-border inter-dealer double-counting, i.e. "net-net" basis.

Source: BIS Triennial Central Bank Survey.

7.4 EXCHANGE RATE QUOTATIONS AND ARBITRAGE

An exchange rate between currencies A and B is simply the price of one in terms of the other. It can be stated either as number of units of B per unit of A or number of units of A per unit of B. Thus, the exchange rate between, say, US dollar and British pound can be stated as 1.7656 dollars per pound or 0.5664 pound per dollar. In stating prices of goods and services in terms of money, the most natural format is to state them as units of money per unit of the good – rupees per litre (or per gallon or whatever) of milk – rather than as amount of a good per unit of money. When it is two monies, either way would be equally natural. The choice of a "unit" is also a matter of convenience. Thus, the rupee-dollar rate is usually stated as number of rupees per dollar, while the rupee-yen rate is stated as number of rupees per 100 yen. (Price of rice is given in rupees per kilogram in the retail market and rupees per quintal in wholesale markets).

Before proceeding, let us clarify the way we will designate the various currencies in this book. The International Standards Organisation (ISO) has developed three-letter codes for all the currencies which abbreviate the name of the country as well as the currency. These codes are used by the SWIFT network which carries out inter-bank funds transfers. Depending upon the context, we will either use the full name of a currency such as US dollar, Swiss franc, Pound sterling, etc., or the ISO code. A complete list of ISO codes is given at the end of this book. Here we will give the codes for selected currencies which will be frequently used in the various examples.

USD: US Dollar	**EUR: Euro**
GBP: British Pound	**IEP: Irish Pound (Punt)**
JPY: Japanese Yen	**CHF: Swiss Franc**
CAD: Canadian Dollar	**AUD: Australian Dollar**
SEK: Swedish Kroner	**MEP: Mexican Peso**
DKK: Danish Kroner	**NZD: New Zealand Dollar**
INR: Indian Rupee	**SAR: Saudi Riyal**

Further, unless otherwise stated, "dollar" will always mean the US dollar, "pound" or "sterling" will always denote the British pound sterling and "rupee" will invariably mean the Indian rupee. We will frequently use just the symbols "**$**", "**£**" and "**¥**" to designate the USD, the GBP and the JPY, respectively.

7.4.1 Spot Rate Quotations

In foreign exchange literature, one comes across a variety of terminology which can occasionally lead to unnecessary confusion about simple matters. You will hear about quotations in ***European Terms*** and quotations in ***American Terms***. The former are quotes given as number of units of a currency per US dollar. Thus, EUR 0.7720 per USD, CHF 1.0500 per USD, INR 61.75 per USD are quotes in European terms. Quotes in American terms are given as number of US dollars per unit of a currency. Thus, USD 0.8040 per CHF, USD 1.6545 per GBP are quotes in American terms. The prevalence of this terminology is due to the common practice mentioned above of quoting all exchange rates against the dollar.

You will occasionally come across terminology such as ***direct quotes*** and ***indirect quotes***. (The latter are also called "**reciprocal**" or "**inverse**" quotes). In any country, a direct quote gives amount of the currency of that country per unit of a foreign currency. Thus, INR 62.00 per USD is a direct quote in India and USD 1.2950 per EUR is a direct quote in the US. Indirect or reciprocal quotes are stated as number of units of a foreign currency per unit of the home currency. Thus, USD 1.8560 per 100 INR is an indirect quote in India[3]. Notice here that the "unit" for rupees is 100s. Similarly, for currencies like Japanese yen, Indonesian rupiah, quotations may be in terms of 100 yen or 100 rupiah. (The reason is otherwise we will have to deal with very small numbers). The notational confusion can get further compounded when we have to deal with two-way, bid-ask quotes for each exchange rate.

[3]Since August 2, 1993, the inter-bank market in India has shifted to the direct method of quoting rates. Before that, indirect method was used.

The inter-bank market uses quotation conventions adopted by ACI (Association Cambiste Internationale) which we will use in this book. These conventions are described below:

- A currency pair is denoted by the 3-letter SWIFT codes for the two currencies separated by an oblique or a hyphen.

  Examples: USD/CHF: US dollar-Swiss franc
  GBP/JPY: Great Britain pound-Japanese yen
  USD/INR: US dollar-Indian rupee
  USD-SEK: US dollar-Swedish kroner

- The first currency in the pair is the "***base***" currency; the second is the "***quoted***" currency. Thus, in USD/CHF, US dollar is the base currency, Swiss franc is the quoted currency. In GBP/USD, British pound is the base currency, US dollar is the quoted currency.
- **The exchange rate quotation is given as the amount of the quoted currency per unit of the base currency.** Thus, a USD/INR quotation will be given as amount of rupees per dollar, a GBP/USD quote will be given as amount of dollars per pound.
- A quotation consists of two prices. **The price shown on the left of the oblique or hyphen is the "bid" price, the one on the right is the "ask" or "offer" price.** The bid price is the price at which the dealer giving the quote is prepared to buy – is "bidding for" – one unit of the base currency against the quoted currency. In other words, it is the amount of quoted currency the dealer will give in return for one unit of the base currency. Ask or offer rate is the price at which the dealer is willing to sell – is "offering" – one unit of the base currency. In other words, it is the amount of quoted currency the dealer will want to be paid in return for one unit of base currency.

  Examples:

  USD/CHF Spot: 1.1550/1.1560

  The dealer will buy 1 USD and pay CHF 1.1550 in return. His "bid" rate for USD is CHF 1.1550. He will sell one USD and would want to be paid CHF 1.1560 in return. His "offer" or "ask" rate for one USD is CHF 1.1560.

  GBP/EUR Spot: 1.3025/1.3035

  Bid rate: Dealer will pay 1.3025 euros per GBP when buying GBP

  Offer rate: Dealer will want to be paid 1.3035 euros per GBP when selling GBP.

- For most currencies, quotations are given in European terms, i.e. the base currency is the US dollar. The major exceptions are EUR, GBP, AUD and NZD. These are quoted in American terms, i.e. USD becomes the quoted currency against these. In market parlance, a "cross rate" or just a "cross" is a quotation between two non-dollar currencies. Thus, GBP/CHF is a "cross rate" and so is EUR/INR. In the US, financial press gives quotations in both European and American terms.
- Quotations in inter-bank markets are usually given up to five or six significant digits or four decimal places. The last digit, thus, corresponds to $(1/100)^{th}$ of $(1/100)^{th}$ unit of the quoted currency. Thus, in the USD/CHF bid rate quoted above, viz. 1.4550, the last two digits, i.e. "50" correspond to 0.0050 CHF. In the GBP/EUR offer rate 1.3035, the last digit corresponds to 0.0005 EUR. The last two digits are called "points" or "pips". The difference between the offer rate and the bid rate is called the "bid-offer spread" or the "bid-ask spread". We say the bid-ask spread in the USD/CHF rate quoted as 1.1550/1.1560 is ten points or ten pips. If the GBP/EUR

rate moves to 1.3028/1.3038, we say the GBP has moved up three pips. For small denomination currencies like the JPY, quotes used to be given up to 2 decimals only. In such cases, a point or pip has the value 0.01 or $(1/100)^{th}$ of the quoted currency. In recent times, quotes for yen are also given up to four decimals.

- The quotations are usually shortened as follows:

    USD/CHF: 1.4550/1.4560 will be given as 1.4550/60.

    When two dealers are conversing with each other, this may be further shortened to 50/60. The first three digits, viz. 1.45 are known as the "big figure" and professional dealers are supposed to know what the big figure is at all times.

    GBP/USD : 1.5365/72 means 1.5365/1.5372. This may be further abbreviated to "65/72".

    USD/INR: 53.4870/90 means 53.4870/53.4890

    Remember that the offer rate must always exceed the bid rate – the bank giving the quote will always want to make a profit on its currency dealing. Hence, a quote such as:

    USD/SEK 6.9595/10 must mean 6.9595/7.9610.

    USD/JPY 106.15 /05 must be interpreted as 106.15/107.05

    The convention of denoting the currency pair as A/B when the rate is being given as number of units of B per unit of A can be a little confusing to those of us who are used to dealing with mathematical fractions in which A/B means amount of A divided by amount of B, i.e. number of units of A per unit of B. With a little care and practice, the confusion is easily avoided.

7.4.2 The Mechanics of Inter-bank Trading

As discussed above, the main actors in the forex markets are the primary market makers who trade on their own account and make a two-way bid-offer market. They deal actively and continuously with each other and with their clients, central banks and sometimes with currency brokers. In the process of dealing, they shift around their quotes, actively take positions, offset positions taken earlier or roll them forward. Their performance is evaluated on the basis of the amount of profit their activities generate and whether they are operating within the risk parameters established by the management. It is a high tension business which requires an alert mind, quick reflexes and the ability to keep one's cool under pressure.

The purpose of this section is to briefly outline the mechanics of actual currency trading as practiced by the primary market makers. We wish to give the reader a flavour of the various dimensions involved in operating in this huge, fast-changing and often extremely volatile global market. For more details, the reader can consult specialist texts such as Bishop and Dixon (1992), Luca (1995), Roth (1996) and Taylor (1997). Even then, it should be kept in mind that the only way to learn all the intricacies of forex dealing is to actually do it.

Inter-bank Dealing We have said that primary dealers quote two-way prices and are willing to deal on either side, i.e. buy or sell the base currency up to conventional amounts at those prices. However, in inter-bank markets, this is a matter of mutual accommodation. A dealer will be shown a two-way quote only if he or she extends that privilege to fellow dealers when they call for a quote.

Communications between dealers tend to be very terse. A typical spot transaction would be dealt as follows:

Monday, February 5, 10.45 am

BANK A: “Bank A calling. DLR-CHF 25 please.

(Bank A dealer is asking for a Swiss franc versus US dollar quote. She specifies the size of the deal viz. 25 million dollars since this is more than the “market lot” of 10 million.)

BANK B: “Forty - Forty-five"

(Bank B is specifying a two-way price – the price at which it will buy a US dollar against Swiss franc and the price at which it is willing to sell a US dollar. Knowing that the caller is also a forex dealer, the dealer in Bank B quotes only the last two decimals of the full quotation. For instance the full quotation might be 1.0540/1.0545. Bank B will pay CHF 1.0540, its “bid rate”, when it buys a dollar and will want to be paid CHF 1.0545, its “ask rate” when it sells a dollar. The difference between the selling and buying price 0.0005 or 5 “pips” is the bid-ask spread. If the caller had been a corporate customer, the dealer would have given the full quote.)

BANK A: “Mine”

(Bank A dealer finds bank B’s price acceptable and wishes to buy USD 25 million. She conveys this by saying “mine”, i.e. “I buy the specified quantity at your specified price”. If she wished to sell USD, she might have said “Yours”.)

BANK B: OK. I sell you USD 25 million against CHF at 1.0545 value February 7. UBS Geneva for my CHF.

(Bank B confirms the quantity, price and settlement date. It also specifies where it would like its CHF to be transferred.)

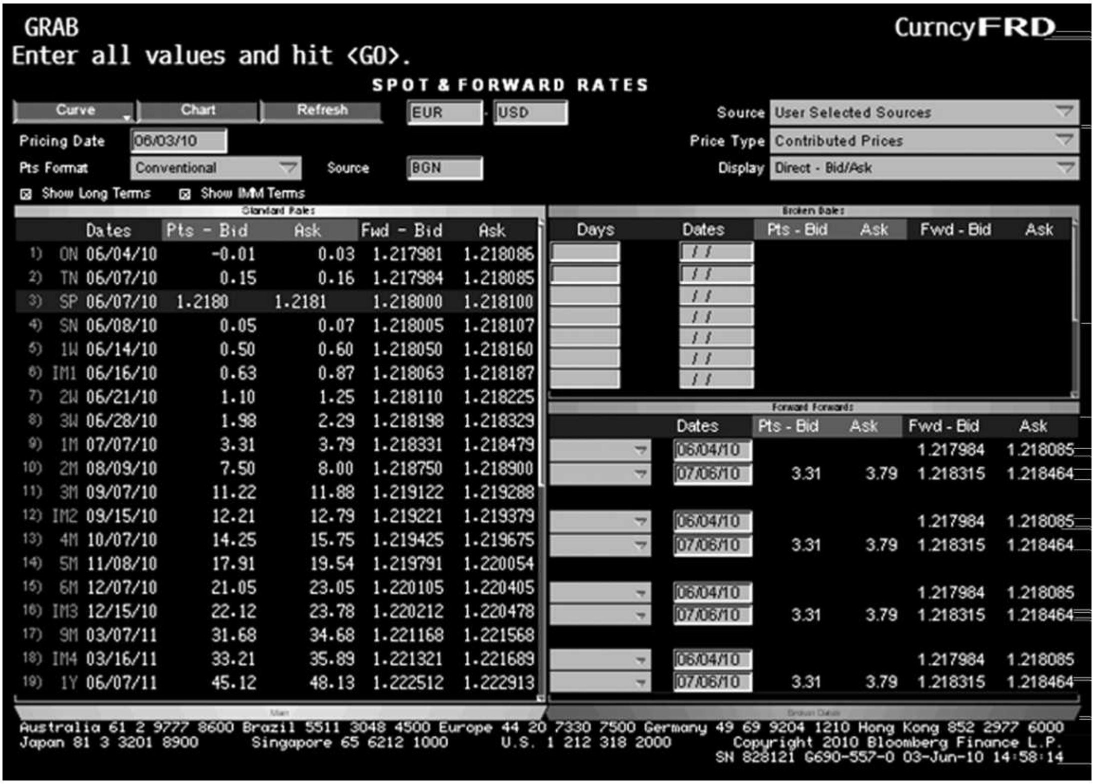
BANK A: CITIBANK NYK for my dollars. Thanks & Bye.

Bank B has been “hit on its ask side”, i.e. the caller, bank A wished to buy dollars.

When a dealer A calls another dealer B and asks for a quote between a pair of currencies, dealer B may or may not wish to take on the resulting position on his own books. If he does, he will quote a price based on his information about the current market and the anticipated trends and take the deal on his own books. This is known as “warehousing the deal”. If he does not wish to warehouse the deal, he will immediately call a dealer C, get his quote and show that quote to A. If A does a deal, B will immediately offset it with C. This is known as “back-to-back” dealing. Normally, back-to-back deals are done when the client asks for a quote on a currency which the dealer does not actively trade.

These days in the inter-bank market deals are mostly done with computerised dealing systems such as Reuters. Real-time information on exchange rates is provided by a number of information services including Reuters, Bridge, and Bloomberg. Some sample screens from Bloomberg system are shown below:

Euro-USD Screen from Bloomberg, June 3, 2010



A Sample Screen from Reuters FoXE: USD/INR

USD/INR	Last Update on 25/09/2000 at 7:45:00 PM (IST)						
Spot Date : 27/09/2000				Spot Bid : 45.9500		Spot Ask : 46.1500	
Period	*Value*	*Forward Rates*		*Forward Differences*		*Swap% [Annualised]*	
Months	*Date*	*Bid*	*Ask*	*Bid*	*Ask*	*Bid*	*Ask*
1 Month	27/10/2000	46.1250	46.3450	17.50	19.50	4.63	5.14
2 Month	27/11/2000	46.3300	46.5500	38.00	40.00	4.95	5.19
3 Month	27/12/2000	46.5350	46.7550	58.50	60.50	5.11	5.26
6 Month	27/03/2001	47.0650	47.2850	111.50	113.50	4.89	4.96
12 Month	27/09/2001	48.1250	48.3450	217.50	219.50	4.73	4.76

A Sample Screen from Reuters FoXE: EUR/INR

EUR/INR	Last Update on 25/09/2000 at 7:45:00 PM (IST)						
EUR/USD : 0.8756/0.8758a						USD/INR : 45.9500/46.1500	
Spot Date : 27/09/2000				Spot Bid : 40.2350		Spot Ask : 40.4200	
Period	*Value*	*Forward Rates*		*Forward Differences*		*Swap% [Annualised]*	
Months	*Date*	*Bid*	*Ask*	*Bid*	*Ask*	*Bid*	*Ask*
1 Month	27/10/2000	40.4500	40.6525	21.50	23.25	6.50	7.00
2 Month	27/11/2000	40.6875	40.8950	45.25	47.50	6.73	7.03
3 Month	27/12/2000	40.9275	41.1325	69.25	71.25	6.90	7.07
6 Month	27/03/2001	41.5500	41.7675	131.50	134.75	6.59	6.72
12 Month	27/09/2001	42.8000	43.0200	256.50	260.00	6.38	6.43

The last two columns headed "Swap % [Annualised]" express the difference between the spot and forward rates as a percentage of the spot rate on an annualised basis. Thus, in the USD/INR screen, the one month forward bid is 46.1250 while the spot bid is 45.95. The annualised swap is calculated as:

$$[(46.1250\text{-}45.9500)/45.9500]\ (365/30)\ (100) = 4.63\%$$

An extract from the Bridge Information System Forex screen is shown below:

Bridge Station	*Market Watch*		*Tue Dec 05 15:33:27 2000*			
Symbol	*Bid*	*Ask*	*Bid.Time*	*Last*	*High*	*Low*
$$USDJPY	110.61	110.66	15:05	110.61	111.36	110.61
$$USDINR	46.7600	46.7700	15:05	46.7600	46.8100	46.7700
$$AUDUSD	.5419	.5424	15:05	.5419	.5445	.5417
$$USDHKD	7.7992	7.8001	15:04	7.7992	7.7995	7.7995
$$USDSGD	1.7420	1.7430	15:04	1.7420	1.7468	1.7427
$$USDKRW	1203.5	1204.5	15:02	1203.5	1216.7	1204.5
G7 Rates						
$$EURUSD	.8845	.8850	15:05	.8845	.8905	.8841
$$GBPEUR	1.6372	1.6377	15:05	1.6372	1.6398	1.6288
$$USDCAD	1.5415	1.5420	15:01	1.5415	1.5443	1.5403
$$GBPUSD	1.4482	1.4492	15:05	1.4482	1.4525	1.4465
$$USDDEM	2.2101	2.2111	15:05	2.2101	2.2124	2.1962
$$DEMJPY	50.04	50.06	15.05	50.04	50.49	50.00

Source: Bridge Information Systems

Computerised dealing systems allow a dealer to carry on multiple conversations simultaneously and provide a visual reproduction of the audio exchange between the dealers. This minimises the likelihood of mistakes and discrepancies. Suppose bank A wishes to buy the British pound sterling against the US dollar. A trader in Bank A might call his counterpart in Bank B and ask for a price quotation. If the price is acceptable they will agree to do the deal and both will enter the details – the amount bought/sold, the price, the identity of the counterparty, etc. – in their respective banks' computerised record systems and go on to the next transaction. Subsequently, written confirmations will be sent containing all the details. On the day of settlement, Bank A will turn over a US dollar deposit to Bank B and B will turn over a sterling deposit to A. The traders are out of the picture once the deal is agreed upon and entered in the record systems. Subsequent processing of the transaction and settlement is handled by the back office staff. This enables dealers to do deals very rapidly[4].

In a normal two-way market, a trader expects "to be hit" on both sides of his quote in roughly equal amounts. That is, in the pound-dollar case above, on a normal business day the trader expects to buy and sell roughly equal amount of pounds (and of course dollars). The bank's margin would then be the bid-ask spread.

But suppose during the course of trading a trader finds that he is "being hit" on one side of his quote much more often than the other side. In our pound-dollar example, this means that he is either buying many more pounds than he is selling or vice versa. This leads to the trader building up "a position". If he has sold (bought) more pounds than he has bought (sold), he is said to have a net ***short position (long position)*** in pounds. Given the volatility of exchange rates, maintaining a large net short or long position for too long can be a risky proposition. For instance, suppose that a trader has built up a net short position in pounds of £1,000,000. The pound suddenly appreciates from say \$1.7500 to \$1.7620. This implies that the bank's liability increases by \$12000 (\$0.0120 per pound for 1 million pounds). Of course, a pound depreciation would have resulted in a gain. Similarly, a net long position leads to a loss, if it has to be covered at a lower price and a gain, if at a higher price. (By "covering a position" we mean undertaking transactions that will reduce the net position to zero. A trader net long in pounds must sell pounds to cover; a net short must buy pounds)[5].

The potential gain or loss from a position depends upon the size of the position and the variability of exchange rates[6]. Building and carrying such net positions for long durations would be equivalent to speculation and banks exercise tight control over their traders to prevent such activity. This is done by prescribing the maximum size of net positions a trader can build up during a trading day and how much can be carried overnight[7].

---

[4]Also, this way the dealing and settlement functions are kept separate which facilitates monitoring and control of dealers' operations.

[5]Positions can be covered by borrowing or lending in the inter-bank deposit market. For instance, a bank may sell more dollars than it buys and borrow dollars. It will do this if it expects to buy dollars later at a price sufficiently low to compensate for the interest cost on borrowing.

[6]Variability is measured by standard deviation. Let the proportionate exchange rate change be defined as

$$\Delta S = [S(t+1) - S(t)]/S(t)$$

where $S(t)$ is the closing rate on day t. If ΔS are normally distributed with mean 0 and standard deviation σ, there is a 68% probability that the daily proportionate change will be within $\pm 1\sigma$ and 95% probability that it will be within $\pm 2\sigma$. Suppose that the standard deviation of the \$/£ rate is 0.0075. Then a £1 million short position can lead to loss or gain of up to \$7500 from one day to the next 68% of the times. Empirically it has been found that daily proportionate exchange rate changes have "leptokurtic" distributions. That is, compared to the normal distribution, they have a greater proportion of very small deviations *and* very large deviations from the mean and a smaller proportion of intermediate deviations. This means chances of large gains and losses are greater.

[7]This is where the importance of having a nearly 24-hour market comes in. Imagine a trader in New York who enters into a large deal to sell Japanese yen to a corporate customer against dollar in the late afternoon when the activity in the New York market has already slowed down. He may find it very difficult to locate a counter-party to do the offsetting deal – sell him yen against dollar – in the New York market at that hour. He can wait for a couple of hours till the Tokyo market opens and square his position rather than carry an overnight short position in yen.

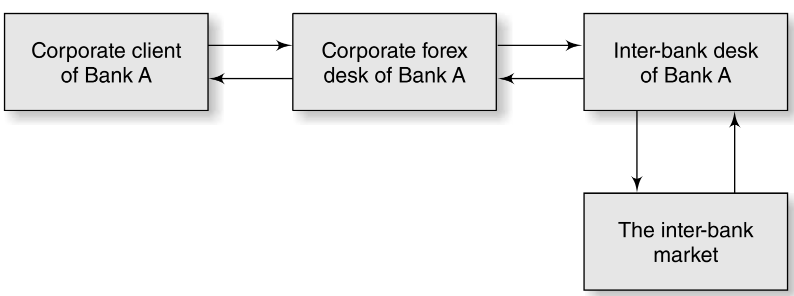
When a trader realises that he is building up an undesirable net position, he will adjust his bid-ask quotes in a manner designed to discourage one type of deal and encourage the opposite deal. For instance, a trader who has overbought, say Swiss francs against the US dollar, will want to discourage further sellers of francs and encourage buyers. If his initial quote was say USD/CHF 1.1500-1.1510, he might move it to 1.1508-1.1518, i.e. offer more francs per dollar sold to the bank and charge more francs per dollar bought from the bank.

Cheung and Chinn (2001) report some findings from a survey of currency traders they carried out in the US forex market in 1998. A significant proportion of responses indicate that every market has some sort of a norm regarding the bid-offer spread for major currency pairs and most traders prefer not to deviate from that norm unless the market becomes very thin or very hectic in anticipation of some economic development.

Since most of the trading takes place between market-making banks, it is a zero-sum game, i.e. gains made by one trader are reflected in losses made by another. However, when central banks intervene, it is possible for banks as a group to gain at the expense of the central bank or vice versa.

For dealing with their corporate customers, banks have corporate dealers who are the contact points for the bank's corporate customers. A corporate treasurer who needs to buy or sell foreign currency or just get a feel for the market would contact a corporate dealer probably on the phone and ask for a quotation. The corporate dealer will, in turn, request the bank's inter-bank dealer on the appropriate "desk" to provide a rate quotation which will be transmitted back to the corporate client. Corporate dealers are generally not allowed to carry positions; they must pass the positions to the appropriate inter-bank desk. Exhibit 7.5 shows a schematic picture of corporate transactions with the bank. For trade-related purchases and sales, or other inward or outward forex remittances, corporate clients would contact import/export desks or non-trade remittance desks who, in turn, contact the corporate forex dealer as shown in Exhibit 7.6.

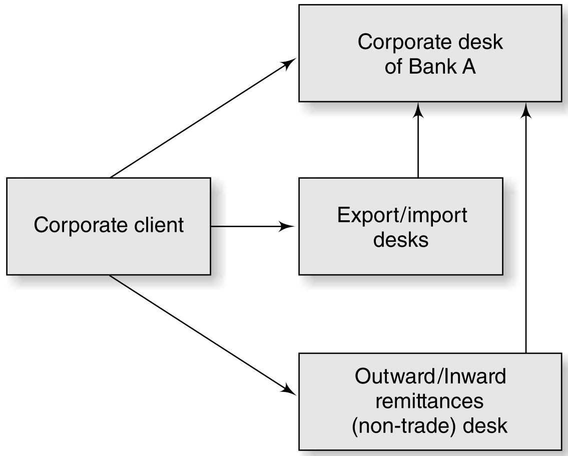
Exhibit 7.5



Bulk of the trading in convertible currencies takes place against the US dollar. Thus quotations for euro, Swiss francs, yen, pound sterling, etc., will be commonly given against the US dollar. If a corporate customer wants to buy or sell yen against Swiss franc, a cross-rate will be worked out from the USD/CHF and USD/JPY quotation as explained in a later section. One reason for using a common currency (called the "vehicle currency") for all quotations is to economise on the number of quotations. If n currencies are being traded, having a quote for each pair will require $n(n-1)/2$ exchange rates[8].

[8]The first currency will have to be quoted against $(n-1)$ currencies, the second against $(n-2)$, the last-but-one against one. The total number of rates will be $[(n-1)+(n-2)+...+1] = n(n-1)/2$

Exhibit 7.6



With 10 currencies, 45 two-way quotes will be needed. By using a common currency to quote against, the number is reduced to 9 or, in general, (n – 1).

Also, by this means the possibility of triangular arbitrage (see below) is minimised. However, some banks specialise in giving these so-called cross-rates. As we will see below, they can operate with a smaller bid-ask spread provided there is sufficient turnover of business in the currency pair concerned.

In an ordinary foreign exchange transaction, no fees are charged. The bid-ask spread itself is the transaction cost. Also, unlike the money or capital markets, where different rates of interest are charged to different borrowers depending on their creditworthiness, in the wholesale foreign exchange market no such distinction is made. Default risk – the possibility that the counterparty in a transaction may not deliver on its side of the deal – is handled by prescribing limits on the size of positions a trader can take with different corporate customers. In some cases, a bank may decline to do a deal with a corporation (or even another bank), if it cannot assess the latter's credit risk.

Communications pertaining to international financial transactions are handled mainly by a large network called Society for Worldwide Inter-bank Financial Telecommunication (**SWIFT**). This is a non-profit Belgian cooperative with main and regional centers around the world connected by data transmission lines. Depending on the location, a bank can access a regional processor or a main centre which then transmits the bank's instructions and any relevant information to the appropriate location.

Banks sometimes employ services of a currency broker to execute a deal. The main advantage of dealing through a broker is anonymity. A bank dealer can "show" his or her prices to the market without revealing the identity of the bank. A broker receives orders from many clients who specify the prices at which they are willing to buy or sell a currency and the amounts. Normally these are "limit" prices, i.e. a bank will specify the highest price it is willing to pay to buy a currency or the lowest price at which it is willing to sell a currency. From among these, the broker will announce the highest buying price (highest bid) and lowest selling price (lowest offer) to all his clients without revealing the identity of the parties who are willing to deal at those prices. A client wanting to buy a currency can accept the best offer price currently available, "join the queue" at the best bid price currently shown or "improve" upon the highest bid currently shown. Thus, suppose a broker has conveyed the best GBP/USD bid as 1.5665 and best offer as 1.5680. If a dealer wishes to buy GBP, he can

(a) Accept the offer price of 1.5680. This guarantees immediate execution[9].
(b) Or he can join the bid at 1.5665. His order will get priority after all earlier bids at that price have been processed.
(c) Or he can improve the bid to 1.5670. This has a better chance of execution. In recent times, electronic broking has been gradually replacing the traditional "voice" brokerage services.

7.4.3 Arbitrage in Spot Markets

Arbitraging between Banks

Though one often hears the term "market rate", it is not true that all banks will have identical quotes for a given pair of currencies at a given point of time. The rates will be close to each other, but it may be possible for a corporate customer to save some money by shopping around. Let us explore the possible relationships between quotes offered by different banks.

1. Suppose Banks A and B are quoting:

	A	***B***
GBP/USD:	1.4550/1.4560	1.4538/1.4548

We will represent this as:

```
                ■---------■ Bank A
               bid       ask

        ■---------■ Bank B
       bid       ask
```

Obviously, such a situation gives rise to an arbitrage opportunity[10]. Pounds can be bought from B at $1.4548 and sold to A at $1.4550 for a net profit of $0.0002 per pound ***without any risk or commitment of capital***. One of the basic tenets of modern finance is that markets are efficient and such arbitrage opportunities will be quickly spotted and exploited by alert traders. The result will be, Bank B will have to raise its ask rate and/or A will have to lower its bid rate. The arbitrage opportunity will disappear very fast. In fact, in the presence of profit-hungry arbitragers, such an opportunity will rarely emerge in the first place.

2. Now suppose the quotes are as follows

	A	***B***
GBP/USD:	1.4550/1.4560	1.4545/1.4555

These can be represented as:

```
            ■---------■   A

        ■---------■   B
```

---

[9]The entire order may not be executed, if the amount available at the best offer price is less than what he wishes to buy.

[10]Arbitrage in finance refers to a set of transactions, selling and buying or lending and borrowing the same asset or equivalent groups of assets, to profit from price discrepancies within a market or across markets. Most often no risk is involved and no capital has to be committed. "Equivalent" in this context means having identical cash flows and risk characteristics.

Now there is no arbitrage opportunity as in (1). Thus, the two quotes must overlap to prevent arbitrage. However, now Bank A will find that it is "being hit" on its bid side much more often, i.e. it will be faced with many more sellers of pound sterling than buyers, while B will find that it is confronted largely with buyers of pound sterling and few sellers.

From time to time, a bank may deliberately move its quote in a fashion designed to discourage one type of deal and encourage the opposite deal. Thus, Bank A may have built a large net short position in sterling and may now want to encourage sellers of pound and discourage buyers. Bank B may be in a reverse position; it wants to encourage buyers and discourage sellers of sterling. Thus, regular clients of Bank A wanting to buy pounds can save some money by going to B and vice versa.

In practice, most corporations will not shop around to make a gain of a few points unless the amount involved is very large. Customers who flit from bank to bank in search of tiny savings often find that when it comes to executing a complex transaction, no bank is willing to give them the kind of service that it would give to its more 'loyal' customers. Also, even in routine foreign exchange transactions, regular customers get better rates. Nevertheless, it is a good idea to do some comparison shopping from time to time to keep the bank on its toes.

Inverse Quotes and Two-Point Arbitrage

Consider the spot quotation:

USD/CHF: 1.4955/1.4962

Suppose this is a quote available from a bank in Zurich. At the same time, a bank in New York is offering the following spot quote:

CHF/USD: 0.6695/0.6699

Is there an arbitrage opportunity? Suppose we buy one million Swiss francs against dollars from the Zurich bank and sell them to the New York bank. The Zurich bank will give CHF 1.4955 for every dollar it buys. It will cost us \$(1,000,000/1.4955), i.e. \$6,68,700 to acquire 1 million Swiss francs.

In New York, the bank will give \$0.6695 for every CHF it purchases. Thus, CHF 1 million can be sold to the New York bank for \$(0.6695 × 1000000), i.e. \$6,69,500. We can make a riskless profit of \$800 with a couple of phone calls! Obviously, the CHF/USD rates implied by the Zurich bank's USD/CHF quotes and the New York bank's CHF /USD quotes are out of line.

Recall that $(\text{CHF/USD})_{\text{ask}}$ is the rate that applies when the bank ***sells Swiss francs in exchange for dollars***. But this is precisely the deal we did with the Zurich bank and for each Swiss franc we bought we had to pay \$(1/1.4955) which is nothing but $1/(\text{USD/CHF})_{\text{bid}}$. In the same way, the $(\text{CHF/USD})_{\text{bid}}$ implied by the Zurich bank's USD/CHF quotes would be the amount of USD dollars it would give when it buys one CHF. It requires CHF 1.4962 for every USD it sells. This means that it will give USD (1/1.4962) when it buys one CHF. Thus, the $(\text{CHF/USD})_{\text{bid}}$ implied by its USD/CHF quote is $1/(\text{USD/CHF})_{\text{ask}}$. Thus, we have

$$\text{Implied } (\text{CHF/USD})_{\text{bid}} = 1/(\text{USD/CHF})_{\text{ask}}$$
$$\text{Implied } (\text{CHF/USD})_{\text{ask}} = 1/(\text{USD/CHF})_{\text{bid}}$$

To prevent arbitrage, the New York bank's (CHF/USD) quotes must overlap the (CHF/USD) quotes implied by the Zurich bank. The latter works out to 0.6684/0.6687. A CHF/USD quote such as 0.6686/0.6690 will not lead to arbitrage though it may lead to a one-way market for the banks. The rates actually found in the markets will obey the above relations to a very close approximation.

The arbitrage transaction described above, viz. buying a currency in one market and selling it at a higher price in another market is called "Two-Point Arbitrage". Foreign exchange markets very quickly eliminate two-point arbitrage opportunities if and when they arise.

Cross-Rates and Three-Point Arbitrage A New York bank is currently offering these spot quotes:

USD/JPY: 110.25/111.10
USD/AUD: 1.6520/1.6530

At the same time, a bank in Sydney is quoting:

AUD/JPY: 68.30/69.00

Is there an arbitrage opportunity? Consider this sequence of transactions:

1. Sell yen, buy US dollars and then sell US dollars and buy Australian dollars. Do both these transactions in New York and
2. Sell the Australian dollars for yen in Sydney.

The calculations are:
(Subscripts N and S denote rates in New York and Sydney, respectively).

1 yen sold in New York gets US $[1/(USD/JPY)_{ask(N)}] = US $(1/111.10)
US $[1/(USD/JPY)_{ask(N)}] sold against AUD gets
AUD{[1/(USD/JPY)_{ask(N)}](USD/AUD)_{bid(N)}}
= AUD (1/111.10)(1.6520)

And finally the amount of yen obtained by selling AUD in Sydney is

$$¥ \{[1/(USD/JPY)_{ask(N)}](USD/AUD)_{bid(N)}(AUD/JPY_{bid(S)}\}$$
$$= ¥ (1/111.10)(1.6520)(68.30) = ¥ 1.0156$$

A risk-less profit of ¥0.0156 per yen. On a 100 million yen, that implies a profit of 1.56 million yen, and 100 million yen is considerably less than the average size of transactions in the inter-bank market in a trading centre like New York.

Once again, the reason is that the AUD/JPY cross-rate implied by the USD/JPY and USD/AUD rates in New York is out of line with the direct AUD/JPY rate quoted by the Sydney bank. No arbitrage condition requires:

$$\frac{1}{(\text{USD/ JPY})_{ask(N)}} \times (\text{USD/ AUD})_{bid(N)} \times (\text{AUD/ JPY})_{bid(S)} \leq 1 \quad (7.1)$$

(Here, we have added the subscripts (N) and (S) to denote rates in New York and Sydney, respectively. The reason for this will become apparent shortly.)

The inequality (7.1) can be rewritten as follows:

$$(\text{AUD/JPY})_{bid(S)} \leq \frac{(\text{USD/JPY})_{ask(N)}}{(\text{USD/AUD})_{bid(N)}} \quad (7.2)$$

But recall from our discussion of inverse rates that

$$[1/(\text{USD/AUD})_{bid(N)}] = (\text{AUD/USD})_{ask(N)}$$

Hence, inequality (7.2) implies

$$(\text{AUD/JPY})_{bid(S)} \leq (\text{USD/JPY})_{ask(N)} \times (\text{AUD/USD})_{ask(N)} \quad (7.3)$$

Now consider arbitrage in the reverse direction. With one USD, buy yen in New York, sell yen for AUD in Sydney and sell AUD for USD in New York. No arbitrage profit condition means that you should not end up with more than one USD. This implies

$$(\text{USD/JPY/})_{\text{bid(N)}} \times \frac{1}{(\text{AUD/JPY})_{\text{ask(S)}}} \times \frac{1}{(\text{USD/AUD})_{\text{ask(N)}}} \leq 1 \tag{7.4}$$

Recall once again that

$$1/(\text{USD/AUD})_{\text{ask(N)}} = (\text{AUD/USD/})_{\text{bid(N)}}$$

So that (7.4) can be rewritten as

$$(\text{AUD/JPY/})_{\text{ask(S)}} \geq (\text{USD/JPY})_{\text{bid(N)}} \times (\text{AUD/USD})_{\text{bid(N)}} \tag{7.5}$$

Instead of New York and Sydney, we could simply have imagined two banks quoting yen versus AUD, one giving rates directly while the other giving the rates derived from the USD/JPY and USD/AUD rates. The no-arbitrage conditions (7.3) and (7.5) simply give us upper and lower bounds on the direct rates in terms of the synthetic rates. To understand this clearly, let us see how a synthetic pair of AUD/JPY quotes is derived.

The synthetic $(\text{AUD/JPY})_{\text{bid}}$ refers to a transaction in which the bank ends up with AUD and the customer with JPY. This can be viewed as the end result of two transactions:

1. In step one, the customer sells AUD and buys USD.
2. In step two, the customer sells USD acquired in step one and gets JPY.

Starting with AUD 1, the customer will get USD $[1/(\text{USD/AUD})_{\text{ask}}]$ in step one; in exchange for this, in step two, the customer will get:

$$¥\ \{[1/(\text{USD/AUD})_{\text{ask}}] \times (\text{USD/JPY})_{\text{bid}}\}$$

Thus,

$$\begin{aligned}\text{Synthetic } (\text{AUD/JPY})_{\text{bid}} &= (\text{USD/JPY})_{\text{bid}}/[1/(\text{USD/AUD})_{\text{ask}}] \\ &= (\text{USD/JPY})_{\text{bid}} \times (\text{AUD/USD})_{\text{bid}}\end{aligned} \tag{7.6}$$

This works as if AUD/JPY, USD/JPY, etc., were mathematical fractions:

$$\text{AUD/JPY} = (\text{USD/JPY}) \times (\text{AUD/USD})$$

In the same way, we can have a synthetic $(\text{AUD/JPY})_{\text{ask}}$ rate:

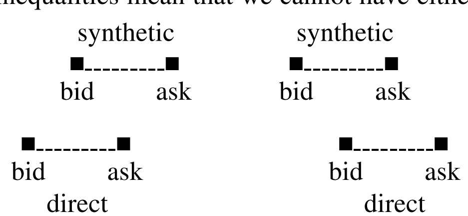
$$\text{Synthetic } (\text{AUD/JPY})_{\text{ask}} = (\text{USD/JPY})_{\text{ask}} \times (\text{AUD/USD})_{\text{ask}} \tag{7.7}$$

Now notice that the right hand side of (7.6) is same as (7.5) and that of (7.7) is identical to that of (7.3). Thus, the no-arbitrage conditions say that

$$\text{Direct } (\text{AUD/JPY})_{\text{bid}} \leq \text{Synthetic } (\text{AUD/JPY})_{\text{ask}} \tag{7.8}$$

$$\text{Direct } (\text{AUD/JPY})_{\text{ask}} \geq \text{Synthetic } (\text{AUD/JPY})_{\text{bid}} \tag{7.9}$$

Diagrammatically, these inequalities mean that we cannot have either of the following situations:



This is a familiar condition. Whenever there are two sets of quotes for a pair of currencies, to prevent arbitrage they must overlap.

The mechanics of working out synthetic quotes works no matter which way the two quotations are given, whether European terms or American terms or a mixture. Thus, suppose we have both quotes in American terms:

GBP/USD: 1.6545/1.6552
IEP/USD: 1.3655/1.3665

Then,

$$\begin{aligned}(\text{GBP/IEP})_{\text{bid}} &= (\text{GBP/USD})_{\text{bid}} \times (\text{USD/IEP})_{\text{bid}}\\ &= (\text{GBP/USD})_{\text{bid}} \times [1/(\text{IEP/USD})_{\text{ask}}]\\ &= (1.6545)\ (1/1.3665) = 1.2108\\ (\text{GBP/IEP})_{\text{ask}} &= (\text{USD/IEP})_{\text{ask}} \times (\text{GBP/USD})_{\text{ask}}\\ &= [1/(\text{IEP/USD})_{\text{bid}}] \times (\text{GBP/USD})_{\text{ask}}\\ &= (1/1.3655)(1.6552) = 1.2122\end{aligned}$$

Synthetic (GBP/IEP): 1.2108/1.2122

Next, we have one quote in European terms and the other in American terms:

USD/CAD: 1.6505/1.6510
GBP/USD: 1.4524/1.4530

$$\begin{aligned}(\text{GBP/CAD})_{\text{bid}} &= (\text{USD/CAD})_{\text{bid}} \times (\text{GBP/USD})_{\text{bid}}\\ &= (1.6505)(1.4524) = 2.3972\\ (\text{GBP/CAD})_{\text{ask}} &= (\text{USD/CAD})_{\text{ask}} \times (\text{GBP/USD})_{\text{ask}}\\ &= (1.6510)(1.4530) = 2.3989\end{aligned}$$

Synthetic (GBP/CAD): 2.3972/2.3989

The term "three-point arbitrage" refers to the kind of transactions we described above. Start with currency A, sell it for B, sell B for C and finally sell C back for A ending up with a larger amount of A than you began with. Efficient foreign exchange markets do not permit riskless arbitrage profits of this kind. This is an instance of the well-known maxim in economics, viz. there is no such thing as a free lunch.

Notice that the synthetic cross rates between any pair of currencies X and Y, calculated from the rates of these two currencies against a third currency Z, impose only lower and upper limits on the rates a bank which is directly making a market between X and Y may quote. In other words, a situation like the following is perfectly acceptable:

synthetic
■---------■
■-------■
direct

In fact, you must have realised that in computing the synthetic (GBP/CAD) rates, the bid-ask spreads in the (USD/CAD) and (GBP/USD) quotes are being compounded. A bank which specialises in making a CAD-GBP market can give direct quotes with narrower spread, provided it has a sufficiently large volume of business in the two currencies.

7.5 FORWARD QUOTATIONS

7.5.1 Outright Forwards

Quotations for outright forward transactions are given in the same manner as spot quotations. Thus, a quote like USD/SEK 3-Month Forward: 7.1500/7.1650 means, as in the case of a similar spot quote, that the bank will give SEK 7.1500 to buy a USD and require SEK 7.1650 to sell a dollar, delivery 3 months from the corresponding spot value date.

Calculation of inverse rates and the notion of two point arbitrage also carry over from similar calculations for spot rates. Given the above USD/SEK 3-month forward quotation,

$$\begin{aligned}\text{SEK/USD 3-month forward} &= (1/7.1650)/(1/7.1500)\\ &= 0.1396/0.1399\end{aligned}$$

Similarly, calculation of synthetic cross rates and the relation between synthetic and direct quotes to prevent three-point arbitrage are also same as in case of spot rates. Suppose we have:

EUR/USD 1-month forward: 1.2510/1.2520
EUR/JPY 1-month forward: 156.25/157.10

Then, the synthetic USD/JPY 1-month forward quotes are given by

$$\begin{aligned}&\text{1-month forward (USD/JPY)}_{\text{bid}}\\ &\quad = [\text{1-month forward (USD/EUR)}_{\text{bid}} \times \text{1-month forward (EUR/JPY)}_{\text{bid}}]\end{aligned}$$

and

$$\begin{aligned}&\text{1-month forward (USD/JPY)}_{\text{ask}}\\ &\quad = [\text{1-month forward (USD/EUR)}_{\text{ask}} \times \text{1-month forward (EUR/JPY)}_{\text{ask}}]\end{aligned}$$

Using the definition of inverse quotes

$$\text{1-month forward (USD/EUR)}_{\text{bid}} = 1/[\text{1-month forward (EUR/USD)}_{\text{ask}}]$$
$$\text{1-month forward (USD/EUR)}_{\text{ask}} = 1/[\text{1-month forward EUR/USD)}_{\text{bid}}]$$

Thus, we get the following quotes for USD/JPY 1-month forward:

$$\begin{aligned}&\text{1-month forward USD/JPY} = (156.25/1.2520)/(157.10/1.2510)\\ &= 124.80/125.58\end{aligned}$$

We will see below that in the inter-bank market forward quotes are given not in this manner but as a pair of "swap points" to be added to or subtracted from the spot quotation.

Discounts and Premiums in the Forward Market Consider the following pair of spot and forward quotes:

GBP/USD spot: 1.5677/1.5685
GBP/USD 1-month forward: 1.5575/1.5585

The pound is cheaper for delivery one month later compared to spot pound. The pound is said to be at a ***forward discount*** against the dollar or, equivalently, the dollar is at a ***forward premium*** against pound.

With two-way quotations, there is no unique way to quantify the discount or premium. One possibility is to use the mid-rate defined as average of the bid and ask rates in the spot and forward quotes. Thus, the mid-rates in the above GBP/USD quotes can be defined as:

$$\text{Spot (GBP/USD)}_{\text{mid}} = (1.5677+1.5685)/2 = 1.5681$$
$$\text{1-month forward (GBP/USD)}_{\text{mid}} = (1.5575 + 1.5585)/2 = 1.5580$$

Forward discounts and premia are usually stated in annualised percentage terms. Let us define the annualised percentage discount on the pound implied in the above quotations as:

$$\frac{[\text{Forward(GBP/USP)}_{\text{mid}} - \text{Spot(GBP/USD)}_{\text{mid}}]}{\text{Spot(GBP/USD)}_{\text{mid}}} \times 12 \times 100$$

$$= \frac{1.5580 - 1.5681}{1.5681} \times 12 \times 100 = -7.73\%$$

In this formula, multiplication by 12 converts the monthly discount on dollar to annual discount and multiplication by 100 converts it into percentage terms.

Strictly speaking to convert the discount or premium to annual terms, we should multiply by a factor (B/n) where n is the actual number of calendar days in the forward contract period and B is the number of days in a year which may be 360 or 365 depending on the market convention. Thus, for a one-month forward GBP/USD quote, B would be 365 while n may be 30 or 31.

With this definition, for any quotation (A/B), if [Forward(A/B) – Spot(A/B)] is negative it would indicate that currency B is at a forward premium vis-à-vis currency A, whereas a positive answer would imply that B is at a forward discount against A. The practitioner's terminology may differ across markets. When a dealer says "GBP on USD is at a premium" it is usually interpreted to mean that the quoted currency, in this case the USD, is at premium. But this usage does not appear to be universal.

In the next chapter, we will see that a certain kind of arbitrage activity leads to a relationship between the spot and forward rates for a currency pair A and B and the interest rates in the eurodeposit markets for the two currencies. As usual, the no-arbitrage condition imposes certain limits on the forward bid and ask rates in relation to the spot bid and ask rates.

7.5.2 Option Forwards

A standard forward contract calls for delivery on a specific day, the settlement date for the contract. In most of the currency markets, banks offer what are known as ***optional forward contracts or option forwards***. Here, the contract is entered into at some time t_0, with the rate and quantities being fixed at this time, but the buyer has the option to take or make delivery on any day between two specified future dates t_1 and t_2, with $t_2 > t_1$. Thus, on February 27, a firm can enter into a 3-month option forward contract to buy a million dollars at 64.5 rupees, with an option to demand delivery anytime during the third month, i.e. between June 1 and June 30. In the next chapter, we will describe this contract and its pricing in greater detail.

7.5.3 Margin Requirement

When a forward contract is between two banks, nothing more than a telephonic agreement on the price and amount is involved. However, when a bank enters into a forward deal with a non-bank corporation, it will want to protect itself against the possibility that the firm may default on its commitment. Remember that having entered into a forward deal with party A to buy currency X against currency Y, the bank will have squared its position by entering into an opposite forward contract with another party B to sell currency X against Y. If party A defaults, the bank must fulfil its commitment to party B possibly by buying currency X in the spot market and in the meanwhile currency X may have appreciated strongly against currency Y. This is known as "reverse exchange rate risk". If the firm has a credit line with the bank, the amount of the credit line will be usually reduced by the amount involved in the forward contract. The forward desk must obtain the approval of the bank's credit department before entering into a forward contract with a party that is not the bank's usual client. Sometimes the bank may decline a customer's request for a forward contract, if it cannot satisfactorily verify the customer's credit status. Sometimes, the bank may ask the firm for collateral in the form of a deposit equal to a certain percentage of the value of the contract. The deposit earns interest so there is no explicit cash cost. It is only a performance bond. In some cases, the bank will agree to do a forward deal, but not for the full amount the client firm wants.

7.5.4 Swaps in Foreign Exchange Markets

Swap Margins and Quotations Recall that a swap transaction between currencies A and B consists of a spot purchase (sale) of A coupled with a forward sale (purchase) of A both against B. The amount of one of the currencies is identical in the spot and forward deals. Since usually there will be a forward discount or premium on A vis-à-vis B, the rate applicable to the forward leg of the swap will differ from that applicable to the spot leg. The difference between the two is the ***swap margin*** which corresponds to the forward premium or discount. It is stated as a pair of ***swap points*** to be added to or subtracted from the spot rate to arrive at the implied outright forward rate. We will clarify this in detail shortly.

While banks quote and do outright forward deals with their non-bank customers, in the inter-bank market forwards are done in the form of swaps. Thus, suppose a bank buys pounds one-month forward against dollars from a customer. It has created a long position in pounds (short in dollars) one-month forward. If it wants to square this in the inter-bank market, it will do it as follows:

- A swap in which it buys pounds spot and sells one month forward, thus creating an offsetting short pound position one-month forward.
- Coupled with a spot sale of pounds to offset the long pound position in spot created in the above swap.

The reason for this is that it is very difficult to find counterparties with matching opposite needs to cover the original forward position by an opposite outright forward whereas swap position can be easily offset by dealing in the eurodeposit markets.

As mentioned above, in the inter-bank market outright forward quotes for a given maturity are derived from the spot quote and a pair of swap margins applicable to that maturity. We will examine how this is done.

A typical swap quotation appears as follows:

USD/CHF Spot: 1.4265/1.4275
1-month Swap: 15/8

The swap margin quotation is given such that the last digit coincides with the same decimal place as the last digit of the spot price. This means that the swap margin is quoted in points or pips. Thus, in the USD/CHF quote given above, the numbers "15/8" mean CHF 0.0015/CHF 0.0008. Consider the following quotation:

EUR/JPY Spot: 124.55/124.65
1-month swap: 230/220

Here, the swap quotation means JPY 2.30/JPY 2.20 since a point or "pip" for EUR/JPY is 0.01 JPY.

To arrive at the implied outright forward, the swap margins must be added to or subtracted from the corresponding side of the spot quotation. Thus, in the USD/CHF case, 0.0015 must be added to or subtracted from the spot bid rate of 1.4265 and 0.0008 must be added to or subtracted from the spot ask rate 1.4275. How do we know whether to add or subtract the swap points in a given case? The answer is, remember the following two principles:

1. The bank must always make profit, i.e. the rate at which bank sells a currency must exceed the rate at which it buys the same currency. Hence, outright forward ask rate must exceed the bid rate.
2. As a general rule, the bid-ask spread widens as we go farther and farther into the future. It is narrowest for spot, narrower for 1-month forward than for 3-month forward and so forth. The reason is that as expiry date goes farther out into the future, the volume of turnover declines and counterparty credit risk increases.

In the above example, suppose we add the swap points. We will have:

USD/CHF 1-month forward: (1.4265 + 0.0015)/(1.4275 + 0.0008)
= 1.4280/1.4283

implying a bid-ask spread of 3 pips in the 1-month forward quote which is narrower than the spread in the spot quote. This violates the second principle above. Sometimes the mistake will be more obvious. For instance, if the spot quote had been 1.4265/1.4270, adding the swap points would have given us a forward quote of 1.4280/1.4278, which violates the first principle.

Now take another example. We have the following quotes:

USD/CAD Spot: 1.2275/1.2282
3-month Swap: 25/30

If we subtract, we get a 3-month forward of 1.2250/1.2252, which violates the widening of spreads rule; if we add we get 1.2300/1.2312 which satisfies both the requirements.

You will have noticed the difference between the two examples. In the USD/CHF case, the swap quotation was 15/8, a larger number followed by a smaller number; in the USD/CAD case it was 25/30, a smaller number followed by a larger number. We can state the following rule to compute outright forwards implied by a swap quotation:

Spot rate (B/A): Bid rate for B/Ask Rate for B. Units of A per unit of B.

A is the quoted currency, B is the base currency.

If swap points are: Low/High

Add swap points. Quoted currency A at discount; Base currency B at Premium;

If swap points are: High/Low

Subtract swap points. Quoted currency A at premium; Base currency B at discount.

Remember that this rule is conditional upon our convention for quoting rates (B/A), viz. rates are given as units of A per unit of B, bid followed by ask, bid is for the bank buying currency B and ask is for bank selling currency B.

Following these rules, given the EUR/JPY quote cited above, viz.

EUR/JPY Spot: 124.55/124.65
1-month swap: 230/220

The outright forwards would be

(124.55 – 2.30)/(124.65 – 2.20) = 122.25/122.45

If a forward swap quote includes the word "par", it means that the spot rate and the forward outright rate are the same. Par in this case means "zero". A/P is "around par", meaning that the left-hand side of the swap quote must be subtracted and right-hand side added. As we will see later, this happens when the interest rates in the two currencies are same or very close.

Thus, suppose we have:

Spot USD/CAD: 1.5695/00 1-month swap: 6/4 A/P

The 1-month outright forward would be 1.5689/1.5704.

Another point is, which swap points are to be added or subtracted in a given case, those on bid side or those on ask side? The answer can be made clear by an example. Suppose we have the following quote from a bank:

USD/CAD Spot: 1.6560/70
2-month Swap: 15/20

A customer wants the following swap:

The customer will sell US dollars spot and buy US dollars 2 months forward against Canadian dollars.

The bank would regard this as a "B/S" swap. This means that the bank would buy the base currency in the "near leg" of the transaction and sell the base currency in the far leg; the relevant points to be added (added because small number followed by large number in the swap quote) are 20, on the offer or ask side of the swap quote. Thus, the bank will do the forward sale of US dollars at a premium of 20 points over the rate used in the spot leg of the swap. The premium on US dollar is against the customer. If the swap is the other way around, – S/B – with customer buying spot US dollar and selling forward US dollar, i.e. bank will be selling the base currency in the near leg and buying in the far leg, the points to be added are those on the bid side of the swap quote, viz.15. The bank will buy forward US dollars at a price 15 points above the rate used in the spot leg. Thus, in a swap where bank sells forward, it collects a 20-point premium over spot whereas when it buys forward it gives only 15-point premium over spot. In effect, in giving the above quote, the bank is saying that it is willing to swap either way (sell US dollars spot-buy forward or buy US dollars spot -sell forward) with the price in the forward leg being 15 points above the spot price, if the bank is buying US dollars forward and 20 points above the spot, if the bank is selling US dollars forward.

The essence of a swap is the magnitude of the swap margin in relation to the spot rate. In the next chapter, we will see that this must bear a definite relation to the interest rate differential in the money market. The exact spot rate used for the spot leg of the transaction does not matter and in many cases may not precisely equal either the bid or the ask in the bank's spot quote. It can be anywhere in the close neighbourhood of the spot quote. Often, it is the mid-rate between spot bid and ask rates. In the next chapter, we will examine in greater details the mechanics of inter-bank forward dealing.

Forward-Forward Swaps The swaps we have looked at so far are spot-forward swaps. It is possible to do a swap between two forward dates. For instance, purchase (sale) of currency A 3-month forward and simultaneous sale (purchase) of currency A 6-month forward, both against currency B. Such a transaction is called a ***forward-forward swap***. It can be looked upon as a combination of two spot-forward swaps:

1. Sell A spot and buy 3-month forward against B
2. Buy A spot and sell 6-month forward against B

In such a deal, both the spot-forward swaps will be "done off" an identical spot so that the spot transactions offset each other. The customer (and the bank) has created what is known as a ***swap position*** – matched inflow and outflow in a currency but with mismatched timing, with an inflow of three months later and a matching outflow six months later for the customer. The gain/loss from such a transaction depends only on the relative sizes of the three-month and six-month swap margins.

Some Applications of Swaps As mentioned above, banks use swaps amongst themselves to offset positions created in outright forwards done with customers. You may have noticed that a swap deal alters the timing of cash flows. A firm with uncertain timing of foreign currency payables or receivables can use swaps as an alternative to option forwards. For instance, to begin with, a firm can enter into a 3-month forward contract on August 30 to purchase foreign currency to settle a payable. This means it has to take delivery on December 1. By late November, it knows that the shipment will not arrive before December 15. On November 29, it can execute a swap in which it sells the foreign currency spot (value date December 1) and buys 15 days forward. The currency received from the initial forward contract can be used to deliver against the spot leg of the swap. The firm has effectively altered the timing of its foreign currency inflow to hedge its outflow on account of imports. This method will generally work out cheaper than option forward unless the premium on the foreign currency has very sharply increased between August 30 and November 29. Of course, the option forward removes exchange rate uncertainty entirely whereas the alternative method only partially – the swap margin the firm has to pay will not be known till November 29. The firm has essentially extended its forward commitment.

Swaps can be used to roll over forward positions to cover long-term exposures. For many currency pairs, forward contracts are not readily available for longer maturities. For instance, in the Indian market till a few years ago, the tenor of forward contracts could not exceed six months. Firms could handle their long-term exposures using the so called "Roll-Over Forward Contracts". Consider the case of a firm which has contracted a foreign currency loan of $1,000,000. The principal has to be repaid in ten six-monthly installments starting six months from today. Ignoring the interest payments (which could be easily figured into the calculations), the firm has definite outflows of $100,000 every six months for the next five years. The firm would like to know the rupee value of its entire liability at all times. However, at one time in the Indian market, it could not buy dollars more than six months forward at any time. It could use swaps as follows:

- Buy $1,000,000 6-month forward at a rate known today.
- Six months later, take delivery, use $100,000 to repay the first installment. For the remaining $900,000, do a six-month swap – sell in the spot market, buy six months forward. Rupee outflow six months later is again known with certainty.
- Repeat this operation every six months till the loan is repaid.

Even though official restrictions on tenors of forward contracts may not exist, the market may dry up beyond a certain horizon or bid-offer spreads may become very wide forcing market participants to roll over their positions in this manner.

We will see in the next chapter that forward-forward swaps can be used to speculate on interest rate movements (rather movements in interest rate differentials) with minimal exchange rate risk. It can also be used to lock-in the forward margin between two future dates. Banks use swaps to gain access to currencies for which there may not be liquid deposit markets. We will understand the close connection between money markets and swaps and forwards in the foreign exchange market. We will also examine some products which attempt to replicate the forward-forward swap without any spot positions being taken onto books.

In the case of some currencies with restricted capital account, a transaction known as ***Non-deliverable forward*** is available. Here the full amounts of the two currencies are not exchanged at contract maturity; only the difference between the contract rate and the spot rate at maturity is settled in a convertible currency such as US dollar. Thus, suppose a firm enters into a 90-day non-deliverable forward contract to buy US dollars 500,000 against the rupee at the rate of ₹56.00; at maturity the spot rate is ₹55.80. The firm must pay the bank US dollar equivalent (at the spot rate at the time of settlement) of:

$$₹[500000 \times (56.00 - 55.80)], \text{ i.e. } ₹100000.$$

The payment would be USD(100000/55.80) = USD 1792.11.

This product allows foreign investors to hedge their investments in the local currency without actual outflow of foreign exchange.

7.6 PRICING OF SHORT-DATE AND BROKEN DATE CONTRACTS

7.6.1 Short-Date contracts

We have seen above that the normal value date for a spot transaction is two business days ahead. It is possible to deal for shorter maturities, i.e. value same day – "cash" – or value next day – "tom" or tomorrow – in currencies whose time zones permit the transaction to be processed. For instance, it is possible to do a £/$ deal for delivery same day because the five-to-six hour delay between New York and London allows instructions to be transmitted to and processed in New York. A $/¥ deal for same day value would not be possible because by the time New York opens for business, Tokyo is closed.

Short date transactions are those in which value date is ***before*** the spot value date[11]. In this section, we will explain the pricing of such deals.

In the foreign exchange markets, one-day swaps are quoted between today and tomorrow (overnight or O/N), tomorrow and the next day (tom/next or T/N) and spot date and the next day (spot/next or S/N). Note that the T/N swap is between tomorrow and the spot date. These swap rates are governed by the relevant interest rate differentials for one-day borrowings. These swaps are used for rolling over maturing positions.

These swap rates work like any other swap rates described earlier. Thus, suppose we have GBP/USD spot rate of 1.5055/60, spot date Wednesday, and S/N swap rates are 12/5. This is like a usual swap. The outrights for Thursday are calculated by subtracting the points. (Recall the rule, big/small, the quoted currency, in this case USD, is at premium). The outrights would be 1.5043/1.5055.

But now suppose we wish to calculate rates applicable to dates ***before*** the spot date. Suppose today is Tuesday and the spot rate quote is 1.5055/65, the spot date being Thursday. The Tom/Next or T/N swap is being quoted at 12/5 and we want outrights for Wednesday – the day before spot[12]. The T/N swap applies to Wednesday/Thursday.

What does the Wednesday/Thursday swap margin of 12/5 mean? If a ***customer*** wishes to ***buy*** USD, i.e. sell GBP value Wednesday, i.e. tomorrow and ***sell*** USD, i.e. buy GBP value Thursday, i.e. the day after tomorrow, he can ***earn*** a 5 point premium – the swap points on the offer side since USD is being sold (base currency GBP is being bought) in the far leg of this swap. If on the other

[11]This is a strict definition of short date. More loosely, short dates refer to maturities less than a month.

[12]In going from spot to the next day we subtracted points. In going from spot to the previous day, there is a temptation to add points. If we do that we will get a quote of 1.5067/1.5065, i.e. bid higher than ask, which cannot be correct.

hand, the customer wants to ***sell*** USD value Wednesday and ***buy*** value Thursday, he will have to ***pay*** a 12-point premium.

Now suppose we wish to ***buy*** USD, ***sell*** GBP value Wednesday. The bank must get USD on Wednesday to deliver to us. How will the bank square its position? It does the following[13] two transactions:

1. A regular spot purchase of USD. Buy USD value Thursday, i.e. spot date and
2. Swap from Thursday to Wednesday, i.e. buy USD sell GBP value Wednesday and sell USD buy GBP value Thursday.

In doing this, bank's Thursday position is squared up and it has ensured an inflow of USD on Wednesday. Also, as seen above, it earns 5 points in the swap – transaction (2) above. It can pass on this gain to us by giving us a higher price for GBP, delivery Wednesday, compared to the spot quote which is for delivery Thursday. It can quote a GBP bid rate of 1.5060 = 1.5055 + 0.0005.

Now consider the reverse, viz. we wish to ***sell*** USD, ***buy*** GBP value Wednesday, i.e. tomorrow. The bank must get GBP tomorrow to deliver to us and find a buyer to take the USD which we will deliver to bank. Now the bank implements this with the following two deals:

1. Buy GBP, sell USD value Thursday
2. Buy USD, sell GBP value Thursday and sell USD buy GBP value Wednesday.

With these two deals, the bank has disposed off the USD it will acquire from us on Wednesday. In the swap transaction (2), it has to ***pay*** 12 points. It will recover this from us. Hence, its offer rate for GBP, value Wednesday, i.e. tomorrow, would be 12 points above the rate it quotes for value Thursday, i.e. spot value date. It would charge us a rate 1.5060 + 0.0012 = 1.5072 for delivering GBP value Wednesday. Thus, GBP/USD outrights for Wednesday which is a day before the spot value date are 1.5060/1.5072. Notice that the spread has increased for early delivery.

Thus, for calculating outrights before spot date, the rule to be followed is

Reverse the swap margins and then follow the usual rule (i.e. add if small/big, subtract if big/small).

In the above example, the swap margins of 12/5 are reversed to get 5/12 and since it is small/ big, points are added. Some examples of short-date rate computations are provided in the appendix to Chapter 8.

7.6.2 Broken Dates

We have seen that banks normally quote forward rates for certain standard maturities, viz. 1, 2, 3, 6, 9 and 12 months. However, they offer deals with any maturity, e.g. 47 days or 73 days, etc., that is not in whole months. Such deals are called ***broken date*** or ***odd date*** deals. Rates for such deals are calculated by interpolating between two standard dates.

Thus, suppose today is September 7, the spot date is September 9 and we have

GBP/USD Spot: 1.7075/80
2 months: 45/35
3 months: 120/110

[13]The bank may not actually do these transactions. But for pricing, it behaves as if it does.

We want the bid rate for GBP for November 19. This is 2 months and 10 days from the spot date. On the bid side, the GBP is at a discount of 45 points value November 9 and a discount of 120 points value December 9 and there are 30 days between November 9 and December 9. This is interpreted to imply that for the 30-day interval between November 9 and December 9 the discount on GBP increases by 75 points. This implies that a discount of 2.5 points per day on GBP gets added to the bid rate applicable for November 9. Hence, for value date of November 19, we must apply a discount on GBP of 25 points over and above the November 9 quote. This yields a quote of (1.7075-0.0045-0.0025) or 1.7005 for value date of November 19.

Keep in mind, however, that interpolating in this manner has a drawback. If the dates between which you are interpolating are far apart this procedure can produce serious errors. Thus, interpolating an eight-month rate from a six-month and a nine-month rate is not proper. The reason for this will become clearer when we examine the relationships between interest rates and the spot-forward margins. Also note that interpolation assumes that the monthly swap margin can be evenly spread over the days in the month. However, due to special conditions (e.g. bank reporting, tax payment days, etc.) one-day swap margins may not be identical throughout the week. In such cases, special adjustments are needed. You can consult Walmsley (1983) for the technical details[14]. Some examples of such calculations can be found in the appendix to Chapter 8.

7.7 EXCHANGE RATE REGIMES AND THE FOREIGN EXCHANGE MARKET IN INDIA

7.7.1 Exchange Rate Regime and Exchange Control

The exchange rate regime in India has undergone significant changes since independence and, particularly, during the 1990s. The following table provides a bird's eye view of the major changes up to 2009.

Year	*Type of Change*
1949	Rupee devalued against the dollar by 30.5 per cent in September.
1966	The rupee was devalued by 57.5 per cent against the Sterling on June 6.
1967	Rupee-Sterling parity changed as a result of devaluation of sterling.
1971	Bretton-Woods system broke down in August. Rupee briefly pegged to the US dollar at ₹7.50 before repegging to Sterling at ₹18.9677 with a 2.25 per cent margin on either side.
1972	Sterling was floated on June 23. Rupee-Sterling parity revalued to ₹18.95 and then in October to ₹18.80.
1975	Rupee pegged to an undisclosed currency basket with margins of 2.25 per cent on either side. Intervention currency was sterling with a central rate of ₹18.3084. Managed float.
1979	Margins around basket parity widened to 5 per cent on each side in January.
1991	Rupee devalued by 22 per cent on July 1 and July 3. Rupee-Dollar rate depreciated from 21.20 to 25.80. A version of dual exchange rate introduced through EXIM scrip scheme giving exporters freely tradable import entitlements equivalent to 30-40 per cent of export earnings.

[14]However, bear in mind that these "special factors" keep changing from country to country and over time. At any given time, only a professional foreign exchange dealer would know the nitty-gritty of rate computation.

1992	LERMS (Liberalised Exchange Rate Management System) introduced with 40-60 dual rate for converting export proceeds, market determined rate for all, but specified imports and market rate for approved capital transactions. US dollar became intervention currency from March 4. EXIM scrip scheme abolished.
1993	Unified market determined exchange rate introduced for all transactions. RBI would buy spot US dollars and sell US dollars for specified purposes. It will not buy or sell forward though it will enter into dollar swaps. FERA amended. Rupee characterised as "independently floating".
1994	RBI announces substantial relaxation of exchange controls for current account transactions and a target date for moving to current account convertibility. Rupee declared current account convertible in August 1994.
1997	Committee on Capital Account Convertibility submits its report. Recommends phased removal of restrictions on capital account transactions.
1999	FEMA enacted to replace FERA.
2001	Further significant liberalisation of the capital account.
2002	Ceiling for FII holdings in a company raised. Limits for Indian companies investing abroad liberalised.
2004	An Indian party may make direct investment in a Joint Venture or Wholly Owned Subsidiary outside India. The total financial commitment of the Indian party in Joint Ventures/Wholly Owned Subsidiaries shall not exceed 100 per cent of the net worth of the Indian Party as on the date of the last audited balance sheet.
2005	With a view to promoting Indian investment abroad and to enable Indian companies to reap the benefits of globalisation, it has been decided to raise the above ceiling from the present 100 per cent of the net worth to 200 per cent of the net worth of the investing company. Accordingly, under the automatic route for overseas investment, eligible Indian entities are now permitted to invest in overseas in JV/WOS up to 200 per cent of their net worth.
2006	Foreign investment and external commercial borrowing (ECB) policy liberalised.
2007	Measures to simplify external payments regime and deepen the forex market. Tarapore Committee submits the report on full capital account convertibility. Foreign investment and ECB policy further liberalised.
2008	Further liberalisation of external payments regime, foreign investment policy and ECB policy.
2009	Measures to encourage capital inflows, particularly equity investment.

The trend towards greater liberalisation continues. Full convertibility on current and capital accounts is expected to be in place in the near future.

Throughout this period, the RBI has administered a very complex system of exchange control. The statutory framework was provided by the Foreign Exchange Regulation Act (FERA) of 1947 which was amended in 1973, 1974 and 1993. It has been replaced by Foreign Exchange Management Act (FEMA) of 1999. Even a summary treatment of its myriad provisions and historical evolution would require a book-length study. Further, exchange control regulations are liable to be changed frequently. Consequently, we cannot present more than a cursory discussion of the key ingredients which have a bearing on the working of the foreign exchange market in India. For further details, the interested readers should consult the latest edition of the Exchange Control Manual which is available on the RBI website and the subsequent exchange control announcements are also available there and published in RBI's Monthly Bulletin.

The following few paragraphs taken from the RBI notifications pertaining to FEMA summarise the broad framework of exchange control.

"Application of FEMA may be seen broadly from two angles, viz., capital account transactions and current account transactions. Capital account transactions relate to movement of capital, e.g. transactions in property and investments and lending and borrowing money. Transactions which do not fall in capital account category are current account transactions which are permitted freely subject to a few restrictions as given in the following paragraph.

(a) Certain current account transactions would require RBI permission, if they exceed a certain ceiling.
(b) A few current account transactions need permission of appropriate Government of India authority irrespective of the amount.
(c) There are seven types of current account transactions which are totally prohibited and no transaction can, therefore, be undertaken relating to them. These include transactions relating to lotteries, football pools, banned magazines and a few others."

"Some other highlights of the new Act are:

- The Foreign Exchange Management Act and Rules give full freedom to a person resident in India who was earlier resident outside India to hold or own or transfer any foreign security or immovable property situated outside India and acquired when he/she was resident there.
- Similar freedom is also given to a resident who inherits such security or immovable property from a person resident outside India.
- A person resident outside India is permitted to hold shares, securities and properties acquired by him while he/she was resident in India.
- A person resident outside India is also permitted to hold such properties inherited from a person resident in India.
- The exchange drawn can also be used for purpose other than for which it is drawn provided drawal of exchange is otherwise permitted for such purpose.
- Certain prescribed limits have been substantially enhanced. For instance, residents now going abroad for business purposes or for participating in conferences/seminars will not need the Reserve Bank's permission to avail foreign exchange up to US $25,000 per trip irrespective of the period of stay; basic travel quota has been increased from the existing US $3,000 to US $5,000 per calendar year.
- The Exchange Earners' Foreign Currency (EEFC) account holders and Residents' Foreign Exchange (RFC) account holders are permitted to freely use the funds held in EEFC/RFC accounts for payment of all permissible current account transactions."

(All exporters are allowed to retain up to 50 per cent of their export earnings in EEFC accounts. Some categories of exporters are allowed up to 70 per cent.)

- "The rules for foreign investment in India and Indian investment abroad are also comprehensive, transparent and permit Indian companies engaged in certain specified sectors to acquire shares of foreign companies engaged in similar activities by share swap or exchange through issue of ADRs/GDRs up to certain specified limits."

Foreign currency financing by Indian companies by way of bank loans and bond issues and other capital account transactions require advance approvals from the Government and/or RBI. Investments by non-residents in India are also subject to a variety of regulations. A list of capital account transactions by residents and non-residents coming under the purview of these regulations is given in the appendix to this chapter. However, keep in mind that these regulations are subject to continuous change and hence in practice one needs to consult the latest circulars and notifications issued by the RBI.

A convenient summary of exchange restrictions in its member countries is published by the IMF in its annual publication titled ***Exchange Arrangements and Exchange Restrictions***.

The liberalisation and unification of the exchange rate in 1993 signalled a significant beginning in the direction of freeing external transactions from cumbersome administrative controls. While exchange controls on some current account transactions and all capital account transactions are still in place there is now a distinct possibility that the former will be eliminated in the near future while the latter will be relaxed though only gradually[15]. The successive revisions of the guidelines governing external commercial borrowings clearly show a trend towards relaxation of restrictions in terms of size and maturity of borrowings which do not require prior approvals. Restrictions on maximum tenor of forward contracts have been done away with and the RBI at one time permitted transactions like third currency forwards and forward-forward swaps. However, during episodes of excessive volatility in the market, the RBI may and does bring back some of the restrictions at least temporarily. Thus, freedom to cancel and rebook forward contract was partially withdrawn as also the freedom to do forward-forward swaps during periods of extreme volatility. These have been restored after the markets stabilised but may be withdrawn during similar episodes of market panics. The limits on balances that can be held in Exchange Earners' Foreign Currency accounts are temporarily lowered from time to time whenever the rupee shows significant weakness and markets tend to panic. The RBI uses a combination of persuasion, administrative fiats, monetary policy measures such as raising the discount rate or the cash reserve ratio and direct intervention in the forex market to "manage" the rupee exchange rate.

In a statement released in August 2000, the RBI tried to clarify the rationale of its exchange rate policy. Among other things it said:

> "In earlier statements as well as the statement made by the Reserve Bank on May 25, 2000 (and in the annual and half-yearly monetary policy statements), it has been stated that, RBI does not "target" a specific exchange rate in determining its intervention policy or the timing of monetary policy and other measures announced by it from time to time.
>
> ....
>
> The simple point is that when RBI says that it does not "target" a particular level of the exchange rate, it is intended to convey that there is no specific level which it is prepared to defend, through unlimited sales of foreign currency and/or through introduction of strong monetary and other measures. The RBI's view is that past international experience has abundantly made it clear that the defence of a "fixed" previously set target by central banks in developing, as indeed in industrial countries, is simply not practical or desirable in a regime of flexible exchange rates.
>
> ....
>
> The fact that RBI does not target a particular exchange rate does not mean that movements in the exchange market, irrespective of the pace and its level, are matter of no concern and can be ignored. It is also possible that at some levels, which happen to be round numbers, certain measures can be taken. These are, however, not designed to defend the rate at that particular level.
>
> ....

[15]On August 18, 1994, the RBI Governer announced that India is moving to Article VIII status under the IMF articles of agreement. This means that restrictions on current account transactions will be completely eliminated or in other words, the Indian rupee became fully convertible on current account. Among other things, the restrictions on travel, payment of fees, payments for services, etc. remaining after the 1994 budget became "indicative" and the RBI will favourably consider requests for additional allocation of foreign exchange for these purposes.

> India has already taken measures to reduce purely speculative demand for foreign exchange or inter-bank speculation. At the same time, it has to be recognised that, outside of purely speculative demand, "leads and lags" in respect of genuine import demand and export repatriation can also have a very large effect on the demand and supply position in forex markets in the short run. This is because during periods of uncertainty and adverse expectations, genuine importers tend to bunch their demands and enter the market to meet their present requirements as well as their future requirements. Similarly, exporters may hold back genuine export receipts in anticipation of further depreciation. Thus, while the relative absence of pure currency speculation in our markets is helpful, it does not eliminate short-term pressures in the foreign exchange market by genuine exporters/importers in anticipation of future value of the currency. Thus, even when the sudden accumulation of demand is genuine, it may become necessary to intervene or take measures to stabilise expectations, if feasible.
>
> ....
>
> Monetary measures announced by RBI on July 21, 2000, reflected RBI's assessment of developments in the domestic and international markets in regard to liquidity as well as movements in international interest rates abroad, which had hardened considerably over the past year (while Indian interest rates came down substantially). These measures were not designed to defend a specific rate. The purpose of the measures was to shift, at the margin, the relative cost of buying rupees vis-à-vis foreign currencies in the short-run.
>
> ....
>
> These measures were deliberately spaced out, and the quantum of increase was smaller than what would have been required to defend a particular rate.
>
> What would RBI do next?
>
> As already announced, the Reserve Bank will continue to intervene directly or indirectly in the market to meet temporary demand and supply mismatches."

While the Tarapore Committee had targeted year 2000 to achieve capital account convertibility (CAC), Indian policy makers have chosen to go slow in this matter. While significant liberalisation of capital account transactions has taken place, the rupee cannot be said to be convertible on capital account as yet. The Reserve Bank of India wishes to guard against excessive short-term commercial borrowings and the risks inherent in the policy of granting unrestricted freedom to domestic residents to convert their domestic assets into foreign currency in response to market developments and exchange rate expectations. Successive RBI Governers have stressed the need to be very cautious and proceed gradually towards achieving full CAC since any liberalisation initiative once introduced is very difficult to reverse. The official views on the issue of capital account liberalisation and removal of capital controls are captured in the remarks made by Dr. Y.V. Reddy, the then Governor of Reserve Bank at the Central Bank Governors' Symposium convened by the Bank of England in June 2004. In the appendix to this chapter some extracts from his speech have been reproduced. The appendix also contains a summary of the present status of liberalisation of capital account.

In early 2010, the RBI Governor Dr. Subbarao restated the RBI stance towards exchange rate policy, viz. no particular exchange rate target but intervention to smooth volatility. Some analysts have pointed out that RBI acts strongly when the rupee tends to appreciate – it buys dollars in open market operations, but does not react so strongly when rupee depreciates.

For a few months prior to the budget in February 1993, the rupee experienced substantial depreciation and forward premiums on the US dollar also increased significantly. Roughly from

April 1993 to October 1995, the rupee ruled very firm moving in a very narrow band. Forward premiums on the dollar also steadily declined reaching a level of less than 2 per cent per annum by the beginning of 1994. The Reserve Bank had to intervene in the market to mop up a large surplus of dollars to prevent the rupee from appreciating. This has been attributed to various causes. Among them were the continuing weakness in the industrial sector which had kept imports down and the large inflow of foreign capital via ADR/GDR issues by Indian companies, portfolio investments in the Indian stock markets by foreign institutional investors and to a lesser extent, direct foreign investment flows.

After nearly two and a half years of stability, the rupee suddenly plunged from a level little above ₹31 per USD to ₹38.00 per USD in October 1995. This was attributed partly to the steady worsening of Indian exporters' loss of competitiveness during the preceding two and a half years as the Indian economy continued to experience inflation rates far higher than its major trading partners. There were also some technical factors such as the decision by the government to acquire foreign exchange in the market (instead of from the RBI) to service its foreign currency liabilities and huge purchases of dollars by the oil companies to settle their oil payments. On the capital account, foreign capital inflows had reduced to a small trickle by the end of 1994. The Indian economy was climbing out of the recession, thus necessitating a larger quantum of imports while export growth experienced during 1992-1993 had leveled off. The rupee recovered thereafter but there was a marked increase in the volatility of both the spot rupee-dollar rate and the forward premiums on the dollar.

Following the Asian crisis in the summer of 1997, there was a general withdrawal by foreign investors from emerging markets. The rupee experienced another sharp decline towards the end of 1997 weakening above ₹39 to a dollar. The downtrend continued till the middle of 1998 with the dollar climbing above ₹42.50. For most of 1999 it ruled slightly above ₹43.50. The rupee again came under pressure around the middle of 2000, and continued to weaken through the rest of the year with the dollar touching almost ₹47.00 on some days. This was attributed to rising current account deficit and net sales of Indian equity by foreign institutional investors. The rupee continued to decline against the dollar through 2001 reaching a peak of almost ₹50 per USD by late 2002.

Since then the rupee has exhibited mixed behaviour. The foreign exchange market saw significant increases in foreign capital inflows on account of foreign institutional and NRI investment in the Indian stock market. While export growth has been quite strong, so has been the growth in imports fuelled by acceleration of economic growth in India and the oil price hike in early 2005. Foreign exchange reserves have accumulated significantly throughout 2004 and first half of 2005. The rupee has generally been strong against the dollar while it has been generally depreciating against the currencies of other advanced economies such as euro and yen.

During 2006-07 and 2007-08, capital inflows far exceeded the current account deficit. RBI intervened strongly to prevent strong appreciation of the rupee. During those two years, rupee appreciated by about 11 per cent. In 2008-09, capital flows turned negative due to the financial crisis in US and the rupee depreciated by nearly 22 per cent.

Figures 7.2 to 7.4 exhibit the long-term, medium-term and short-term behaviour of the rupee-dollar exchange rate over the period early 2003 to May 2013. Figure 7.5 depicts the rupee against other major currencies. The appreciation of the rupee against the US dollar during 2007 and part of 2008 caused considerable anxiety as to whether it would have serious adverse impact on the competitive position of Indian exporters.

A vigorous debate is on about the advisability of opening up the capital account before the domestic financial sector reforms are completed. Experience of some Latin American countries shows that a premature relaxation of capital controls (before deregulation of interest rates) may

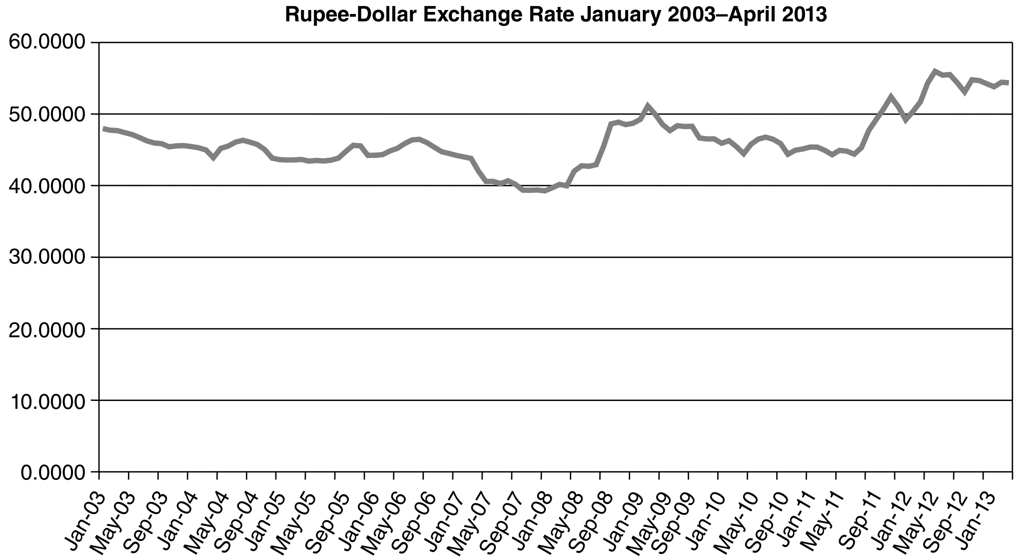


Fig. 7.2

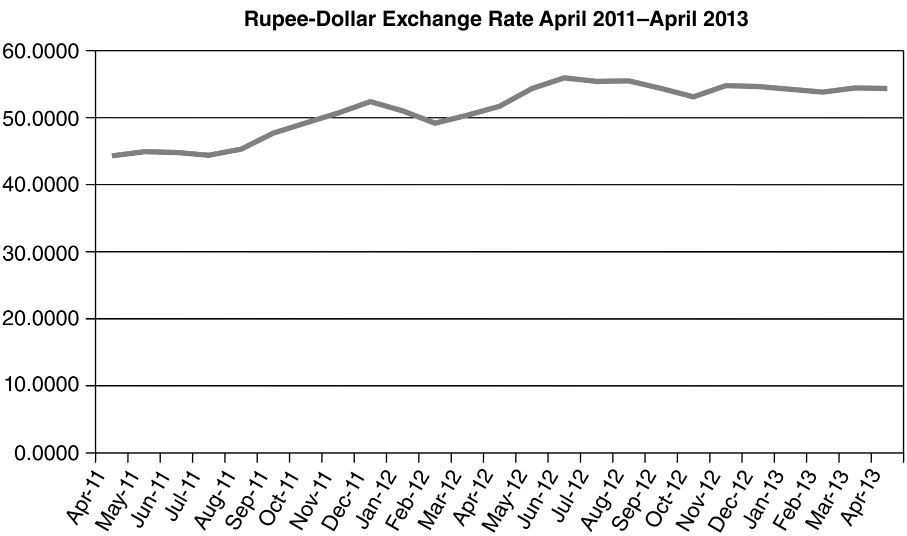


Fig. 7.3

induce massive short-term capital inflows putting upward pressure on the rupee and thus hurting India's exports.

However, a study by Caprio et al. (1993) of the experiences of various developing countries regarding financial sector reforms shows that some countries have opened up the capital account before completing financial sector reforms without significant adverse consequences. However, the same study does conclude that prior to a full relaxation, it is necessary to achieve macroeconomic balance and ensure the soundness of the domestic financial system including commercial banks.

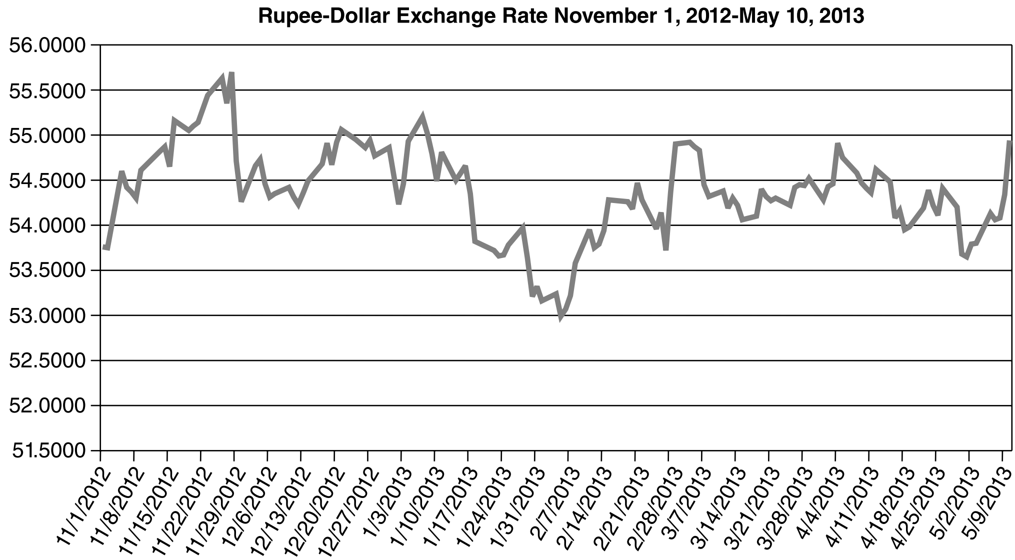


Fig. 7.4

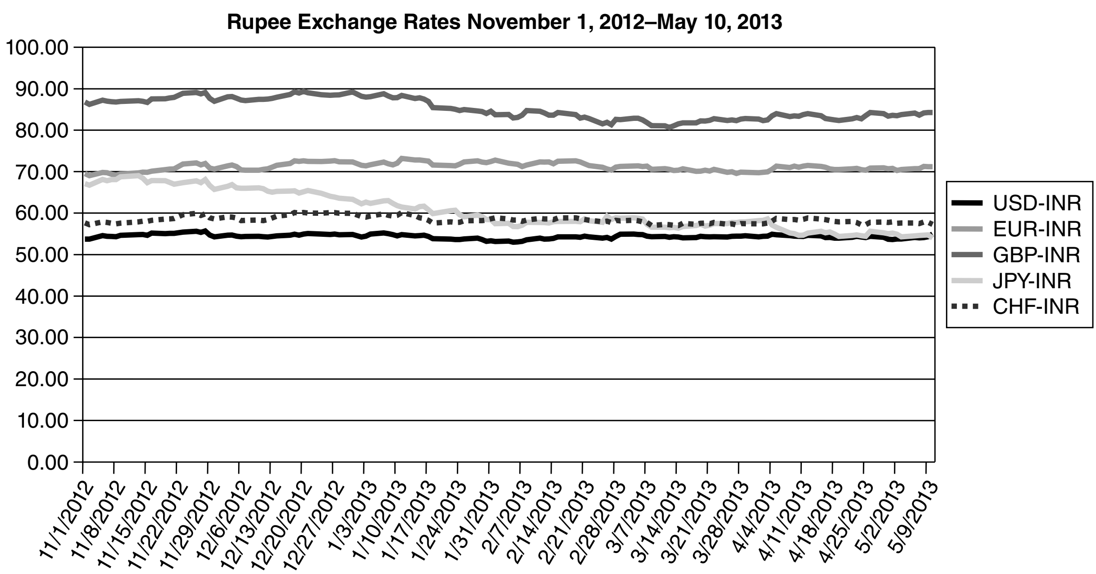


Fig. 7.5

In early 1997, a committee was appointed to recommend steps to be initiated for a phased introduction of capital account convertibility. The committee submitted its report in the first week of June 1997. The committee recommended that conditional upon meeting certain macroeconomic stability criteria – reduction in public deficits, sustained low inflation, reduction in the debt service ratio and improvements in banking system's balance sheet – India should move to capital account convertibility in a phased manner by the year 2000. The attainment of macroeconomic stability is not visualised to be a one-time event, but a continuous process. The opening up is to be carried out in three phases with periodic review and the option – under extreme circumstances – of suspending or reversing the process.

The three phases were to be characterised by increasing liberalisation of capital flows into and out of the country and widening and deepening of the foreign exchange market including introduction of derivative products. Apart from the "preconditions" in terms of fiscal deficit, inflation rate and strengthening of the financial sector, the Committee also suggested monitoring of certain indicators among which are state of the current account and adequacy of foreign exchange reserves. They suggested that the Reserve Bank of India should manage the exchange rate so as to keep the real exchange rate within ± 5% of the equilibrium real exchange rate. In the appendix to this chapter we have provided an extract from the report of the Committee on Capital Account Convertibility which gives a summary of the recommendations regarding the phased opening up of the capital account. As of April 2005, capital controls continue to exist though there has been considerable progress in the direction of relaxation of controls on inward foreign direct and portfolio investments including external commercial borrowings. Restrictions on outward capital flows continued more or less unchanged till the budget for the year 2001-02 announced significant relaxations. As stated above, in 2004, Indian companies were permitted to invest up to 100 per cent of their net worth in foreign joint ventures or wholly owned subsidiaries. In 2005, this ceiling was further raised to 200 per cent of their net worth. Recently it has been revised upwards to 400 per cent of net worth. However, this restriction does not apply if the company is funding the foreign investment using funds from its EEFC – Export Earners' Foreign Currency – account or by means of an ADR/GDR issue.

As the economy moves further towards full capital account convertibility, the volatility of exchange rate is bound to increase. Also, the extent of uncertainty regarding the pattern and quantum of exchange rate fluctuations will also increase substantially as has happened in the case of all convertible currencies. Foreign exchange risk management will then become a very important concern for many Indian firms. The menu of risk management products has been expanding in India and currency options have been introduced more than three years ago. Currency futures markets were launched in India in 2008 by the three major stock exchanges – NSE, MCX and BSE – between INR and USD. Subsequently in January 2010, contracts between INR and EUR, INR and GBP, and INR and JPY were introduced in these markets. The successive budgets presented to the parliament starting in the year 2000 have contained several measures which have eased the restrictions on both inward and outward capital flows. The appendix to this chapter contains the relevant extracts from some of the RBI notification announcing these changes.

In 2005, the RBI appointed an Internal Technical Group on Forex Markets to undertake a comprehensive review of measures initiated by RBI till then and identify areas for further liberalisation of exchange controls along with a medium-term framework to examine issues concerning capital account liberalisation. The report of this group is available on RBI's website.

7.7.2 The Structure of the Indian Foreign Exchange Market

The foreign exchange market in India consists of three segments or tiers. The first consists of transactions between the Reserve Bank of India (RBI) and the ***Authorised Dealers*** (ADs). In March 2006, the RBI issued a circular categorising authorised dealers into three categories. Category I which includes all commercial banks, state co-operative banks and urban co-operative banks are allowed to engage in all current and capital account transactions following RBI guidelines in force at the time. Category II includes co-operative banks, Regional Rural Banks and upgraded Full Fledged Money Changers (FFMCs) who are allowed to release or remit foreign exchange for specified non-trade related current account transactions such as business travel, medical treatment abroad, film shooting, overseas education, etc. RBI specifies criteria to grant Category II AD licences which mainly focus on strong financials, good corporate governance and prudential comfort and adequate internal controls. Category III consists of selected financial institutions such as EXIM Bank who are allowed to undertake forex transactions related to their activities. Apart from these there are Full Fledged Money Changers who are allowed to purchase foreign exchange and sell for private and business visits abroad. The details of activities permitted to various categories of authorised dealers can be found in RBI's circular titled "A.P. (DIR Series) Circular No. 25" available on its website. The second segment of the forex market is the inter-bank market in which the ADs deal with each other and the third segment consists of transactions between ADs and their corporate customers[16]. The retail market in currency notes and travellers' cheques caters to tourists. In the retail segment, in addition to the ADs, there are ***Money Changers*** who are allowed to deal in foreign currencies[17].

Figure 7.6 taken from an RBI document titled "Financial Markets" depicts the average daily turnover, inter-bank and merchant segments in the Indian foreign exchange market during recent years. The most important centre is Mumbai. Other active centres are Delhi, Calcutta, Chennai, Cochin and Bangalore.

The Indian market started acquiring some depth and features of a well functioning market, e.g. active market makers prepared to quote two-way rates, only around 1985. Even then, two-way forward quotes were generally not available. In the inter-bank market, forward quotes were given in the form of near-term swaps mainly for ADs to adjust their positions in various currencies.

Apart from the ADs, currency brokers engage in the business of matching sellers with buyers in the inter-bank market collecting a commission from both. At one time FEDAI[18] rules required that deals between ADs in the same market centres must be effected through accredited brokers.

The volume of transactions in both the merchant and inter-bank segments of the foreign exchange market has been rapidly increasing during the last decade. The Annual Report of RBI provides data on various aspects of the Indian foreign exchange market. The daily total turnover in all segments used to be less than US $4 billion in 1996-97. In the month of June 2009, it was reported to be over US $40 billion. This was after a significant decline following the global crisis in 2008. As seen in Figure 7.6, the average daily turnover reported during September 2008 was over US $60 billion. During June 2009, the average daily turnover in the merchant segment was about US $10 billion compared to US $1 billion in 1997-98 while the inter-bank volume had risen to US $30 billion from a level of 4 billion in 1997-98. The composition of the total turnover in terms of types of transactions – spot, forward or swaps – is quite different in merchant segment compared to the interbank segment. It also varies between the rupee-foreign currency segment and foreign currency-foreign currency segment. In general, in the rupee-foreign currency part of the merchant segment, spot transactions are about 75 per cent of the total while in the interbank segment swaps and forwards taken together account for about 65 per chant of the total while spot transactions are about 35 per cent of the total. The ratio of inter-bank to merchant turnover hovered in the range of 3.0-5.0 during the year 2009 indicating orderly market activity.

The annual turnover in the foreign exchange market during 2005-06 was reported to be 6.6 times the size of the balance of payments and a little over 30 times the foreign currency assets of RBI.

With increasing turnover, the bid-offer spreads have also narrowed. The normal spot market quote has a spread of 0.50 to 1.0 paise while swap quotes have spreads of around 1 to 2 paise.

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[16]In addition, the ADs also engage in overseas transactions in the overseas markets.

[17]There are "Full-fledged" money changers and "Restricted" money changers. The former are allowed to both buy and sell foreign exchange while the latter can only buy.

[18]Foreign Exchange Dealers' Association of India.

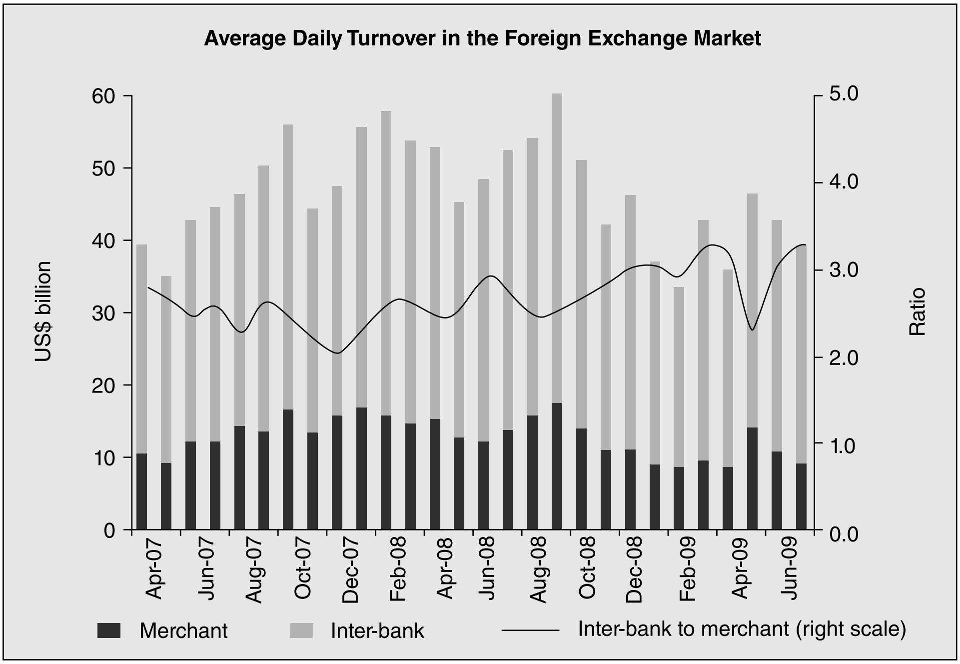

Fig. 7.6 Indian Foreign Exchange Market (Average Daily Turnover Us $ Billion)

As mentioned above, the foreign exchange market in India has been undergoing rapid changes since 1993. The RBI has relaxed a number of restrictions on AD's holding of open positions, balances held abroad and their dealings with customers. The market has acquired some depth though it remains considerably skewed. For instance, it is estimated that nearly 30 per cent of the merchant business originates from the State Bank of India and the foreign banks account for a very large chunk of inter-bank business. Trade related transactions dominate and in the absence of capital mobility forward premiums or discounts are not closely related to interest rate differentials. We cannot present here all the details of its workings, regulatory framework and specific practices. In a particular situation, a practicing banker is the best source of up-to-date information on what kinds of transactions are permissible, how to execute them, how to calculate applicable rates, fees and penalties and so forth. Some useful references are:

1. Chapter VI of the RBI Report on Currency and Finance, May 2007.
2. The report of RBI's Internal Technical Group on Forex Markets cited above.
3. Annual Policy Statement for the Year 2007-08

All these can be accessed on RBI's website.

A number of trading platforms are used by dealers for communicating and trading with each other on a bilateral basis. In the Indian forex market, spot trading takes place on four platforms – FX CLEAR of CCIL, FX Direct launched by IBS Forex (P) Ltd. and two other platforms provided by Reuters.

According to the Report on Currency and Finance of RBI published in May 2007, the Tarapore Committee on Fuller Capital Account Convertibility (FCAC 2006) has proposed introduction of an electronic trading platform for the conduct of all foreign exchange transactions. A brief description can be found in Chapter VI of this report.

One of the risks involved in a foreign exchange transaction between two parties is known as "settlement risk". It is the danger that a bank could lose the principal amount it pays out in a transaction. For example, if an Indian bank pays out $100000 to receive 75000 euros in return from a European counterparty, the Indian bank runs the risk of losing the entire amount, if the European bank defaults.

CLS, a bank-owned institution launched in 2002, plays the role of a clearing and settlement agency that mitigates the settlement risk. It handles this problem by ensuring that both sides' payment instructions are settled at the same time. It operates a payment-versus-payment mechanism in which instructions from the two counterparties to a foreign exchange trade are authenticated, matched and settled on an agreed date. Seventeen central banks are currently members of CLS.

A similar organisation was set up in India in 2001. Designated as Clearing Corporation of India Ltd. (CCIL), it provides clearing and settlement services for transactions in call money, government securities and foreign exchange. It began providing settlement of foreign exchange transactions from November 2002. It has developed a foreign exchange trading platform "FX-CLEAR" which started functioning in August 2003. It started settling cross-currency transactions – transactions involving two foreign currencies – through CLS from April 2005.

7.7.3 Exchange Rate Calculations

Foreign exchange contracts are for ***"cash"*** or ***"ready"*** delivery which means delivery same day, ***"value next day"*** which means delivery next business day and ***"spot"*** which is two business days ahead. For forward contracts, either the delivery date may be fixed in which case the tenor is computed from the spot value date or it may be an option forward in which case delivery may be during a specified week or fortnight, in any case not exceeding one calendar month.

Till August 2, 1993, exchange rate quotations in the wholesale (i.e. inter-bank market) used to be given as indirect quotations, i.e. units of foreign currency per ₹100. Since then, the market has shifted to a system of direct quotes given as rupees per unit (or per 100 units) of foreign currency, with the bid rate referring to the market maker buying the foreign currency and the offer rate being the market maker's rate for selling the foreign currency. We are already familiar with this way of quoting exchange rates.

The rates quoted by banks to their non-bank customers are called "Merchant Rates". Banks quote a variety of exchange rates. The so called ***"TT"*** rates (the abbreviation TT denotes "Telegraphic Transfer") are applicable for clean inward or outward remittances, i.e. the bank undertakes only currency transfers and does not have to perform any other function such as handling documents. For instance, suppose an individual purchases from CitiBank in New York a demand draft for $2000 drawn on CitiBank Bombay. The New York bank will credit the Bombay bank's account with itself immediately. When the individual sells the draft to CitiBank Bombay, the bank will buy the dollars at its ***"TT Buying Rate"***. Similarly, ***"TT Selling Rate"*** is applicable when the bank sells a foreign currency draft or MT. TT buying rate also applies when an exporter asks the bank to collect an export bill and the bank pays the exporter only when it receives payment from the foreign buyer as well as in cancellation of forward sale contracts. (In these cases there will be additional flat fees.)

When there is some delay between the bank paying the customer and itself getting paid, e.g. when the bank discounts export bills, various margins are subtracted from the TT buying rates. Similarly, on the selling side, when the bank has to handle documents such as letters of credit, shipping documents and so forth apart from effecting the payment, margins are added to the TT selling rate. The margins are subject to a ceiling specified by the FEDAI (Foreign Exchange Dealers' Association of India) though a bank can charge less. All this is best illustrated by some examples.

We will explain the principles of rate computation in the text; several worked examples can be found in the appendix to this chapter.

Spot TT Buying Rate This rate is calculated as:

Spot TT Buying Rate = Base Rate – Exchange Margin

The "base rate" is the inter-bank rate. Thus, suppose the inter-bank US dollar quote is ₹53.75/53.77 and the bank wants exchange margin of 0.150%; the TT buying rate would be:

$(53.75)(1 \times 0.00150) = 53.6693$ rounded off to 53.67[19]. Thus, if a draft for $10,000 is cashed by the bank where its overseas account has already been credited, it will give ₹[53.67×10000] = ₹536700.

When cashing a personal cheque or a banker's cheque payable overseas, the bank will not give this rate because it has to send the cheque overseas for collection. This means a delay which is called ***transit period***. The bank will further subtract an exchange margin from the TT buying rate and also recover interest from the customer for the transit period. The transit periods for various countries are specified by the FEDAI and the interest rate to be charged is specified by the RBI. The purpose of the exchange margin is to recover the costs involved and provide a profit margin to the bank.

Spot Bill Buying Rate Exporters draw bills of exchange[20] on their foreign customers. They can sell these bills to an AD for immediate payment. The AD buys the bill and collects payment from the importer. Since there is a delay between the AD paying the exporter and itself getting paid, various margins have to be subtracted from the TT buying rate to compute the bill buying rate.

Bills are of two kinds. ***Sight or demand bills*** require payment by the drawee on presentation. The delay involved in such a bill is only the transit period. ***Time or usance bills*** give time to the importer to settle the payment, i.e. the exporter has agreed to give credit to the importer. In such cases, the delay involved is transit period plus the usance period.

In addition to the exchange margin to cover costs and provide profit, the AD will now load the forward margin for an appropriate period. If the bill is bought on a spot basis, the forward period includes the transit period plus usance period if any. The rate computation formula is laid out below.

Spot Bill Buying Rate

Spot Bill Buying Rate = Inter-bank forward rate for a forward tenor equal to transit plus usance period of the bill, if any – Exchange margin

In addition, the bank is entitled to recover from the customer, interest for the transit plus usance period[21].

The use of this formula is illustrated by some examples worked out in the appendix to this chapter.

For a forward TT purchase, the bank will start with the inter-bank forward rate for the appropriate period and deduct exchange margin. For a forward bill purchase, the bank will start from the inter-

[19]FEDAI prescribes rules for rounding off for various currencies. See Rule 7 in ***Rules of FEDAI*** June 1991, p.45. Rates are quoted up to four decimal points in inter-bank dealings with the last two digits in multiples of 25 while merchant rates are quoted up to two decimal points, rounded off to the nearest paisa.

[20]See appendix to Chapter 4 for a brief discussion of bills as also documentation in international trade.

[21]This interest is charged on account of the fact that in buying the bill from the customer, the bank is paying the customer immediately. In a forward deal, both parties deliver at maturity. If a bill is submitted for collection, the bank pays only when the proceeds are realised. In such cases the TT buying rate applies.

bank forward rate for a tenor which includes (1) the interval between current time and the delivery date of the bill plus (2) transit period plus (3) usance period of the bill if any and finally deduct an exchange margin.

Spot TT Selling Rate This rate is computed as follows:

TT Selling Rate = Base Rate + Exchange Margin

The base rate here is the inter-bank spot selling rate. As usual, the exchange margin is subject to a ceiling specified by the FEDAI.

Thus, suppose a customer wishes to purchase a draft drawn on London for £10,000. The inter-bank £/₹ selling rate is ₹86.50/£. The bank wants an exchange margin of 0.15%. The TT selling rate would be

$$86.50(1 + 0.0015) = 86.6297 \text{ rounded off to ₹}86.63.$$

The customer will have to pay

$$₹\ [10000 \times 86.63] = ₹866300$$

apart from any other bank charges.

Bill Selling Rate When an importer requests the bank to make a payment to a foreign supplier against a bill drawn on the importer, the bank has to handle documents related to the transaction. For this, the bank loads another margin over the TT selling rate to arrive at the Bill Selling Rate. Thus,

Spot Bill Selling Rate = TT Selling Rate + Exchange Margin

Some worked examples in the appendix illustrate the calculation of bill selling rates.

To compute forward TT and bill selling rates, the bank would start from the appropriate inter-bank forward rate for the desired maturity and load TT selling or bill selling margin. Numerical examples can be found in the appendix.

Computations of cross rates are done in the usual manner. In some cases, quotes against rupee may not be available in the Indian inter-bank market. The bank then has to base its quotation on rates available in a foreign market such as London or Singapore. For instance, suppose a customer wishes to buy Spanish peseta. The bank will synthesise a quote based on the ESP/USD rate from the London market and the INR/USD rate in the Bombay market. If INR/USD selling rate is say 45.50 and ESP/USD bid rate is 110.00, then the INR/ESP offer rate will be 41.36 (₹ per 100 pesetas).

Banks often undertake swap transactions among each other to square up their positions arising out of their transactions with customers. The swap quotes as they appear in financial press and their interpretation are dealt with in the appendix to this chapter.

Summary

In this chapter we have discussed the organisation and functioning of the foreign exchange markets in India and abroad. The chapter focuses on the mechanics of spot trading including quotation conventions and trading procedures. It goes on to discuss the structure and functioning of the foreign exchange market in India including recent changes in the exchange control regime. We discuss the notions of two-point and three-point arbitrage in spot markets and the constraints imposed on currency quotes given by different traders so as to make arbitrage impossible. The chapter concludes with explanations of the various types of exchange rates quoted in the Indian market such as TT rates, bill rates, and so forth for transactions between banks and their corporate customers.

Questions and Problems

1. Explain the following terms:
(a) Bid rate
(b) Offer rate
(c) Bid offer spread
(d) Value date
(e) Swap transaction

2. Explain the terms European Quotes, American Quotes, Direct Quotes, Indirect Quotes.
On a particular day at 11.00 a.m., the following $/CHF spot quote is obtained from a bank 1.6225/35
(a) Explain this quotation.
(b) Compute the implied inverse quote CHF/$.
(c) Another bank quoted CHF/$ 0.6154/59. Is there an arbitrage opportunity? If so, how would it work?

3. The following quotes are obtained from two banks:
$/SEK Spot 10.9570/80 10.9578/90
(a) Is there an arbitrage opportunity?
(b) What kind of a market will result?
(c) What might be the reasons for this?

4. The spot bid rate for CHF in New York is $0.5910. A corporate treasurer is going to buy SFr in Zurich at $/CHF 1.6650 and sell them in New York. Will he make a profit? If yes, then how much?

5. In London a dealer quotes:
£/CHF Spot 3.5250/55
£/JPY Spot 180.80/181.30
(a) What do you expect the CHF/JPY rate to be in Geneva?
(b) Suppose that in Geneva you get a quote CHF/JPY Spot 51.1530/51.2550, is there an arbitrage opportunity?

6. The following quotes are obtained in New York:
£/$ = 1.5275/85
$/CHF = 1.5530/35
(a) What rates do you expect for £/CHF spot in London?
(b) If a London bank quotes £/CHF 2.3730/40, can you make arbitrage profits? If so, then how?

7. The following quotes are obtained in New York:
$/CHF Spot: 1.5880/90
1-month forward: 10/5
2-month forward: 20/10
3-month forward: 30/15
Calculate the outright forward rates.

8. The following quotes are available in Amsterdam:
EUR/$ Spot: 0.8875/85
1-month: 12/18
2-month: 15/25
3-month: 20/30
Calculate the outright forwards.

9. A bank is quoting the following rates:
$/CHF Spot: 1.5975/80
2-month: 20/10
3-month: 25/15
$/SAR Spot: 3.7550/60 SAR: Saudi Riyals
2-month: 20/40
3-month: 30/50
A firm wishes to buy Riyals against CHF 3-months forward with an option over the third month. What rate will the bank quote?

10. The following quotes are available in London:
£/AUD Spot: 2.8375/85
Spot/Next: 7/12
Today is Monday. Calculate the rate for delivery on Thursday. Explain your calculations.

11. Electronics Corporation Ltd., your customers, have imported 5,000 catridges at a landed cost in Mumbai, of US$ 20 each. They have the choice of paying for the goods immediately or in three months time. They have a clean overdraft limit with you where 10% p.a. rate of interest is charged. Calculate which of the following methods would be cheaper to your customer:
(a) Pay in three months time with interest at 7% and cover the exchange risk forward for three months.
(b) Settle now at the current spot rate and pay interest of the overdraft for three months.
The rates are as follows:
Mumbai $/INR Spot: 48.75–48.80
3-month swap: 25/35
(*Hint:* For the exercise three months should be taken as a quarter year; exchange commission is to be ignored.)

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APPENDIX

A.7.1 EXCHANGE RATE COMPUTATIONS

We will illustrate calculation of exchange rates for a number of typical situations with some hypothetical examples. Note that we have not followed the FEDAI conventions for various currencies about rounding off the quotes. FEDAI also prescribes ceilings for spot TT buy/sell spreads for half a dozen major currencies[22] as also for loading exchange margins.

Example 1:

A client wants to buy USD 1 million for value date spot. The client contacts the corporate desk and asks for a rate. The corporate dealer asks his inter-bank dealer for USD 1m for value spot. The inter-bank spot dealer quotes 54.92/93. The corporate dealer quotes this to the client. If the client wants to buy USD, then he would buy at 54.93 plus the agreed spread for the corporate client, say

[22]The TT spread (%) is defined as

$$\frac{\text{[TT sell rate – TT buy rate]}}{\text{(1/2)[TT sell rate + TT buy rate]}} \times 100$$

The FEDAI specified ceilings are :

GBP : 2% USD : 1% DEM : 2% JPY : 2% FRF : 2%
NLG : 2% AUD : 2%

There is no ceiling for other currencies as of now.

0.0050. Thus, the net rate to the client to buy 1 million of base currency USD at ₹(54.93 + 0.0050) or ₹54.9350 per one USD. The client has to pay ₹54,935,000 to get USD 1,000,000 for value spot.

Example 2: A Sight Export Bill for $100,000.
A bank purchases a USD demand draft drawn by an Indian exporter on an American customer. This would be backed by a letter of credit accepted by the US customer's bank. The transit period is 15 days. The interbank market spot buying rate is: ₹55.25. One month forward buying rate is at a premium of 15 paise, i.e. the buying rate is ₹55.40. Exchange margin is 0.125%.

The market 15-day forward buying rate would be ₹55.25 plus a premium of 7.5 paise, i.e. ₹55.3250. With the commission the rate given to the customer would be ₹55.3250(1 – 0.00125) = ₹55.2558 rounded off to ₹55.26. The customer will be paid

$$₹[100000 \times 55.26] = ₹5526000$$

Interest for 15 days will be debited separately to the customer's account.

Example 3: A Usance Export Bill for £50,000.
An exporter wants the bank to buy a 30-day bill drawn on a British firm for £50,000. Exchange margin is to be retained at 0.15%. The transit period is 10 days. The market spot bid rate is ₹86.25, one month discount on sterling is 20 paise and two month discount is 50 paise.

Transit period plus usance period add up to 40 days. Interpolating between 30 and 60 days, the discount for 40 days would be $[20 + (10/30) \times 30] = 30$ paise. The rate paid to the customer will be:

$$85.95(1 - 0.0015) = 85.8210, \text{ rounded off to } 85.82.$$

The customer will be paid ₹4291053.75. Interest for 40 days will be recovered separately.

Examples of computation of forward rates are given in the appendix to the next chapter.

Apart from the rate calculations illustrated here, the banks' dealings with their importer/exporter customers are governed by a variety of rules and procedures. In settling import and export payments time lags often arise between a bank paying the customer (e.g. purchasing an export bill) and the bank getting paid or a bank paying on behalf of a customer (under a letter of credit opened for the customer for an import) and the customer paying the bank. In such cases obviously the bank will recover interest from the customer on the amount involved. There are also procedures governing the treatment of overdue bills. For instance, if an export bill purchased from a customer remains unpaid (by the foreign importer) for 30 days beyond the due date, the bank cancels the original purchase of foreign currency by selling the foreign currency back to the customer at the rate ruling on that day; when the bill is finally paid, it buys back the currency again at the ruling rate. In specific cases, such details are best ascertained from a practicing banker well versed in the latest procedures and practices.

A.7.2 PHASED INTRODUCTION OF CAPITAL ACCOUNT CONVERTIBILITY

The following is an extract from the report of the Committee on Capital Account Convertibility which summarises the Committee's recommendations for phased opening up of the capital account over the period 1997-2000.

"... The timing and sequencing of measures for liberalisation of capital outflows and inflows are set out in a tabular form in Chapter 4 classified in relation to various economic agents, viz. corporates, banks, non-banks and individuals. A three-year road map is outlined with Phase I (1997–

98), Phase II (1998–99) and Phase III (1999–2000). Concomitant measures for the development and integration of the foreign exchange, money and securities markets are also set out. Some of the important measures are:

1. Direct investment in ventures abroad by Indian corporates should be allowed up to US $50 million at the level of authorised dealers in terms of transparent guidelines by RBI and beyond US $50 million through the Special Committee. The restrictions on repatriation of dividend, etc., within a time period should be removed. Ventures abroad should not be confined to exporters/exchange earners.
2. Corporate should be allowed to freely open offices abroad for promoting their businesses.
3. ECB (External Commercial Borrowing) ceiling should not be applicable for loans with average maturity of 10 years and above which in Phase II could be reduced to 7 years and above. Restriction on end use of ECB for rupee expenditure should be removed.
4. RBI approval for various purposes while executing projects should be dispensed with subject to guidelines and reporting.
5. Exporters/exchange earners may be allowed 100 per cent retention of earnings in EEFC accounts with complete flexibility in operation of the accounts for current and permitted capital transactions and allowed cheque writing facility in these accounts.
6. Foreign direct and portfolio investment and disinvestment should be governed by comprehensive and transparent guidelines and prior RBI approval at various stages may be dispensed with subject to reporting by ADs. Direct/portfolio investment may be open to all non-residents on par with NRIs and FIIs.
7. Banks may be allowed to borrow from overseas markets and deploy their funds outside India. Borrowings (short and long-term) may be subject to an overall limit of 50 per cent of unimpaired Tier I capital in Phase I, 75 per cent in Phase II and 100 per cent in Phase III with a sub-limit for short-term borrowing. Deployment of funds outside India should be permitted subject to the adherence to Section 25 of the BR Act and prudential norms relating to open position and gap limits.
8. SEBI registered Indian investors may be allowed to set up funds for investments overseas subject to overall limit of US $500 million in Phase I, US $1 billion in Phase II and US $2 billion in Phase III.
9. Individuals may be allowed to invest in assets in financial markets abroad to the extent of US $25,000 in Phase I, US $50,000 in Phase II and US $100,000 in Phase III. Similar limits may be allowed for non residents out of their non-repatriable assets in India.
10. Residents may be allowed to have foreign currency denominated deposits with corporates and banks (only rupee settlement).
11. Residents may be allowed to obtain loans from non residents US $250000 on repatriation basis with interest at LIBOR with no restrictions on use of funds.
12. The non resident non-repatriable rupee deposit scheme should be discontinued in Phase I. Maturity proceeds if kept in a special NRE account for 3 years with no early withdrawal facility should be allowed for full repatriation.
13. All participants in spot markets should be allowed participation in forward markets; FIIs, non-residents and non-resident banks may be allowed forward cover to the extent of their assets in India.
14. All India FIs fulfilling requisite criteria should be allowed to become full-fledged ADs.
15. Currency futures may be introduced with screen based trading and efficient settlement systems.

16. Participation in money markets may be widened, market segmentation removed and interest rates deregulated.
17. RBI should withdraw from primary market in Government securities, role of Primary and Satellite Dealers should be increased, fiscal incentives should be provided for individuals investing in government securities and the government should set up its own office of public debt.
18. Banks and FIs should be allowed to participate in gold markets in India and abroad and deal in gold products.

Some of these recommendations were accepted by the RBI. In 2006, RBI appointed another committee designated as Committee on Fuller Capital Account Convertibility to draw up a second roadmap towards opening up the capital account. The process of capital account liberalisation has maintained its momentum. Regulations governing capital flows – inward and outward – have been substantially liberalised during the period 2006 to 2009. The government has a preferred hierarchy in the liberalisation process. Thus, it has liberalised regulations pertaining to equity flows more than those pertaining to external debt. The group of economic sectors and activities in which foreign direct investment is allowed has been considerably enlarged. Limits on outbound investments by mutual funds and certain registered trusts have been frequently raised. Indian companies are permitted to invest up to 400 per cent of their net worth in foreign joint ventures and wholly owned subsidiaries. In certain sectors such as energy and natural resources, this limit is larger subject to prior approval of RBI.

In a high-level conference on 'The International Monetary System' jointly organised by Swiss National Bank and IMF in early 2010, RBI Governor

Mr. D. Subba Rao said:

"We will continue to move towards liberalising our capital account, but we will revisit the road map to reflect the lessons of the crisis"

He also said that the economy should traverse towards capital convertibility along a gradual path recalibrated on a dynamic basis in response to domestic and global developments.

RBI is likely to appoint a third committee to examine the issues related to full convertibility and come up with a new road map.

A.7.3 CAPITAL ACCOUNT TRANSACTIONS BY RESIDENTS AND NON-RESIDENTS WHICH ARE SUBJECT TO EXCHANGE CONTROL

Classes of capital account transactions of persons resident in India

(a) Investment by a person resident in India in foreign securities.
(b) Foreign currency loans raised in India and abroad by a person resident in India.
(c) Transfer of immovable property outside India by a person resident in India.
(d) Guarantees issued by a person resident in India in favour of a person resident outside India.
(e) Export, import and holding of currency/currency notes.
(f) Loans and overdrafts (borrowings) by a person resident in India from a person resident outside India.
(g) Maintenance of foreign currency accounts in India and outside India by a person resident in India.
(h) Taking out of insurance policy by a person resident in India from an insurance company outside India.

(i) Loans and overdrafts by a person resident in India to a person resident outside India.
(j) Remittance outside India of capital assets of a person resident in India.
(k) Sale and purchase of foreign exchange derivatives in India and abroad and commodity derivatives abroad by a person resident in India.

Classes of capital account transactions of persons resident outside India–

(a) Investment in India by a person resident outside India, that is to say,
    (i) issue of security by a body corporate or an entity in India and investment therein by a person resident outside India; and
    (ii) investment by way of contribution by a person resident outside India to the capital of a firm or a proprietorship concern or an association of persons in India.
(b) Acquisition and transfer of immovable property in India by a person resident outside India.
(c) Guarantee by a person resident outside India in favour of, or on behalf of a person resident in India.
(d) Import and export of currency/currency notes into/from India by a person resident outside India.
(e) Deposits between a person resident in India and a person resident outside India.
(f) Foreign currency accounts in India of a person resident outside India.
(g) Remittance outside India of capital assets in India of a person resident outside India.

Recent liberalisation measures announced in the Union budgets and subsequently notified by the RBI:

1. Indian companies wishing to make acquisitions of foreign companies or direct investment abroad in joint ventures/wholly owned subsidiaries may now invest up to US $50 million on an annual basis through Automatic Route without being subject to the three-year profitability condition. Thus, the limit of investment up to US $50 million which was earlier available in a block of three years would now be available annually without any profitability condition. This ceiling was subsequently raised to US $100 million.
2. Companies may invest 100 per cent of the proceeds of their ADR/GDR[23] issues for acquisitions of foreign companies and direct investments in joint ventures and wholly owned subsidiaries. Earlier such investments out of ADR/GDR issues were subject to a ceiling of 50 per cent.
3. A new facility for additional Block Allocation of foreign exchange to companies with proven track record which have already exhausted the limit of US $50 million available under the Automatic Route for investment/acquisition overseas is also being instituted by the RBI. While considering such application, the Reserve Bank would consider (a) the financial position and business track record of the Indian company (b) prima facie viability of the investments and justification for additional requirement of foreign exchange and (c) contribution of the applicant company to the external trade and other potential benefits to the country out of the investment. Such Block Allocation will be sanctioned by the Reserve Bank in advance and will, therefore, enable Indian companies to negotiate and finalise their acquisitions/direct investments without having to secure permission of the Reserve Bank, subject to post-facto reporting to the RBI. While providing such Block Allocation, RBI would also specify the means of financing as well as the time period over which such permission would be valid.

[23]The ADR/GDR (American/Global Depository Receipts) mechanism is essentially a route to raise equity capital from non-resident investors. It is explained in detail in Chapter 18.

4. Any Indian company that has issued ADRs/GDRs may acquire shares of foreign companies engaged in the same area of core activity upto an amount of US $100 million or an amount equivalent to ten times of their exports in a year, whichever is higher. Earlier this facility was available only to Indian companies in certain sectors.
5. Two-way fungibility in ADR/GDR issues of Indian companies has been introduced, subject to sectoral caps, wherever applicable. Stock brokers in India may now purchase shares and deposit these with the Indian Custodian for issue of ADRs/GDRs by the overseas depository to the extent of the ADRs/GDRs that have been converted into underlying shares.
6. Indian companies will now be able to sponsor ADR/GDR issues with an overseas Depository against shares held by its shareholders who wish to use this option. The issue price shall be determined by the Lead Manager to the issue and the issue proceeds shall be repatriated within one month. The sponsoring company shall have to comply with the provisions of the Scheme for Issue of Foreign Currency Convertible Bonds and Ordinary Shares (through Depository Receipt Mechanism) Scheme, 1993 and guidelines issued thereunder by the Central Government.
7. The ban on overseas investments by registered partnership firms has been removed. Partnership firms providing certain specified professional services, viz. Chartered Accountancy, Legal services, Medical and Health care services, Information Technology and Entertainment Software related services would now be able to invest abroad in foreign concerns in the same line of activity up to US $1 million under Automatic Route. For such investments exceeding US $1 million, approval of the Reserve Bank will be necessary.
8. Indian employees who have the benefit of ESOP schemes in foreign owned companies can now invest up to US $20,000 per annum. Earlier this facility was available only to the extent of US $10,000 in a block of five years.
9. Foreign Institutional Investors (FIIs) can invest in a company under the portfolio investment route up to 24 per cent of the paid up capital of the company. This can be increased to 40 per cent with the approval of the General Body of the shareholders by a special resolution. This limit has now been increased from 40 per cent to 49 per cent.
10. Indian companies may make overseas investment in joint ventures abroad by market purchases without prior approval up to 50 per cent of their net worth.
11. Full convertibility of deposit schemes for Non-resident Indians. The schemes, which do not offer full convertibility to NRIs to be discontinued from April 1, 2002. NRIs will be free to repatriate in foreign currency their current earnings in India.
12. Indian mutual funds allowed to invest in rated securities in countries with fully convertible currencies, within the existing limits.
13. Ceiling on FII investment in debt funds raised from US $1 billion to 1.75 billion in the 2004 budget.

Extracts from a speech by Dr. Y. V. Reddy, Governor, Reserve Bank of India at the Central Bank Governors Symposium convened by the Bank of England in London on June 25, 2004

"In this background, based on the Indian experience, I will present some issues relating to managing capital account.

i. First, capital account liberalisation is a process and it has to be managed keeping in view elasticities in the economy, and vulnerabilities or potential for shocks. These include fiscal, financial, external, and even real sector – say, oil prices and monsoon conditions for India. Professor Rogoff's presentation places special emphasis on government borrowings as a vulnerability.

ii. Second, caution is needed in moving forward with each step in capital account liberalisation, recognising that reversal of any step in liberalisation is very difficult since markets tend to react very negatively to reversals, unless there is already a crisis situation.
iii. Third, the capital account itself needs to be managed during the process of capital account liberalisation. There is a hierarchy in the nature of different types of capital flows in real life. For example, foreign direct investment is preferred for stability, and quantum of short-term external debt, by residual maturity, should not be excessive. Furthermore, adequate reserves, keeping in view the national balance sheet considerations, which include public and private sectors, provide comfort. Public policy can achieve these desirable conditions only through some sort of management of capital account.
iv. Fourth, the management of capital account will be effective under enabling conditions, such as, reasonable confidence in macro policies, in particular tax regimes, and safeguards against misuse of liberalised current account regime to effect capital transfers. Sound management will also avoid dollarisation of the domestic economy and internationalisation of domestic currency.
v. Fifth, operationally, management of capital account involves a distinction not only between residents and non-residents or between inflows and outflows but also between individuals, corporates and financial intermediaries. The financial intermediaries are usually a greater source of volatility amongst these. If such financial intermediaries operating in the developing countries are owned or controlled by foreign entities/investors, there is perhaps greater tendency to volatility in the flows. It is noticed that such foreign owned/controlled intermediaries are often influenced by considerations other than domestic economy and have less appreciation of local conditions – apart from the issues relating to cross-border supervision of financial intermediaries by the host country supervisor.
vi. Sixth, the prudential regulations over financial intermediaries, especially over banks, in respect of their forex exposures and forex transactions must be effective and a dynamic component of management of capital account as well as financial supervision. Such prudential regulations should not be treated as capital controls.
vii. Seventh, capital controls should be treated as only one of the components of management of capital account. As liberalisation advances, the control-regime would contract, and thus, it is the changing mix of controls that characterises the process of liberalisation in management of capital account.
viii. Eighth, capital controls may be price based, including tax-regimes, or administrative measures. Depending on the legal framework and governance structures, the mix between the two would vary. As liberalisation advances, the administrative measures would get reduced and price-based increased, but the freedom to change the mix and reimpose controls should always be demonstrably available. Such freedom to exercise the policy of controls adds comfort to the markets at times of grave uncertainty.
ix. Finally, as mentioned by Professor Kenneth Rogoff, a distinction needs to be made between *de jure* and *de facto* financial integration in general and hence, in the context of capital account in particular. In practice, there are difficulties in measuring the degree of financial integration. However, the institutional structures, both of public policy and markets, need to be evolved to meet the imperatives of liberalised capital account. In the final analysis, the basic issue in any policy context is whether capital controls lead to distortions in exchange rate or the liberalised capital flows that lead to distortions in exchange rate. In respect of emerging economies, the conduct of market participants shows that automatic self-correcting mechanisms do not operate in the forex markets. Hence, the need to manage capital account – which may or may

not include special prudential regulations and capital controls. There are many subtleties and nuances in such a management of capital account which encompasses several macro issues and micro structures.“

A.7.4 BASEL II NORMS FOR CAPITAL REQUIREMENTS AGAINST CURRENCY RISK

In its document titled “Amendment to the Capital Accord to incorporate market risks” [BIS(2005)], the BIS has proposed BASEL II capital adequacy norms for market risks one of which is the risk related to a bank’s foreign exchange business. The document states that two processes are needed to calculate the capital requirement for foreign exchange risk. The first is to measure the exposure in a single currency position. The second is to measure the risks inherent in a bank’s mix of long and short positions in different currencies.

The bank’s net open position in each currency is to be calculated by summing its net spot position, net forward position including currency futures and the notional principal on currency swaps not included in the spot position, any guarantees and net future income/expenses not yet accrued but already fully hedged. Also, as we will see later, if a bank trades in currency options, it is subject to additional currency exposure which is measured by the “delta” of its total options book and BASEL II norms require provision of capital against this risk.

The bank is also required to measure the foreign exchange risk in a portfolio of foreign currency positions and gold. The bank can use a “shorthand” method treating all currencies equally or develop internal models to assess the risk of its total currency positions portfolio. The capital requirement is 8 per cent against total net short or long position whichever is greater.

For further details of BASEL II norms pertaining to currency risk, the reader may consult the BIS publication cited above.

A.7.5 FOREIGN EXCHANGE MANAGEMENT ACT (FEMA)

The Foreign Exchange Regulation Act (FERA) was repealed on 1st June, 2000. It was replaced by the **Foreign Exchange Management Act** (FEMA), which was passed in the winter session of Parliament in 1999. FERA was enacted in 1973, in the backdrop of acute shortage of foreign exchange.

FEMA, which has replaced FERA, had become the need of the hour since FERA had become incompatible with the pro-liberalisation policies of the government of India. FEMA has brought a new management regime of Foreign Exchange consistent with the emerging framework of the WTO.

The object of the Act is to consolidate and amend the law relating to foreign exchange with the objective of facilitating external trade and payments and for promoting the orderly development and maintenance of foreign exchange market in India. FEMA extends to the whole of India. It applies to all branches, offices and agencies outside India owned or controlled by a person who is a resident of India.

A write-up containing the various provisions of FEMA and punishments for contraventions can be accessed on RBI’s website.

Present Status of Capital Account Liberalisation

Account	*Present Regulation*
Authorised Dealers (AD)	RBI has provided licence to the entities for dealing in foreign exchange. They have 3 categories: (a) Authorised Dealers Category-I (Public, Private and Foreign Banks). (b) Authorised Dealers Category-II (Authorised on the city basis. They include cooperative banks, private forex dealers and travel agents, etc.). (c) Authorised Dealers Category-III (Non Banking Finance Corporations) The authority vested in the hands of AF-I is largest (ranging from stock market transactions to NRI accounts, ECBs, ADRs, etc.) while other categories of ADs have a limited role to play.
Foreign Direct Investment (FDI)	FDI is restricted in the following sectors: (a) Multi brand retailing. (b) Lottery (public, private, online), gambling, betting and casino. (c) Chit funds and Nidhi Company. (d) Trading in Transferable Development Rights in real estate business or construction of farm houses. (e) Manufacturing of Cigars, cheroots, cigarillos and cigarettes, of tobacco or tobacco substitutes (f) Atomic energy and Railway transport In rest other sectors such as agriculture, mining, manufacturing, broadcasting, print media, aviation, courier services, construction, telecom, banking, insurance, etc; the limits of FDI range from 26% to 100%. All the foreign operators have to abide by the sectoral restrictions of the statutory regulators in addition to FDI rules.
ADRs/GDRs by Indian companies	Indian companies can raise additional finances abroad through the issue of ADRs/GDRs, in accordance with guidelines issued by the Government of India. Unlisted companies, which have not so far accessed the ADR/GDR route for raising funds in the global market, would require prior listing in the domestic market. Unlisted companies, which have already issued ADRs/GDRs in the international market, have to list in the domestic market on making profit or within three years of such issue of ADRs/GDRs, whichever is earlier. A limited two-way fungibility scheme is also operationalised through the custodians of securities and stock brokers under SEBI.
External Commercial Borrowings (ECBs)/ Foreign Currency Convertible Bonds (FCCBs)	The ECB limit under the automatic route is enhanced to USD 750 million (Circular No. 27 dated September 23, 2011). The maturity guidelines have also been revised (Circular No. 64 January 05, 2012). (a) ECBs up to $20 million in a financial year should have a minimum average maturity of three years. (b) ECBs of more than $20 million and up to $750 million or equivalent should have a minimum average maturity of 5 years. (c) Eligible borrowers under the automatic route can raise Foreign Currency Convertible Bonds (FCCBs) up to USD 750 million or equivalent per financial year for permissible end-uses. (d) Corporates in services like hotel, hospital and software, can raise FCCBs up to USD 200 million or equivalent for permissible end-uses during a financial but the proceeds of the ECB should not be used for acquisition of land. (e) ECB/FCCB availed of for the purpose of refinancing the existing outstanding FCCB should be viewed as part of the limit of USD 750 million available under the automatic route.

Government Securities	NRIs and SEBI registered FIIs are permitted to purchase Government Securities/Treasury bills and Corporate debt. The details are as under. 1. On repatriation basis a Non-resident Indian can purchase without limit, (a) Dated Government securities (other than bearer securities) or treasury bills or units of domestic mutual funds. (b) Bonds issued by a public sector undertaking (PSU) in India. (c) Shares in Public Sector Enterprises being disinvested by GoI. 2. On non-repatriation basis (a) Dated Government securities (other than bearer securities) or treasury bills or units of domestic mutual funds. (b) Units of Money Market Mutual Funds in India. (c) National Plan/Savings Certificates. A SEBI registered FII may purchase, on repatriation basis, dated Government securities/treasury bills, listed non-convertible debentures/bonds issued by an Indian company and units of domestic mutual funds either directly from the issuer of such securities or through a registered stock broker on a recognised stock exchange in India. The FII investment in Government securities and Corporate debt is subject to the Investment limit. For the FIIs in Government securities currently is USD 10 billion and limit in corporate debt is USD 20 million.
Rupee and Foreign Currency Denominated Bonds	Rupee and Foreign currency denominated bonds issued by the Infrastructure Debt Funds (IDFs) set up as an Indian company and registered as Non-Banking Financial Companies (NB-FCs) with the Reserve Bank of India have been allowed (circular number 49, dated 22.11.2011) **Eligible non-resident investors:** Sovereign Wealth Funds, Multilateral Agencies, Pension Funds, Insurance Funds, Endowment Funds, FII, NRI, HNIs registered with SEBI are allowed to invest in these bonds. **Maturity and lock-in period:** The maturity period for these bonds is five years. They are subject to a lock-in period of three years. However, all on-resident investors can trade amongst themselves within this lock-in period of three years. **Quantitative limits:** All non-resident investment in IDFs would be within an overall cap of USD 10 billion. The limit would be within the overall cap of USD 25 billion for FII investment in bonds/non-convertible debentures issued by Indian companies in the infrastructure sector.
Joint Venture/ Wholly owned subsidiary	Overseas Investment can be made under two routes (i) Automatic Route and (ii) Approval Route **Under Automatic Route**, an Indian party has been permitted to make investment in overseas Joint Ventures (JV)/Wholly Owned Subsidiaries (WOS), not exceeding 400% of the net worth as on the date of last audited balance sheet. Investment in an overseas JV/WOS may be funded out of one or more of the following sources: (a) Drawal of foreign exchange from an AD bank in India (b) Capitalisation of exports (c) Swap of shares (d) Proceeds of ECBs/FCCBs (e) Balances held in EEFC account of the Indian party (f) Proceeds of foreign currency funds raised through ADR/GDR issues. In respect of (e) and (f) above, the ceiling of 400% of the net worth will not apply. **Approval of the Reserve Bank:** Sectors have been currently reserved for RBI approval. Investments in energy and natural resources sector, overseas investments by Proprietorship concerns and Registered Trust/Society require prior approval of the Reserve Bank for direct investment abroad.

Disinvestment from Joint Venture/ Wholly owned subsidiary abroad	An Indian Party is allowed to disinvest, subject to the satisfaction of conditions, without prior approval of the RBI in the following cases: (a) The JV/WOS are listed in the overseas stock exchange. (b) The Indian partly is listed on a stock exchange in India and is having a net worth of INR 1000 million and investment in JV/WOS outside India is not exceeding USD 10 million. (c) The Indian Party is an unlisted company and its investment in JV/WOS outside India does not exceed USD 10 million. (d) The Indian party does not have any outstanding dues by way of dividend, technical know-how fees, royalty, consultancy, commission or other entitlements, and/or export proceeds from JV/WOS (e) JV/WOS has been in operation for at least one full year and the Annual Performance Report together with the audited accounts for that year has been submitted to RBI (f) The Indian party is not under investigation by Central Bureau of Investigation (CBI)/ Directorate of Enforcement (DoE)/Securities and Exchange Board of India (SEBI)/ Insurance Regulatory and Development Authority (IRDA) or any other regulatory authority in India An Indian Party, which does not satisfy the conditions stated above for undertaking any disinvestment in its JV/WOS abroad, shall have to apply to the RBI for permission.
Foreign Venture Capital Investment (FVCI)	FVCIs can purchase equity/equity linked instruments/debt/debt instruments, debentures of an Indian Venture Capital Fund through initial public offer or private placement. All their investment would be subject to the SEBI regulation and sector specific caps of FDI.
Foreign Institutional Investment (FII)	Non Resident (NRI)/Persons of Indian Origin (PIO) are allowed to make direct investment in Indian companies under the automatic route. FII/NRI/PIO/HNIs are allowed to invest in the following: (a) Securities in the primary and secondary markets including shares, debentures, and warrants of companies, unlisted, listed, or to be listed on a recognised stock exchange in India (b) Units of schemes floated by domestic mutual funds including the Unit Trust of India, whether listed or not listed on a recognized stock exchange (c) Government securities (d) Derivatives (e) Commercial paper (f) Security receipts (g) Indian Depository Receipts Investments in shares or convertible debentures of an Indian company engaged in the following type of activities are not permitted: (a) Chit fund or Nidhi company; (b) Agricultural or plantation activities (c) Real estate business; (d) Construction of farm houses; or
Commodity Hedging	**Users:** (i) Delegated Route: Companies in India listed on a recognized stock exchange engaged in import and export of commodities are permitted to hedge the price risk of permitted commodities in the international commodity exchanges/markets. (ii) Approval Route: Applications of companies/firms which are not listed on recognized stock exchanges, engaged in import and export of commodities may be forwarded to the Reserve Bank for consideration.

<table>
<tr><td></td><td>(iii) Entities in Special Economic Zones: AD-I may allow entities in SEZ to undertake hedging transactions in the overseas commodity exchanges/markets, subject to the condition that such contract is entered into on a stand-alone basis.

Facilitators: Authorized Dealer category-I provide facilities for remitting foreign currency amounts towards margin requirements and may issue guarantees/standby letters of credit to cover specific payment obligations related to commodity derivatives.

Products: Standard exchange traded futures and options (purchases only) in international commodity exchanges.

Operational Guidelines: AD Category I banks satisfying certain minimum norms, and authorized by the Reserve Bank may grant permission to companies listed on a recognized stock exchange to hedge price risk on import/export in respect of any commodity (except gold, silver, platinum) in the international commodity exchanges/markets.</td></tr>
<tr><td>Derivatives Trading</td><td>Products: Various instruments available under this facility are—Foreign Currency-INR Swaps
Facilitators: AD Category I banks
Users: Residents and companies having a foreign currency liability and undertaking a foreign currency-INR swap to move from a foreign currency liability to a Rupee liability and vice versa, subject to certain minimum prudential requirements or a minimum net worth of ₹200 crore.
Statutory limits: No limits are placed on the AD category I banks for undertaking swaps to facilitate customers to hedge their foreign exchange exposures, a limit of USD 100 million is placed for net supply of foreign exchange in the market on account of swaps which facilitate customers to assume foreign currency liability
Cross currency option and foreign currency-INR option
Facilitators: AD category I banks
Users: Listed companies and their subsidiaries/joint ventures/associates having common treasury and consolidated balance sheet or unlisted companies with a minimum wet worth of ₹200 crore
Interest rate swap, Cross currency swap, Coupon swap, Forward rate agreement
Facilitators: AD category I, Overseas branch of Indian bank authorized to deal in foreign exchange in India and Offshore banking unit in a SEZ in India.
Users: Persons resident in India who have borrowed foreign exchange in accordance with the provisions of FEMA.
Forward foreign exchange contracts
Facilitators: AD Category I banks
Users: Importers and exporters of goods and services, Small and Medium Enterprises and Resident Individuals

Currency Futures: Currency futures contracts have been permitted to be traded in stock exchanges recognised by SEBI in the country.

Regulations:
(a) Currency futures are permitted in US Dollar (USD)-(INR), Euro (EUR)-INR, Japanese Yen (JPY)-INR and Point Sterling (GBP)-INR.
(b) Only ‘persons resident in India’ may purchase or sell currency futures contracts to hedge an exposure to foreign exchange rate risk.
(c) The size of each contract shall be USD 1000 for USD-INR contracts, Euro 1000 for Euro-INR contracts, GBP 1000 for GBP-INR contracts and JPY 100,000 for JPY-INR contracts.</td></tr>
</table>

	(d) The contracts shall be quoted and settled in Indian Rupees with a maturity period of 12 months. (e) AD Category-I are permitted to become trading and clearing members of the currency futures market. **Currency Options:** These are allowed to be traded in stock exchanges approved by SEBI. Regulations: (a) The underlying for the currency option shall be US Dollar-Indian Rupee (USD-INR) spot rate. (b) Only 'persons resident in India' may purchase or sell exchange traded currency options contracts to hedge an exposure to foreign exchange rate risk. (c) The maturity of the contracts shall not exceed twelve months. (d) The size of each contract shall be USD 1000. (e) AD Category-I are permitted to become trading and clearing members.
Overseas Investment by Indian Mutual Funds	Mutual Funds can now invest up to $7 billion overseas. The investment would be subject to the terms and conditions and operational guidelines are issued by SEBI. Besides investment can be also be made in- (a) Overseas mutual funds that make nominal investments (to the extent of 10% of net asset value) in unlisted overseas securities (b) Overseas exchange traded funds that invest in securities (c) ADRs/GDRs of foreign companies
Borrowing in Foreign Exchange by Residents	There is general permission to borrow up to US$ 250,000 or its equivalent in foreign exchange on a repatriable basis by an individual resident from his close relatives resident outside India subject to: (a) The loan is free of interest (b) The minimum maturity period of the loan is 1 year (c) The amount of loan is received by inward remittance in free foreign exchange through normal banking channels or by debit to the NRE/FCNR account of the non-resident lender. A resident, not being a company incorporated in India, may borrow in rupees on non repatriation basis from an NRI to PIO subject to: (a) The term of the loan shall not exceed 3 years (b) The loan has to be utilised for meeting the borrower's personal requirement or for his business purposes and under no circumstances be used for relending or for investment in shares, securities or immovable property (c) The rate of interest shall not exceed 2% over the bank rate prevailing on the date of availing of loan
Exchange Earners' Foreign Currency Account (EEFC)	All categories of foreign exchange earners, such as individuals, companies, etc. who are resident in India, may open EEFC accounts. An EEFC account can be held only in the form of a current account. No interest is payable on EEFC accounts. EEFC account holders were permitted to retain 100% of their Forex earnings in EEFC account with any Authorized Dealer in India. This scheme has been reviewed now (RBI Circular No. 124 dated 10.05.2012) and it has been revised as follows: (a) 50% of the balances lying in the EEFC Account should be transferred to Indian Rupee accounts of the account holders within 15 days from the date of Circular (10/05/2012) (b) For future earnings, only 50% shall be retained in Foreign Currency and the balance 50% shall be converted and transferred to Indian Rupee account (c) EEFC account holders henceforth will be permitted to access the forex market for purchasing foreign exchange only after utilising fully the available balances in the EEFC accounts.

Rupee loans to NRIs	Authorised Dealers (ADs) may grant loan in rupees to NRIs against the security of shares or immovable property in India for personal or business purposes and housing loans against the security of houses/flats to be acquired for residential accommodation in India. Restriction has been removed on the use of loan and allows it to be applied for any purpose other than the basic embargoes on chit funds, Nidhi companies, agricultural and or plantation activities, etc. It cannot also be applied for trading in Transferable Development Rights (TDRs) or investment in capital market including margin trading and derivatives. The loan is non-repatriable. Hence, the loan amount cannot be credited to the NRIs NRE/FCNR accounts. The repayment of the loans should be by direct remittance from abroad or by way of debit to the NRE/FCNR account or by way of sale of shares and immovable property.
Branch/ Project/ Liaison Office of a foreign company in India	Foreign companies keen on setting up of Liasion Office/Branch Office (LO/BO) are required to submit their application to RBI through an Authorised Dealer bank. The applications from such entities in Form FNC will be considered by the Reserve Bank under two routes: **Reserve Bank Route**–Where principal business of the foreign entity falls under sectors where 100% Foreign Direct Investment (FDI) is permissible under the automatic route. **Government Route**–Where principal business of the foreign entity falls under the sectors where 100% FDI is not permissible under the automatic route. Applications from entities falling under the category and those from Non-Government Organisations/Non-Profit Organisations/Government Bodies/Departments are considered by the Reserve Bank in consultation with the Ministry of Finance, Government of India.
Facilities for Non-Resident Indians/ Persons of Indian Origin	Remittance outside India of current income like rent, dividend, pension, interest, etc. in India of the account holder is a permissible debit to the NRO account NRI or PIO may remit an amount up to USD one million, per financial year, from the balances held in its NRO account from the sale proceeds of assets and immovable property without any lock-in-period. Repatriation of sale proceeds of residential property purchased by NRI/PIO is permitted to the extent of the amount paid for acquisition of immovable property in foreign exchange received through banking channels. The facility is restricted for two such properties. The balance amount can be credited to the NRO account and can be remitted under USD 1 million scheme. Authorised Dealer banks have been permitted to issue International Credit Cards to NRIs/ PIO, without prior approval of the Reserve Bank.

Source: RBI Revisions up to 15th June 2012.

Case Study

I

You are just one week 'young' in your job as a treasury executive in a leading laptop trader/supplier in India. Earlier your company was sourcing assembled laptops from China, but with the incentives provided in the Budget of 2006 by the Finance Minister of India, your company is planning to enter assembly/manufacturing market in India.

Now, your company is planning to source components and sub assemblies from Taiwanese firms. This will involve a lot of foreign exchange trading and contracts.

Since you are from a leading business school in India, your CFO has asked you to make a presentation to the top management on various possibilities relating to forex market in India.

Question: What is all that you would like to tell the top management so as to establish your credibility?

II

While you are making presentation to the top management a middle aged person enters the board-room. All the board members exchange smiles with this person.

At the end of your presentation, this new entrant speaks up, "Well, that was a very interesting presentation. It appears that you know a lot about forex markets in India." This person continues, "While, I was on flight today, I came across an interesting bit of information. There was a story in the newspaper mentioning that one can make a 'killing' in forex market, if one is smart enough. I feel that you should tell us about this 'killing' business as well." And goes on to add with a smile and tinge of sarcasm, "I guess this will make our treasury a 'profit centre'". All the board members nod in unison. The chairman takes out the day's paper and hands it over to you to examine the possibility of making a 'killing' in the market.

Sweat breaks on your eyebrows. You do not remember having seen newspaper quotes during your course work, since you devoted the majority of your time during MBA days to cultural activities and student exchange programmes. This is going to be your first real challenge in the industry. You ask for some time to examine the numbers. The chairman and CFO give you patronizing looks and ask you to come back after a working lunch and tell the board about your findings. As you come back to your desk, you feel sudden loss of appetite.

After a while, the same person walks up to your desk and says, "I can understand your predicament. I know you are fresh from your MBA, and just one week young with our company. I hope these numbers help you to present your case", while handing over a piece of paper to you. You do not like the patronizing tone. You thank this person for encouragement (!). You find following details staring at you.

USD/CHF : 1.5963/1.5973. This is a quote available from a bank in Zurich. At the same time, a bank in New York is offering the following spot quote : CHF/USD : 0.6265/0.6270

Further, a New York bank is currently offering these spot quotes:

USD/JPY : 112.25/112.55 and USD/AUD : 1.6659/1.6672

Chapter 8

Forwards, Swaps and Interest Parity

8.1 INTRODUCTION

In the last chapter, we saw that the exchange rate between a pair of currencies varies with the time interval between the transaction date and the settlement date. At various places in that chapter, we also said that the forward premiums or discounts, or swap margins are closely related to the interest rate differential between the two currencies. In particular, interest rate differentials quoted in the inter-bank money markets are closely related to the spot-forward margins. In this chapter we will investigate in detail the nature of that relationship.

We have looked at the concept of arbitrage in the context of the foreign exchange market. In this chapter, we look at a different kind of arbitrage involving the euro-deposit markets and the spot and forward foreign exchange market. We have already come across this concept when we discussed eurocurrency interest rates in Chapter 6. An investor choosing between assets denominated in different currencies looks for the highest possible return ***adjusted for exchange rate changes.*** Since forward markets provide a way of eliminating exchange rate uncertainty, arbitragers will arbitrage between various assets using forward contracts to eliminate the exchange risk. This kind of arbitrage, called ***Covered Interest Arbitrage,*** provides a link between foreign exchange markets and money markets in different currencies.

However, there is another kind of arbitrage referred to as "one-way arbitrage" by Deardorff (1979). One example of this is as follows. Suppose a British corporation needs dollars three months from now and wishes to lock in the pound cost of dollars now. One way to do this is to purchase dollars three months forward against pounds. Another is to borrow pounds now, convert spot to dollars and keep the dollars in the form of a eurodollar deposit for three months. Which method will be more cost effective depends upon the transaction costs in the various markets, the interest rate differential and the spot-forward margin. This kind of arbitrage also provides a link between the deposit markets and foreign exchange markets.

This chapter will begin with a detailed examination of these arbitrage relations including the well-known ***interest parity theorem***. In the process, we will also understand how banks continuously exploit the links between money and foreign exchange markets. We will then introduce the reader to the mechanics of inter-bank dealing in the forward markets.

Next, we will discuss the various uses of the swap transaction for managing cash positions, making covered investments in a foreign currency and speculating on interest rate differentials. Finally, we will examine several innovative products which attempt to replicate forward-forward swaps without actually entering into forward contracts which have credit and capital adequacy implications.

8.2 ARBITRAGE WITHOUT TRANSACTION COSTS

8.2.1 Covered Interest Arbitrage

Before turning to the analysis of covered interest arbitrage, recall the conventions used in stating interest rates in money markets. All interest rates are given as "annualised" rates and interest calculations are done on a simple interest basis. Thus, an interest rate of 10 per cent on 90-day eurodollar deposits means that \$1 put in such a deposit gives you \$[1 + 0.10(90/360)] at the end of 90 days. For some currencies, the "basis" is 365 and not 360 so that the day count fraction[1] is (Actual/365) rather than (Actual/360) as in the case of eurodollar deposit above. Consider the problem of a British investor in London who is choosing between a eurodollar deposit and a sterling deposit to place some surplus funds. The investor does not want to incur any exchange rate risk. To begin with, we will assume away all transaction costs. This means that in the foreign exchange market there are no bid-ask spreads and in the money market, there is no difference between borrowing and lending rates. We will use the following notation:

S : the GBP/USD spot rate
F_n : the GBP/USD forward rate for n-year maturity (n = 1/12, 1/6, 1/4, etc., for 1, 2, 3 months)
$i_{\mathbf{GBP}}$: Annualised interest rate, stated as a fraction, on sterling deposits of maturity n years
$i_{\mathbf{USD}}$: Annualised interest rate, stated as a fraction, on eurodollar n-year deposits

If the investor puts GBP 1 in a n-year sterling deposit, at maturity the value will be

$$\text{GBP } (1 + ni_{\mathbf{GBP}})$$

If the investor chooses to invest in eurodollar **and** eliminate all exchange rate risk, he or she must proceed as follows:

(i) Convert sterling into dollars spot. Each sterling sold will give S dollars
(ii) Invest the S dollars in a n-year eurodollar deposit. At maturity, the deposit will have grown to $\$[(S)(1 + ni_{\mathbf{USD}})]$.
(iii) Simultaneously, enter into a n-year forward contract to sell the dollar proceeds of the deposit for sterling
For each sterling invested in this fashion, the maturity value is

$$\text{GBP } [(S)(1 + ni_{\mathbf{USD}})/(F_n)]$$

In this expression, S is the amount of dollars obtained by converting one GBP into USD at the spot rate, $S(1 + ni_{\mathbf{USD}})$ is the maturity value of the dollar deposit in dollars, which sold forward at F_n dollars per GBP yields the maturity value in sterling.

[1]For a discussion of day count fractions, see Appendix A at the end of the book.

Now suppose these are unequal. Specifically, suppose

$$(1 + ni_{\mathbf{GBP}}) > (S/F_n)(1 + ni_{\mathbf{USD}}) \tag{8.1}$$

i.e.

$$[(1 + ni_{\mathbf{GBP}})\ (F_n/S)] > (1 + ni_{\mathbf{USD}})] \tag{8.2}$$

then the British investor would find it profitable to invest in sterling. Not only that, ***all*** investors would find it profitable to liquidate dollar deposits or borrow dollars and invest in sterling with forward cover. To see this, \$1 in eurodollar deposit gives:

$\$(1 + ni_{\mathbf{USD}})$ at maturity

while the same dollar invested on a covered basis in a sterling deposit gives: $\$[(1/S)(1 + ni_{\mathbf{GBP}})(F_n)]$

If (8.2) holds, the latter exceeds the former.

If the rates are such that (8.2) holds, and there are no restrictions on funds flows, a large number of arbitragers would want to:

1. Liquidate dollar deposits or borrow dollars
2. Sell dollars and buy sterling in the spot market
3. Invest the sterling so acquired in sterling deposits
4. Enter into forward contracts to sell the sterling in their deposit accounts against dollars on maturity of the deposits

The resulting market forces would give rise to one or more of the following:

1. The dollar interest rate $i_{\mathbf{USD}}$ will tend to rise.
2. Dollar will tend to depreciate against the sterling in the spot market, i.e. S would increase.
3. The sterling interest rate $i_{\mathbf{GBP}}$, would fall.
4. Dollar would rise against the sterling in the n-year forward Market, i.e. F_n would fall.

These changes would continue till (8.2) holds with equality. In the reverse case, i.e. if $(1 + ni_{\mathbf{GBP}}) < (S/F_n)(1 + ni_{\mathbf{USD}})$, you can easily see that covered investment in eurodollar would be more attractive and opposite forces will be initiated till again equality is restored.

Thus, in efficient markets, covered investment in either currency would give the same return. There are no riskless arbitrage profits to be had. This is the famous **Covered Interest Parity Theorem.**

Covered Interest Parity Theorem

In the absence of restrictions on capital flows and transaction costs, for any pair of currencies *A* and *B*, the following relation must hold:

$$\frac{(1+ni_A)}{(1+ni_B)} = \frac{F_n(B/A)}{S(B/A)} \tag{8.3}$$

Here, i_A and i_B are annual deposit rates, for currencies *A* and *B*, respectively, F_n is the n-year forward rate and *S* is the spot rate, both stated as amount of *A* per unit of *B*.

It must be stressed that covered interest parity relation is ***not a causal relationship***. It does not say that interest rate differentials “cause” spot-forward margins or vice versa. It is an ***equilibrium relationship***. It only says that in a free market, market forces would enforce the relationship captured in equation (8.3) between interest rates on the two currencies and the spot and forward exchange rates between the two currencies.

Equation (8.3) can also be written as

$$(ni_A - ni_B) = [(F_n - S)/S](1 + ni_B) \tag{8.3a}$$

Figure 8.1 shows this relation graphically. On the x-axis is $[(F_n - S)/S](1 + ni_B)$ and on the y-axis, $(ni_A - ni_B)$. The interest rate parity (IRP) line plots the above equation.

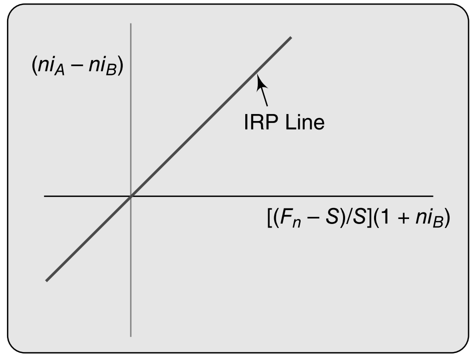

Fig. 8.1

From equation (8.3), it is clear that if $i_A > i_B$ then $F_n(B/A) > S(B/A)$. You have to pay a larger amount of A per unit of B for forward delivery than spot delivery, i.e. currency A is at a forward discount or equivalently B is at a forward premium while if $i_A < i_B$, $F_n(B/A) < S(B/A)$, i.e. currency A is at a forward premium. Thus, the currency with the higher (lower) interest rate is at a forward discount (premium). The logic of this is obvious. Covered interest parity means there cannot be riskless profits – what you gain by way of higher interest rate, must be given up in currency conversion, if you are not willing to take currency risk.

An approximate version of the IRP relation can be derived from (8.3a). It can be rewritten slightly to get:

$$(F_n - S)/S = (ni_A - ni_B)/(1 + ni_B)$$

Since ni_B is usually a small number, $(1 + ni_B)$ can be approximately taken to equal unity. We then get an approximate relation:

$$(F_n - S)/S \approx (ni_A - ni_B)$$

Finally multiply both sides by $(1/n)$. This converts the left-hand side into annualised premium/discount $(F - S)/S$ while the right-hand side is the annualised interest rate differential $(i_A - i_B)$. However, keep in mind that annualised premium or discount does not mean one-year forward premium or discount.

Thus, the IRP relation can be (approximately) interpreted as saying that annualised premium/discount in the foreign exchange market should equal the (annualised) interest rate differential in the deposit markets.

Consider a numerical example. Suppose the spot USD/CHF rate is 1.5000, 6-month forward is 1.4625, the 3-month deposit rates are 4 per cent p.a. for USD and 1.50 per cent p.a. for CHF. A deposit of USD 1 million would be worth USD 1.02 million 6 months later. USD 1 million converted spot to CHF would yield CHF 1.5 million which would grow to CHF (1.5)(1.0075) million 6 months later. This amount sold at CHF 1.4625 per USD would yield USD [(1.5 × 1.0075)/1.4625] million or USD 1.0333 million. This would lead to arbitrage gain – USD can be borrowed, converted to CHF, CHF deposited and the maturity amount of the CHF deposit sold 6 months forward. Given the interest rates and the spot exchange rate, covered interest parity requires that the 6-month forward rate must be [(1.0075/1.0200)(1.5000)] = 1.4816.

8.2.2 One-Way Arbitrage

Notice that covered interest arbitrage involves activities in four markets, viz. the spot and forward foreign exchange markets and the two money markets. We will now look at an arbitrage transaction that avoids the use of one of the markets.

To illustrate this, let us begin with a numerical example. Suppose the market rates are as follows:

USD/CHF spot: 1.6450 6-month forward: 1.6580
Euro$ 6-month interest rate: 4.50% p.a.
EuroCHF 6-month interest rate: 6.50% p.a.

It is easy to see that the forward discount on CHF is

$$[(1.6580 - 1.6450)/1.6450] \times 100 \times 2 = 1.58\%$$

which is less than 2.0 per cent as required by the covered interest parity condition. Forward CHF is overvalued relative to spot CHF.

Consider the following three cases:

1. A Swiss firm needs $1million right now to settle an import bill. It can acquire this in the spot market at a cost of CHF 1.6450 million. Alternatively, it can take a 6-month $1million loan in the eurodollar market to settle the import bill and set aside enough CHF on deposit to buy the dollar loan principal and interest six months forward. The 6-month forward USD/CHF rate is 1.6580.

   To acquire the dollars in the spot market, the company would have to pay CHF 1645000 million right now.

   If it borrows USD 1 million to settle the payable, it will have to repay:

   $$\$1000000[1 + (0.045/2)] = \$1.0225 \text{ million}$$

   To acquire this in the forward market, it will need

   $$\text{CHF } (1.0225 \times 1.6580) \text{ million} = \text{CHF } 1.695305 \text{ million}$$

   Since the euroCHF 6-month interest rate is 6.50 per cent p.a., to have this amount ready six months later, it must deposit now an amount of CHF:

   $$\text{CHF } (1.695305/1.0325) \text{ million} = \text{CHF } 1641941.90$$

   Thus, it saves a little over CHF 3000 by following the indirect route and avoiding the spot market altogether. This accords with the observation above that CHF is relatively overvalued in the six-month forward market and the firm is selling CHF 6-month forward.

2. A US firm needs CHF 1 million 6 months from now to pay off a maturing payable. How should it go about acquiring it? It can directly buy it in the forward market or indirectly acquire it via the spot and money markets – borrow dollars, convert spot to CHF and deposit CHF in the euromarket, use the maturing deposit to settle the payable and pay off the dollar loan. Intuitively, we can guess the answer. It should use the spot-money market route since forward CHF is relatively overvalued and it is buying CHF. We can confirm this by comparing the costs. For a forward purchase, it will need:

   $$\$(1000000/1.6580) = \$603136.31, \text{ 6 months hence.}$$

   Via the indirect route, to have CHF 1 million 6 months hence, it must deposit:

   $$\text{CHF } (1000000/1.0325) = \text{CHF } 968523 \text{ now.}$$

   To acquire this in the spot market it will need to borrow:

   $$\$(968523/1.6450) = \$588767.78 \text{ now.}$$

   The repayment of this loan will require

   $$\$(588767.78 \times 1.0225) = \$602015.06, \text{ six months hence.}$$

Thus, the US firm saves a little over a thousand dollars by avoiding the forward market.

Hence, those who wish to acquire CHF six months from now will use the spot market-money market route while those who wish to sell CHF will want to use the forward market route. Obviously, this will give rise to demand-supply imbalances in the two markets and the rates will have to move.

In an exactly analogous fashion, we can see that if the forward CHF is relatively cheaper, the Swiss firm above will use the spot market-money market route while the American firm will want to use the forward market route. Equilibrium thus demands that the spot-forward margin must conform to interest rate parity. We will generalise this result for any pair of currencies and any horizon.

Suppose a firm needs currency *B* now. It can acquire it in the spot market against currency A at the spot rate *S*(*B/A*). Alternatively, it can borrow *B* in the euro deposit markets, set aside a certain amount of *A* in a deposit and sell the proceeds of the deposit forward against *B* for a maturity equal to the maturity of the *B* loan. The receipts from the forward contract can be used to repay the *B* loan. The amount of *A* that has to be set aside now is the cost of acquiring a unit of *B* in this indirect fashion. This is calculated as follows:

1. Assuming one unit *B* is borrowed for a period of *n* years. To repay the loan, the firm must have $[1 + ni_B]$ units of *B* when the loan matures.
2. To acquire it in the forward market, the firm must have $F_n[1 + ni_B]$ units of *A* when the forward contract matures.
3. So the firm must now set aside an amount of *A* given by $[F_n(1 + ni_B)]/(1 + ni_A)$.

If the cost of the direct spot purchase is not to exceed the cost of the indirect transaction, we must have:

$$\frac{F_n(B/A)(1+ni_B)}{(1+ni_A)} \geq S(B/A) \tag{8.4}$$

If this inequality does not hold, all traders who need *B* now will shun the spot market and there will be no spot demand for *B*. By doing a similar calculation, you can convince yourself that those who need *A* now, will in that case want to acquire it in the spot market by selling *B*. Market forces will push *S*(*B/A*) down.

Suppose (8.4) is satisfied as a strict inequality. Now consider a firm who needs *B*, *n*-year later. It can directly buy it in the forward market or acquire it indirectly by buying it in the spot market against *A* and keeping it in a *n*-year deposit. For the cost of direct purchase not to exceed that of indirect purchase, we must have[2] :

$$\frac{S(B/A)(1+ni_A)}{(1+ni_B)} \geq F_n(B/A)$$

or

$$\frac{F_n(B/A)(1+ni_B)}{(1+ni_A)} \leq S(B/A) \tag{8.5}$$

If (8.5) does not hold, those who need *B* for future use will acquire it in the indirect fashion and demand for *B* in the forward market will dry up leading to excess supply of *B*, driving down the forward price of *B*.

[2]Now we must compare cash outflows in *A*, *n*-year from now.

The conclusion therefore is that both (8.4) and (8.5) must hold with equality, i.e.

$$\frac{F_n(B/A)}{S(B/A)} = \frac{(1+ni_A)}{(1+ni_B)}$$

This is identical to the interest parity relation (8.3). Thus, in the absence of transaction costs, the same condition guarantees absence of covered interest arbitrage as well as one-way arbitrage. We will see below that once transaction costs are introduced, this may not hold.

You might be wondering as to why we have focused on interest rates in the euro deposit markets as governing the spot-forward differential. Why not some other pair of comparable rates such as the prime rates in the two national money markets or treasury bill rates? One reason for this is historical[3]. Euro deposit markets grew out of the Merchant Banks' markets of late 1950s. At the time, euro deposit dealing was done by foreign exchange traders. Conventions regarding settlement dates, maturity dates, etc., were chosen to correspond to those in the foreign exchange markets. A trader could arbitrage between the two markets without having to worry about timing mismatches, e.g. a 30-day forward contract and a 30-day euro deposit have identical maturity dates. The other reason cited in the literature is the fact that euro deposits are practically free from controls and restrictions whereas deposits in a national banking system are subject to potential controls and interference from national monetary authorities. The rates on such deposits may, therefore, include a premium for "political risk", a factor absent from eurodeposits.

A firm may however face interest rates that are different from those in the relevant euromarkets. For instance, an American firm with excellent reputation at home might be able to borrow dollars in the New York money markets cheaper than the eurodollar rate quoted in London. Such "market imperfections" can sometimes give rise to opportunities for cost saving. An example will bring out this point.

An American corporation needs Swedish kroner 10 million three months from now to pay a Swedish supplier. The foreign exchange and eurodeposit rates are as follows:

Spot (USD/SEK) : 7.3050 3-month forward : 7.2688
EuroSEK 3-month deposits: 2%
Euro$ 3-month deposits: 4%

The company can borrow dollars in New York at the prime rate of 3 per cent, while it can earn 2 per cent on euroSEK deposits. Should it purchase SEK in the forward market or acquire them indirectly?

First, you can convince yourself that the IRP relation is satisfied. The dollar cost of acquiring SEK10 million in the forward market is

$(10/7.2688) million = $1375742.90

Alternatively, the firm can borrow dollars for 3 months at 3 per cent, convert spot to SEK, deposit SEK earning 2.0 per cent and pay the supplier when the deposit matures. To have SEK 10 million 3 months later, it must deposit today SEK[10/1.005] million. To acquire this in the spot market, it would need:

USD [(10/1.005)/(7.3050)] today.

[3]Here we refer the reader to Grabbe (1991) who provides a very readable account of the historical evolution of the international financial system including the eurocurrency markets.

It borrows this at 3 per cent p.a. The dollar cost is the amount of repayment for the dollar loan. It is given by:

$(1.0075){[(10)/(1.005)]/(7.3050)} million = $1372330.68

The company saves $3412.22 by the indirect method.

Such situations are by no means rare. A few simple calculations can at times lead to significant savings.

8.3 ARBITRAGE WITH TRANSACTION COSTS

In the real world there are transaction costs. In the foreign exchange markets, these are in the form of bid-ask spreads (In addition, there are costs such as telephone calls, telexes, etc., but these have to be incurred in any market). In the money markets too, there are bid-ask spreads. For instance, the rate at which a eurobank will accept a eurodeposit from another bank, its bid rate, is lower than the rate at which it will lend short-term funds to another bank, the ask rate. The relative magnitudes of these spreads vary between markets depending primarily upon the volume of business. Also, as mentioned above, the interest rates faced by a particular firm may be different from the euromarket rates. The net result of all this is that different ways of achieving the same end result can sometimes have different costs or returns.

In this section, we want to examine the relationships between spot and forward rates, both with bid-ask spreads, and the eurodeposit rates again with bid-ask spreads. As before, we will analyse covered interest arbitrage as well as one-way arbitrage. Before we proceed, we will explain how transactions costs will be incorporated in the analysis.

The Foreign Exchange Market

For any pair of currencies X and Y,

$$\text{Spot } (Y/X)_{\mathbf{bid}} = S(1 - t_s)$$
$$\text{Spot } (Y/X)_{\mathbf{ask}} = S(1 + t_s)$$

Thus suppose spot GBP/USD = 1.4750/1.4758

Then $S = 1.4754$ and $t_s = 0.0002711$

Thus, S can be regarded as the "mid rate" and the spread $2t_sS$ as the transaction cost. When there is no ambiguity, the spot bid rate will be denoted S_b and the spot ask rate S_a.

Similarly, in the forward market

$$\text{Forward } (Y/X)_{\mathbf{bid}} = F(1 - t_f)$$
$$\text{Forward } (Y/X)_{\mathbf{ask}} = F(1 + t_f)$$

Once again, F is the "mid-rate" and $2t_fF$ is the transaction cost in the forward market.

To avoid cluttering up the algebraic expressions, we will assume that all forwards are for one year maturity unless stated otherwise. This involves no loss of generality. The notations F_b and F_a are to be interpreted as the bid and ask rates, respectively for one-year forward.

Eurodeposit Markets: Bid rates are rates banks will pay on deposits; ask rates are rates they would charge on loans.

The bid rate for euro$X$ deposits $i_{Xb} = i_X(1 - t_X)$

The ask rate for euro$X$ loans $i_{Xa} = i_X(1 + t_X)$

The bid rate for euro$Y$ deposits $i_{Yb} = i_Y(1 - t_Y)$
The ask rate for euro$Y$ loans $i_{Ya} = i_Y(1 + t_Y)$
To illustrate, suppose eurodollar interest rates are 4.25/4.75 % p.a.
Then $i_\$$, the "mid-rate" is 4.50% and $t_\$ = 0.0556$

Once again, unless otherwise stated, all deposits will be assumed to be of one year maturity.

8.3.1 Covered Interest Arbitrage with Transaction Costs

Let us begin with a numerical example.

Suppose we have the following rates:

GBP/USD spot: 1.5625/35
Euro\$ deposits: 8¼ – 8½
Euro£ deposits: $12^5/_8$ – 13

With these rates we wish to work out the limits on forward quotes such that there are no covered interest arbitrage opportunities.

(a) Consider first the transaction:
Borrow sterling at 13 per cent p.a., convert spot to dollars, invest dollars and sell the maturing dollar deposit forward. Each sterling borrowed will give \$1.5625 in the spot market. This is deposited at the rate of 8.25 per cent p.a. The maturity value of the deposit is

$$\$(1.5625 \times 1.0825) = \$1.6914$$

This is sold forward at a forward ask rate of F_a. The sterling inflow would be £$(1.6914/F_a)$. The repayment of the sterling loan would require £1.13. If there is to be no riskless profit we must have:

$$(1.6914/F_a) \le 1.13 \text{ or } F_a \ge (1.6914/1.13) = 1.4968$$

(b) Now consider reverse arbitrage. Borrow dollars at 8.5 per cent p.a., convert spot to sterling at \$1.5635 per pound, invest sterling at $12^5/_8$ per cent p.a. and sell the sterling deposit forward. One dollar sold spot would get us (1/1.5635) sterling. This amount deposited at an interest rate of $12^5/_8$ or 12.625 per cent will grow to (1/1.5635)(1.12625) sterling a year later. This would be sold forward at the forward bid rate F_b to fetch F_b [(1/1.5635)(1.12625)] dollars a year later. The repayment of the dollar loan would require \$1.0850. To prevent riskless profit, we must have :

$$F_b\,[(1/1.5635)(1.12625)] \le 1.0850$$

or $$F_b \le (1.0850 \times 1.5635)/1.12625 = 1.5062$$

Finally of course $F_b < F_a$.

The following figure shows the limits:

■---------■
1.4968 1.5062

The actual forward market quote must overlap this range. Thus, a quote such as 1.4965/1.4975 would be acceptable, but 1.4925/1.4950 or 1.5065/1.5085 would permit riskless profits.

Let us now generalise this. Consider a pair of currencies X and Y. The spot bid/offer rates Y/X are S_b/S_a and the forwards are F_b/F_a. The deposit and lending rates are $i_X(1 - t_X)$, $i_X(1 + t_X)$ for X and $i_Y(1 - t_Y)$, $i_Y(1 + t_Y)$ for Y.

Consider first the following set of transactions:

1. Borrow a unit of X
2. Convert spot to Y
3. Invest in euro$Y$ deposit
4. Sell the proceeds of the deposit forward against X

The amount of X obtained on maturity of the forward contract is given by[4] :

$$(1/S_a)[1 + i_Y(1 - t_Y)]\ F_b$$

The repayment of the X loan will require

$$[1 + i_X(1 + t_X)] \text{ units of } X$$

If there is to be no riskless profit, we must have

$$(1/S_a)[1 + i_Y(1 - t_Y)]\ F_b \text{ £ } [1 + i_X(1 + t_X)]$$

or

$$F_b \le S_a \frac{[1 + i_X(1 + t_X)]}{[1 + i_Y(1 - t_Y)]}$$

$$F_b \le \alpha S_a \tag{8.7}$$

where

$$\alpha = \frac{[1 + i_X(1 + t_X)]}{[1 + i_Y(1 - t_Y)]}$$

Now consider arbitrage in the reverse direction, i.e. borrow a unit of Y, convert spot to X, invest in X, sell maturity value of the investment forward against Y. No arbitrage profit condition now requires:

$$\frac{S_b[1 + i_X(1 - t_X)]}{F_a} \le [1 + i_Y(1 + t_Y)]$$

or

$$F_a \ge \frac{S_b[1 + i_X(1 - t_X)]}{[1 + i_Y(1 + t_Y)]}$$

$$F_a \ge \beta S_b \tag{8.8}$$

where

$$\beta = \frac{[1 + i_X(1 - t_X)]}{[1 + i_Y(1 + t_Y)]}$$

Note that whatever be the values of i_X, i_Y, t_X and t_Y, since t_X and t_Y are positive fractions, we must always have $\beta < \alpha$ and since $S_b < S_a$, we must have $\beta S_b < \alpha S_a$.

Figure 8.2 shows the limits on the bid and ask forward quotes imposed by the requirement that there be no profit in a covered interest arbitrage transaction. It also shows permissible and non-permissible forward quotes.

The quotes shown as (i) and (ii) would not lead to arbitrage. The quote (iii) violates (8.8) while (iv) violates (8.7).

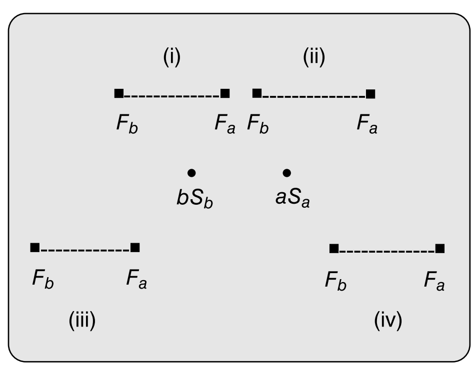

Fig. 8.2

[4]This is obtained as follows: 1 unit of X will buy $1/S_a$ units of Y. This invested at a rate of $i_Y(1 - t_Y)$ will grow to $(1/S_a)[1 + i_Y(1 - t_Y)]$ units of Y, which sold forward will yield $(1/S_a)[1 + i_Y(1 - t_Y)]F_b$ units of X.

Recall from the last chapter the principle that whenever there are direct and "synthetic" quotes for a pair of currencies, they must overlap to prevent arbitrage. The limits βS_b and αS_a are in a sense "synthetic" forward rates.

Unlike the case without transaction costs, now there is no exact relationship between "the spot rate" and "the forward rate". Given a spot bid-ask quote and bid-ask interest rates, a range of forward bid-ask quotes are consistent with the requirement that there be no riskless covered interest arbitrage profits.

8.3.2 One-Way Arbitrage with Transaction Costs

We saw above that in the absence of transaction costs, the condition which renders covered interest arbitrage unprofitable also makes one-way arbitrage activities unprofitable. This is no longer true when transaction costs are introduced. As usual we will begin with a numerical example to illustrate this point and then derive the formulae for the limits on forward quotes implied by the requirement that the rates should not permit one-way arbitrage.

The following rates are available in the market:

Spot USD/CHF: 1.6010/20
3-months forward: 1.5710/25
CHF 3-month rates: 4 - 4¼
EuroUSD 3-month rates: 121/8 – 123/8

1. First let us examine whether there are covered interest arbitrage possibilities.
   Borrow 1 CHF to make a covered investment in 3-month euro\$. At the end of 3 months, you must repay:

   CHF [1 + (0.25)(0.0425)] = CHF 1.0106

   Covered investment in Euro\$ yields, after conversion back to CHF:

   CHF {(1.0/1.6020) [1 + (0.25)(0.12125)](1.5710)} = CHF 1.0104

   This is a losing proposition.
   Borrow \$1 to make a covered investment in CHF.

   You have to repay: \$[1 + (0.25)(0.12375)] = \$1.0309

   Covered CHF investment yields, after conversion back to USD:

   \${(1.6010)[1 + (0.25)(0.04)]}/(1.5725) = \$ 1.0283

   Once again not enough to cover the repayment of the dollar loan.
   Thus, there is no riskless profit to be had by way of covered interest arbitrage.
2. Now consider the case of a Swiss firm which needs \$10 million 3 months from now. The firm has access to the eurodeposit markets, i.e. can borrow or lend at the euro\$ and CHF rates quoted above.
   If the firm buys dollars forward, each dollar will cost CHF 1.5725 three months later.
   As an alternative, it can borrow CHF, convert spot to dollars, place dollars in a euro\$ deposit and use these to make the payment. For every dollar it needs three months later, it must deposit:

   USD {1/[1 + 0.25(0.12125)]} today;

   To acquire this in the spot market, it must borrow:

   CHF(1.6020){1/[1 + 0.25(0.12125)]}

The cost per dollar in terms of CHF outflow 3 months later is

$$\text{CHF}\,(1.6020)\left\{\frac{[1+0.25(0.0425)]}{1+0.25(0.0425)}\right\} = \text{CHF}\,1.5714$$

This yields a saving of CHF 0.0011 per dollar or CHF 11,000 for the \$10 million payment.

This example illustrates the possibility that even when market rates do not allow covered interest arbitrage gains, a firm may still find it profitable to employ the indirect way of obtaining a currency for future use. In a more general sense, it illustrates the principle that market equilibrium is sustained not only by covered interest arbitrage but also by one-way arbitrage. Traders who need to acquire and dispose of currencies as a part of their operating requirements, i.e. not for arbitrage gains, will use the least-cost way of doing so.

Now to proceed to deriving the limits on forward quotes implied by one-way arbitrage. Let us consider the following situation.

A firm needs currency Y now. It can obtain it in the spot market by selling X or it can get it indirectly as follows. It borrows Y in the eurodeposit market, sets aside a certain sum of X earning interest and sells forward the maturity value of this deposit to repay the Y loan. Thus, it bypasses the spot market entirely. What is the condition to ensure that the direct spot purchase costs no more than the indirect acquisition?

The cost of direct purchase of a unit of Y is S_a units of X now. The amount of X that has to be set aside now for the indirect transaction is given by[5]

$$\frac{[1+i_Y(1+t_Y)]F_a}{[1+i_X(1-t_X)]}$$

The required condition therefore is

$$\frac{[1+i_Y(1+t_Y)]F_a}{[1+i_X(1-t_X)]} \geq S_a$$

or

$$F_a \geq S_a \frac{[1+i_x(1+t_X)]}{[1+i_Y(1+t_Y)]}$$

$$\geq \beta\, S_a \tag{8.9}$$

The constant β has been defined above. In an exactly similar fashion, we can compare the cost of direct spot purchase of X against Y and indirect acquisition by borrowing X and covering the repayment of the loan by setting aside an amount of Y and selling it forward. The condition which makes direct purchase no more expensive than indirect acquisition is:

$$F_b \leq \alpha\, S_b \tag{8.10}$$

Now notice however that we cannot a priori say whether $\beta S_a > \alpha S_b$ or $\beta S_a < \alpha S_b$. It depends upon the relative magnitudes of bid-ask spreads in the spot market on the one hand and the deposit markets on the other[6].

- Finally consider the situation of a firm which needs currency Y a year from now. A forward purchase costs F_a units of X, a year from now. Alternatively, the firm could borrow currency X,

[5] This is arrived at as follows: 1 unit of Y borrowed now will require repayment of $[1 + i_Y(1 + t_Y)]$ units of Y. Remember all borrowings, deposits, forward contracts are for one year. To get this amount of Y in the forward market, the firm will need $F_a[1 + i_Y(1 + t_Y)]$ units of X when the contract matures. It must now deposit $F_a[1 + i_Y(1 + t_Y)]/[1 + i_X(1 - t_X)]$ units of X.

[6] $\chi S_a > < \beta S_b$ according to whether

$(S_a/S_b) > < [1 + i_X(1 + t_X)][1 + i_Y(1 + t_Y)]/[1 + i_X(1 - t_X)][1 + i_Y(1 - t_Y)]$

convert spot to Y and keep the proceeds in a one-year deposit. The amount of X required to be paid back a year from now is

$$\frac{[1+i_X(1+t_X)]}{[1+i_Y(1-t_Y)]}S_a = \alpha\, S_a$$

For a viable forward market to exist, we must have

$$F_a \le \alpha S_a \tag{8.11}$$

In the same manner, we can get the condition

$$F_b \ge \beta S_b \tag{8.12}$$

Figure 8.3 shows the limits imposed by the one-way arbitrage conditions along with those derived from the covered interest arbitrage condition.

We have assumed that $\beta S_a < \alpha S_b$.

In Figure 8.3, forward quotes like (i) and (ii) satisfy all the conditions (8.7)-(8.12). Those like (iii) and (iv) violate the one-way arbitrage conditions (8.9)-(8.12), while quotes like (v) and (vi) satisfy (8.7), (8.8), (8.11) and (8.12), but violate (8.9) and (8.10).

Essentially the one-way arbitrage conditions discussed here impose the requirement that there be non-trivial equilibria in the spot market ***and*** the forward market, i.e. there be willing suppliers and demanders for a currency in the spot and forward markets.

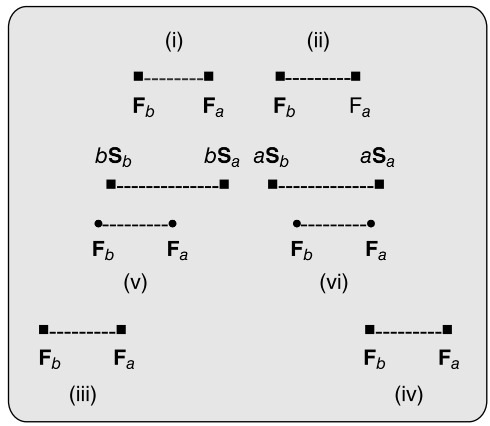

Fig. 8.3

The lesson to be drawn is that at any time, with the various banks quoting a spectrum of spot rates, some of the forward rates available in the markets may violate some of these conditions. There is also the fact mentioned above that a particular firm may face interest rates which are different from those quoted in the euromarkets. The result is, alternative ways of achieving the same end result – e.g. buying or disposing off a currency spot or forward – may not always be equivalent in terms of their costs or benefits. A quick calculation can at times yield significant gains. Our numerical example above has illustrated this point. For more on this see, Deardorff (op.cit.).

8.3.3 Covered Interest Arbitrage in Practice

Does covered interest arbitrage work in reality and, if not, what could be the reasons for departures from covered interest parity? We will take up the second question first.

We have already examined how transaction costs can create a range of forward rates which are all consistent with the "no riskless profits" condition. Given the spot bid-ask rates as well as bid-ask rates in deposit markets, covered interest parity ***does not imply a unique pair of forward bid-ask rates.*** Apart from this, other factors are cited which might lead to further departures from covered interest parity, i.e. departures over and above, what can be explained by the presence of transaction costs[7].

[7]Our treatment here follows closely that in Levi (1996).

We have seen above that one-way arbitrage imposes tighter limits on forward quotes than two-way arbitrage. The departures from interest parity attributable to transaction costs are, therefore, likely to be quite small since bid-ask spreads in foreign exchange markets as well as deposit markets are quite small.

Another factor which is said to cause departures from interest parity is political risk. For an investor resident in country A, home investments are free from political risks (such as confiscation, temporary freezing of foreign deposits, controls on interest payments to non-resident depositors, etc.) while investment in country B does have an element of such risks. Hence, such an investor may demand a risk premium which causes covered yields on A and B currencies to differ. However, it must be noted that if both A and B currencies are traded in Euromarkets, for third-country investors, both have an equal element of political risk and as such they will be guided only by differences in covered yields. Thus, euromarket interest rate differentials and forward margins will obey the interest parity relation quite closely.

Still another explanation offered is taxes. Withholding taxes on interest paid to non-residents may cause departures from interest parity if the investor's home tax authorities do not give full credit for the amount withheld (and also if the tax rate at home is smaller than the withholding tax rate so that the credit cannot be fully utilised). Otherwise, withholding taxes cannot account for the departures. If taxes on ordinary income are higher than capital gains taxes and exchange gains are regarded as capital gains, a covered foreign investment is relatively more attractive even if covered yields are equal.

To see this, let us look at an example. Consider a German investor. Each EUR invested for a year at home brings, post tax:

$$\text{EUR}[1 + (1 - \tau_I)i_G],$$

where τ_I is the tax rate on ordinary income and i_G is the EUR interest rate. A covered investment in dollars yields, pre-tax,

$$[S(\text{EUR/\$})/F(\text{EUR/\$})][1 + i_{US}] = [(S - F)/F](1 + i_{US}) + (1 + i_{US})$$

The first term on the RHS is the exchange gain and the second term is principal plus interest. Post tax, the return is

$$1 + (1 - \tau_I)i_{US} + (1 - \tau_C)[(S - F)/F](1 + i_{US})$$

Here τ_C is the capital gains tax rate. The investor would be indifferent if the two returns are equal i.e. if

$$i_G - i_{US} = [(1 - \tau_C)/(1 - \tau_I)][(S - F)/F](1 + i_{US})$$

With no taxes or τ_C and τ_I equal, the equilibrium condition would be:

$$i_G - i_{US} = [(S - F)/F](1 + i_{US})$$

If $\tau_C < \tau_I$, then $(1 - \tau_C) > (1 - \tau_I)$ and $[(1 - \tau_C)/(1 - \tau_I)] > 1$. Hence, the equilibrium condition must satisfy

$$i_G - i_{US} > [(S - F)/F](1 + i_{US})$$

The German interest rate will have to be higher for investor indifference than in the case when the two tax rates are equal or there are no taxes.

This may account for the departures if such taxation treatment applies to the dominant players in the foreign exchange market. However, for such players, e.g. commercial banks, exchange gains are a part of normal business and are usually taxed as ordinary income. Consequently, it is unlikely that this factor by itself will cause significant departures from interest parity.

If a covered foreign investment has to be prematurely liquidated, extra transaction costs are incurred because an additional spot and a forward transaction must be undertaken – spot to convert the foreign currency on liquidation, forward to cover the original forward sale. These do not arise, if a domestic investment is liquidated. This may lead to a slight preference for domestic investment. This does not apply to third-country investors, e.g. Japanese banks, deciding between covered investment in GBP versus US dollar.

It must be stressed again that covered interest parity applies to eurorates, i.e. the rates in the inter-bank market and spot-forward margins. The interest rates accessible to a particular firm may differ significantly from eurorates because of government restrictions or the firm's own creditworthiness.

Finally, we must keep in mind that there are different categories of market participants with different objectives operating in the spot and forward markets. One set of participants is commercial hedgers – e.g. corporate treasurers – who are using the forward market to hedge the currency exposure on their import payables and export receivables. One can argue that the hedging demand for forward purchase of foreign currency from importers will be a decreasing function of the forward rate while the exporters' supply of forward foreign currency will be an increasing function of the forward rate. If there are no other participants in the market, an equilibrium forward rate would be established which clears the market. However, there are arbitragers and speculators also in the market. As we have seen above, arbitragers will respond to violation of covered interest parity and will be net suppliers or buyers of forward foreign exchange. However, recall that their access to funds is not unlimited. Hence, given the spot rate, home and foreign interest rates, and transaction costs, the value of forward rate which eliminates covered interest arbitrage will not be unique and may vary over time. Also, it will in general differ from the value which equates hedgers' demand and supply of forward foreign exchange. Last but not the least, consider speculators. Given their "forecast" of the spot rate *n*-years from now, if they find that the *n*-year forward rate differs from this, they would want to be net buyers or sellers of forward foreign exchange. In addition to the gap between their forecast and forward rate being offered in the market, the volume of speculative forward purchases and sales will also be influenced by the degree of risk aversion of the speculators and their access to funds and transaction costs. Given all these factors, a particular value of forward rate will result in the net speculative demand being zero. However, once again this value of forward rate may vary over time and at any given time will not equal the values which lead to equilibrium in the hedging and arbitrage markets.

Thus, at any given time, given the spot rate, the overall equilibrium in the forward market will be the net result of the demands and supplies originating from hedgers, arbitragers and speculators. The equilibrium forward rate may thus differ from what is indicated by the covered interest parity. Figure 8.4 adapted from Gandolfo (2002) illustrates.

In this figure values of forward rate for some *n*-year horizon stated as units of home currency per unit of foreign currency are plotted on *Y*-axis and the demand for forward foreign exchange on the *X*-axis. The lines *S-S*, *H-H* and *A-A* denote respectively the demand for forward purchase by speculators, hedgers and arbitragers.

F_S denotes the value of forward rate at which net speculative demand for forward delivery is zero. This would equal the speculators' forecast of what the spot rate is going to be at the expiry of the forward contract. F_A and F_H denote the values of forward rate at which arbitragers' and hedgers' demand for forward purchase is zero. For simplicity, we have assumed that F_A and F_H are equal but it need not be the case. If the forward price of foreign currency is less than F_S, speculators buy it forward because their forecast exceeds the market rate. F_A is the value of forward rate which would be realized if arbitragers were the only players in the market. The equilibrium forward rate is indicated as F^E. At this rate, the net demand by speculators is positive, its amount indicated as OD. The net demand by hedgers is OD″ which is negative and that from arbitragers is *OD″* which is also negative. In absolute value terms:

$$OD = OD' + OD''$$

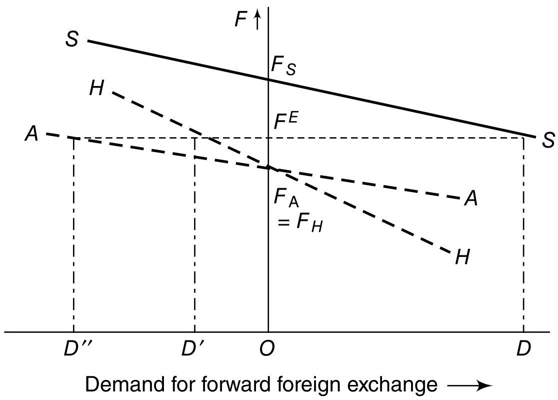

Fig. 8.4 Equilibrium in the Forward Market

For a more detailed exposition, see Gandolfo (***op. cit.***).

Empirical studies of forward markets in major convertible currencies confirm that the interest parity relationship does in fact hold within the limits imposed by transactions costs.

8.4 SWAPS AND DEPOSIT MARKET

At various places, we have used the phrase that banks arbitrage between foreign exchange swap markets and the eurodeposit markets. What does this mean? One straightforward meaning is that the banks will constantly monitor its swap rates so that they are not out of line with the forwards implied by eurodeposit rates. A bank cannot make arbitrage profits at the expense of another. Nor should it permit another bank to make riskless gains at its own expense.

We have seen that a foreign exchange swap is a temporary exchange of one currency for another. In this sense, it is quite similar to a combination of lending a currency and borrowing another. In fact, a bank can "manufacture" a swap quote from eurodeposit rates or manufacture a eurodeposit rate from swap quotes. We will look at two examples to illustrate this.

- Suppose a customer approaches a bank for a 3-month CHF-KPW (South Korean Won) swap. The customer will sell CHF 1 million spot against KPW and buy CHF 1 million 3 months forward against KPW. At the time, the forward markets in won are very thin and volatile. There is however a market in won deposits. The rates are as follows:

  CHF/KPW Spot: 748/754
  EuroCHF 3-month: 2-2¼
  KPW 3-month: 5-5½

  What swap margin should the bank quote?
  Assume that the swap is done off a spot rate of CHF/KPW 751.00. The bank borrows KPW 751 million at 5½ per cent and delivers it to the customer. It invests the CHF 1 million received from the customer at 2%.

At maturity, the bank must repay:

$$KPW \{751 [1 + 0.25(0.0550)]\} \text{ million} = KPW\ 761.33 \text{ million}$$

Its CHF deposit will have grown to:

$$CHF[1 + 0.25(0.02)] \text{ million} = CHF\ 1.005 \text{ million}$$

The bank will break even if it charges a rate of

(761.33/1.005) = 757.54 won per CHF on the forward leg of the swap[8].

The bank has, thus, "manufactured" a swap quote from the inter-bank deposit markets.

- Now consider another situation. A customer approaches a bank with a request for a 3-month loan of DKK 50 million. At the time there is no active euromarket in Danish krone. There are, however, active spot and forward USD/DKK markets. The bank can cater to the customer's needs by doing the following:
  1. Borrow dollars
  2. Do a USD-DKK 3-month swap, i.e. sell dollars spot against DKK and buy dollars 3-month forward and
  3. Loan the DKK to the customer.

  The rates available to the bank are as follows:

  Spot USD/DKK: 5.7505/10
  3 month swap: 350/400
  Eurodollar 3 month rates: 3¼ - 3¾

  What interest rate should the bank quote on the DKK loan?

  Suppose the bank can do the swap at a spot rate of 5.7508 and a swap margin of 400 pips. Thus, on the forward leg it will have to pay DKK 5.7908 per USD. It must borrow: \$(50/5.7505) million to buy and loan DKK 50m. At maturity, it has to buy back the same amount of dollars at a rate of DKK 5.7908. In addition, it has to pay interest on the dollar loan which it must buy forward outright. The amount of interest is:

$$\$(50/5.7505)[0.25(0.0375)] = \$81514.65$$

  and the outright forward USD/DKK rate is 5.7910. The total amount of Danish kroner the bank must recover from the customer is therefore:

$$(50/5.7505)[5.7908 + (0.25)(0.0375)(5.7910)] \text{ million}$$
$$= DKK\ 50.8224 \text{ million.}$$

  Hence, the breakeven rate of interest is:

$$4 \times [(50.8224/50) - 1] = 0.0657 = 6.57\%$$

In this example, the bank has "created" a euroDKK deposit using the foreign exchange markets and the eurodollar market.

These examples illustrate how banks arbitrage between deposit markets and foreign exchange markets using the principle of covered interest arbitrage. Now you can also understand why banks offset positions created by an outright forward transaction by means of a spot and a swap. Banks can easily simulate a swap by lending and borrowing in the euromarkets.

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[8]Actually there is a small complication. The customer will buy back CHF 1 million and pay KPW 757.54 million. The remaining amount KPW 3.79 million must be bought in the outright forward market. The bank will have a surplus of CHF 0.005 million. Thus, it must get the breakeven rate, viz. 757.54 on the outright forward too.

8.5 INTER-BANK FORWARD DEALING

Inter-bank forward deals are swap deals. The buyer is really buying the swap points, i.e. the interest rate differential, and the spot risk is removed by doing a spot deal in conjunction with the forward deal. A typical dialogue would go as follows:

February 13

BANK A: "Bank A calling. Three-month yen-dollar please."
BANK B: "Thirty two; twenty five."

BANK A: "Fifteen dollars yours at thirty two".
BANK B: "OK. Let's use a spot of 121.95 which is for value February 15: I buy at 121.63 for value May 15."

Bank A asks Bank B for its 3-month forward quote between yen and dollars. Bank B quotes the swap points as 32/25[9]. (Recall that a point in case of yen is 0.01 not 0.0001). Bank A conveys that it wishes to sell forward 15 million dollars at a discount of 32 points. Bank B agrees to this and may immediately try to cover its position with a buy-spot-sell-forward swap and spot sell deal.

The reason for this is that the two dealers are really trading the euroyen-eurodollar interest rate differential. Bank B's decision to buy 3-month forward dollars at a discount of 32 points would be justified only if this discount expressed as a percentage of the spot rate, annualised, equals the interest rate differential[10]. In order to fix this, both the swap points and the spot rate must be fixed. Otherwise, the dealer leaves himself open to the risk that the spot rate may move.

Now let us see how Bank B covers its position. Having agreed to take delivery of USD 15 million three months forward, it must find a counterparty who will agree to buy USD 15 million three months forward. Most often, bank does this by entering into a swap deal, viz. buy USD 15 million spot and sell three months forward. However, this creates a spot buy position which must be squared up by doing a spot sell transaction unless before doing the forward deal with Bank A; its spot position was short dollars. Of course, it is possible that the forward dollar purchase deal done with Bank A itself squares up an earlier forward short position so that no further action is needed. However, if such is not the case, Bank B could do one of the following two things:

(a) Enter into an offsetting forward deal with a counterparty C which may be a bank or a corporate in which it sells 15 million dollars three months forward and buys spot. This will remove the maturity mismatch and square up its forward position. If it can locate a counterparty which will deal at swap points 32/25, it will earn 7 points, i.e. 0.07 yen per dollar or a total gain of ¥1.05 million. However, keep in mind that the spot could have moved before doing such an offsetting deal. In this case, there will be a residual cash position[11]. Also it would be a rare event to find a counterparty whose needs exactly offset the position of Bank B. It then squares its spot position by doing a spot sale with a counterparty D.

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[9]Recall that this quote means that Bank B will buy dollars three-month forward at a discount of 0.32 yen per dollar and sell at a discount of 0.25 yen per dollar both with reference to a spot rate to be agreed upon.

[10]Suppose the interest rate differential is higher, then Bank B has allowed Bank A to make covered interest arbitrage at its own cost; conversely if it is lower, Bank A has allowed arbitrage against itself.

[11]Thus, suppose it sells forward to Bank C at a discount of 25 points but the accompanying spot purchase is done not at 105.50 but 105.52. It has, thus, a shortage of ¥(0.02×15000000) = ¥300,000 in its spot position which it must carry for 3 months. The interest cost of this will partly offset the gain.

(b) Alternatively, Bank B can roll forward its position by a series of overnight swaps. Recall that due to its outright forward deal with bank A, and an offsetting swap with party C, it has a long position in dollars and a short position in yen both for spot value date. It can do a spot-next swap in which it sells dollars against yen value spot date and buys dollars against yen value the day after the spot date. It has rolled its spot position one day forward. Since the yen is at a forward premium, it will lose some points in this roll over, equal to the difference in interest earning on an overnight dollar deposit and an overnight yen deposit. It can keep rolling its position from one day to the next till the maturity of the original forward done with Bank A. Provided the total number of points it loses on such rollovers is less than the number of points discount it has earned in the original swap, i.e. 32 points, it will have made a gain. There is, however, one small problem. Each of the overnight swaps will be done off a spot rate different from the spot rate in the original swap; hence, small cash positions in yen will arise. Also, how many points it will have to lose in each overnight swap is uncertain.

The inter-bank forward market is really a market for duplicating the money market lending-borrowing transactions via the currency market. Thus, the traders must monitor interest rate differentials and attempt to guess how these interact with the spot rate. A movement in spot rate after a forward deal is done (accompanied by its companion spot deal), will change swap points for a ***given*** interest rate differential, but may also affect the interest rate differential. As we have seen above, spot rate movements also give rise to temporary short and long positions in different currencies and hence interest expenses and earnings. This is the "spot risk" in forward transactions. It is possible to create hedges for a part of this risk but the effectiveness of the hedge is difficult to judge because of the complex interrelationships between spot rate, forward rate and interest rate differentials[12]. See Bishop and Dixon (1992) for examples of how dealers hedge spot risk in forward transactions.

8.6 OPTION FORWARDS

There are situations in which the exact timing of a foreign currency inflow or outflow is not certain though the amount is known. Banks offer a contract known as ***option forwards*** in which the rate of exchange between the two currencies is fixed at the time the contract is entered into as in a standard forward contract, but the delivery date is not a fixed date. One of the parties (usually a corporate customer) can, at its option, take or make delivery on any day between two fixed dates. The interval between these two dates is the ***option period.*** Figure 8.5 illustrates.

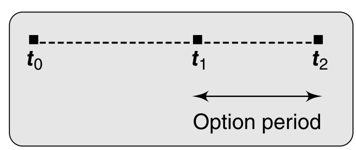


Fig. 8.5

The contract is entered into at t_0; it will expire at t_2 but the buyer has the option of demanding settlement on any day between t_1 and t_2.

In fixing the rate, the bank assumes that the customer firm will settle the contract at a time most favorable to itself. Accordingly, the bank gives the customer the worst rate ruling during the option period. We will clarify this with some examples.

[12]Recall from the text that the covered interest arbitrage relation which appears to be quite simple, is ***not*** a causal relationship. All the three variables involved in it are influenced by fundamental factors like monetary policy, BOP developments and expectations.

- On a particular day, the following rates are ruling in the market:

  USD/CHF spot: 1.6200/10
  3 months: 250/240
  6 months: 500/480

  The 3-month and 6-month outright forward rates are:

  3 months: 1.5950/70
  6 months: 1.5700/30

  The CHF is at a premium both for the 3-month and 6-month maturity. Suppose the customer wants to sell CHF, i.e. buy USD three months forward with the option of settlement at any time between the spot value date and three months thereafter. The bank's spot selling rate for USD is CHF 1.6210 while three months forward selling rate is 1.5970. In this case, the bank will give the customer the least possible premium for CHF over the option period, i.e. the bank's offer rate for dollars will be the spot offer rate, viz. 1.6210. If the customer wanted to buy CHF, the bank will charge the largest possible premium over the option period. Its bid rate for dollars will be the 3-month forward bid rate, viz. 1.5950. For a 6-month contract with option period from 3 to 6 months (i.e. delivery on any day after 3 months but before 6 months), the bank's bid and offer rates for the dollar would be:

  $(USD/CHF)_{\mathbf{bid}}$: 1.5700 $(USD/CHF)_{\mathbf{ask}}$ = 1.5970

  i.e. when bank sells CHF (buys $), it will charge the six-month premium, but when it buys CHF (sells dollars), it pays only the three-month premium.
- The following AUD/USD rates are observed in the market

  AUD/USD Spot: 0.7807/0.7812
  3 months: 40/35
  6 months: 83/68

  The corresponding outright forwards are:

  3 months: 0.7767/0.7777
  6 months: 0.7724/0.7744

  AUD is at a forward discount for three as well as six months. Now, when bank buys AUD, it will take the maximum possible discount and when it sells AUD, it will give the least possible discount. Its AUD/USD bid and ask rates for 0-3 month(s) and 3-6 months options are as follows:

	0-3 month(s)	3-6 months
$(AUD/USD)_{\mathbf{bid}}$	0.7767	0.7724
$(AUD/USD)_{\mathbf{ask}}$	0.7812	0.7777

  The Danish krone-U.S. dollar rates are as follows:

  USD/DKK spot: 5.6920/30
  3 months: 100/200
  6 months: 150/50

- The Danish kroner is at discount for 3-month forwards, but at a premium for 6-month forwards. Applying the same principle, we get the following rates:

	0-3 month(s)	3-6 months
$(USD/DKK)_{\mathbf{bid}}$	5.6920	5.6770
$(USD/DKK/)_{\mathbf{ask}}$	5.7130	5.7130

Thus, when bank sells DKK with 0-3 month(s) option period, it does not give any discount; for 3-6 month option period, it charges the 6-month premium. When it buys kroner, it takes 3-month discount in the former case and also in the latter case.

Option forwards are an attempt to combine features of a standard forward contract and an option contract. The party who gets the option to settle prematurely over a sub-period of the life of the contract has to pay for this timing option. Banks recover this payment by charging the rate most favourable to them as seen above. Are they valuing the timing option correctly? Kraizberg (1991) has employed option pricing models (see Chapter 10) to investigate this question. He finds that the method employed by banks implies that the timing option is being valued at zero.

8.7 FORWARD-FORWARD SWAPS: SWAP POSITIONS

Swap transactions need not be restricted to swaps between spot and a forward date. They can be between two forward dates. For example, a one-month forward sale can be combined with a three month forward purchase.

Such transactions are called forward-forward swaps[13]. As the following example illustrates, a forward-forward swap can be used to take a view on interest rate differentials with a minimum of exchange rate risk.

- A treasurer finds the following rates in the market:

  GBP/USD Spot: 1.7580/90
  1-month : 20/10 2-month: 30/20
  3-month: 40/3 6-month: 40/30
  12-month: 30/20

  US interest rates are somewhat below UK rates, but less so at the far end. The treasurer is confident that in six months, UK rates are going to fall, and the sterling will go into a forward premium. He expects the 6-month swap points to become 100/200 in six months time. How can he profit from this forecast?

  1. Outright Speculation: Buy 12 months forward sterling 5 million at $1.7570. Six months later, after sterling has gone to premium, sell six months forward sterling. Suppose the rates then are:

     GBP/USD spot: 1.7585/95 6-months: 40/60

     He can sell 6-months forward at 1.7625. This represents a gain of $0.0055 per sterling (transaction costs will reduce this somewhat) or $27,500 for 5 million sterling. The risk of course is that the sterling may depreciate in the meanwhile. Suppose the spot rate goes to 1.7000/05, then even with a six-month forward premium on sterling he will lose.
  2. Creating a Swap Position: On day 1, do two swaps, viz. buy sterling spot and sell 6 months forward and sell sterling spot, buy 12 months forward. Essentially a forward-forward swap has been done – sell 6 months forward and buy 12 months forward.

     The spot leg in the two swaps cancels out. Suppose both the swaps are done off a spot rate of 1.7580. In the first the discount against the treasurer is 40 points; in the second, the discount in his favour is 20 points. Thus, the planned cash flows now are:

[13]Such positions are known as "swap positions". In a swap position, the net outflows in each currency are zero, but the timings of inflows and outflows are different.

6 Months	12 Months
– £5,000,000	+ £5,000,000
+ $8,770,000	– $8,780,000
(= 5000000 × 1.7540)	(= 5000000 × 1.7560)

Six months later, suppose the treasurer's forecast has materialised to an extent. Sterling has gone to a premium, but not to the extent forecast. The rates are:

GBP/ USD spot: 1.7000/1.7005   6-month: 80/160

Now execute another swap, viz. buy £5 million spot and sell six months forward. The spot rate will be 1.7005 and the swap margin will be 80 points premium on sterling. The resulting cash flows are

6 Months	12 Months
+ £5,000,000	– £5,000,000
– $8,502,500	+ $8,542,500

Combining this with the cash flows from the original swaps, we have a net cash inflow of $2,67,500 at six months and a net outflow of $2,37,500 at twelve months for a net gain of $30,000 plus the interest received on the six-month inflow.

Suppose instead that the sterling had appreciated between the start time and six months to say 1.8000/1.8010. We continue to assume that the interest rate forecast has materialised so that 6-month swap points are 80/160. Now at six months, sterling is bought spot at 1.8010 and sold 6-months forward at 1.8090. You can check that there will be a loss of $2,35,000 at six months and a gain of $2,65,000 at twelve months, with an overall gain of $30,000 minus the interest on the outflow at six months.

Note that by creating this swap position, the treasurer is speculating on the interest rate differential. The risk of spot exchange rate is eliminated.

If the interest rate forecast turns out to be wrong, e.g. if sterling interest rates increase so that sterling goes further into discount, a loss will be incurred. Thus, if the spot moves to 1.8000/1.8010 as above, but 6-month swap points are 60/40, there will be a loss of $2,35,000 at six months and a gain of only $1,95,000 at twelve months producing a net loss.

We will see other applications of forward-forward swaps in later chapters.

Swaps can be employed in a number of other situations. One such application which can be called "cash management swap" arises when an entity has to manage short-term cash surpluses and deficits in different currencies. For instance, consider the following situation:

- An Australian MNC has a surplus of Singapore dollars (SGD) 1.2 million and a requirement of Australian dollars (AUD) 1 million both for 3 months. The spot AUD/SGD rate is 1.1990/1.2000 and 3-month swap points are 18/12. It can borrow AUD at a rate of 5.5 per cent p.a. and invest SGD at a rate of 4.25 per cent p.a. Consider the following alternatives:
  1. Borrow AUD and invest SGD both for 3 months. Sell the SGD interest 3-month forward.
  2. Swap the SGD into AUD for 3 months, i.e. sell SGD spot and buy 3-months forward both against AUD.

  Alternative (1):

  Interest paid on AUD borrowing:
  AUD [1,000,000 × 0.055 × (90/360)] = AUD 13750

Interest earned on SGD deposit:

SGD [1,200,000 × 0.0425 × (90/360)] = SGD 12750

This amount of SGD sold forward at SGD 1.1988 per AUD brings in AUD 10635.64.

The net cost is AUD 3114.36.

Alternative (2):

Sell SGD 1.2 million spot obtain AUD 1 million

Buy SGD 1.2 million 3-month forward and pay

AUD [1200000/1.1972] million = AUD 1002338.80.

(Note that the forward bid rate is 18 pips below the spot bid rate of 1.1900).

Net cost AUD 2338.80. Thus, alternative (2) saves AUD 775.56.

You should have realised that this is merely an instance of the fact that at the interest rates accessible to the firm, covered interest parity is violated. This could be because the firm has to pay a higher rate on its AUD borrowing than what is ruling in the euromarket.

Swaps can also be used instead of option forwards in cases where the timing of a foreign currency payment or receipt is uncertain. Suppose on October 30, a firm buys USD 1 million one-month forward against GBP. The contract rate is GBP/USD 1.5450 and the delivery date is December 1. On November 29, the firm decides that the USD is not needed on December 1, but on January 1. It has two alternatives:

1. Borrow GBP to pay for USD on the forward contract, and invest the USD for 1 month.
2. Roll over the contract with a swap, viz. take delivery of USD on the original forward contract and do another spot-forward swap – sell USD spot and buy one-month forward.

If at the interest rates accessible to the firm, the covered interest parity holds, then the two alternatives would be equivalent. A third possibility is a "rollover at historical rates". In this, the spot leg of the new swap is done at a rate equal to the original forward rate and the forward leg is done at a rate which reflects the current swap points and a working capital interest factor. A numerical example will illustrate this method.

- On October 30, a UK firm enters into a one-month forward to buy USD 10 million at a price of USD 1.5450 per GBP. The contract matures on December 1. On November 29, it wishes to roll over this contract to January 1.

  On November 29, the USD/GBP spot is 1.5180/90 and one-month swap points are 15/10.

  Let us first compute a swap at market rates. The bank agrees to a one-month swap at a spot rate of 1.5180 and swap points of 15. Thus, the firm sells USD 10 million spot at 1.5180 and buys USD 1-month forward at 1.5165. Its cash flows are:

  December 1:
  Original forward: USD 10 million inflow
  GBP 6472491.9 outflow

  Spot leg of swap: USD 10 million outflow
  GBP 6587615.3 inflow

  Net cash flow: GBP 115123.4

  January 1
  Forward leg of the swap: USD 10 million inflow
  GBP 6594131.2 outflow

The effective rate is:

$$[10{,}000{,}000/(6594131.2 - 115123.4)] = 1.5435$$

However, the firm can use the net cash inflow on December 1 to invest or reduce its borrowing for one month. Suppose its GBP borrowing rate is 12 per cent. Its interest saving is then:

$$115123.4(0.12)(31/365) = \text{GBP } 1173.31$$

Rollover at historical rate:

On November 29, a swap is done off a spot equal to 1.5450, the original forward rate. This does not give rise to any net cash flows on December 1.

On January one, the firm buys USD 10 million at a rate of 1.5435 (= 1.5450-0.0015). This results in an outflow of GBP 6478782.

Effectively, the working capital gain has been passed to the bank.

The bank must compensate the firm for this. This is done by adjusting the forward rate in the swap. The gain is GBP 1173.31 in a USD 10 million. This can be adjusted by using a forward rate in the swap equal to 1.5435 + 0.0001 = 1.5436.

In the next section, we will examine a number of other products which are closely related to the forward-forward swap. In fact, one of them replicates the cash flows from a forward-forward swap without actually having to take on the swap transactions onto the books.

8.8 FORWARD SPREAD AGREEMENTS (FSA), EXCHANGE RATE AGREEMENTS (ERA) AND FORWARD EXCHANGE AGREEMENTS (FXA)

Let us begin with another example of a forward-forward swap.

GBP/USD Spot: 1.4995/1.5005	
3-month swap points: 92/83	9-month swap points: 290/269
3-month eurodollars: 5.50%	9-month eurodollars: 6.25%
3-month eurosterling: 8.00%	9-month eurosterling: 8.80%

A trader expects USD interest rates to rise and sterling interest rates to soften. This would imply a reduction in the premium on the USD.

He undertakes the following two spot-forward swaps:

Buy GBP 1 million spot, sell 3-month forward
Sell GBP 1 million spot, buy 9-month forward

Both swaps are done off a spot of 1.5000. Using this spot, the 3 and 9-month outright forwards are 1.4908 (= 1.5000 – 0.0092) and 1.4731(= 1.5000 – 0.0269), respectively which are in line with covered interest parity:

$$1.4908 = 1.5000[(1 + (0.055/4))/(1 + (0.08/4))]$$
$$1.4731 = 1.5000[(1 + 0.0625 \times 0.75)/(1 + 0.088 \times 0.75)]$$

Effectively, the trader has done a forward-forward swap; sell GBP 1 million 3 months forward and buy GBP 1 million 9 months forward both against USD. The spot position is washed out.

At 3 months, suppose we have:

GBP/USD Spot: 1.4500
6-month eurodollar: 7.00%
6-month eurosterling: 8.00%

6-month GBP/USD outright implied by interest parity would be: 1.45(1.035/1.04) = 1.4430

The trader buys GBP 1 million spot at 1.45 and delivers on the forward leg of the 3-month swap. The cash flows are:

GBP + 1 million USD – 1.45 million Spot purchase of GBP
GBP – 1 million USD + 1.4908 million delivery on the original spot-3 month swap.

Net: USD 0.0408million = USD 40800

He closes out the 9-month position by selling GBP 1 million 6 months forward at the rate of 1.4430.

At 9 months:

GBP + 1 million USD – 1.4731 million delivery on the original spot-9 month swap.
GBP – 1 million USD + 1.4430 million delivery on the 3-9 month swap.

Net: USD – 0.0301 million = USD – 30100.

Suppose the USD 40800 obtained at 3 months is invested at 7 per cent for 6 months. Overall gain at 9 months:

USD [40800(1.035) – 30100] = USD 12128.

We will now discuss three products which are closely related to the forward-forward swap. Only one of them exactly replicates the forward-forward swap.

Forward Spread Agreement (FSA) This innovation is attributed to HSBC. With the data given above, the 3-9 month discount on the sterling reflects the 3-9 month forward interest rate differential. The given 3 and 9 month interest rates, imply 3-month forward 6-month rates. Essentially the 3-month forward 6-month rate answers the following question:

Suppose you have some funds to spare for 9 months. Would you like to invest in a 9-month deposit or a 3-month deposit followed by a 6-month deposit? The interest rate you will receive on the 6-month deposit starting three months from now will be known only three months from now. Obviously, your choice would depend upon your forecast of what the 6-month deposit rate will be 3 months from now. The 3-month forward 6-month rate is simply the 6-month rate 3 months from now which would make you indifferent between the two choices. Given 3 and 9 months USD and GBP rates the 3-month forward 6-month rates denoted $r^{\$}_{3,9}$ and $r^{£}_{3,9}$ are calculated as follows:

Eurodollars: $(1 + 0.055 \times 0.25)(1 + r^{\$}_{3,9} \times 0.5) = (1 + 0.0625 \times 0.75)$

Eurosterling: $(1 + 0.08 \times 0.25)(1 + r^{£}_{3,9}) = (1 + 0.088 \times 0.75)$

The left hand side in both the equations is the return you will get with a 3-month deposit followed by 6-month deposit strategy while the right-hand side is the return from a 9-month deposit. The values of $r^{\$}_{3,9}$ and $r^{£}_{3,9}$ obtained from these equations make the two alternatives equivalent.

Solving the above two equations we get $r^{\$}_{3,9} = 6.54\%$ $r^{£}_{3,9} = 9.02\%$

These are 6-month rates at the end of 3-months from now, implied by the 3 and 9 month rates observed in the market today[14]. These are used as benchmarks for Forward Rate Agreements or FRAs[15]. The outright forward rates for 3 and 9 months today reflect the differential ($r^{£}_{3,9} - r^{\$}_{3,9}$):

$$1.4731 = 1.4908\ [(1+ r^{\$}_{3,9}/2)/(1+ r^{£}_{3,9}/2)]$$

The FSA seller locks in a 6-month discount of 2.48 per cent on the sterling with reference to the 3-month rate. Suppose the notional principal is GBP 1 million. Notionally, he agrees to buy sterling (i.e. sell the "foreign currency") at 9 months at an exchange rate 2.48 per cent below its price at 3 months.

Three months later suppose the 6-month rates are, as above, 7 per cent for dollars and 8 per cent for sterling. Now the actual 6-month discount on sterling will reflect this 1 per cent differential. The FSA buyer notionally sells sterling at a 1 per cent discount. His gain is 1.48 per cent on GBP 1 million for 6 months or GBP 7000. This is paid at 9 months or its discounted value immediately using the 6-month GBP discount rate of 8 per cent p.a.

Note that the payoff is based only on the spot-forward spread as measured by interest rate differentials. The movements in spot are irrelevant.

As we will see in Chapter 15, a similar result could have been achieved by entering into FRA contracts. The trader buys a USD 1.5m 3-9 FRA and sells a 3-9 GBP 1 million FRA. Suppose the former can be bought at a contract rate of 6.6 per cent and the latter sold at 9 per cent.

At settlement 3 months later if USD 6-month rate is 7 per cent, the USD FRA gives a payoff: USD[1.5 m(0.004)(0.5)] = USD 3000

The GBP FRA payoff is

$$\text{GBP}\ [1\ \text{million}(0.01)(0.5)] = \text{GBP}\ 5000.$$

Either both these payoffs are paid at 9 months or their discounted values are paid immediately.

Notice that this would be identical to the FSA payoff only if the spot rate has remained at 1.5000. If the dollar has gone up (down) against the sterling, payoff with FRAs would be greater (smaller) than with FSA.

Exchange Rate Agreements (ERAs) This product was launched by Barclays bank. It is quite similar to FSA. The ERA seller agrees to receive a 3-9 USD-GBP spread of 177 pips implied by the starting spot, and the 3 and 9 months USD and GBP interest rates. In effect, the ERA seller expects the pound interest rate to fall and/or US interest rate to rise leading to a reduction in the premium on USD (discount on GBP). He agrees to buy GBP 9 months forward at a discount of 177 pips relative to its 3-month rate. At 3 months, he will close out by selling GBP 6 months forward at a 6-month spread over spot existing at that time. However, the bet is only on the spread. This can be looked at as follows:

Today, the ERA seller agrees to do the following transactions at 3 months:

> Sell GBP spot, buy 6 months forward at a 6-month premium/discount implied by today's 3 and 9 months forward rates.

Buy GBP spot, and sell 6 months forward at the actual premium/discount existing at that time.

Effectively, he will collect the difference between the 3-9 months spread implied by today's interest rates and the 6-month spread that will materialise in the market at the end of 3 months based on the actual USD and GBP rates at that time.

---

[14] These are "forward interest rates". See Appendix A for a fuller discussion.

[15] Forward Rate Agreements or FRAs are discussed in detail in Chapter 15.

The notional principal is GBP 1 million. If at the end of 3 months the rates are:

USD/GBP spot: 1.4500.

6-month interest rates are 7 per cent and 8 per cent for USD and GBP, respectively.

The actual 6-month USD-GBP spread is

1.4500 – 1.4500[(1.035/1.04)] = 1.4500 – 1.4430 = 70 pips.

The ERA seller is paid

USD[(0.0177 – 0.0070) × 1 million/(1.035)] = USD 10338.16 = GBP 7129.77

In general, the ERA seller is paid (ERA seller pays if the calculation below leads to a negative result)

$$A = -\left\{ \mathrm{NP} \times \frac{(\mathrm{CFS}_{t,T} - \mathrm{SFS}_{t,T})}{[(1 + r_{t,T} \times (T - t)]} \right\}$$

The relevant points in time are

t_0 t T

t_0 : Current time or "today".

t, T : Two future dates, $T > t$

NP: Notional principal in base currency.

$\mathrm{CFS}_{t,T}$: Contract forward spread from t to T defined as forward rate at time t_0 for delivery at T minus forward rate at time t_0 for delivery at t.

$\mathrm{SFS}_{t,T}$: Actual forward spread on settlement date t, i.e. the forward rate at time t for delivery at T minus the spot rate at t. (In practice, the settlement date may be two days before t).

$r_{t,T}$: Interest rate for quoted currency applicable at time t for horizon T.

The payment is made at time t in the quoted currency.

In the example $\mathrm{CFS}_{t,T}$ is –0.0177, $\mathrm{SFS}_{t,T}$ is –0.0077, NP is GBP 1 million, $(T – t)$ is six months (in practice you must use the actual/360 or actual/365 convention) and $r_{t,T}$ is 7.00 per cent.

By convention, ERA seller is the party which agrees to buy the base currency – sell the quoted currency – at the far end.

Note again that the spot rate at time t matters only to the extent that the settlement pips are decided by applying the actual interest differential at time t to the spot rate at time t.

Forward Exchange Agreements (FXAs) This product, originally launched by Midland bank reproduces the payoff of the forward-forward swap without actually having to take on the two swaps on the balance sheet. Continuing the same example, the settlement amount A paid to the FXA seller (paid by FXA seller if negative) is calculated as:

$$A = -\left\{ \mathrm{NP} \times \frac{[(F_{t0,t} - \mathrm{S}_t) + (\mathrm{CFS}_{t,T} - \mathrm{SFS}_{t,T})]}{[(1 + r_{t,T} \times (T - t)]} \right\} + \mathrm{NP}(\mathrm{F}_{0,t} - \mathrm{S}_t)$$

The contract is initiated at time t_0 ("today"). The FXA period starts at time t and ends at time T. Both t and T are measured in years. NP, $\mathrm{CFS}_{t,T}$, $\mathrm{SFS}_{t,T}$ and $r_{t,T}$ are as defined above. Other notation is:

$F_{t0,t}$: Forward rate at time t_0 for maturity at time t

S_t : Spot rate at time t.

The payment is made at time t in the quoted currency.

In the example, the base currency is sterling and the quoted currency is US dollars. Once again, FXA seller is the party which sells the base currency at the near forward date and buys it at the far forward date.

NP = GBP 1 million	$t = 0.25$ (3 months)	$T = 0.75$ (9 months)
$F_{t0,t} = 1.4908$	$S_t = 1.4500$	$CFS_{t,T} = -0.0177$
$SFS_{t,T} = -0.0070$	$r_{t,T} = 0.07$	

With these data, the payoff to the FXA seller at 3 months is USD 11717.87, a result identical to the one obtained with forward-forward swap. (Note that with the latter, a payment of USD 12128 was due at 9 months). But unlike the forward-forward swap where two forward contracts are taken on the balance sheet, here only the spread and spot adjustment are involved. This mitigates credit risk, obviates tying up counterparty credit lines and does not require additional capital to satisfy capital adequacy norms applicable to forward contracts.

FXAs can be used to synthesise FRAs in currencies where there is no FRA market. It can also be used to arbitrage between the FRA market and forex market. The fundamental relationship between the two instruments is:

Buy FRA in currency A + Sell FRA in currency B = Buy FXA with base currency A and quoted currency B.

You can understand this by looking at the FSA product described above and combining the spot rate adjustment with it.

8.9 FORWARD CURRENCY MARKETS AND RATES IN INDIA

During the last few years, a forward rupee-dollar market with banks offering two-way quotes has evolved in India. The rupee-dollar spot forward margin is not entirely determined by interest rate differentials since due to exchange controls on capital account transactions, interest arbitrage opportunities are open only to authorised dealers and that too with some restrictions. An interbank money market began to develop around the start of the new millennium with active interbank deposit trading and MIBOR (Mumbai Interbank Offered Rate) as the market index. During the first half of this decade an active interbank call money market has emerged. The level of trading activity in the treasury bill market is also on the rise. As a result, a rupee money market yield curve is now available. However, since access to foreign currency borrowing is not perfect, arbitrage transactions across domestic and euromarket do not necessarily determine the structure of forward premiums or discounts though movements in call rates do have considerable influence on overnight, Tom/Next and Spot/Next swaps. The call money market occasionally becomes extremely volatile with call money rates climbing as high as 60 per cent p.a. In such situations, banks with access to eurodollars can arbitrage across the money markets even if the forward premium on dollars goes as high as 20 per cent p.a.

Thus to some extent, the call-money market drives the forward rupee-dollar margins. The other consideration is supply of and demand for forward dollars arising out of exporters and importers hedging their receivables and payables. This factor is influenced by exchange rate expectations. Hence, the market has witnessed a substantial degree of volatility in forward premiums on the US dollar. Figure 8.6 taken from a RBI publication titled "Financial Markets" shows the behaviour of forward premiums during the period.

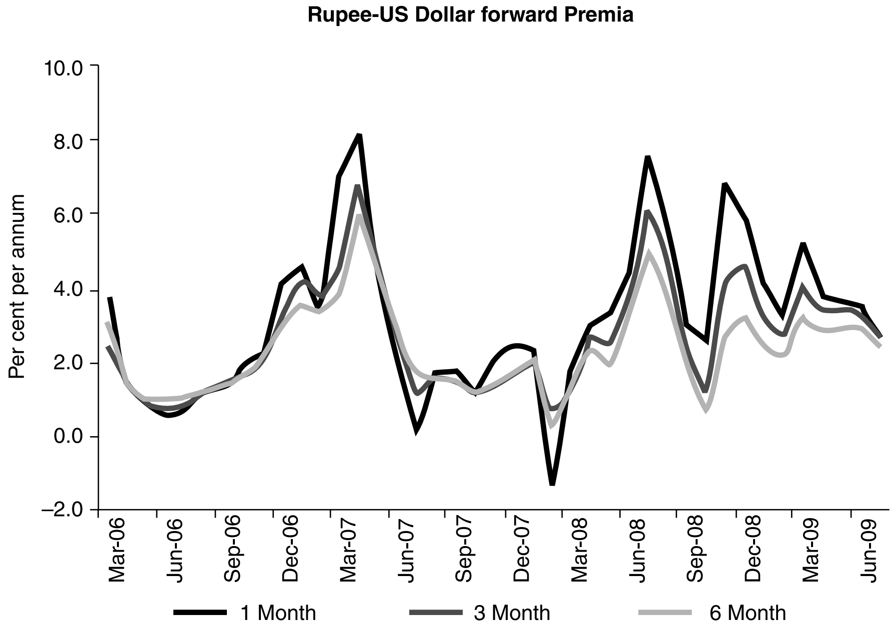


Fig. 8.6

March 2006 to June 2009. Figure 8.7 shows how the dollar-rupee spot rate and the 6-month forward premium have varied from July 2007 to May 2013.

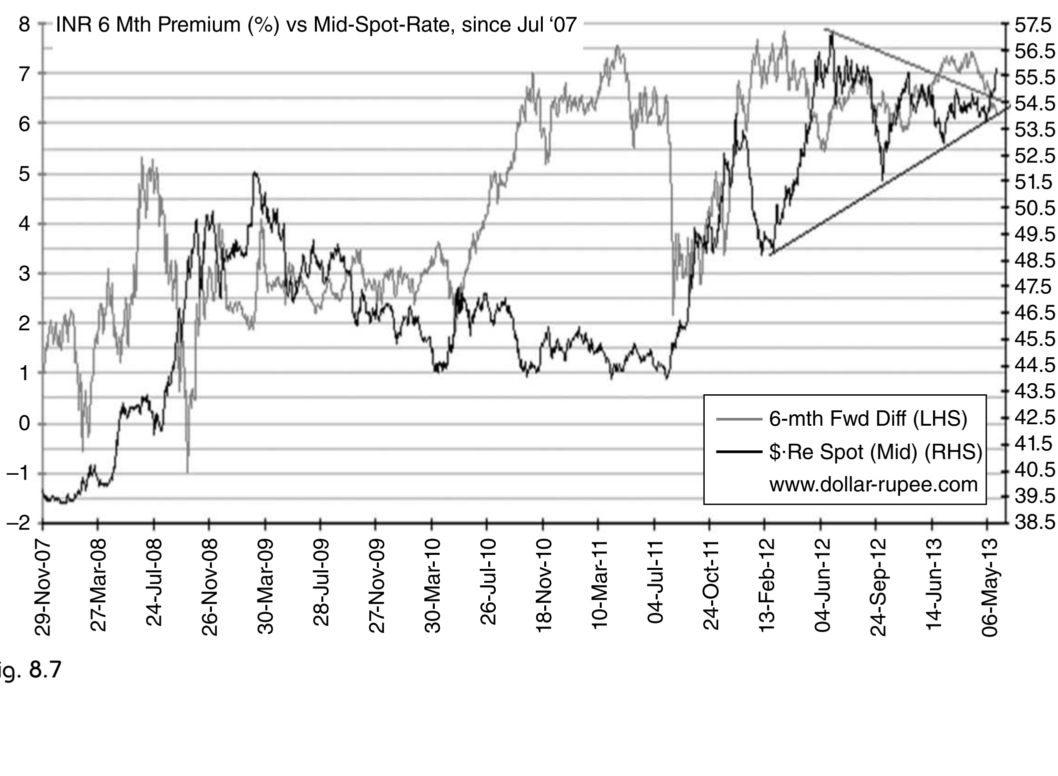


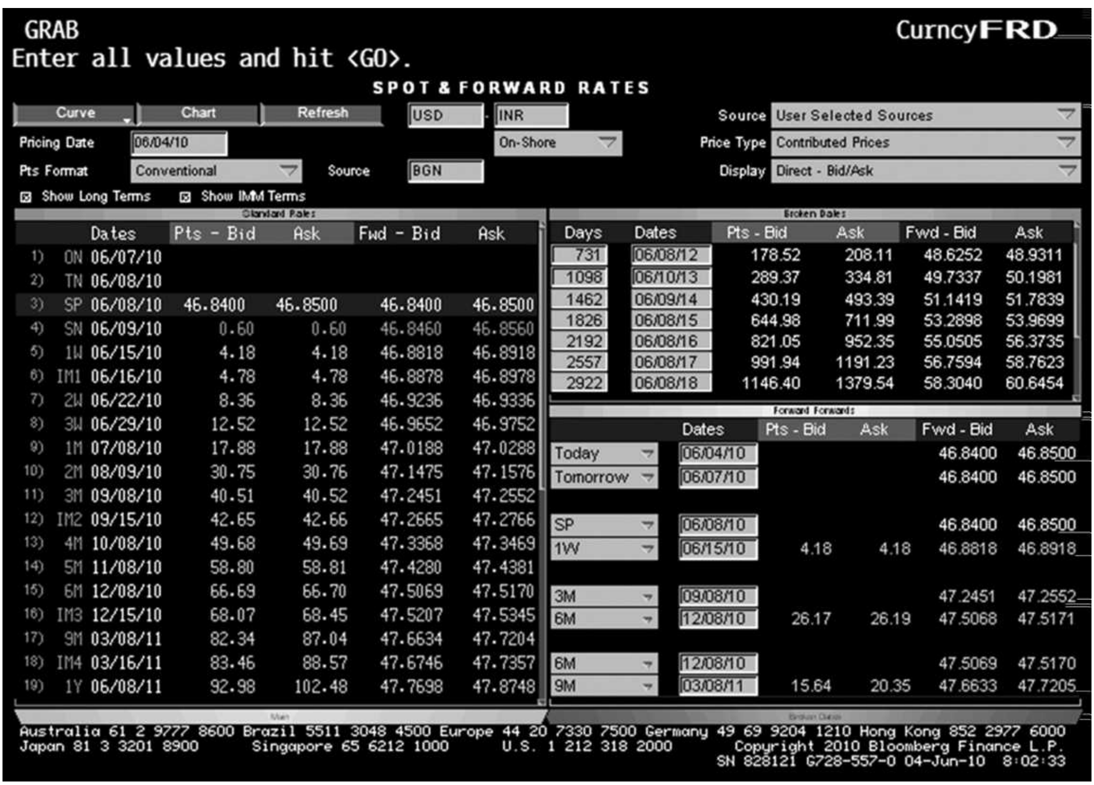
Fig. 8.7

This absence of a tight relationship between interest differentials and forward premia also opens up arbitrage opportunities for exporter firms related to their credit requirements.

A firm can avail of pre-shipment credit in foreign currency to finance its working capital requirements instead of availing domestic rupee finance. Consider a firm which can avail of domestic credit at 8 per cent while US dollar financing is available at LIBOR plus 3 per cent from a domestic bank. If LIBOR is say 2 per cent, then as long as the annualised forward premium on US dollar is less than 3 per cent, the firm is better off taking its pre-shipment credit in US dollars. If the capital account is opened up before complete deregulation of interest rates, similar situations may arise depending upon a firm's access to various different sources of borrowing and avenues for investing surplus cash.

Forward contracts in the Indian market are usually option forwards though banks do offer fixed date forwards, if the customer so desires. In the interbank market forward quotes are given as swap margins from the spot to the end of successive months. Exhibit 8.1 shows an extract from the Indian foreign exchange rates screen as on June 4 2010, provided on line by Bloomberg.

Exhibit 8.1


GRAB Curncy FRD
Enter all values and hit <GO>.
SPOT & FORWARD RATES
Curve | Chart | Refresh | USD - INR | Source: User Selected Sources
Pricing Date: 06/04/10 | On-Shore | Price Type: Contributed Prices
Pts Format: Conventional | Source: BGN | Display: Direct - Bid/Ask
☒ Show Long Terms ☒ Show IMM Terms

Standard Rates

		Dates	Pts - Bid	Ask	Fwd - Bid	Ask
1)	ON	06/07/10				
2)	TN	06/08/10				
3)	SP	06/08/10	46.8400	46.8500	46.8400	46.8500
4)	SN	06/09/10	0.60	0.60	46.8460	46.8560
5)	1W	06/15/10	4.18	4.18	46.8818	46.8918
6)	IM1	06/16/10	4.78	4.78	46.8878	46.8978
7)	2W	06/22/10	8.36	8.36	46.9236	46.9336
8)	3W	06/29/10	12.52	12.52	46.9652	46.9752
9)	1M	07/08/10	17.88	17.88	47.0188	47.0288
10)	2M	08/09/10	30.75	30.76	47.1475	47.1576
11)	3M	09/08/10	40.51	40.52	47.2451	47.2552
12)	IM2	09/15/10	42.65	42.66	47.2665	47.2766
13)	4M	10/08/10	49.68	49.69	47.3368	47.3469
14)	5M	11/08/10	58.80	58.81	47.4280	47.4381
15)	6M	12/08/10	66.69	66.70	47.5069	47.5170
16)	IM3	12/15/10	68.07	68.45	47.5207	47.5345
17)	9M	03/08/11	82.34	87.04	47.6634	47.7204
18)	IM4	03/16/11	83.46	88.57	47.6746	47.7357
19)	1Y	06/08/11	92.98	102.48	47.7698	47.8748

Broken Dates

Days	Dates	Pts - Bid	Ask	Fwd - Bid	Ask
731	06/08/12	178.52	208.11	48.6252	48.9311
1098	06/10/13	289.37	334.81	49.7337	50.1981
1462	06/09/14	430.19	493.39	51.1419	51.7839
1826	06/08/15	644.98	711.99	53.2898	53.9699
2192	06/08/16	821.05	952.35	55.0505	56.3735
2557	06/08/17	991.94	1191.23	56.7594	58.7623
2922	06/08/18	1146.40	1379.54	58.3040	60.6454

Forward Forwards

	Dates	Pts - Bid	Ask	Fwd - Bid	Ask
Today	06/04/10			46.8400	46.8500
Tomorrow	06/07/10			46.8400	46.8500
SP	06/08/10			46.8400	46.8500
1W	06/15/10	4.18	4.18	46.8818	46.8918
3M	09/08/10			47.2451	47.2552
6M	12/08/10	26.17	26.19	47.5068	47.5171
6M	12/08/10			47.5069	47.5170
9M	03/08/11	15.64	20.35	47.6633	47.7205

Australia 61 2 9777 8600 Brazil 5511 3048 4500 Europe 44 20 7330 7500 Germany 49 69 9204 1210 Hong Kong 852 2977 6000
Japan 81 3 3201 8900 Singapore 65 6212 1000 U.S. 1 212 318 2000 Copyright 2010 Bloomberg Finance L.P.
SN 828121 G728-557-0 04-Jun-10 8:02:33

Let us see how to interpret these quotes. The row SP provides the spot bid-ask quotes. On June 4, which was a Friday, the spot value date was Tuesday, June 8. The subsequent rows provide forward bid-ask points and forward bid-ask rates for various horizons. In the column designated as "Pts-bid-ask" the forward premiums or discounts are given as "points", but a point here is equivalent to 0.01. If the forward points are positive, they are to be added to the spot quotes; if negative, they are to be subtracted. Since the spot quotes are USD/INR, positive points imply that dollar is at a forward premium while negative points would indicate that dollar is at a forward discount. In the columns "Fwd- Bid-ask" outright forward bid-ask rates are provided. On June 4, the two month forward premium bid-ask points were 30.75/30.76. This implies a premium of ₹0.3075 and ₹0.3076. The value date for the two-month forward was two calendar months after June 8. This turned out to be August 9, 2010 since August 8 was a Sunday. With the spot quote at 46.8400/46.8500, the two month forward outrights are:

$$(46.8400 + 0.3075)/(46.8500 + 0.3076) \text{ or } 47.1475/47.1576$$

What about an option forward with maturity on August 9, 2010 but the option of delivery anytime from July 9 to August 9? If the bank was a buyer of USD in this deal, it would give only one-month premium which was 17.88 points or ₹0.1788. Its bid quote would be ₹(46.8400 + 0.1788) or ₹47.0188 per USD. If it was selling dollars, it would charge the two month premium ₹0.3076 and give a quote of (46.8500 + 0.3076) or ₹47.1576.

Now let us find the outright bid for a fixed date forward maturing on September 28, 2010. The bank was quoting a bid premium of 42.65 points for September 15 and a premium of 49.68 points for October 8, 2010. Thus, over a period of 23 days the premium increased by 7.03 points. From September 15 to September 28, it would increase by:

$$(7.03)(13/23) = 3.97 \text{ points}$$

So, the total premium for September 28 would be (42.65 + 3.97) or 46.62 points. The outright forward bid quote would have been (46.8400 + 0.4662) or 47.3062.

All forward transactions are for the purpose of hedging an underlying exposure such as trade related payables and receivables or approved capital account transactions such as debt service. Many forward transactions in the Indian market between banks and their non-bank customers tend to be of the option forward type. Hence, swap margins are commonly quoted from spot to end of the current and future calendar months. Banks do, however, do fixed-date forwards if the customer so desires. Most of the forward transactions in the Indian market are for a maximum maturity of six months, but rolling over of positions is permitted[16]. Till January 1997, authorised dealers could offer their customers contracts for maturities longer than six months with the prior approval of the Reserve Bank of India on a case-by-case basis. Since then the requirement to obtain RBI approval has been removed. However, in the absence of an active money market in India and hence, the interest parity linkage, it is very difficult for dealers to assess the correct forward rate which they should offer their customers. Forward contracts can be cancelled extended or early delivery can be arranged by paying a small cancellation fee and any settlement payments[17]. The latter depend upon how the rates have moved after the initial contract was entered into. Numerical examples in the appendix illustrate these

[16]In Chapter 12, we will see an application of the rollover forward cover. The six-month limit arises from the fact that foreign currency receivables and payables arising from exports and imports have to be settled within six months and forward cover is available only for exposures arising out of genuine trade transactions. Rates for maturities up to a year are available with some difficulty. Earlier, rollovers could be done at historical rates as explained above. This facility has been withdrawn. Now rollovers are done at market rates.

[17]Many companies are reported to have made tidy sums by cancelling their forward purchase contracts during the period prior to the 1993 budget when the rupee depreciated and forward discounts on the rupee rose significantly. Firms which did not share this gloomy view of rupee cancelled their forward contracts booked earlier, leaving short open positions. In essence, they speculated on the exchange rate.

calculations. For entering into forward contracts, a small flat fee is charged to cover administrative expenses and stamp duty.

At one time, to book every forward contract the company had to produce evidence of exposure – export receivable or import payable or interest payable on a foreign currency loan, etc., as the case may be. Now the regulations permit booking of forward contracts based on a company's export or import business during the past three years. The eligible limit for amount of forward purchases or sales during a year equals the average of previous three years import/export turnover. Documentary evidence of exposure has to be produced at the time of expiry of the contract. Contracts in excess of 75 per cent of the eligible limits cannot be cancelled. Details of these and other regulatory provisions can be found in a circular issued by RBI to authorised dealers dated December 13, 2006 titled "***Booking of Forward Contracts Based on Past Performance***". Subsequently, further modifications have been announced which can be found on RBI's website.

Earlier, an exposure in a particular currency could be hedged only with a forward transaction in that currency against the rupee. Now "third currency forwards" are permitted. This means that if an Indian corporate has an exposure in a foreign currency *A*, it can do a forward deal between currency *A* and another foreign currency *B* and leave the exposure in *B* open. Let us consider an example.

- Suppose an Indian firm has a 6-month payable of JPY 20 million. The market rates are as follows:

  Mumbai: USD/INR spot: 53.50/55
  6-months: 54.80/85

  Singapore: USD/JPY spot : 110.25/111.10
  6-months : 111.50/112.00

  From this, the JPY/INR 6-month forward cross rate is:
  48.93/49.19 (per 100 JPY)

  If the firm buys JPY forward against INR, it will have to pay

  ₹[20,000,000/100](49.19) = ₹9838000.00

  The firm feels that the US dollar is overvalued in the forward market. It buys JPY 20 million forward against USD and leaves the USD position uncovered[18]. It has to deliver

  USD[20,000,000/111.50] = USD 1,79,372.20

  Six months later, its view turns out to be correct. The spot INR/USD rate is 53.60/65. It buys the required US dollars in the spot market to deliver against its forward contract. It has to pay:

  ₹[179372.20 × 53.65] = ₹9623318.53

  Thus, the firm saves ₹214681.47. Note, however, that this is a speculative strategy. The firm's view about how the market is valuing dollar six-month forward may turn out to be wrong and the dollar may rise above the six-month forward rate quoted at the start.

  Another new product in the Indian market is "forward-forward contracts". It is very similar to the forward-forward swaps discussed above. It works as follows:

- Today is July 30. A firm is expecting an import shipment to arrive on October 1. Payment has to be made on January 1 and the invoice will be for USD 100,000. The market rates are as follows:

  USD/INR Spot: 55.50/70
  2-months swap: 25/30 Outrights: 55.75/56.00
  5-months swap: 75/85 Outrights: 56.25/56.55

[18]Note that it makes no sense to hedge the dollar position at the current rates. It would be equivalent to buying yen against rupees forward.

The firm would like to lock-in the 80 paise swap premium between October 1 and January 1 but feels that the dollar is likely to weaken somewhat between July 30 and October 1. It does the following set of transactions on July 29:

1. Buy USD spot, sell value October 1.
2. Sell USD spot, buy value January 1.

It has essentially created a swap position, with an outflow of USD on October 1 and a matching inflow on January. The premium locked in is INR(56.55 – 55.75) = 80 paise. By September 15, the dollar has weakened and the current spot is 54.80/55.00. The firm buys spot at 55.00 and delivers on the forward 15 days later at 55.75 gaining 0.75 per USD. On January 1, the firm pays 56.55 per USD. The net price paid is 55.80. On July 30, a forward contract to buy USD on January 1 would have cost ₹56.55 per USD. It is as if the firm could lock in the 3-month premium over October 1 and "pick any spot rate" between July 29 and October 1 to which the premium would then be added.

Note, however, that we have ignored the timing mismatches and hence, time value of money. Specifically, there is an interest element on the rupee borrowing needed to buy USD spot on September 15 and the dollars invested for 15 days before they are delivered against the July-October swap. Further, there is an interest gain on the small profit of 0.75 made on October 1.

After permitting the use of this product for some time the RBI revoked the freedom granted to market participants to engage in such forward-forward swaps.

In recent years, there has been considerable deepening of the forward markets in India against the major currencies like USD, GBP, EUR and JPY. Markets beyond 6-month maturities are active only in USD and to some extent GBP. Since late 1995, the forward margins have been quite volatile.

Like in the spot market, brokers play an important role also in the forward market. The trading platforms available for forward trades include FX CLEAR of CCIL, RMDS from Reuters and FX Direct from IBS.

The appendix to this chapter contains some examples of calculation of forward rates applicable to merchant transactions. It also contains the terms and conditions applicable to booking a forward contract with an authorised dealer in India.

8.10 NON-DELIVERABLE FORWARD (NDF) CONTRACTS

While currency forward contracts protect buyers and sellers of foreign currencies by locking in a rate today for future delivery, not all currencies have freely tradable forward markets. This is especially true in emerging markets currencies such as Argentina or Brazil and restricted currencies such as China and Taiwan. In many instances, the most volatile currencies in the world are often also those without active and open forward markets, leaving companies that do business in those countries exposed to unpredictable exchange rates.

Exhibit 8.2 shows currencies where access to forward markets by non-residents was restricted.

In situations in which access to forwards is non-existent or restricted, Non-Deliverable Forward (NDF) contracts provide an efficient method to protect the dollar value of foreign currencies and reduce the inherent uncertainty of exchange rates.

Like standard forward contracts, non-deliverable forward contracts fix exchange rates for conversion on a future date. But unlike forward contracts, there is no delivery of underlying foreign currency. Instead, the net US dollar is settled with a compensating payment made or due based upon

Exhibit 8.2 Access to onshore forward markets by non-residents

Chinese renminbi	No offshore entities participate in onshore markets
Indian rupee	Allowed but subject to underlying transactions requirement
Indonesian rupiah	Allowed but restricted and limted
Korean won	Allowed but subject to underlying transactions requirement
Philippine peso	Allowed but restricted and limited
New Taiwan dollar	Only onshore entities have access to onshore market

Source: HSBC (2003); national data.

the difference between the NDF contract rate and the exchange rate prevailing at maturity. Effectively, the NDF user is economically protected from exchange rate fluctuations by the compensating US dollar payment paid or received based upon the NDF fixed rate even though there is no exchange of foreign currency.

The following example illustrates the working of an NDF contract:

- An Indian company XYZ imports from USA and is concerned about the effects a potential upward revaluation of the Chinese Yuan may have on its import costs. To protect itself, XYZ enters into an NDF contract with the following terms:
  - Company XYZ buys USD NDF
  - Amount: USD 500,000
  - Rate: USD/INR 55.25
  - Maturity: 6-months

  At the contract rate, USD 500,000 translates into INR 2,76,25,000.

  The principal amount, maturity and corresponding NDF contract rate are set at the inception of the contract. The NDF contract rate varies by tenor and is based upon market conditions.

  Two days prior to contract maturity, an exchange rate fixing reflecting the prevailing market spot rate is set to determine the net settlement of dollars. The fixing rate is State Bank of India's USD/INR rate quoted say at 11.00 am Mumbai time on the fixing date. The fixing rates for NDF contracts are typically an official published rate or otherwise publicly available exchange rate and are stipulated in advance. Consider the following alternative scenarios:

  Scenario 1: USD has depreciated compared to the NDF contract rate. Fixing rate USD/INR is 54.90 (< 55.25, upon the NDF contract rate). XYZ pays \$3,812.64

  This is calculated as:

  $$[500000(55.25 - 54.90)]/54.90 = \text{USD } 3187.61$$

  i.e. compute the difference in rupee value of the agreed amount of dollars at the NDF contract rate and the fixing rate and convert this into its dollar equivalent at the fixing rate.

  XYZ is protected at the NDF contract rate of 55.25 and has to pay a compensating dollar payment equal to the difference between the NDF rate and the fixing rate at maturity.

  Scenario 2: USD has strengthened vs. the NDF contract rate.
  Fixing rate USD/INR is 55.65 (>55.25, NDF contract rate). XYZ receives \$3593.89 = [500000(55.65 – 55.25)]/55.65

XYZ is fixed at the NDF contract rate and receives a compensating payment in US dollars equivalent to the difference between the fixing rate and the NDF contract rate.

With foreign institutional investors using the non-deliverable forwards (NDF) market to hedge against the rising rupee, the daily turnover in rupee NDF market has shot up from $100 million in 2003-04 to $750 million in 2007-08.

The turnover in some of the NDF markets in Asia is illustrated in Exhibit 8.3.

Exhibit 8.3 Average Daily NDF Turnover

(in millions of US dollars)

Sources of estimates	***HSBC***	***Deutsche Bank***	
	(mid-2003)	***(2003-04)***	***(2008-09)***
Chinese Renminbi	1,000	50	1,000
Indian rupee	100	20-50	800
Indonesian rupiah	100	50	400
Korean won	500	700-1,000	3,000
Philippine peso	50	20-30	500
Malaysian Ringitt		—	500
New Taiwan dollar	500	300-500	—
Total	**2,250**	**1,140-1,680**	**6,200**

Summary

This chapter was built around the principle that the spot and forward rates in the foreign exchange markets on the one hand and interest rates in the money markets on the other bear certain relationship with each other. However, ***this should not be interpreted to mean that forward premia/discounts "cause" interest rate differentials or conversely that interest rate differentials "cause" forward premia/discounts.*** The arbitrage relationships discussed in this chapter are not causal theories of either interest rate differentials or spot-forward differentials. What these relationships say is that whatever the underlying determinants of spot rates, forward rates and the two interest rates, the resulting equilibrium values of these variables must satisfy the arbitrage relations analysed here. The four variables are simultaneously determined so as to validate the relationships. In later chapters, we will analyse the determinants of each of the four variables.

The second point to remember is that by definition, validity of arbitrage relationships depends neither on traders' risk preferences nor on expectation formation mechanisms. Whether the forward rate can be said to be the market's expectation of the future spot rate is a separate question to be discussed later. It is irrelevant to the validity of parity conditions which derive from pure arbitrage arguments.

The chapter discusses the relationships between the money markets and the forex markets with and without transaction costs. It illustrates various applications of forex swaps as also related products. It concludes with a discussion of the forward forex market in India.

Questions and Problems

1. Discuss the various reasons for departures from covered interest parity in practice.
2. Suppose the spot \$/¥ rate is 120.00. The euroyen 3-month interest rate is 8% and the eurodollar 3-month interest rate is 12%. Ignore transaction costs.
   (a) What should be the \$/¥ 3-month forward rate?
   (b) What should be the swap rate?
   (c) Will the yen be at premium or discount?
   (d) How much is the annualised premium or discount?
3. Suppose the \$/AUD spot rate is 2.00. The 180-day interest rates are 6% for AUD and 12% for dollar.
   (a) Verify that a dollar investment and a hedged AUD investment provide identical returns.
   (b) Suppose you want to sell a AUD receivable 180-day forward. How can you use the money market instead? Check whether the two hedges are equivalent.
4. The term structure of interest rates for both the CHF and the dollar is flat for maturities up to one year. This means that interest rates for all maturities upto one year are same. The CHF rate is 5% and the dollar rate is 9%.
   (a) The following matrix shows various combinations of \$/CHF spot rate and contract prices in a set of two-month forward contracts to buy dollars against CHF. Fill in the present values of the forward contracts.

	Contract Price		
	1.50	1.75	2.00
Spot Rate			
1.50			
1.75			
2.00			

   (b) Repeat the exercise with interest rates reversed.
5. Consider the following data:

   £/\$ spot: 1.7500/10
   3-month forward: 1.7380/1.7400

   3-month eurodollar: 8.00/8.20% p.a.
   3-month eurosterling: 10.50/11.00% p.a.
   (a) Check whether there is a covered interest arbitrage opportunity.
   (b) A British firm has a 3-month dollar receivable. How should it hedge?
   (c) A US firm has a 3-month sterling payable. How should it hedge?
6. Suppose a month ago you entered into a 3-month forward contract to purchase US\$ 100,000 against rupee at the then 3-month forward rate of ₹49.10 per dollar. The two-month forward rate today is ₹49.25. The seller wants "to mark the contract to market", i.e. replace the contract rate of ₹49.10 by the current forward rate for the same maturity. Rupee interest rate is 18% p.a.
   (a) Does this change in the terms of the contract warrant payment by one party to another? From whom to whom? How much?
   (b) Will both parties be indifferent if the required payment if any is effected?
7. For the purpose of this question and Questions 8–11, ignore the fact that there are exchange controls in India. Assume that the Indian rupee is freely convertible on both current and capital

accounts. Also, assume that you are free to borrow in any currency in any market and that there are active spot and forward markets accessible to all parties in rupee against any currency. The present rates are:

CHF/₹ spot: 24.8750/25.1250
3-month forward: 25.6195/25.9805
3-month rupee interest rates: 17.50/18.50
3-month CHF interest rates: 5.75/6.25

Determine whether there is a covered interest arbitrage opportunity.

8. An Indian firm has a 3-month CHF receivable, determine the optimal method of hedging it.

9. An Indian firm needs CHF right now for 3-months. What alternatives does it have to acquire them without incurring exchange risk?

10. A Swiss firm has a 3-month rupee payable. How should it hedge?

11. A Swiss firm needs rupees right now. How should it acquire them?

12. A trader at a major bank in UK observes the following rates in the market:

GBP/AUD spot: 3.5060/3.5065
1 month forward: 3.5120/27
1 year forward: 3.5715/30
AUD 1 year interest rate: 8%
GBP 1 year interest rate: 6%

Both GBP and AUD yield curves are flat upto one year.

The trader expects the AUD interest rates for all maturities upto one year to rise to 10% in one month's time. Further, he expects the GBP rates to hold steady.

(a) What are the different ways the trader can exploit this forecast?
(b) What are the risks associated with each?

13. A trader in New York observes the following rates:

\$/CHF spot: 1.6005/15
3-month forward: 165/155
6-month forward: 300/295
3 and 6-month dollar rate: 12%
3 and 6-month CHF rate: 8%

The trader expects the Bundesbank to tighten monetary policy over the next three months. Three months from now she expects the CHF rate to rise to 9% and the dollar rate to fall to 11%. How can she profit from this forecast? What are the risks?

14. The central bank of Shangri-La makes a forward market in its currency Rupyaka. The spot \$/Rupyaka rate is 2.10/15 and one year forward is 2.35/45. The one year Eurodollar interest rates are being quoted at 8¼–8½. A bank trader wishes to oblige a borrower who wants a one year (360 days) Eurorupyaka loan of 1 million. Assuming no default risk, what is the minimum interest rate the trader should charge?

15. A customer wishes to do a swap deal with a bank in which he buys GBP spot against ZAR (South African Rand) and sell GBP 3 months forward against ZAR. There are no active forward markets in ZAR. However, there is fairly active Eurodeposit market. The rates are:

GBP/ZAR spot: 15.6500/20
3-month Euro GBP: 6.25/6.50
3-month EuroZAR rates: 14.50/15.00.

What swap rate should the bank quote to break even on the transaction?

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APPENDIX

A.8.1 THE VALUE OF A FORWARD CONTRACT[19]

A forward contract confers on the holder the right (and the obligation) to buy or sell a given quantity of a commodity[20], at a specified price (called the delivery price) at a specified future date. A ***long position*** in a forward contract implies that the holder has agreed to buy the commodity while a ***short position*** implies that the holder has agreed to sell it. Note that unlike an ***option contract*** discussed in Chapter 10, a forward contract gives both a right and imposes an obligation.

A typical forward contract has no secondary market. That is, the holder of the contract cannot get out of the commitment by simply selling the contract. For instance, suppose a firm enters into a contract today to buy euros three months forward against dollars. Sometime before the contract

[19]There are a number of excellent treatments of the theory of forward and futures contracts. We have found the one provided in Hull (1989) to be very lucid, concise and with only a moderate level of mathematics in the body of the text.

[20]The term "commodity" is used here in a rather general sense to denote both physical commodities like gold, cotton, oil and financial assets like currencies, bonds, equity shares.

matures, it finds that its anticipated need for euros has disappeared. It must still perform on its forward purchase. It can square its position by entering into a contract to sell EUR forward that matures on the same day as the original contract, if it can find a counterparty. ***But this is a separate forward contract and does not cancel the first contract***. If the counterparty in the first contract fails to deliver, the firm must deliver on its second contract possibly by buying EUR in the spot market. (As we will see below, the bank that originally sold the contract will cancel it by entering into a new contract. Apart from a settlement payment it will also charge some administrative fee). In Chapter 9, we will discuss an instrument called ***futures contract*** that shares some of the features of a forward contract in as much as it also calls for future delivery of a specific quantity of a commodity at a specific price, but with the important difference that futures contracts are traded on organised exchanges. (There are other crucial differences which will be discussed in Chapter 9). Thus, if I buy a futures contract that gives me the right to buy CHF at a future date at a specified dollar price, I can extinguish my commitment (before the contract matures) by simply selling the contract. Of course, in general I will make a loss or a gain depending upon how the futures price has moved between my buying the contract and selling it.

As we have seen, a forward contract is costless to enter into (there may be a small flat fee to meet some administrative expenses), i.e. for the buyer of a forward contract, there is no cash outflow involved at the initiation of the contract. Obviously, the value of the contract must be zero at that time. Now consider the value of the contract on the day of maturity, T. If the delivery price specified is K and the spot price of the commodity on that day is S_T, the long side of the contract, i.e. the party who had agreed to take delivery of the underlying asset at a price K makes a gain of $(S_T - K)$ which can of course be negative. This must be the value of the contract. Suppose a firm has bought pounds forward at the rate of \$1.6500 and the spot £/\$ rate on the day of maturity is 1.6850. The firm gains \$0.0350 per pound and if someone wants to "buy" the contract from the firm, it will charge that price. If the spot rate is 1.6200, the firm must pay \$0.0300 for someone to take the contract off its hands.

What about the value of the contract on an intermediate date between initiation and maturity? That is the question we will address in this section of this appendix. As in the text, we will use arbitrage arguments. The general form of such an argument is that two or more assets with identical payoffs and risk must have the same market price. Otherwise, a trader can buy the cheaper one and short-sell the more expensive one. Since this kind of argument will be used often throughout the book, let us understand this more clearly.

Short selling an asset simply means selling something that you do not own. You can do it, if someone is willing to lend you the asset. You hope to replace it later by buying it at a price lower than what you received when you sold it, thus making a profit. If the asset pays any income from the time you borrow it till the time you replace it, you must pay it to the original owner who has lent you the asset. Thus, you can short sell equity shares by borrowing them from someone hoping to return them later after the price has fallen. If, in the meanwhile, a dividend is declared, you must compensate the owner to the amount of dividends paid. As long as you can continue to borrow the asset you can maintain your short position. When this is no more possible, you must buy it in the spot market and replace it. This may happen at a time when the price is higher than what you received in which case you suffer a loss.

Short selling may be subject to certain restrictions such as margin requirements and in some markets not possible at all for some or all assets. In what follows, we assume that it is possible without any effective restrictions.

For the purpose of the arguments that follow (and at other places in this book), a distinction has to be made between commodities which are held by most market participants purely for investment purposes and those which are held for consumption purposes including as inputs in a production process. In the latter case, stocks are held not primarily to profit from price movements but to minimise the inconvenience of being without the commodity. Thus, a steel producer would normally hold an inventory of iron ore and coal to ensure that the production process does not have to come to a halt due to delays in the delivery of these inputs. Such commodities are said to have a "convenience yield" which creates some difficulties in applying arbitrage arguments in a straightforward manner. In the case of an asset which is held purely for investment purposes, it has no use in and of itself and stocks are held primarily to receive income in the form of interest or dividends and to profit from price movements. Examples of such "commodities" are securities (financial assets) and physical goods like precious metals[21]. We will confine ourselves to such commodities.

We will use the following notation:

t_0: Time at which a forward contract was initiated.
T: Time at which the contract matures.
t: The current time – "now". $t_0 < t < T$.
t_0, t, T are measured in years from some time $t = 0$
K: The delivery price specified in the contract initiated at t_0
S_t : Spot price of the commodity (at time t)
$F_{t,T}$: Forward price of the commodity at time t for delivery at T. This is the delivery price quoted in the forward market at time t for a forward contract initiated now, at time t, maturing at time T.
r: The risk-free interest rate.

We will denote by $V(t, t^*, T)$ the value at time t, i.e. "now" of a forward contract initiated sometime in the past at time t^*, maturing at T, $t^* \leq t < T$.

- We will first examine the simpler case of a security which pays no income between t_0 and T. Examples are, a non-dividend paying equity share, a zero-coupon bond (a pure discount bond). It must be pointed out that some of the forward contracts used here for illustration may not be actually available in any market.

  Suppose a forward contract is available now, i.e. time t, which was initiated at time t_0, which matures at time T and has a delivery price of K. For instance, suppose a 3-month forward contract was initiated 2 months ago to buy GBP at a price of ₹78.25. This contract has one month left to mature. The original buyer of this contract wants to sell it. We wish to determine the market value. Consider the following two investment portfolios, P1 and P2:

  P1: A long position in the forward contract and an amount of cash $K e^{-r(T-t)}$ invested at the risk-free rate with continuous compounding. This means I buy this contract from the original party who had entered in the contract at time t_0 by paying him a price denoted $V(t, t_0, T)$ and invest an amount of cash $K e^{-r(T-t)}$ in a deposit earning interest at the rate r, continuously compounded.

  Value of this portfolio or in other words the amount of money I have to spend to acquire this portfolio is:

$$V(\mathrm{P1}) = V(t, t_0, T) + K e^{-r(T-t)}$$

  P2: One unit of the security on which the forward contract is written. The value of this portfolio is $V(\mathrm{P2}) = S_t$, i.e. the spot price of one unit of the underlying asset.

[21]Economists have argued that money has a "convenience yield" since it is used as a means of payment. Businesses hold cash balances to be able to pay for the inputs they buy as and when needed. However, transactors who hold money for investment purposes largely dominate those who hold it for its convenience yield.

At time T, the cash invested in the risk-free asset in portfolio P1 will have grown to K which I can deliver on my forward commitment and acquire a unit of the security which will be worth S_T. Portfolio P2 will also have one unit of the security worth S_T.

Thus, irrespective of what happens to the spot price of the underlying security, both portfolios have identical values at time T. Hence, they must cost the same today or else riskless profit can be made by buying the cheaper one and short selling the more expensive one. Hence,

$$V(t, t_0, T) + K\, e^{-r(T-t)} = S_t \tag{A.8.1}$$

or,
$$V(t, t_0, T) = S_t - K\, e^{-r(T-t)} \tag{A.8.2}$$

Recall that at the time of initiation, the forward contract has zero value. This means

$$V(t_0, t_0, T) = S_{t_0} - K^{e-r(T-t_0)} = 0$$

$$K = S_{t_0}\, e^{r(T-t_0)} \tag{A.8.3}$$

At the time the forward contract is entered into, the delivery price is set such that the value of the contract is zero. As the spot price changes, the value of the contract changes. By the same logic, the delivery price $F_{t,T}$, in the forward contracts initiated today maturing at time T, would be set so that $V(t, t, T)$ is zero.

$$F_{t,T} = S_t\, e^{r(T-t)} \tag{A.8.4}$$

There is a somewhat different way of arriving at (A.8.2) which gives $V(t, t_0, T)$. Suppose at time t you already hold a long position in the forward contract initiated at t_0, i.e. you have agreed to take delivery of one unit of the security at time T at price K. Suppose you offset this by taking a short position at today's forward price, i.e. you enter into a new forward contract to deliver one unit of the security at time T at the forward rate being quoted in the market today. Thus, your portfolio consists of a long contract at the delivery price K and a short contract at delivery price $F_{t,T}$. The value of this portfolio today, at time t, is:

$$V(t, t_0, T) - V(t, t, T)^{22} = V(t, t_0, T)$$

since $V(t, t, T)$ is zero. The value of this portfolio at time T consists of two components, viz. the gain/loss from the long forward which involves buying the security at price K whose market value is S_T and gain/loss from the short forward which requires you to deliver the security at price $F_{t,T}$. Thus, the total value of your portfolio is:

$$(S_T - K) + (F_{t,T} - S_T) = F_{t,T} - K$$

But this is known with certainty at time t. Hence,

$$V(t, t_0, T) = (F_{t,T} - K)\, e^{-r(T-t)} \tag{A.8.5}$$

Thus, value at time t, of the forward contract initiated at t_0 is just the change in forward price from time t_0 to time t discounted by a factor $e^{-r(T-t)}$. Now substitute for $F_{t,T}$ from (A.8.4) into (A.8.5) which again gives (A.8.2).

- Now consider the case of a security which pays a known income during the period between initiation and maturity of the forward contract. Interest bearing bonds and foreign currencies (which, remember, are held as bank deposits) are examples of such assets. We will consider forward contracts in currencies. Our notation above needs to be slightly modified. Now let S_t denote the spot rate between two currencies A and B, $S_t(B/A)$. Recall that this is stated as units

[22] The value to the seller is negative of the value to the buyer.

of A per unit of B. K and $F_{t,T}$ are also to be interpreted as delivery prices expressed as number of units of A per unit of B. Let i_A denote the (annualised) risk-free rate on A deposits and i_B be the risk-free rate on B deposits. We will assume that interest is paid on maturity of a deposit. Consider again two portfolios P1 and P2 at time t as follows:

P1: A forward contract, initiated at t_0, maturing at T, to buy one unit of B for K units of A and an amount of A equal to $(K)/[1 + i_A(Tt)]$ in a bank deposit.

The value of P1, in terms of A is:

$$V(P1) = V(t, t_0, T) + (K)/[1 + i_A(T - i)]$$

P2: An amount of B equal to $1/[1 + i_B(T - t)]$.

Its value in terms of A is:

$$V(P2) = S_t/[1 + i_B(T - t)]$$

At time T, the cash component of P1 will have grown to K units of A with which a unit of B can be purchased under the forward contract. P2 will also consist of a unit of B. Thus, irrespective of what happens to the spot rate $S(B/A)$, P1 and P2 have identical values at T. Hence, they must have identical values now. This implies

$$(t, t_0, T) + (K)/[1 + i_A(T - t)] = S_t/[1 + i_B(T - t)]$$

or

$$V(t, t_0, T) = \{S_t/[1 + i_B(T - t)]\} - \{K/[1 + i_A(T - t)]\} \quad \text{(A.8.6)}$$

As usual, a forward contract must have zero value at the time of initiation. This means that the current forward rate $F_{t,T}$ must be such that $V(t, t, T) = 0$. Or

$$\{S_t/[1 + i_B(T - t)]\} - \{F_{t,T}/[1 + i_A(T - t)]\} = 0$$

Rearranging this, we get

$$F_{t,T} = S_t \frac{[1 + i_A(T - t)]}{[1 + i_B(T - t)]}$$

This is nothing, but our good old interest parity relation without transaction costs. Substituting in (A.8.6)

$$\begin{aligned} V(t,t_0,T) &= \{F_{t,T}/[1 + i_A(T - t)]\} - \{K/[1 + i_A(T - \mathrm{t})]\} \\ &= (F_{t,T} - K)/[1 + i_A(T - t)] \end{aligned} \quad \text{(A.8.7)}$$

Thus, the value of a "seasoned" forward contract is the difference between the forward rate today for the same maturity date as in the seasoned forward contract and the rate in the old contract discounted over the remaining life of the contract.

Let us look at an example.

On January 1, 2013 a firm entered into a 6-month forward contract to buy USD 500,000 to settle an import payable. The exchange rates at the time were:

USD/INR Spot: 52.25/35 6-month Forward: 55.60/90

Thus, the company's buying rate was 55.90. The expiry date of the contract was July 3, 2013.

Towards the end of March 2013 the company cancelled the import order. On April 1, 2013, it approached the bank to cancel its forward purchase contract. The exchange rates at that time were:

USD/INR Spot: 52.25/35 3-month Forward: 52.44/68

The 3-month INR and USD interest rates were 5 per cent and 3 per cent, respectively.

A 3-month forward contract initiated on April 1, would also expire on July 3.

The cancellation of the contract can be looked upon as follows. The original contract required the firm to take delivery of USD 500,000 on July 3, at a price of INR 55.90 per USD. On April 1, the firm enters into a fresh 3-month forward contract to sell USD 500,000 to the bank, delivery on July 3, 2013. The bank agrees to buy at the 3-month forward bid rate viz. 52.44. On July 3, 2013 the following two transactions must take place:

Bank sells, the firm buys USD 500,000 at the rate of INR 55.90 per USD.
Bank buys, the firm sells USD 500,000 at the rate of INR 52.44 per USD.

The USD leg of the contracts cancels out; effectively the firm must pay the bank:

INR [(55.90 – 52.44)500000] = INR 17,30,000

In practice, instead of waiting till July 3, the firm can pay on April 1, the present value of this amount as of April 1. With INR interest rate at 5 per cent, this would have been:

NR[1730000/(1 + 0.05 × 0.25)] = INR 17,08,641.98

If on April 1, the bank's 3-month forward bid rate had been higher than 55.90, the bank would have to pay the firm the difference between the two rates per dollar. For example, if the bid rate had been 56.25, the bank would pay the firm on April 1:

INR{[(56.25 – 55.90) × 500000]/(1 + 0.05 × 0.25)} = INR 1,72,839.50

A.8.2 FORWARD RATE COMPUTATIONS

Example 1

On June 7, 2005, a client discounted his EUR 500,000 usance 90 days export bill with the export desk. The export desk reported this to the corporate dealer and asked for the conversion rate. The corporate dealer asked the USD/INR spot interbank dealer for spot quote and the USD/INR forward interbank dealer for 3 months forward swap points. The quotes given are, say, 42.92/93 for value spot and the forward dealer asked the corporate dealer to look at INRF = page for relevant swap points.

From the Dow Jones Telerate Screen, the display for INR forwards is shown below. Usually, for all currencies the forward swap points are given as one month forward from spot, two months forward from spot, etc., but for Indian rupee the forward swap points are conventionally given as spot over end of the months as shown in the display.

07-Jun-2005					**07-Jun-2005**				
INRF=					**INR FWDS & TERM**				
RIC	***BID***	***ASK***	***Srce***	***Time***	***RIC***	***BID***	***ASK***	***Srce***	***Time***
INR=	42.92	42.93	CIBY	11.05					
INROND=	8.00	8.40	BABX	11.05	Cash/Tom	0.0150	0.0175	GVDR	10.59
INRTND=			BABX	11.05	Cash/Spot	0.0175	0.0225	GVDR	11.00
INR1WD=	8.25	8.50	ABAM	11.05	Tom/Spot	0.0025	0.0050	GVDR	11.00
INR2WD=	8.40	8.90	CIBY	11.05	Spot/29 Jun 05	0.1100	0.1200	GVDR	11.05
INR1MD=	8.90	9.40	HDFC	11.05	Spot/30 Jul 05	0.2850	0.2950	GVDR	11.05
INR2MD=	9.25	9.75	BABX	11.05	Spot/31 Aug 05	0.4850	0.5050	GVDR	11.05

(Contd.)

INR3MD=	9.75	10.25	DBSB	11.05	Spot/29 Sep 05	0.6800	0.7000	GVDR	11.05
INR6MD=	10.50	11.50	HDFC	11.05	Spot/29 Oct 05	0.8750	0.8950	GVDR	11.05
INR9MD=					Spot/30 Nov 05	1.0850	1.1050	GVDR	11.05
INR1YD=					Spot/30 Dec 05	1.2900	1.3050	GVDR	11.05
					Spot/31 Jan 06	1.5900	1.6050	GVDR	11.05
					Spot/29 Feb 06	1.8600	1.8800	GVDR	11.05
					Spot/31 Mar 06	2.1300	2.1500	GVDR	11.05
					Spot/28 Apr 06	2.3600	2.3800	GVDR	11.05
					Spot/31 May 06	2.5900	2.6100	GVDR	11.05

Also note that the swap margins are given as rupees. The spot date is June 9 2005; the swap margin spot over 31 August is 0.4850/0.5050. With the rule "small/big – add" this indicates a premium on the dollar of 48.50 paise (bid) and 50.50 paise (offer).

The EUR forwards are taken from, say, Reuters Terminal which are:

07-Jun-05					*07-Jun-05*				
EURF=					***EUR DEPS & FWDS***				
RIC	***BID***	***ASK***	***Srce***	***Time***	***RIC***	***BID***	***ASK***	***Srce***	***Time***
EUR=	1.0378	1.0383	CHMK	11.05					
EUROND=	2.47	2.62	SGFS	11.05	EURON=	1.84	1.89	CHLD	10.59
EURTND=	2.47	2.59	SGFS	11.05	EURTN=	-0.63	-0.60	NWEL	11.00
EUR1WD=	2.52	2.57	NWEL	11.05	EURSN=	0.64	0.65	NWEL	11.00
EUR2WD=	2.52	2.62	BHFS	11.05	EURSW=	4.55	4.70	CHLD	11.05
EUR1MD=	2.55	2.60	CHLD	11.05	EUR2W=	9.25	9.35	CMHK	11.05
EUR2MD=	2.56	2.61	NWEL	11.05	EUR1M=	20.20	20.40	SGFS	11.05
EUR3MD=	2.56	2.61	CHLD	11.05	EUR2M=	42.50	43.00	BHFS	11.05
EUR6MD=	2.60	2.65	NWEL	11.05	EUR3M=	65.00	65.50	CHLD	11.05
EUR9MD=	2.66	2.78	BHFS		EUR6M=	135.00	136.50	CHLD	11.05
EUR1YD=	2.73	2.78	CMHK		EUR9M=	210.00	212.00	NWEL	11.05
					EUR1Y=	288.00	291.00	NWEL	11.05
					EUR2Y=	605.00	620.00	NWEL	11.05

From both these tables, we want an outright forward rate for September 9, 2005.

The bank is purchasing the client's export bill for value September 9, 2005 and hence, the foreign exchange rate is computed as follows:

Client sells EUR and buys USD and
Client sells USD and buys INR

Thus, the computation is as follows:

USD/INR Spot Bid :: 42.92
USD/INR 3 month forward points: ??

From the table, the forward points are:

Spot over 31 Aug 05 :: 48.50/50.50
Spot over 29 Sep 05 :: 68.00/70.00

Thus, for Sept. 9, 2005, the bid points for USD/INR are interpolated as

$$= [(68.00 - 48.50)/29] \times 9 \text{ days} + 48.50$$
$$= 6.05 + 48.50$$
$$= 54.55$$
$$= 55 \text{ pips premium}$$

EUR/USD Spot Bid :: 1.0378

EUR/USD 3-month forward points bid: 65.00 pips premium from the table directly (otherwise use interpolation)

Thus, the outright EUR/INR 3-month outright forward rate for Sept. 9, 2005 is

$$= (42.92 + 0.55)\ (1.0378 + 0.0065)$$
$$= 43.47\ (1.0443)$$
$$= 45.3957$$

Thus, EUR/INR September 9, 2005 Bid: ₹45.40

The corporate dealer would adjust this bid rate by subtracting his margin, say 5 paise, and arrive at the net bid rate to the client as ₹45.35 per EUR.

The client receives discounted value of INR (500000 × 45.35) = INR 2,26,75,000 today.

Example 2

Today is June 7, 2005. A client wants to buy JPY 25 million, for value three months from spot date, for covering his LC opened with the import desk. The import desk reports this to the corporate dealer and asks for the conversion rate.

The corporate dealer gets the USD/INR rates from the above table of INRF page.

USD/INR Spot Ask :: 42.93
USD/INR 3 month forward points : ??

From the table, the forward points are:

Spot over 31 August 05 :: 48.50/50.50
Spot over 29 September 05 :: 68.00/70.00

Thus, for September 9, 2005, the ask points for USD/INR are interpolated as

$$= [(70.00 - 50.50)/29] \times 9 \text{ days} + 50.50$$
$$= 6.05 + 50.50$$
$$= 56.55$$
$$= 57 \text{ pips premium}$$

In this transaction, the client is to buy JPY. Thus, the bank is selling JPY to the client, value September 9, 1999 and hence, the foreign exchange rate is computed as follows:

Client sells INR and buys USD and
Client sells USD and buys JPY
USD/JPY Spot Bid :: 122.30

USD/JPY 3-month forward points bid :: – 154.50 pips discount from the table given below (otherwise use interpolation). Recall that a pip for JPY is 0.01.

Thus, the outright JPY/INR 3-month outright forward rate for Sept. 9, 1999 is

$$= [42.93 + 0.57]/[122.30 – 1.5450] = 43.50/[120.7550] = 0.360234$$
$$= 0.3602$$

Thus, JPY/INR September 9, 2005 ask rate would be ₹36.02 per one hundred units of JPY. The corporate dealer adjusts this rate by adding a spread, say of 3 paise. The rate to the client would be ₹36.05 per one hundred units of JPY.

The client pays INR 9,012,500 for JPY 25 mio, on Sept. 9, 1999.

07-Jun-05					*07-Jun-05*				
JPYF=					***JPY DEPS & FWDS***				
RIC	***BID***	***ASK***	***Srce***	***Time***	***RIC***	***BID***	***ASK***	***Srce***	***Time***
JPY=	122.30	122.40	NBKX	11.05					
JPYOND=	0.07	0.19	CLD1	11.05	JPYON=	–4.80	–4.70	CBAA	10.59
JPYTND=	0.03	0.06	STBQ	11.05	JPYTN=	–1.65	–1.55	CLUK	11.00
JPYSWD=	0.03	0.06	STBQ	11.05	JPYSN=	–1.65	–1.55	LIST	11.00
JPY1MD=	0.02	0.10	INGX	11.05	JPYSW=	–11.40	–11.20	PBPF	11.05
JPY2MD=	0.03	0.06	STBQ	11.05	JPY1M=	–49.20	–48.60	PBPF	11.05
JPY3MD=	0.03	0.06	STBQ	11.05	JPY2M=	–105.00	–104.00	PBPF	11.05
JPY6MD=	0.06	0.09	STBQ	11.05	JPY3M=	–154.50	–153.50	PBPF	11.05
JPY9MD=	0.04	0.12	STBQ	11.05	JPY6M=	–316.00	–314.00	PBPF	11.05
JPY1YD=	0.09	0.15	BNL2		JPY9M=	–486.00	–483.00	PBPF	11.05
			STBQ		JPY1Y=	–656.00	–653.00	PBPF	11.05
					JPY2Y=	–1340.00	–1320.00	YENS	11.05
					JPY3Y=	–1970.00	–1940.00	YENS	11.05
					JPY4Y=	–2513.00	–2473.00	YENS	11.05
					JPY5Y=	–2981.00	–2931.00	YENS	11.05
					JPY7Y=	–4030.00	–3430.00	YENS	11.05
					JPY10Y=	–4650.00	–3750.00	IBJQ	

The following two examples illustrate rate calculations for erstwhile European currencies which are no longer in existence.

Example 3

A client wants to remit funds out of India for equivalent FRF 5 million for value July 15, 1999.

Thus, the client has to

Sell INR and buy USD and
Sell USD and buy FRF (equivalent EUR)

The fixed EUR/FRF rate is 6.55957 FRF per one unit of EUR.

The forex rate computed is as follows:

USD/INR Spot Ask :: 42.93
USD/INR Forward Ask 15 Jul 99 :: ??

From the USD/INR table given above, the forward points are:

Spot over 29 Jun 99 :: 11.00/12.00
Spot over 30 Jul 99 :: 28.50/29.50

Thus, for July 15, 1999, the ask points for USD/INR are interpolated as

= [(29.5 – 12.00)/31] * 16 days + 12.00
= 9.03 + 12.00
= 21.03
= 21.00 pips premium

EUR/USD Spot Ask :: 1.0383
EUR/USD 15 Jul 999 Ask :: ??

From the EUR/USD table, the forward points are:

Spot over 9 Jul 99 :: 20.20/20.40
Spot over 9 Aug 99 :: 42.50/43.00

Thus, for July 15, 1999, the ask points for EUR/USD are interpolated as

= [(43.00 – 20.40)/31] × 6 days + 20.40
= 4.37 + 20.40
= 24.77
= 25.00 pips premium

Thus, the outright FRF/INR forward rate for July 15, 1999 is

= [42.93 + 0.21]/[6.55957/(1.0383 + 0.0025)]
= 43.14/[6.55957/1.0408]
= 43.14/6.302431
= 6.8450
= 6.85

Thus, FRF/INR July 15, 1999 ask :: ₹6.85 per one unit of FRF

The corporate dealer adjusts this rate by adding his spread, say of 3 paise, then the net rate to the client would be ₹6.88 per one unit of FRF.

The client pays ₹34,250,000 for FRF 5 million, on July 15, 1999.

Example 4

A client wants to remit funds into India, for equivalent ITL 200 million for value July 15, 1999.

Thus, the client has to sell ITL (equivalent EUR) and buy USD and

Sell USD and buy INR.

The fixed EUR/ITL rate is 1936.27 ITL per one unit of EUR.

The forex rate computed is as follows:

USD INR Spot Bid :: 42.92
USD/INR Forward Bid 15 Jul 99 :: ??

From the table, the forward points are:

Spot over 29 Jun 99 :: 11.00/12.00
Spot over 30 Jul 99 :: 28.50/29.50

Thus, for July 15, 1999 the ask points for USD/INR are interpolated as

= [(28.5 – 11.00)/31] × 16 days + 11.00
= 9.03 + 11.00
= 20.03
= 20.00 pips premium

EUR/USD Spot Bid :: 1.0378
EUR USD 15 Jul 1999 Bid :: ??

From the table, the forward points are:

Spot over 9 Jul 1999 :: 20.20/20.40
Spot over 9 Aug 1999 :: 42.50/43.00

Thus, for July 15, 1999, the bid points for EUR/USD are interpolated as

= [(42.50 – 20.20)/31] × 6 days + 20.20
= 4.32 + 20.20
= 24.52
= 25.00 pips premium

Thus, the outright ITL/INR forward rate for July 15, 1999 is

= [42.92 + 0.20]/[1936.27/(1.0378 + 0.0025)]
= 43.12/[1936.27/1.0403]
= 43.14/1861.2612
= 0.02317783
= 0.0232

Thus, ITL/INR July 15, 1999 ask: ₹2.32 per one hundred units of ITL.

The corporate dealer adjusts this rate by adding his spread, say of 3 paise, then the net rate to the client would be ₹2.29 per one hundred units of ITL.

The client would receive ₹4,580,000 for ITL 200 million, on July 15, 1999.

Examples 5-8 involve changing the delivery dates of forward contracts. These examples will illustrate the computations involved in cancellation and extension of forward contracts.

Example 5: Postponement of Imports/Outward Remittances
Transaction Date: January 15, 2007
Spot Date: January 17, 2007

USD/INR Spot:	46.5400/5450
31 January 2007:	7.75/8.25
28 February 2007:	23.50/24.25
30 March 2007:	40.00/41.00

Customer bought USD value February 28, 2007 at (46.5450 + 0.2425) = 46.7875.

(Recall that when swap points are small/big, add, i.e. quoted currency at discount).

On February 15, 2007, the customer comes to know that he has to make payment for his payable on March 30, 2007 and not on February 28, 2007. The current rates on February 15, 2007 transaction date are:

USD/INR Spot:	46.5025/5075
28 February 2007:	6.50/7.00

30 March 2007:	22.25/22.75
27April 2007:	39.00/40.00

Thus, the quote of 30 March 2007 over 28 February 2007 by the market maker are:
30 March, 2007 over 28 February, 2007 Forward-Forward Swap Margins

= (22.25 – 7.00)/(22.75 – 6.50) pips
= 15.25/16.25

The premium of 15.25 paise applies when the customer wishes to buy February 28 and sell March 30; if he wants to sell February 28 and buy March 30, he must pay a premium of 16.25 paise.

To postpone the dollar purchase to March 30, the customer must:

1. Sell dollars value February 28 to cancel his initial long position
2. Buy dollars value March 30

Effectively the customer does a forward-forward swap: sell February 28 and buy March 30. This may be viewed as a combination of two spot-forward swaps:

Buy spot sell February 28
Sell spot buy March 30

Suppose both spot-forward swaps are done off a spot of 46.5050. The rate for February sale would then be (46.5050 + 0.0650) or ₹46.5700 and the rate for March 30 purchase would be (46.5050 + 0.2275) or ₹46.7325. The customer's original purchase for value February 28 was at ₹46.7875. Thus, the customer must pay the bank the difference of (46.7875 – 46.5700) or ₹21.75 paise per dollar. If the rates had moved such that the February 28 selling rate was above 46.7875, the bank would have paid the difference to the customer. Suppose the original contract was for USD 100,000. The customer would have to pay the bank ₹21,750. This payment would be effected on February 28. Alternatively, discounted value of this payment could be paid on February 15[23]. On March 30, the customer would pay ₹46.7325 per USD and take delivery of USD 100,000.

Example 6: Preponement of Imports/Outward Remittances
Transaction Date: January 15, 2007
Spot Date: January 17, 2007

USD/INR Spot:	46.5400/5450
31 January 2007:	7.75/8.25
28 Febryary 2007:	23.50/24.25
30 March 2007:	40.00/41.00

Customer bought USD value March 30, 2007 at:

46.5450 + 0.4100 = 46.9550.

On February 15, 2007, the customer comes to know that he has to make payment for his payable on February 28, 2007 and not on March 30, 2007. The current rates on February 15, 2007 transaction date are:

[23]The practice regarding the settlement varies. Some banks settle on the day of maturity of the original contract – February 28 in the example – whether the settlement is in favour of the bank or the customer or occasionally agree to settle on the day of cancellation – February 15 in the example – at the discounted value. However, some banks settle the full value on the cancellation date, if the difference is in bank's favour as in the example above, but on the day of maturity of the original contract, if the difference is in customer's favour.

USD/INR Spot:	46.8025/8075
28 February 2007:	6.50/7.00
30 March 2007:	22.25/22.75
27 April 2007:	39.00/40.00

Now, the customer again does a forward-forward swap, viz. buy value February 28, sell value March 30. This may be viewed as a combination of:

Buy spot sell March 30
Sell spot buy February 28.

Assuming both swaps to be off a spot of 46.8050, the rates are (46.8050 + 0.2225) = 47.0275 for March 30 sale and (46.8050 + 0.0700) = 46.8750 for the February 28 purchase. Since the original March 30 purchase was at 46.9550, the bank must pay the customer (47.0275 – 46.9550) = 0.0725 or 7.25 paise per dollar on March 30 or its discounted value on February 15. On February 28, the customer pays 46.8750 to take delivery of dollars.

Example 7: Postponement of Exports/Inward Remittances

This is opposite of postponement of Imports. Using the same data as in Example 5, suppose on January 15, a customer sold USD value February 28. On February 15, the firm would like to postpone delivery to March 30. It must do two spot-forward swaps, viz.

Sell spot buy value February 28; and buy spot sell value March 30.

The customer is originally short USD against INR at a rate (46.5400 + 0.2350) = 46.7750. With the swaps done on February 15, the customer buys at 46.5750 value February 28, and sells at 46.7275 value March 30.

On February 28, the bank pays the customer the difference (46.7750 – 46.5750) = 0.20 or 20 paise per dollar. On March 30, the customer delivers dollars and receives 46.7275 per dollar.

Example 8: Preponement of Exports/Inward Remittances

This is opposite of preponement of Imports.

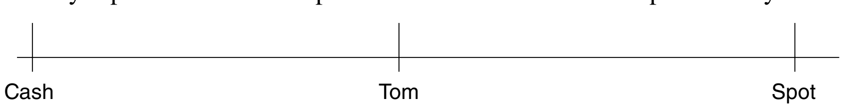
The customer is originally short USD against INR value March 30. This is to be advanced to February 28. The customer does two swaps - sell spot buy value March 30 and buy spot sell value February 28. The first of these cancels the customer's original sale contract; the second creates a new sale contract maturing February 28. March 30 buy rate would be (46.5050 + 0.2275) = 46.7325. Since the original sale for the same value date was at 46.5400 + 0.4000 = 46.9400, the bank must pay the customer the difference ₹0.2075 per dollar on March 30. On February 28, the customer delivers dollars at the rate of (46.5050 + 0.0650) = 46.5700 per dollar.

The next two examples will illustrate calculations for short-dated contracts.

Example 9: Buying USD Value Cash/Outward Remittance

This short dated contract basically involves:

A customer buys spot and does a swap in which the customer sells spot and buys back value cash



Customer buys for spot notionally at mid rate

Customer does Forex Swap of B/S, i.e. buy at near date and sell at far date USD against INR. The near date here is "cash" or "today"; the far date is the spot date.

Customer sells back for spot notionally at mid rate (far leg with reference to Value Date Cash) to neutralise the spot position and buys back for value cash (near leg with reference to Value Date Cash)

USD/INR Spot:	46.5025/5075
Cash/Tom:	2.25/2.75
Tom/Spot:	0.75/1.25

Thus,

Cash/Spot Premia 3.00/4.00
(S/B) /(B/S) ……. by the market maker for USD against INR

This means that if the bank is selling at near date (cash) and buying at far date (spot), it will give a premium of 3 paise per USD over the near date. In other words, the price for near date would be 3 paise below the price for the far date.

This is precisely the transaction the customer wants to do: sell to bank at far date (spot) and buy from the bank at near date (today). With reference to spot, "cash" is at a discount of 3 paise. Thus, in this case, the customer would pay

(46.5075 – 0.03) = 46.4775 for value today.

If the customer firm wished to sell value today, it would sell value spot and then do a swap in which it would buy spot and sell cash; it would suffer a discount of 4 paise under the spot price in this swap getting a price of (46.5025 – 0.04) = 46.4625. Thus, the quote for value today would be: 46.4625/46.4775.

As stated in the text, the same result is achieved by reversing the swap points cash/spot from 3.00/4.00 to 4.00/3.00 and then following the rule "big/small – subtract".

Example 10: Selling USD Value Tom/Inward Remittances
Here the bank must buy from the customer value tomorrow. To cover this, it must sell value tomorrow. This is effected by the bank selling value spot and then doing a swap in which it buys spot and sells value tomorrow. In this swap, the bank must suffer a discount of 1.25 paise since the tom/spot swap is 0.75/1.25. The bank will recover this from the customer. The customer will be paid 1.25 paise less per dollar compared to spot bid rate of 46.5025. The net price paid to customer would be 46.4900. Once again, reverse the swap points to 1.25/0/75 and follow the rule “big/small – subtract".

A.8.3 BOOKING FORWARD CONTRACTS AND TERMS AND CONDITIONS APPLICABLE TO FORWARD CONTRACTS

A.8.3.1 Booking Forward Contracts

1. The transaction of booking a forward contract is initiated with the customer enquiring of his bank the rate at which the required forward currency is available. Before quoting a rate, the bank should get details about (i) the currency, (ii) the period of forward cover, including the particulars of option, and (iii) the nature and tenor of the instrument.
2. If the rate quoted by the bank is acceptable to the customer, he is required to submit an application to the bank along with documentary evidence to support the application, such as the sale contract.
3. After verification of the application and the documentary evidence submitted, the bank prepares a ‘Forward Exchange Contract’.

4. No usance option may be stated in any contract for the purchase of bills. That is, the contract should not give the option to the customer to tender sight bill or in the alternative 30 days bill, etc. It can be either sight bill or a usance bill of a specified usance as mentioned in the contract.
5. The details of the contract are entered in a Forward Contract Register. The register also provides for recording of details of documentary evidence verified.

A.8.3.2 Regulatory Aspects

Till about 2000-2001, the forward market was very tightly regulated. The following terms and conditions were applicable to execution of forward transactions between authorised dealers and their corporate clients.

1. For corporates, forward cover is available only for exposures arising out of genuine import/export transactions which are in conformity with the existing trade control legislation or exposures arising out of servicing foreign currency liabilities and assets (like EEFC, ECB, Euroissues once issue price is fixed, overseas direct investments) which have been contracted after obtaining the necessary approvals.
2. Forward contracts can be entered between an authorised dealer and an entity which is resident of India at the time the contract is booked. (Also allows NRIs, partnership, individual and FIIs.)
3. Exchange brokers cannot act as brokers in a forward transaction. (This applies only to deals between corporates and banks; brokers' services can be used for deals between banks)
4. The authorised dealer must ensure that the customer is actually exposed to exchange rate risk arising out of the underlying commercial transaction. (AD is required to check genuineness of documents).
5. The forward contract must be in writing, in the prescribed form of the authorised dealer.
6. The amount of forward cover cannot exceed the value of the underlying commercial transaction.
7. The customer must present to the authorised dealer the original commercial contract[24].
8. Forward cover can be given on the basis of an irrevocable letter of credit, provided the customer gives a declaration that no other forward contract has been entered into for the same transaction.
9. If exports are on a consignment basis, forward contract can be entered into only after shipment is effected and the appropriate bill, if any, has been drawn in respect of the shipment. (Some banks do not permit this as it is not a crystallised exposure.)
10. If a forward cover is booked for a particular underlying transaction, another transaction can be substituted in its place.
11. The quality/grade/specifications of goods in an export contract can be changed provided the overseas buyer has agreed to such a substitution.
12. Forward contracts can be cancelled. The authorised dealer will levy a cancellation charge. Any gain made by the authorised dealer is credited to the customer, any loss is debited to the customer's account. The customer can leave his position open or book a fresh contract with the same or another authorised dealer. Early settlement and extension are also possible. Forward contracts for imports, once cancelled cannot be rebooked for the same underlying exposure; however, they may be rolled over. No such restriction on forward contracts for exports.
13. An exposure in, say euro, can be broken up into two parts. One or both of these may be covered. Thus, suppose a firm has a payable in euro. It can buy euro forward against US dollar,

[24]A forward contract can be entered into on the basis of a cable from the customer specifying the quantity and price/value of the goods shipped. In such cases, the original commercial contract must be presented to the A.D. within a month.

and US dollar forward against the rupee. Or it may leave the dollar exposure uncovered. This is the "third currency forward" we discussed in the text.

14. The maturity of most forward contracts between banks and their customers in India does not exceed six months. Prior to January 1997, dealers could offer their customers forwards with longer maturities, but only with the prior approval of the Reserve Bank of India in each case. Since then, this requirement to obtain RBI's prior approval has been removed. Typically, the market is quite liquid for contracts up to one year; beyond one year, while in theory, it is a market going out to five years till recently it used to be very illiquid beyond a year and mostly between foreign banks. More recently, the liquidity has improved and contracts with maturities of two years are available from many banks.

Starting sometime in 2003, the regulations were progressively liberalised. Earlier, companies had to book a forward contract for a specific exposure on account of export receivable or import payable. Then the regulation was relaxed and companies could book forward contracts up to a certain limit calculated on the basis of their average export or import volumes in three preceding years or the volume during the immediately preceding year whichever was higher. A limit was imposed on the size of total open position at any point in time which a company could have which was related to the total volume of contracts it could enter into during a year. This limit was progressively enhanced fro 25% to 50% and then 100%. More recently, companies have been allowed to use forward contracts to hedge their economic exposures and not just transactions exposures.

It must be stressed that these regulations keep changing over time. Every year, the RBI puts out a document titled "**Master Circular on Risk Management and Interbank Dealing"** which provides the details of the regulations governing the use of currency forwards, currency options, etc., by residents of India as well as non-residents. The document currently in force has been released in July 2013. The document is available on the website:

www.fema.rbi.org

A.8.4 EARLY DELIVERY, CANCELLATION AND EXTENSION OF FORWARD CONTRACTS

In the Indian foreign exchange market, holder of a forward sale or purchase contract can ask for settling the contract before maturity, cancel the contract on or before maturity date or ask for extension of the contract maturity. The following examples illustrate how these are effected.

- Early Delivery against a Purchase Contract
  Suppose on February 12, a firm books a contract to buy US dollars 100,000, 4 months forward at a rate of ₹46.50. The delivery date is June 14. On April 12, the firm requests the bank for delivery on May 14. The rates on April 12 are as follows:

  Interbank USD/INR Spot: 45.40/45.42
  1-month swap: 20/25 Outright: 45.60/45.67
  2-month swap: 30/38 Outright: 45.70/45.80
  Bank wants 0.125% margin on TT selling

  There are two alternative ways to look at this.
  We can view this as a combination of:

  1. A 2-month forward sale of USD by the customer to the bank at 45.70 plus
  2. A 1-month forward purchase by the customer at 45.67 and
  3. The original purchase to be settled on June 14 at 46.50.

Transactions (1) and (3) would result in a net payment by customer to the bank of ₹0.80 per USD on June 14. Transaction (2) would give the customer USD on May 14.

Instead, we could reason as follows. To deliver USD to the customer on June 14, the bank would have bought USD in the market delivery June 14. Now the bank must square this position by selling USD 2 months forward. Also, to deliver to customer on May 14, it must buy 1 month forward. Thus, effectively it does a 1 month-2 month swap. At the given rates, it gains ₹0.03 – 3 paise – per dollar in this swap. The bank can do one of the following:

(a) Deliver USD 100,000 to customer on May 14, at a rate of 46.47 = (46.50 - 0.03). On this the bank may add a TT selling margin.

Or, a conceptually more correct procedure would be

(b) Deliver USD to customer on May 14 at a rate of 45.67 (plus a margin) and recover the difference (46.50 – 45.70), i.e. ₹0.80 per USD or a total of ₹80,000 from the customer on June 14.

This would be identical to the first alternative. In either case, there would be a flat cancellation fee of about ₹250.

- Cancellation before Maturity Date

On August 15, an exporter sells GBP 50,000 two months forward at a rate of 68.50. The delivery date is October 15. On September 15, the exporter requests the bank to cancel the contract.

The bank will effectively sell GBP 50,000 to the customer one-month forward at the forward TT selling rate. The bank will cover itself by buying one-month forward. Suppose the rates on September 15 are:

Interbank spot GBP/INR: 67.40/67.42
1-month forward: 15/30
Exchange margin: 0.15%
One-month forward TT selling rate: 67.70(1.0015) = 67.80

Amount to be paid to the customer:

₹[(68.50 – 67.80)(50000)] = ₹35000.

This payment would be due on October 15. Discounted value of this amount can be paid on September 15 using an appropriate rate of discount such as the PLR. A flat fee for cancellation would be charged.

Notice that while the bank covers itself in the interbank market, cancellation is done at forward TT selling rate. Thus, the bank collects exchange margin both on the original contract and on cancellation.

If a firm anticipates that a forward contract may have to be cancelled, it is better to book on a fixed date basis rather than on an option forward basis. Recall that in an option forward, the bank gives the customer the worst rate ruling during the option period. Even if the original contract is on an option forward basis, it is better to book the cancellation contract on a fixed date basis[25].

[25]Thus, suppose on April 1, a June forward purchase of GBP was entered into by a customer. At the time the spot rate was 69.00 and the GBP was at a discount of 10 paise per month. Being an option forward, the bank would give two month's discount, i.e. 20 paise and the selling price would be 68.80. On May 1, the customer wishes to cancel. The spot is 68.87 and the discount is 15 paise per month. The customer should enter into a fixed date forward sale of GBP for June 1 delivery; the price would be 68.72 and the loss would be 8 paise per GBP; if the cancellation is done on option forward basis, the bank would extract 2 months discount, viz. 30 paise and the customer would lose 23 paise per GBP.

When a third-currency forward is cancelled, there is a small additional detail, viz. the loss or gain to the customer would arise in a foreign currency which has to be translated into rupees at the going buy/sell rate.

- Extension of a Contract

An importer bought USD 100,000 3 months forward on December 29 at a contract rate of ₹45.50, delivery March 31. On March 29, the importer requests the bank to extend the contract to April 30.

On March 30 the market rates are:
USD/INR Spot: 44.80/44.82 1-month swap: 10/12

(a) Extension at Market Rates

(i) The importer takes delivery under the old contract at a rate of 45.50

(ii) The importer executes a swap: sells the dollars spot at a rate of 44.80 and buys one-month forward at 44.92 (12 paise premium over the spot rate.)

Importer's cash flows:

31 March: – 45,50,000 + 44,80,000 = ₹ –70,000
30 April: ₹ – 44,92000

(b) Extension at Historical Rates

Extension at market rates gives rise to an intermediate cash flow for the importer on the maturity date of the original contract. This may result in some accounting or tax complications. To avoid these, the following method can be adopted:

(i) The spot sale in the swap is done at the historical rate of 45.50 and the forward purchase at 45.62 – 12 paise premium applied to the historical rate of 34.50.

(ii) Effectively, the customer is borrowing a sum of ₹70,000 from the bank for one month. The bank is entitled to receive interest on this. However, instead of paying interest outright, the bank adjusts the forward rate. Suppose the relevant interest rate is 14 per cent p.a. The amount of interest is:

$$70,000 \times 0.14 \times (30/365) = ₹805.48$$

On the contract sum of USD 100,000, this implies ₹0.00805 per USD. Thus, the forward premium is increased by 0.80 paisa to 12.80 paise. The adjusted forward rate is 45.6280. The importer has only one cash flow – an outflow of ₹4562800 on April 30.

With market rates, the value of importer's cash flows as of April 1, again using an interest rate of 18 per cent is:

$$-\ 70000[1 + 0.14(30/365)] - 4492000 = ₹45,62,805.48$$

Thus, with time-value of money taken into account the two methods lead to identical result apart from rounding errors.

The current exchange control regulations do not permit extension at historical rates.

In these examples we have assumed interbank quotations of non-dollar currencies against the rupee. Actually these are computed from USD/INR quotes in the Bombay market and the London market quotes between the dollar and other currencies. Also, often we have ignored the distinction between interbank rates and rates applied to merchant transactions. Appropriate margins would be added or deducted in practice.

Case Study

It is month of December, Christmas holidays are fast approaching, everyone is getting into a festive mood, but you—the Chief Investment Officer of a large corporate—are in a restive mood. You have had a somewhat dull year. It is close to bonus time. You have promised your teenaged daughter a new Porsche as the Christmas present. You are looking for making a killing on the forex front. Working on tips given by your economist friend about interest rate theorem, you are trying to build a contract that will help your company in counteracting the movement in exchange rate and interest rates will get you enough bonus to make that Christmas present.

As you open your e-mail, there is a message saying: the spot USD/CHF rate is 1.5960, and 6-month forward is 1.5625, the 3-month deposit rates are 4.50% p.a. for USD and 1.75% p.a. for CHF. Will you able to make that killing?

It looks like your lucky day. The very next message has the following news: USD/CHF spot: 1.5960/10; 3 months: 275/260; 6 months: 550/500. The 3-month and 6-month outright forward rates are: 3 months: 1.5950/70; 6 months: 1.5700/20. Can you do something here?

The last message from your banker gives some good information about the rates prevailing in the market. GBP/USD Spot: 1.7580/90; 1-month: 25/20; 2-months: 30/20; 3-months: 45/35; 6-months: 25/20; 9-months 35/30; 12-months: 30/20. US interest rates are somewhat above UK rates but less so at the far end.

Your experience in these markets makes you feel confident that in nine months, UK rates are going to fall, and the sterling will go into a forward premium. Your gut feel is: 6-month swap points to become 150/250 in nine months time.

You have a Porsche in mind and 100 million dollars to play with. Will you make it this time?

Chapter 9

Currency and Interest Rate Futures

9.1 INTRODUCTION

In Chapters 7 and 8, we analysed the spot and forward contracts and markets in foreign exchange. In the appendix to Chapter 8, we mentioned that another type of financial instrument called ***futures contract*** shares some features with the forward contract. The purpose of this chapter is to introduce the reader to the futures markets and their possible uses.

At first glance, a futures contract, like a forward contract is an agreement between two parties to exchange one asset for another, with the actual exchange taking place at a specified date in the future, but with all the other aspects of the transaction, viz. the rate of exchange between the two assets, the quantity of one of the assets to be delivered (the quantity of the other is automatically implied by the agreed upon rate of exchange) the precise date and mode of delivery, etc., being fixed at the time the agreement is entered into. However, there are a number of significant differences between forwards and futures. These relate to contractual features, the way the markets are organised, profiles of gains and losses, kinds of participants in the markets and the ways in which they use the two instruments. Most of these differences will be explained in the next section and their significance will become clearer as we proceed.

Futures contracts in physical commodities such as wheat, cotton, corn, gold, silver, cattle, crude oil and its derivatives, coffee, cocoa, etc., have existed for a long time. Futures in financial assets such as currencies, interest bearing instruments like T-bills and bonds, and other innovations like futures contracts in stock indexes and individual stocks are a relatively new development dating back mostly to early 1970s in the United States, and subsequently, in other markets around the world. We will confine ourselves to financial futures that too only currency and interest rate futures.

Even within that limitation, a detailed and comprehensive treatment is beyond the scope of this book as this would require a separate volume or two devoted to futures alone. Our purpose here is to provide the reader with sufficient familiarity with the basics of futures and their uses in international financial management. Apart from a voluminous periodical literature, there are several excellent textbook treatments available for the interested reader to pursue the topic in greater depth. Among the ones the author has found to be useful are Kolb (1985), Hull (2005), Marshall (1989), Siegel and Siegel (1990), Blank *et al*. (1991), Stoll and Whaley (1993), Burghardt (2003) and two volumes dealing with financial futures, Rothstein (1984) and Fitzgerald (1983). Besides these, the various exchanges on which futures contracts are traded, regularly publish useful literature on the subject. A lot of material is available free on the websites of major futures exchanges such as Chicago Mercantile Exchange (CME) and London International Financial Futures Exchange (LIFFE). In India, MCX, NSE and BSE provide online learning material on futures. In addition to the specific citations, this chapter draws extensively on these sources.

9.2 FUTURES CONTRACTS, MARKETS AND THE TRADING PROCESS

In order to fully understand the nature and uses of futures, it is necessary to acquire familiarity with the major features of futures contracts, organisation of the markets and the mechanics of futures trading. At this stage, we want to keep the discussion fairly general. Also, we will concentrate on the essential characteristics of futures and not the institutional details. The discussion will serve to bring out the crucial differences between forwards and futures.

9.2.1 Major Features of Futures Contracts

As mentioned above, a futures contract is an agreement for future delivery of a specified quantity of a commodity or financial asset at a specified price. The principal features of the contract are as follows:

Organised Exchanges Unlike forward contracts which are traded in Over-the-Counter (OTC) markets, futures are traded on organised futures exchanges either with a designated physical location where trading takes place or electronic screen based trading. This provides a ready, liquid market in which futures can be bought and sold at any time like in a stock market[1]. Only members of the exchange can trade on the exchange. Others must trade through the members who act as brokers. They are known as Futures Commission Merchants (FCMs).

Standardisation As we saw in the case of forward currency contracts, in any forward contract the amount of the underlying asset to be delivered and the maturity date are negotiated between the buyer and the seller, and can be customised to the requirements of one of the parties. In a futures contract, both these are standardised by the exchange on which the contract is traded[2]. Thus, for instance, one futures contract in pound sterling on the International Monetary Market (IMM), a financial futures exchange in the US, (part of the Chicago Mercantile Exchange or CME), calls for delivery of £62,500 and contracts are always traded in whole numbers. Similarly, for each contract, the exchange specifies a set of delivery months and specific delivery days within those months. A three-month sterling time deposit contract on the London International Financial Futures Exchange (LIFFE) has March, June, September, December and two serial months as the delivery cycle. The exchange also specifies the minimum size of price movement (this is known as a "tick") and, in some cases, may also impose a ceiling on the maximum price change within a day. Thus, for a GBP

[1]The fact that forwards have no secondary markets while futures are traded on organised exchanges does not matter significantly for foreign currencies since commercial banks make two-way forward markets in all major currencies at all times.

[2]In some cases, mostly in the context of commodity futures and for some financial futures, the exchange also specifies the quality or grade acceptable for delivery and the place of delivery.

contract on CME, the minimum price movement is \$0.0002 per GBP, which, for a contract size of GBP 62,500, translates into \$12.50 per contract.

Clearinghouse The clearinghouse is the key institution in a futures market. It may be a part of the exchange in which case a subset of the exchange members are clearing members or an independent institution which provides clearing services to many exchanges. It performs several functions. Among them are recording and matching trades, calculating net open positions of clearing members, collecting margins and, most important, assuring financial integrity of the market by guaranteeing performance on obligations among clearing members. On the trading floor, a futures contract is agreed between two parties *A* and *B* who are members of the exchange trading on their own behalf or acting as brokers for their public clients. When it is reported to and registered with the clearinghouse, the contract between *A* and *B* is immediately replaced by two contracts, one between *A* and the clearinghouse and another between *B* and the clearinghouse[3]. Thus, the clearinghouse interposes itself in every deal, being buyer to every seller and seller to every buyer. This eliminates the need for *A* and *B* (and their clients) to investigate each other's creditworthiness and guarantees the financial integrity of the market. The clearinghouse guarantees performance for contracts held till maturity, i.e. it ensures that the buyer will get delivery of the underlying asset provided he pays the appropriate price and, conversely, the seller will get paid, provided he delivers the underlying asset. It protects itself by imposing margin requirements on traders and a system known as ***marking to market*** described below. Exhibit 9.1 illustrates operation of a clearinghouse.

Initial Margins Only members of an exchange can trade in futures contracts on the exchange[4]. The general public uses the members' services as brokers to trade on their behalf. (Of course an exchange member can also trade on its own account.) A subset of exchange members are "clearing members", i.e. members of the clearinghouse when the clearinghouse is a subsidiary of the exchange. A non-clearing member must clear all its transactions through a clearing member. Every transaction is thus between an exchange member and the exchange clearinghouse. The exchange requires that a performance bond in the form of a margin must be deposited with the clearinghouse by a clearing member who enters into a futures commitment on his own behalf or on the behalf of his broker-client or a public customer whose transaction he is clearing. A clearing member acting on behalf of a broker-client, in turn, requires the broker-client to post a margin with the clearing member. The broker, in turn, would demand a margin from his client on whose behalf he has executed the trade.

The amount of margin varies at different levels. Usually the regulatory authority specifies a minimum margin to be posted by clearing members with the clearinghouse. At subsequent levels – i.e. between a clearing member and the broker whose trade he is clearing, between the broker and his client – the margins may be negotiated or again minimum levels specified by the exchange. The minimum specified may be changed, if price volatility increases. Margins vary with the nature of the trade too. A hedge transaction would usually call for a smaller margin than a purely speculative position. Margins on most exchanges appear to be between 2.5 per cent to 10 per cent of the value of the contract. Whether margins are applied on a net basis, i.e. only on the difference between the number of contracts sold and bought or on a gross basis (i.e. number of contracts sold plus number of contracts bought) varies from exchange to exchange.

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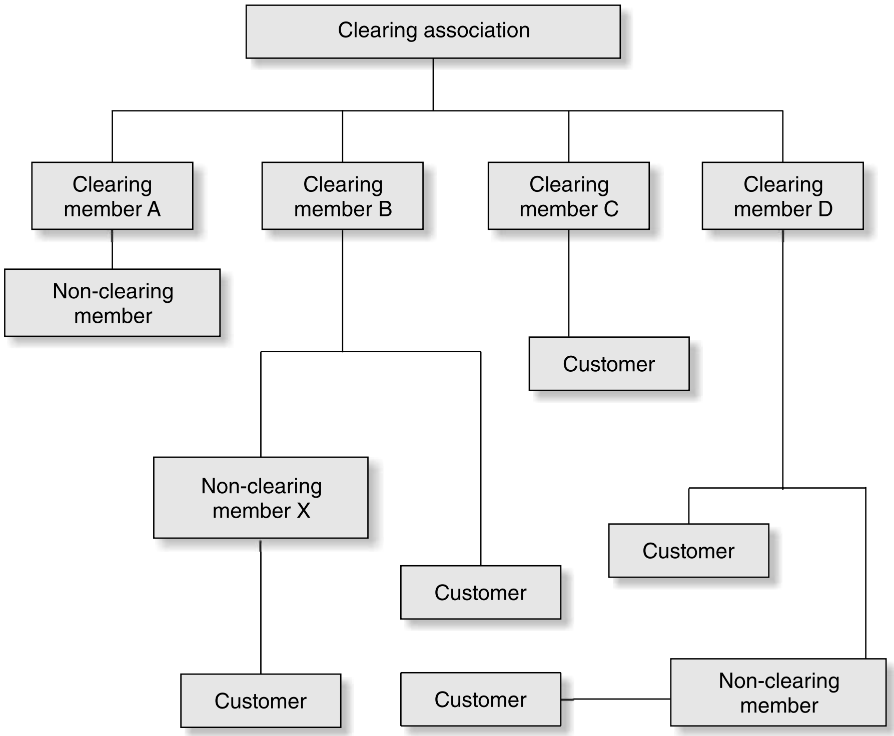
[3]The clearinghouse may be a subsidiary of the exchange itself or an independent corporation.

[4]On some exchanges, it is possible for a non-member to lease a member's seat for a fee. Also, some exchanges create special licences which permit non-members to trade in some contracts. This is done to encourage trading and build volume. [See Kolb (1985)].

Exhibit 9.1 Clearinghouse Operation



A member – clearing or non-clearing – may simultaneously have sold and bought positions since he may trade on his own behalf as well as on behalf of his customers.

The margin can be in the form of cash, or securities such as treasury bills[5] or, in some cases, letters of credit from a bank. The initial margin is posted on opening a position. Thereafter, the marking-to-market process explained below results in a series of daily credits into or debits from the margin account. These are called variation margins. The details of this process are explained below.

Marking to Market Marking to market essentially means that at the end of a trading session, all outstanding contracts are re-priced at the settlement price of that session. Margin accounts of those who made losses are debited and of those who gained are credited. This is explained in detail below but a quick example here will be useful. Suppose I buy a June delivery pound sterling future on say April 14 at a price of \$1.60 per pound or \$100,000 per contract (= 62500 × 1.60). Next day, the price increases and at the end of trading on April 15, the settlement price is 1.62. I have made a gain of 2 cents per pound – 100 "ticks" or \$1250 per contract. (Obviously, someone with a short position lost a matching amount.) This is credited to my margin account (and I can immediately withdraw it in cash), and my contract is re-priced at 1.62 or \$1,01,250 per contract. How this procedure limits the risk of the exchange is discussed below. At this stage, you can see an important difference marking to market creates between forwards and futures. In a forward contract, the entire

[5]In case the securities are interest bearing, any interest payments belong to the person depositing the margin.

gain or loss arises only on maturity. There are no intermediate cash flows; in a futures contract, even though the overall gain/loss is same, the time profile of its accrual is different[6] – the total gain or loss over the entire period is broken up into a series of daily gains and losses which clearly has a different present value. Consider the following two sets of cash flows to be received (or paid if negative) at monthly intervals for the next six months:

	1	2	3	4	5	6
I	0	0	0	0	0	500000
II	100000	–200000	400000	–100000	100000	200000

Over the six-month period both sets add up to 500,000 but with non-zero interest rates, obviously the NPV of these two sets of cash flows would be quite different.

Also note that the mark-to-market settlements do not involve discounting, i.e. the gainer receives (the loser pays) the undiscounted change in the value of the futures contract. This is not the same thing as settling an outstanding forward contract and marking it to market.

Actual Delivery is Rare In most if not all forward contracts, the underlying asset is actually delivered by the seller and accepted by the buyer. Forward contracts are entered into for acquiring or disposing off the asset at a future date, but at a price known today. Of course, as we have seen in the previous chapter for currencies where forward markets are not accessible to all parties, non-deliverable forward contracts have emerged and have fairly large trading volumes. In most financial futures contracts, actual delivery takes place in less than one percent of the contracts traded. Futures are used as a hedging device against price risk and as a way of betting on price movements rather than as a means of physical acquisition of the underlying asset. Most of the contracts are extinguished before maturity by entering into a matching contract in the opposite direction[7].

9.2.2 The Futures Trading Process

Futures contracts are traded by a system of open outcry on the trading floor (also called the trading pit) of a centralised and regulated exchange. Increasingly, trading with electronic screens is becoming the preferred mode in many exchanges around the world. All traders represent exchange members. Those who trade for their own account are called ***floor traders*** while those who trade on behalf of others are ***floor brokers***. Some do both and are called ***dual traders*** [See Marshall (1989)].

The variables to be negotiated in any deal are the price and the number of contracts. A buyer of futures acquires a ***long position*** while the seller acquires a ***short position***. As we have seen above, when two traders agree on a deal, it is entered as a short and a long both vis-à-vis the clearinghouse.

When a position is opened, the trader (both the long and the short) must post an ***initial margin***. As prices change, the contract is marked to market with gains credited to the margin account and losses debited from the account. These are called ***"variation margins"***. If, as a result of losses, the

[6]The difference can be understood as follows: In a forward contract, the long acquires the underlying commodity on the maturity date at the delivery price written into the contract. In a futures contract, if it is held to maturity, the price paid for acquisition of the commodity is the futures price on the maturity day which must equal the spot price on that day. This price ***minus*** the algebraic sum of all the positive and negative cash flows throughout the life of the contract equals the original futures price at which the long bought the contract.

[7]Since for every buy there is a matching sell, the exchange does not have to worry about balancing the two sides. Suppose on day 1, A buys a EUR future and B sells it. As we saw, this leads to two contracts: (1) A buys and clearinghouse sells (2) B sells and clearinghouse buys. Next day, suppose A sells and C buys. Now, A is out of the picture, clearinghouse is seller to C and buyer from B. Subsequently, suppose B buys and D sells, clearinghouse becomes buyer to D and is still seller to C and so forth.

amount in the margin account falls below a certain level known as ***maintenance margin***[8]**,** the trader receives a ***margin call*** and must make up the amount to the level of the initial margin in a specified time. This is called "paying the variation margin". If the trader fails to do so, his or her position is liquidated immediately. Thus, daily marking to market coupled with margins, limit the loss the clearinghouse or a broker may have to incur to at most a couple of days' price change.

There are various kinds of orders given to floor traders and brokers. A client may ask his or her broker to buy or sell a certain number of contracts at the best available price (***Market Orders***) or may specify upper price limit for buy orders and lower limit for sell orders (***Limit Orders***). An order can become a market order, if a specified price limit is touched though it may not get executed at the limit price or better (***Market If Touched or MIT* orders).** A trader with a long (short) position may wish to limit his losses by instructing his broker to liquidate the position, if the price falls (rises) to or below (above) a specified level below (above) the current market price (***stop-loss orders*).** Stop orders can be combined with limit orders by stating that execution is restricted to the specified limit price or better (***stop limit orders***). Some traders may wish their orders to be executed during specified intervals of time – e.g. first half an hour of trading (***time of day orders)***. For a description of other types of orders and the order matching and execution process, see Siegel and Siegel (1990) or Edwards and Ma (1992).

For every contract, the exchange specifies a "last trading day". Those who have not liquidated their contracts at the end of this day are obliged to make or accept delivery as the case may be. For some contracts, there is no physical delivery of the underlying asset, but only a cash settlement from losers to the gainers (like in a non-deliverable forward contract discussed in Chapter 8). Where physical delivery is involved, the exchange specifies the mechanism of delivery.

Futures markets also have market-makers and bid-ask spreads. Floor traders who perform this service are known as **scalpers**[9]. The rules of futures trading ensure that a single market price is produced at each instant based on competing bids and offers. All bids and offers have to be announced publicly. The highest bid takes precedence over all bids and the lowest offer takes precedence over all offers. This ensures that a sale takes place at the highest bid price currently available and a purchase takes place at the lowest offer price available. As a consequence, one does not see a spectrum of prices in futures markets as in, for instance, the inter-bank forward market in foreign exchange. Since most major banks also participate in currency futures markets, the single price at any time conveys information that helps banks set prices in the inter-bank over the counter market for currencies.

9.2.3 Some Typical Currency Futures Contract Specifications

Exchange: Chicago Mercantile Exchange CME

British Pound Futures Contract Specifications
Size of Contract: 62,500 Pounds

Expiry Months: January, March, April, June, July, September, October, December, & Spot Month

Minimum Price Fluctuation ("Tick"): $ 0.0002 per Pound (2 pt) ($6.25/point) $12.50 per contract

[8]Not all exchanges have a separate maintenance margin. In that case, the margin account balance must be maintained at the level of initial margin.

[9]Scalpers are a group of traders who trade on very small price differences, but do a large volume of trading during a typical trading day. Mainly they exploit the timing mismatch between sell and buy orders coming from outside. They provide liquidity to the market. In a trending market, they can lose a lot of money.

Limit**:** No limit for the first 15 minutes of trading. A schedule of expanding price limits will be in effect when the 15-minute period is ended.

Japanese Yen Futures Contract Specifications

Size: 12,500,000 Yen

Expiry Months: January, March, April, June, July, September, October, December, & Spot Month

Minimum Price Fluctuation ("Tick"): $0.000001 per Yen or 0.01 cent per 100 Yen (1 pt) ($12.50/pt). $12.50 per contract

Limit: No limit for the first 15 minutes of trading. A schedule of expanding price limits will be in effect when the 15-minute period is ended.

9.2.4 Futures Price Quotations

Financial newspapers such as ***The Wall Street Journal*** and ***The Financial Times*** report futures prices on major exchanges every day for the previous day's trading session. Table 9.1 taken from CME website exhibits IMM price quotations for some currency futures as on May 29, 2013. The amount mentioned in brackets after each currency title is the size of the contract in units of that currency. This is the amount of the currency the contract seller has to deliver if he holds the position till contract expiry and settlement is by physical delivery. Thus, one Pound Sterling contract is for 62500 pounds, Japanese yen is for ¥ 12.5 million while for euro and Swiss francs, the contract size is 1,25,000. Prices for futures contracts maturing in June 2013 and September 2013 are shown in the two rows following each currency title. In each row, the successive figures are:

1. The day's opening price
2. The highest price reached during the day
3. The day's lowest price
4. Day's last or closing price (this is the price used in marking to market)[10]
5. The change in closing price from the previous day denoted as "CHG". It is the difference between last price of the current session and the settlement price of the prior day.
6. The trading volume in the particular contract
7. The settlement price of the prior day
8. Open Interest (Op Int) denotes the number of contracts which are still outstanding as of the reporting date

Prices are stated as number of USD per unit of the currency. In case of the JPY contract, the price is given as amount of USD per 100 JPY. "CHG" denotes the change in settlement price from the previous day stated. The change in settlement price can also be stated as "points". The size of a "point" is $0.0001 per unit of the currency for British pound, euro and Swiss franc while for Japanese Yen a point is $0.000001 per yen. Some sources also provide data on open interest. This denotes the number of contracts outstanding at the end of the day.

[10] Actually the closing price is not the price at which the last trade of the day was done. The exchange provides data on what is called "closing range" which are prices observed during the last few minutes of trading and the closing price is the average of these. Similarly the opening price is the average of the "opening range".

9.3 FUTURES PRICES, EXPECTED SPOT PRICES AND FORWARD PRICES

Let the current spot price at time t of the underlying asset be denoted by S_t. The futures price for a unit of that asset in a futures contract initiated at t and maturing at some specified time T in the future is denoted $FU_{t,T}$ and the forward price for a contract maturing at T is $F_{t,T}$. In this section, we will explore first the nature of the relationship between $FU_{t,T}$ and $E(S_{t,T})$, the latter being the spot price expected to rule at T, the expectation being formed at time t. Subsequently, we will discuss the relation between futures prices and forward prices for the same asset for contracts maturing on the same date. Lastly, we will examine the relationship between the current futures price $FU_{t,T}$ and the current spot price S_t.

Table 9.1 CME Currency Futures Quotes (May 29, 2013)

EURO

Expiry	*Current Session*							*Prior Day*	
	Open	*High*	*Low*	*Last*		*Chg*	*Vol*	*Set*	*Op Int*
Jun'13	1.28560	1.29800	1.28390	1.29310	—	0.00550	179415	1.28760	260597
Sep'13	1.28620	1.29860	1.28480	1.29390	—	0.00550	1369	1.28840	4173

CHF (125,000)

Expiry	*Current Session*							*Prior Day*	
	Open	*High*	*Low*	*Last*		*Chg*	*Vol*	*Set*	*Op Int*
Jun'13	1.02420	1.04180	1.02150	1.03610	—	0.00840	32765	1.02770	68580
Sep'13	1.02780	1.03970	1.02780	1.03970	—	0.01100	52	1.02870	1460

JPY (12,500,000)

Expiry	*Current Session*							*Prior Day*	
	Open	*High*	*Low*	*Last*		*Chg*	*Vol*	*Set*	*Op Int*
Jun'13	0.97770	0.99060	0.97540	0.98700	—	0.00730	138969	0.97970	224083
Sep'13	0.97810	0.99100	0.97570	0.98720	—	0.00710	1816	0.98010	7143

(**Note: For JPY the prices are quoted as USD per 100 JPY**)

Expiry	*Current Session*							*Prior Day*	
	Open	*High*	*Low*	*Last*		*Chg*	*Vol*	*Set*	*Op Int*
Jun'13	1.5037	1.5124	1.5006	1.5110	—	0.0048	79934	1.5062	219051
Sep'13	1.5019	1.5111	1.4999	1.5100	—	0.0046	399	1.5054	1949

GBP (62,500)

In the terminology of futures markets, the difference between the current spot price and the futures price, viz. $(S_t - FU_{t,T})$, is known as the ***basis***[11]. Over the life of a futures contract the basis changes. It equals zero on the maturity date as the futures price at T for delivery at T must equal the spot price at T[12].

[11]Some authors define basis as $(FU_{t,T} - S_t)$.

[12]This is true provided there are no differences between the spot commodity and the commodity on which futures are traded. Differences in grade, place of delivery, etc., can cause the basis to be nonzero on maturity date. Not relevant for financial assets.

9.3.1 Futures Prices and Expected Spot Prices

There has been a continuing debate on whether the futures price $FU_{t,T}$ is an unbiased predictor[13] of what the spot price of the asset will be on the expiry date of the contract. viz. S_T, i.e. whether $FU_{t,T} = E(S_{t,T})$. The traditional theory of futures price known as ***normal backwardation hypothesis*** says that at any time, the futures price must be a downward biased estimate of the future spot price, i.e. $FU_{t,T} < E(S_{t,T})$ and the futures price must rise as the contract nears maturity. We know that at time T, the futures price $FU_{T,T}$ must equal the actual realised spot price S_T. Figure 9.1 shows the behaviour of futures price as t approaches T. In the figure we have assumed that $S_T = E(S_{t,T})$. The argument behind the normal backwardation hypothesis can be presented as follows.

In the futures market, there are basically two types of traders. There are ***hedgers*** who use futures to eliminate price risk and there are ***speculators*** who are attempting to profit from price movements and are willing to accept some risk. Consider a commodity like wheat. At the time of plantation, the farmer does not know the price he will get when the crop is harvested.

He can lock in a price by selling wheat futures.

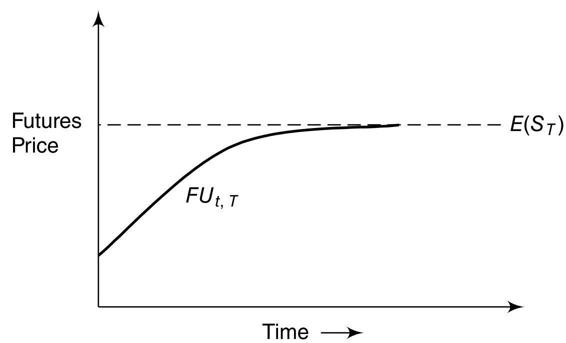


Fig. 9.1 Normal Backwardation

If farmers as a group wish to take a short position in futures, someone else must be willing to take a net long position. This could be another group of hedgers who wish to protect themselves against a ***rise*** in wheat prices, e.g. owners of flour mills or bread bakers. In the absence of such matching hedging needs, the net short position of farmers must be balanced by a net long position of speculators. A speculator would be willing to take a long position only if he or she thinks that the current futures price underestimates the spot price that will rule on the day of maturity so that futures prices will rise over the life of the contract and the speculator will be able to make profits. If the current futures price equals the expected future spot price, speculator's ***expected gain*** would be zero, but there would be a risk that the speculator might make a loss. If speculators as a group are risk averse, they would want to be compensated for taking on the risk which the hedgers wish to eliminate. Hence, futures prices must underestimate the future spot prices and rise over the life of the contract.

[13]The concept of an unbiased predictor can be explained as follows. Suppose you have a random variable Y_t and you would like to predict at time t, the value Y_T, it will take at some future time $T > t$. You have a formula that produces a prediction $P_{t,T}$. The formula may use any data available at time t including the past values of Y. The predictor is unbiased, if the prediction errors $(Y_T - P_{t,T})$ in repeated applications have a zero mean and are serially uncorrelated. The former means that while you may under or over predict in a particular instance, on average the error is zero. The latter means that successive errors have no predictable pattern.

The normal backwardation hypothesis assumes that hedgers on average will be net short so that speculators have to be net long. What if it is the other way around, i.e. hedgers wish to be net long so that speculators must be net short? In this case, the futures price must overestimate the future spot price and futures prices must decline as maturity approaches. This pattern of futures price behaviour is known as ***contango***[14]. It is depicted in Figure 9.2.

A third possibility is that hedgers are net short to begin with, but then wish to be net long. In this case, the futures price will be initially below the expected spot price, but will then rise above it before converging to it at maturity. This pattern is known as the ***net hedging hypothesis***.

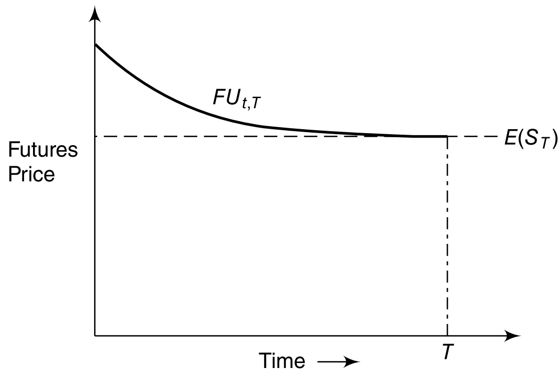


Fig. 9.2 Contango

There have been extensive empirical studies of the relationship between futures prices and expected future spot prices. Some of the important ones are listed in the bibliography at the end of this chapter. While the unbiased hypothesis continues to be debated, the weight of the available evidence favours the view that we cannot at any time really know whether hedgers and speculators are net long or net short and, therefore, cannot say whether futures prices underestimate or overestimate future spot prices. In such a situation, the futures price can be accepted as the best estimate of the future spot price. A deeper theoretical analysis of the question can be found in Richard and Sundaresan (1981).

9.3.2 Futures Prices and Forward Prices

We have remarked above that the daily marking to market feature of futures contracts creates a significant difference between the cash flows from a futures contract and those from a forward contract. Let us look at an example.

Suppose on a Monday a trader buys one CHF futures contract. The futures price is \$0.8146 per CHF or \$101825 per contract. Let us assume that he has to deposit a margin of \$5091. The contract calls for delivery on Wednesday of the following week and the last trading day is the Monday before that, i.e. a week from the date of the contract. Assume that the forward CHF/USD rate for delivery on the same day is also \$0.8146. The futures settlement prices over the next five working days and the resulting cash flows[15] are as follows:

[14]Some authors, e.g. Marshall (1989), use the term normal backwardation to denote a situation in which the current futures price is less than the ***current*** spot price and contango to denote the opposite case. This is based on the argument that in "stable markets" the current spot price is a good estimator of future spot price. We will explore below the nature of the relation between the current futures price and the current spot price.

[15]The cash flow is given by the product $(F_t - F_{t-1}) \times 125000$ where F_t is the settlement price at the end of day t.

Day	***Futures Price***	***Cash Flow***
Tuesday	\$0.8140	– \$75.00 [= (0.8140 – 0.8146) * 125000]
Wednesday	\$0.8147	+ \$87.50 [= (0.8147 – 0.8140) * 125000]
Thursday	\$0.8151	+ \$50.00 …and so on
Friday	\$0.8149	– \$25.00
Monday	\$0.8148	– \$12.50
		Total: + \$25.00

On the last trading day, the futures price equals the spot CHF/USD rate. Assume that the trader liquidates his position on that day. He makes a gain of \$25 over the week composed of two cash inflows and three cash outflows. If the trader had purchased a forward contract at \$0.8146, he could have made a profit of \$0.0002 per CHF by selling CHF spot at \$0.8148, two days before the maturity of the forward contract. This also yields a profit of \$25 for a contract size of CHF 125,000 but all of it accrues on the last day. In the futures contract, on some days there is a cash inflow that can be withdrawn and invested, while on some days there is an outflow that reduces the margin account, and if the balance in the margin account drops below the maintenance margin, the trader may have to borrow money to replenish the margin account.

This is an issue we have touched upon earlier, viz. is a single net cash flow of size C obtained N days from today equivalent to N daily net cash flows X_1, X_2, …. X_N, some positive i.e. inflows, some negative i.e. outflows which all add up to C?

The relation between forward prices $F_{t,T}$ and futures prices $FU_{t,T}$ has been analysed in Cox, Ingersoll and Ross (1981) and Richard and Sundaresan (1981). Cox *et al*. demonstrate that when interest rates are stochastic, futures and forward prices will differ. The proof is beyond the scope of this book, but we can provide an intuitive argument. In the appendix to this chapter, it is shown that when the risk-free interest rate is constant and same for all maturities, the forward price equals the futures price. A more general proposition, that the two prices are equal, when interest rates are deterministic (but not necessarily same for all maturities), is proved in Cox *et al*.

Suppose the spot price of the underlying asset has a strong positive correlation with interest rates. When spot price rises, so does the futures price and so a long futures position makes an immediate gain which can be reinvested at a higher than average interest rate because interest rate will also tend to rise. When spot price falls, the long futures position makes a loss which can be refinanced at a lower than average interest rate. A long position in forwards is not affected by changes in interest rates. Hence, under this condition, a long position in the futures contract will be more attractive than a long position in the forward contract on the same asset, maturing on the same day. Futures price will exceed the forward price. Conversely, when the correlation between the spot price and interest rates is strongly negative, a long position in futures will incur losses when interest rates are rising and make profits when interest rates are falling. This implies that futures will be less attractive than forwards and futures price will be less than the forward price.

Empirically, there is no stable correlation pattern between spot prices and interest rates.

These theoretical models only account for the effect of uncertain interest rate. In practice, there are other factors which will cause the two prices to differ. Among them are taxes, transaction costs, treatment of margins and differences in default risk which is higher with the forward contract. In any case, the theoretical difference is quite small. Empirical investigations also reveal that the difference between futures price and forward price for the same delivery date is not significant[16].

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[16]See Cornell and Reinganum (1981) for evidence on curreny futures and forwards and Rendleman and Carbini (1979) for T-bill futures and forwards.

To conclude this section, we will examine the relation between the futures price and the spot price at any given time. In the Appendix to Chapter 8, we investigated the relation between the forward price and the spot price. Ignoring the theoretical difference between futures and forward prices we can apply the same analysis to the spot-futures relationship.

Consider first the case of a commodity like gold which is held largely for investment purposes and can be stored. The relation between the spot price and futures price can be established by using an argument called "cash-and-carry arbitrage". For such a commodity it is clear that the cost of carry and the spot price are important determinants of the futures price. The cost of carry would include the interest cost of funds required to buy the commodity in the spot market plus any storage costs such as renting a safe deposit box etc. Assume that lending and borrowing can be done at the risk-free interest rate which is 100 per cent per annum. Let C denote the present value of carrying costs, i.e. the discounted present value of all the costs such as rental of a safe deposit box that will have to be incurred to store and carry the gold purchased today. Then, we must have

$$FU_{t,T} = (S_t + C)[1 + r(T - t)] \tag{9.1}$$

Here time is measured in years from some arbitrary origin so that $(T - t)$ is the maturity period of the futures contract expressed in years.

Thus, suppose the current spot price of ten grams of gold is ₹27000, the cost of storing gold for three months is ₹ 800 (to be paid up-front) and the risk-free interest rate is 6 per cent p.a., then the futures price for three month delivery must be

$$(27800)[1 + (0.06/4)] = ₹28217$$

The reason once again is arbitrage. Suppose (9.1) does not hold. Instead if

$$FU_{t,T} > (S_t + C)[1 + r(T - t)] \tag{9.2}$$

For example suppose the three month futures price is ₹28800.

An arbitrageur can borrow the amount $(S_t + C)$ – in our example ₹27800 — to pay for a unit of the commodity and the storage costs and sell a futures contract. He or she will realise a riskless profit of

$$FU_{t,T} - (S_t + C)[1 + r(T - t)] = 28800 - 28217 = ₹583$$

As a large number of arbitrageurs attempt to do this – all of them buying gold in the spot market and selling futures contracts — the spot price S_t will rise and futures price $FU_{t,T}$ will fall. If the reverse inequality holds, i.e.

$$FU_{t,T} < (S_t + C)[1 + r(T - t)] \tag{9.3}$$

reverse cash-and-carry arbitrage will generate profits. A trader can sell a unit of the commodity, save storage costs, invest the proceeds at the risk free rate and buy a futures contract again making riskless profits. Thus, for commodities which are held primarily for investment purposes and can be stored, (9.1) must hold. For financial assets, carrying cost primarily consists of interest cost on funds invested in buying the asset since physical storage costs are negligible.

When the underlying asset yields an income stream while it is being carried, the relationship needs modification. Suppose the asset yields an income stream whose present value is I_t. Then an amount I_t can be borrowed to finance the acquisition of the asset to carry out a cash-and-carry arbitrage and the borrowing can be paid off from the income yielded by the asset. Ignoring the physical storage cost, the relationship is then[17]

$$(S_t - I_t)[1 + r(T - t)] = FU_{t,T} \tag{9.4}$$

[17]For cash and carry arbitrage, the cash outlay required to acquire the asset is $S_t - I_t$. In reverse cash and carry arbitrage, the arbitrager must compensate the owner of the asset for the income stream yielded by the asset. For this purpose, he must set aside a sum I_t out of the proceeds of short sale so that investible funds are $S_t - I_t$.

Note that (9.4) can be applied to foreign currency futures too. Let us use the following notation:

$FU_{t,T}$: Futures price of currency B in terms of currency A,
S_t: Spot rate B/A,
r_A: The risk-free rate for deposits in currency A
r_B: The risk-free rate for deposits in currency B.

One unit of B can be "stored" in the form of a deposit which earns interest $r_B(T - t)$. The present value of this, in terms of, A is

$$[S_t r_B(T - t)]/[1 + r_B(T - t)]$$

This corresponds to I_t in (9.4). From (9.4) we have

$$FU_{t,T} = \left\{ S_t - \frac{[S_t r_B(T-t)]}{[1 + r_B(T-t)]} \right\}[1 + r_A(T-1)] \tag{9.5}$$

A simple manipulation yields the interest parity relation which was analysed in Chapter 8.

Also note that a relation like (9.1) should link prices of two futures contracts with different maturities. Let $FU_{t,T1}$ and $FU_{t,T2}$ denote prices at time t of two futures contracts maturing at $T1$ and $T2$ respectively, with $T2 > T1$. Interpret C as the present value, at time $T1$, of the cost of storing the commodity from $T1$ to $T2$. Assuming the risk-free rate to be constant we must have:

$$FU_{t,T2} = (FU_{t,T1} + C)[1 + r(T2 - T1)] \tag{9.6}$$

In practice, these relationships will hold only approximately. The main reason for the departure from the theoretical relation is the fact that the cost of carrying the asset as well as the present value of the income yielded by the asset depend on interest rate which in general will not remain constant between time t at which the futures position is acquired and time T when it matures. Further, in some markets, use of the entire proceeds of short sales may not be permitted. The reverse cash-and-carry arbitrage argument will have to be modified in such cases[18]. In case of assets yielding an income stream, there may be some uncertainty regarding the timing and amount of income generated as for instance in the case of stock portfolios[19]. Also, notice that we have ignored the marking to market feature of futures contracts and transactions costs like bid-ask spreads – e.g. the fact that lending and borrowing rates in the money market are different – and brokerage commissions. In cash-and-carry arbitrage, the trader has to borrow money while in reverse arbitrage he lends money; the rates being unequal, no unique value for futures price can emerge. For all these reasons, cash and carry arbitrage and its reverse are not really risk-free and one can expect that in practice, futures prices will not conform exactly to the relationships derived from arbitrage arguments. There will be an arbitrage-free band within which they can move[20].

The above argument applies to cases where the asset to be delivered against a futures contract is available in the spot market. Such assets are called "carryable" assets. This may not always be the case. For instance, in a US treasury bill futures contract, the long must deliver a US treasury bill which has 91 or 92 days to maturity from the expiry date of the contract. No such bill may be available in the spot market at time t, before the expiry date. The arbitrage arguments must be modified to take account of this. We will return to this matter below in the section on interest rate futures.

[18]This is not a serious difficulty since most of the arbitragers hold the asset in inventory and need not engage in short selling.
[19]This becomes relevant in the context of stock index futures.
[20]Recall from Chapter 8 that in the case of forward rates too transactions costs lead to a band within which the forward price can move without giving rise to arbitrage.

In passing it must be pointed out that the same cash and carry arbitrage argument cannot be applied to commodities which are primarily held for consumption purposes including as an input in production. In particular, inequality (9.3) can persist without giving rise to arbitrage forces since holders of the commodity may not necessarily sell it and buy futures. The commodity – say, wheat – can be used for consumption or as an input in production of bread, futures contracts on wheat cannot be consumed or used to make bread. We say that the commodity has a "convenience yield" which must be taken into account while deriving any arbitrage relations.

9.4 HEDGING AND SPECULATION WITH CURRENCY FUTURES

By now it should be clear that trading in futures is equivalent to betting on the movements in futures prices. If such bets are employed to protect a position in the underlying asset we say the trader is engaging in hedging. If, on the other hand, the bets are taken solely to generate profits from absolute or relative price movements, we say it is speculation. Speculators perform the valuable service of providing liquidity to the futures markets by their willingness to take open positions.

9.4.1 Hedging with Currency Futures

Corporations, banks and others use currency futures for hedging purposes. In principle, the idea is very simple. If a corporation has an asset, e.g. a receivable in a currency *A* which it would like to hedge, it should take a futures position ***such that futures generate a positive cash flow whenever the asset declines in value***. In this case since the firm is ***long*** in the underlying asset, it should go ***short*** in futures, i.e. it should sell futures contracts in *A*. Obviously, the firm cannot gain from an appreciation of *A* since the gain on the receivable will be eaten away by the loss on futures. The hedger is willing to sacrifice this potential profit to reduce or eliminate the uncertainty. Conversely, a firm with a liability in currency *A*, e.g. a payable, should go long in futures.

Hedging with currency futures essentially involves the following three decisions:

(1) Which contract should be used, i.e. the choice of "underlying" This decision would be straight-forward, if futures contracts are available on the currency in which the hedger has exposure against his home currency. If not, the choice is not so simple. Thus, suppose a Japanese firm has a receivable in Canadian dollars. If there are no futures on CAD in terms of JPY (or vice versa), which contract should it choose? It might choose a USD/JPY contract. This is called a cross hedge. If it had exposure in USD, it would have hedged using the same contract; now it would be direct hedge.

(2) Choosing the maturity of the contract Suppose on February 28, a Swiss firm contracts a 3-month USD payable. This would mature on June 1. There is no CHF/USD futures contract maturing on that date; traded contracts mature on third Wednesday of June, September, etc. Our immediate response would be "sell the June CHF contract" — nearest to the date of the payable. But remember that rarely does a hedger use futures to actually take (or make) delivery of the underlying asset; they are used only as hedging devices. In this case, the firm will buy USD in the spot market two days prior to settling its payable; at the same time, it will lift the hedge by buying the futures. It hopes that if the USD has appreciated in the meanwhile, its loss on the payable will be made up by the gain on futures (conversely of course if USD has depreciated, its cash market position will show a gain which will be offset by loss on its futures position). There is, therefore, no reason why it must buy the June contract. Does the choice of expiry date of the futures contract have any implications for minimising the loss it might incur due to appreciation of USD? What can it do to recoup as much of the loss as possible?

Recall the behaviour of futures price vis-à-vis the spot price. On the day the futures contract matures, its price must equal the spot price. This is known as "convergence". The hedging firm must determine whether convergence works in its favour or against it.

Suppose on February 28, the spot CHF/USD is 0.8200 and June, September and December futures are trading at 0.8100, 0.7900 and 0.7700, respectively. Thus, the basis (spot-futures) is 0.01 for the June contract, 0.03 for September and 0.05 for December. The firm's objective is to protect itself in the event dollar appreciates, i.e. spot CHF/USD goes down. In that case, to recoup the higher outlay on the payable, it would like the futures price also to go down by as much, if not more as the fall in the spot rate. In other words, at the time the hedge is lifted on June 1, it would like the basis to remain the same or widen compared to what it is at the start. Let us clarify this with a quick example. Suppose its payable is USD 100,000. At the spot rate on February 28, this translates into CHF (100000/0.82) or CHF 121951.22. Ignoring the standard size problem, suppose it could sell CHF futures worth exactly CHF 121951.22 at a price say USD 0.79 per CHF, a basis of 0.03. Now suppose by June 1, the dollar has appreciated to 0.78. To buy USD 100,000, the firm must now pay CHF(100000/0.78) or CHF 128205.13. Its cash position has suffered a loss of CHF(128205.13-121951.22) or CHF 6253.91. If the futures contract price also declines by 0.04 to 0.75 so that the basis remains constant at 0.03, the firm would recoup the loss exactly; if the futures price declines by a larger amount say to 0.73, it will in fact gain. However, if the basis contracts to 0.01 with futures price falling only to 0.77, the loss on cash position would exceed the gain on futures.

The June contract will be about 3 weeks from maturity and it is much more likely that its price will have moved closer to the spot rate – i.e. the basis will have **narrowed** – compared to the September and December contracts which have another three and six months to expiry. Thus, in this case, convergence works against the hedger and it would be advisable to use a **distant** contract – September or December – rather than June[21]. You can easily see that if the firm had a dollar receivable (in which case it would buy CHF futures) and the basis started out positive, it would want a narrowing of the basis; it would be advisable to buy a **near contract**, i.e. June. You can also see that with a dollar payable, if the basis was negative to begin with, it would again like the basis to narrow. We can, thus, summarise the effects of convergence as follows:

	Basis at the start	
	Positive	Negative
Nature of hedge		
Long	*F*	*A*
Short	*A*	*F*

A "long hedge" means your obligation is to take delivery of the asset underlying the futures contract; a "short hedge" requires you to deliver the underlying asset. "*F*" indicates that convergence works in your favour while "*A*" implies that convergence will work against you.

There are, however, two counteracting factors. First, usually, liquidity in near contracts tends to be higher and bid-ask spreads lower compared to distant contracts. Brokers would demand a higher brokerage fee to execute an order on a distant contract because with lower liquidity and trading

[21]What if the dollar goes down, i.e. spot USD/CHF increases? Now futures would produce a loss and there would be a saving on the payable. Here again, if spot rate increases, the firm would like futures price to increase **less** than the increase in the spot price. This means it would again want the basis to remain constant or widen.

volume, it would take them longer to execute the order. This consideration militates against choosing too distant a contract. The other factor is volatility of basis. Longer the gap between lifting the hedge and delivery date of the futures contract, greater is the basis risk[22]. A thumb rule recommended by practitioners is that the expiry date of the futures contract should be as close as possible but later than the settlement date of the underlying exposure against which the futures position is taken on as a hedge.

(3) Choosing the Number of Contracts This is perhaps the most important decision. Once again, an easy but generally wrong answer would be that the value of the futures position should match as closely as possible the value of the cash market position. An exact match will generally not be possible because of the standardised size of futures contracts. Thus, suppose the Swiss firm mentioned above has a USD payable of $500,000 and it decides to sell September contracts priced at $0.79/CHF. At this price, the CHF equivalent of $500,000 is CHF 632911.39.

Since one CHF contract is for CHF 125,000, it should sell: (632911.39/125000) = 5.0633 rounded off to 5 or 6 contracts.

Define the **"Hedge Ratio"(HR)** as:

$$\mathrm{HR} = \frac{\mathrm{V_F}}{\mathrm{V_C}} = \frac{\text{Value of the future position}}{\text{Value of the cash position}}$$

Both values are measured in a common currency. The simple answer suggested above says that hedge ratio should be as close to unity as possible. As we will see below, this would be correct only in the very special case of a direct hedge where the cash position being hedged matures on the same date as the futures contract being used to hedge it. Such situations would be very rare in practice. Because of standardisation of delivery dates, in general there will be a timing mismatch between the maturity of the futures contract and the settlement date of the cash position. In addition, in the case of a cross hedge, there will be currency mismatch too. We will consider these two cases separately.

Direct Hedge with a Timing Mismatch

Consider once again the Swiss firm which on February 28 has a USD 500,000 payable to be settled on June 1. It chooses to hedge by selling September CHF contracts. This contract matures on September 18. We wish to determine the number of contracts it should short.

We will employ the following notation:

- V_C: The value of the cash market position measured in the foreign currency. Here V_C = USD 500,000.
- S_t: The spot rate at the start stated as units of home currency (HC) per unit of foreign currency(FC). Here it is (1/0.8200) = CHF 1.2195 per USD
- T_1: The date when the cash position has to be settled. In the present case T_1 is June 1.
- T_2: The date when the futures contract expires, $T_2 > T_1$

Here T_2 is September 18

- V_F: The value of the futures position measured in US dollars. For the moment, ignore the problem of standard size.

[22]There are other considerations. In some cases futures prices behave somewhat erratically during the delivery month. Hence, even if a hedge is expiring in a delivery month, practitioners choose a contract expiring in a later month. In some cases where the short chooses to make delivery on any business day in the delivery month, the long runs the risk of having the delivery assigned to him if he is still holding an open long position. This can be quite inconvenient.

$F_{t,T2}$: The price at time t of the futures contract maturing at T_2 once again stated as units of HC per unit of FC. In the present example $F_{t,T2}$ is (1.0/0.7900) = CHF 1.8518.

$\tilde{F}_{T1,T2}$: The price of the same contract at time T_1, expressed as units of HC per unit of FC (The "~" denotes that it is a random variable)

$\tilde{S}_{T1}$: The spot rate at time T_1 when the hedge is lifted. Stated as units of HC per unit of FC.

CHF value of the futures position is ($V_F \times F_{t,T2}$). The total cash flow generated by the futures position between t and T_1 (when the hedge is lifted) is given by[23]

$$V_F(F_{t,T2} - \tilde{F}_{T1,T2}) \tag{9.7}$$

The HC value of the hedged cash flow at time T_1 is given by

$$\tilde{V}_{H,T1} = -V_C\tilde{S}_{T1} + L_F(F_{t,T2} - \tilde{F}_{T1,T2}) \tag{9.8}$$

The first term on RHS is the amount of CHF the firm has to spend to buy the USD payable in the spot market – an outflow. The second term is the gain it makes on the futures contracts. This could also be negative, if the price of the futures contract at time T_1 is higher than the price at time t when the firm sold the CHF contracts.

A commonly used measure of the effectiveness of a hedge is variance of the value of the hedged position at the time of lifting the hedge. If the firm would like to minimise this variance, it must choose V_F so as to minimise the variance of $V_{H,T1}$ in equation (9.8). This variance is given by

$$\mathrm{Var}(\tilde{V}_{H,T1}) = V_C^2\ \mathrm{Var}(\tilde{S}_{T1}) + V_F^2\ \mathrm{Var}(\tilde{F}_{T1,T2})$$

$$-\ 2V_CV_F\ \mathrm{cov}\,(\tilde{S}_{T1}\tilde{F}_{T1,T2}) \tag{9.9}$$

Choosing V_F to minimise this is a simple problem in elementary calculus and the optimal value of V_F denoted V^*_F is given by

$$\frac{V^*_F}{V_C} = \frac{\mathrm{cov}(\tilde{S}_{T1}, \tilde{F}_{T1,T2})}{\mathrm{var}(\tilde{F}_{T1,T2})} \tag{9.10}$$

The LHS of (9.10) is the hedge ratio HR defined above. The minimum-variance hedge requires that the hedge ratio should equal the ratio of the covariance of $\tilde{S}_{T1}$ and $\tilde{F}_{T1,T2}$ to the variance of $\tilde{F}_{T1,T2}$.

Let us apply this result to the Swiss firm's case. Assume that we have somehow obtained estimates of the covariance of $\tilde{S}_{T1}$ and $\tilde{F}_{T1,T2}$ and the variance of $\tilde{F}_{T1,T2}$. Their ratio is 0.90. Then the USD value of the futures position must be (500,000 × 0.90) = USD 450,000. At the futures price of \$0.79/CHF, this translates into CHF 569620.25. With each contract being CHF 125,000 this is equivalent to 4.56 contracts rounded off to 4 or 5 contracts.

The key question is how to obtain estimates of the ratio of the covariance to the variance. The standard approach to such problems is to estimate a regression of the form:

$$\tilde{S}_{T1} = \alpha + \beta\tilde{F}_{T1,T2} + u \tag{9.11}$$

The least-squares estimate of β is given by the ratio of the sample covariance of $\tilde{S}_{T1}$ and $\tilde{F}_{T1,T2}$ to the sample variance of $\tilde{F}_{T1,T2}$. This approach is known as **"delta hedging"**.

[23]We are ignoring the intermediate cash flows due to marking to market and their time value. The error due to this is small and in any case as we will see we cannot get a perfect hedge.

Note however a major difficulty. Equation (9.11) is a **forward-looking** regression; at time t we wish to estimate the covariance between the spot rate and the futures price and the variance of the latter both as of time $T_1 > t$. From interest parity, we know that the following relation will hold at time T_1

$$\tilde{F}_{T1,T2} = \tilde{S}_{T1} \frac{1+\tilde{r}_{d,T1,T2}}{1+\tilde{r}_{f,T1,T2}} \tag{9.12}$$

Here $\tilde{r}_{d,T1,T2}$ and $\tilde{r}_{f,T1,T2}$ are domestic and foreign currency (in the example, CHF and USD respectively) interest rates applicable for the period $T_1 - T_2$. Note that as of time t, these interest rates are unknown and hence have to be regarded as random variables.

Thus, to determine the hedge ratio, we need to know (or predict) what the forward discount or premium for the period $(T_2 - T_1)$ will be at time T_1. If the interest rate factor in (9.12) i.e. $\left[\frac{1+\tilde{r}_{d,T1,T2}}{1+\tilde{r}_{f,T1,T2}}\right]$, is known to be, say k, then it is easy to see that[24] $[\text{cov}(\tilde{S}_{T1}, \tilde{F}_{T1,T2})/\text{var}(\tilde{F}_{T1,T2})] = 1/k$.

In practice, we **do not know the value of *k*.** One way out would be to estimate from past data the covariance between the spot rate and the forward rate for period equal to $(T_2 - T_1)$. In the appendix we briefly discuss how to go about estimating this parameter.

A Cross-Hedge with Timing Mismatch

Now let us consider the case of cross-hedging. Suppose on August 25, 2009 an American software firm contracts a three-month, 30 million Swedish kroner receivable. The settlement date is November 25. There are no futures contracts on SEK in terms of US dollars. The exporter believes that the SEK is closely tied to the EUR so that their movements against the US dollar will be closely correlated. The spot and futures prices are as follows (we are ignoring bid-ask spreads):

Spot USD/SEK: 7.2550 Spot EUR/SEK: 9.2320

These rates imply:

Spot EUR/USD: 1.2725 Spot SEK/USD: 0.1378
EUR futures: December 2009: 1.2950
March 2010: 1.3210
June 2010: 1.3650

The firm is long in SEK (it will receive SEK) and hence, it must sell EUR contracts. The basis is negative so convergence works in its favour. The firm decides to sell December contracts. It must decide the number of contracts to be sold.

In terms of the notation used above time t is August 25, 2009, T_1 is 25 November 2009, and T_2 is third Wednesday of December 2009. Let $\tilde{S}_{T1}$ denote the SEK/USD rate at time T_1, i.e. November 25, 2009 and $\tilde{F}_{T1,T2}$ denote the price of the December 2009 futures contract at time T_1. The size of the cash position V_C is SEK 30 million or EUR 3249566.72 at the spot rate EUR/SEK 9.2320 at time t, August 25. Let V_F be the size of its futures position measured in SEK. The exporter's cash flow in USD at time T_1 will be

$$V_C\tilde{S}_{T1} - V_F(\tilde{F}_{T1,T2} - F_{t,T2})$$

[24]From (9.12), $S_{T1} = F_{T1,T2}/k$. Then, $\text{cov}(S_{T1}, F_{T1,T2}) = (1/k)\ \text{var}(F_{T1,T2})$

To minimise its variance as before, the hedge ratio V_F/V_C must equal:

$$\text{cov}(\tilde{S}_{T1}\,\tilde{F}_{T1,T2})/\text{var}(\tilde{F}_{T1,T2})$$

which is estimated by the coefficient β in the forward-looking regression

$$\tilde{S}_{T1} = \alpha + \beta\tilde{F}_{T1,T2} + u$$

Now note that we are regressing the spot SEK/USD rate on the futures price in USD of the EUR contract at time T_1. From covered interest parity at time T_1, we can write

$$\begin{aligned}\tilde{F}_{T1,T2} &= \tilde{S}_{T1}\,(\text{EUR/USD})[(1 + r_{\$\,T1,T2})/(1 + r_{EUR\;T1,T2})]\\ &= \tilde{S}_{T1}\,(\text{SEK/USD}) \times \tilde{S}_{T1}\,(\text{EUR/SEK})\;[(1 + r_{\$\,T1,T2})/(1 + r_{EUR\;T1,T2})]\end{aligned}$$

Suppose for a moment that the firm knows with certainty that at time T_1, S_{T1}(EUR/SEK), the EUR/SEK spot rate will be 9.50 while the interest rate factor $[(1 + r_{\$\,T1,T2})/(1 + r_{EUR\;T1,T2})]$ will be (1.045/1.03) = 1.0146. Then the hedge ratio V_F/V_C should equal:

$$[1/(9.50)(1.0146)] = 0.1037.$$

The SEK value of the futures position should be:

$$\text{EUR }(3249566.72 \times 0.1037) = \text{EUR } 336980.07$$

With a contract size of EUR 125,000, this corresponds to 2.6958 or rounded off to 3 contracts.

In practice, an estimate of the hedge ratio will have to be obtained by regressing the spot SEK/USD rate on the $(T_2 - T_1)$ period EUR/USD forward rate using past data. The estimate of the slope coefficient in this regression will be used as the hedge ratio.

Now the reader can easily work out that the variance-minimising hedge ratio would be unity when the cash market position expires on the same day as the expiry of the futures contract and it is a direct hedge, i.e. there is no currency mismatch[25].

Thus, the problem of choosing the number of contracts to be traded is by no means simple. Using historical data to estimate the required covariance-variance ratio introduces error since these parameters do not remain constant. Also note that our procedure for selecting the hedge ratio is optimal only if the hedger's objective is to minimise the variance of the cash flow at the time the hedge is lifted.

An alternative, but equivalent way, is to examine how we can design a "perfect hedge". A perfect hedge is said to have been achieved when the loss (gain) on the cash position is exactly matched by the gain (loss) on the futures position. Consider an American firm at time t, with a EUR receivable of V_C maturing at time T_1. It sells EUR futures worth V_F, maturing at time T_2 at a price $F_{t,T2}$. At time T_1 when the hedge is lifted, the gain (loss) on the receivable is $V_C(S_{T1} - S_t)$ where S_{T1} and S_t denote the EUR/USD spot rates at time T_1 and t, respectively. The loss (gain) on futures is $V_F(F_{T1,T2} - F_{t,T2})$. The two would be of equal magnitude if we choose V_F such that

$$\begin{aligned}V_F/V_C &= \text{HR} = [\text{change in spot rate/change in futures price}]\\ &= \Delta S/\Delta F\end{aligned}$$

Suppose the relation between the spot and futures price is given by

$$S_{T1} = \alpha + \beta F_{T1,T2} + u \tag{9.13}$$

where u is a random error with zero mean. Then the required hedge ratio is β. Notice again that this is a forward-looking regression. In practice, it is estimated by regressing historical spot rates on

[25]Hint: In this case, $T_1 = T_2$ and $F_{T1,T2} = S_{T1}$.

futures prices. This is exactly the procedure we followed for the variance-minimising hedge in the timing mismatch case above. Thus, the "perfect hedge" as defined here is nothing but the variance-minimising hedge.

There are two reasons why such a perfect hedge can rarely be achieved with futures. The first and the less important reason is the fact that futures contract size is standardised. If an American importer has a payable of GBP 100,000, it cannot be perfectly hedged with futures since the standardised size of a GBP contract is 62,500.

The second and more important reason is that the correlation between changes in spot rate and changes in futures prices is less than perfect or, in other words, the basis does not remain constant. This is known as the ***basis risk***. It is captured by the random error u in (9.13).

Consider a simple example. On March 1, the £/\$ spot rate is 1.6750, while June futures are trading at 1.6680. The basis is 0.0070 or 70 "ticks". Suppose an American firm has a three-month sterling receivable of £1,00,000 and hedges it by selling two sterling futures. By June 1, the spot sterling has depreciated to 1.6620 while June futures are trading at 1.6590. The basis has shrunk to 0.0030 or 30 ticks. The loss on the receivable is

$$\$100000\ (1.6750 - 1.6620) = \$1300$$

while the gain on futures is

$$\$[125000\ (1.6680 - 1.6590)] = \$1125$$

for a net loss of \$175[26].

Essentially, the difficulty is that the change in the spot price between t and T_1, viz. $(S_{T1} - S_t)$, does not in general equal the change in futures price $(F_{T1,T2} - F_{t,T2})$. Once again the interest parity relation tells us that

$$F_{t,T2}(\pounds/\$) = S_t(\pounds/\$)\frac{[1 + r_\$(T - t)]}{[1 + r_\$(T - t)]} = k\ S_t(\$/\pounds) \tag{9.14}$$

where $$k = \frac{[1 + r_\$(T - t)]}{[1 + r_\$(T - t)]}$$

If the factor k remains constant[27], then

$$(F_{T1,T2} - F_{t,T2}) = k(S_{T1} - S_t)$$

and a hedge ratio $V_F/V_C = 1/k = \beta$ would give a perfect hedge. In practice, since interest rates keep changing, k and therefore β does not remain constant, i.e. basis risk cannot be eliminated. It can be estimated with a regression using historical data on changes in the spot price and changes in the price of the futures contract. The estimation procedure is discussed in the appendix to this chapter.

In practice, of course the standard size of the futures contract would not permit achievement of a perfect hedge even if basis risk could be eliminated. Thus, in the example of the American firm with GBP receivable, β equals 0.9958 and the futures position valued in GBP should have been (100,000/0.9958) = GBP 100419.66. If indeed β had remained fixed, the basis at maturity would have been a little over 69 ticks and the hedge would have been perfect.

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[26]Even if the standard size problem were not there, the hedge would not be perfect. In fact, in this example, if the value of futures position were to be £100,000, the gain on futures would have been only \$900.

[27]That is, we must have

$$\{[1 + r_\$(T_2 - t)]/[1 + r_\pounds(T_2 - t)]\} = \{[1 + r_\$(T_2 - T_1)]/[1 + r_\pounds(T_2 - T_1)]\}$$

Since β changes, what if the firm decides to engage in **dynamic hedging**? To do this, the firm continuously monitors the β factor and adjusts the size of its futures position. Whenever β decreases, V_F is increased by selling more futures and vice versa. This is called "**rebalancing the hedge**". The problem with strategy is that the possible improvement in hedge performance can be largely wiped out by transactions costs – remember there are bid-ask spreads and brokerage commissions to be paid in futures transactions. Frequent re-balancing would involve a large number of buy/sale transactions with associated transaction costs which might entirely wipe out any gain from such a strategy. In practice, if the size of the exposure is large and the settlement date is far into the future some practitioners may decide to rebalance the hedge once a week or once a month.

The standard size problem cannot be circumvented. In the example, V_F = 100419.66 corresponds to 1.6067 contracts each of size GBP 62,500. This could have been rounded off to 1 or 2. Suppose it is rounded off to 2. Now, if GBP depreciates as before to 1.6620 and the futures price declines to 1.6550 (basis = 69 ticks), the futures gain would have been \$1612.5, more than the loss on the cash position; however, if the pound had appreciated, let us say to 1.6875, futures price to 1.6806 (again basis = 69), gain on the cash position would have been \$1250, but loss on futures would have been \$1575. In this case, the firm would have been better off selling one contract.

The problem is more complicated in the case when a firm is using a futures contract between two currencies *A* and *B*, to hedge an exposure in, say currency *A*, and its home currency is a third currency *C*. Thus suppose a Danish firm is hedging a USD receivable by buying EUR contracts which are priced in terms of USD. Here, the optimal hedge ratio involves an estimate of the correlation between changes in (USD/DKK) spot rate and changes in the (EUR/USD) futures price as well as an estimate of the spot (USD/DKK) rate at the time the hedge is to be lifted. The gain on cash position will be proportional to the change in (USD/DKK) spot rate while the loss on futures (measured in DKK) will be proportional to the product of change in the (EUR/USD) futures price ***and*** the spot (USD/DKK) rate.

More examples of hedging with currency futures will be discussed in Chapter 12 which deals with management of transaction exposure.

9.4.2 Speculation with Currency Futures

Unlike hedgers who use futures markets to offset risks from positions in the spot market, speculators trade in futures to profit from price movements. They hold views about future price movements which are at variance with the market sentiments as reflected in futures prices and want to profit from the discrepancy. They are willing to accept the risk that prices may move against them resulting in a loss.

Speculation using futures can be classified into ***open position trading***[28] and ***spread trading***. In the former, the speculator is betting on movements in the price of a particular futures contract while in the latter he or she is betting on movements in the price differential between two futures contracts. We will look at examples of each.

- Open Position Trading
  It is February 26, 2010. The following spot and futures prices are available in the interbank and futures markets:

  Spot CHF/USD: 0.8065 March futures : 0.8195
  June futures: 0.8325 September futures : 0.8505

[28]Some traders attempt to profit from price movements only during the course of a trading day, i.e. they do not carry open positions overnight. These are called "Day Traders". In contrast, those designated as "Position Traders" carry open positions over longer periods sometimes weeks or even months.

These prices imply that the market is expecting the CHF to appreciate against the dollar over the next seven months. A speculator holds the view that the market is wrong and the CHF will actually depreciate. Another speculator agrees with the market that the CHF will appreciate but thinks that the market is overestimating the extent of potential appreciation. Both sell a September CHF contract at 0.8505. On September 10 the following rates materialise:

Spot CHF/USD: 0.8410 September futures : 0.8440

Both speculators close their positions by buying a September contract. The profit is:

$(0.8505 – 8440), i.e. $0.0065 per CHF

Or $(125000 × 0.0065) = $812.5 per contract

(Once again we are ignoring marking to market as well as transactions costs such as brokerage commissions).

Note that the first speculator made a profit even though his forecast turned out to be wrong. What matters is the movement in September futures price relative to its value on February 26. A loss would have resulted if the CHF had appreciated so strongly that September futures price had in fact increased[29].

In this example, the market believed that the price of the underlying commodity will increase while the speculator believed the price will decrease or at least not increase as much as the market thought. To make profit, the speculator had to go ***short*** in futures. In the opposite case, when the market anticipates a decline in price and the speculator disagrees, he or she must take an open ***long*** position and carry it[30]. In either case there is a risk of loss.

In contrast to open position trading, spread trading is a more conservative form of speculation. Spread trading involves buying one futures contract and selling another. Essentially, it is betting on the change in the difference or "spread" between two prices rather than absolute movement in the level of a particular price. Spreads are of two kinds. An ***intra-commodity spread*** involves speculating on difference in prices of two futures contracts on the same underlying commodity or financial asset, but with different maturity dates. They are also called ***time spreads*** or ***calendar spreads.*** An ***inter-commodity spread*** involves betting on the difference in prices of two futures contracts on two different but related commodities, or financial assets, usually with the same maturity dates. In the context of foreign currencies, inter-commodity spreads are useful when the speculator has views on movements of currencies X and Y relative to each other, no particular views about the movement of each relative to say the US dollar, but futures contracts are available for both only against the dollar (and not against each other). Let us look at an example of both kinds of spreads.

- **An Inter-commodity Spread**

On February 12, the following prices are observed in the inter-bank spot market and the IMM futures market.

	CAD/USD	AUD/USD	Implied CAD/AUD
Spot	0.8542	0.7728	1.1053
March	0.8650	0.7820	1.1061
June	0.8735	0.7865	1.1106
September	0.8875	0.7935	1.1185

[29]It should be obvious that similar profit could have been made by speculating in the forward market. However, banks normally refuse to deal with an individual in the forward market.

[30]This is simply another way of stating that you should sell what you think is overpriced and buy what you think is underpriced.

These rates imply that the market expects the Australian dollar to depreciate against the Canadian dollar over the coming seven months. A speculator, however, does not agree with this view. He feels that the Australian central bank will soon raise interest rates pushing the AUD up. In his view the market is undervaluing the AUD relative to the CAD. He has no particular views about how the AUD and the CAD will individually move against the USD, but he feels quite confident that the AUD is going to rise against the CAD. In his view, the market is undervaluing AUD vis-à-vis CAD for September settlement. The size of both the CAD and AUD contracts is 100000 units of those currencies.

To profit from his forecast, he must follow the basic principle, viz. sell what you think the market is overvaluing and buy what you think the market is undervaluing:

Buy one September AUD contract at \$0.7935 per AUD. Sell one September CAD contract at \$0.8875 per CAD.

On September 10 the rates are as follows:

	CAD/USD	AUD/USD	Implied CAD/AUD
Spot	0.8866	0.7974	1.1118
September	0.8706	0.7833	1.1115

The speculator closes his position by the reverse trades:

Sell one September AUD contract at 0.7833
Buy one September CAD contract at 0.8706

His transactions can be summarised as follows:

	AUD	CAD
Sold at	0.7833	0.8875
Bought at	0.7935	0.8706
Net	–0.0102	+0.0169

The overall net gain is \$(100000 × 0.0067) = \$670

Notice that the speculator's forecast has actually turned out to be wrong. The AUD did depreciate against the CAD. Nevertheless he made profit because **the extent of depreciation of the AUD turned out to be less than what was reflected in the September futures prices quoted on February 12.** In other words, what matters is what happened to the difference or the spread between the prices of September CAD and AUD futures. As long as this spread narrows, the speculator would make profits. On February 12 the spread was 0.094 (= 0.8875 – 0.7935); by September 10 it narrowed to 0.0873 (= 0.8706 – 0.7833), i.e. it had narrowed by 0.0067, exactly equal to the overall gain.

Of course, once transaction costs such as bid-offer spreads, brokerage commissions etc are taken into account, the spread must narrow by a sufficient amount before net profit is realised. The speculator is really betting that the spread will narrow rather than betting about depreciation or appreciation of the AUD **per se**. Suppose the September futures prices on September 10 had been 0.8706 and 0.7780 for the CAD and AUD, respectively. These would imply a CAD/AUD rate of 1.1190 which is higher than what was implied by the same prices on February 12. The speculator still makes profit because the spread has narrowed.

To emphasise the point that it is immaterial whether the AUD and CAD appreciate or depreciate against the dollar, suppose the September 10 spot and futures prices had been as follows:

Spot CAD/USD: 0.8345 September futures: 0.8340
Spot AUD/USD: 0.7610 September futures: 0.7590

Now both currencies have depreciated against the USD.

The implied CAD/AUD rates are spot 1.0965 and September futures 1.0988. As before, the speculator sells a AUD contract for a loss of \$(0.7935 – 0.7590), i.e. \$ 0.0345 per AUD and buys a CAD contract realizing a profit of \$(0.8875 – 0.8340), i.e. \$0.0535 per CAD, for a net gain of \$0.0190 per unit or \$1900 per contract. Once again the spread has narrowed from 0.0940 to 0.0750. The AUD depreciated against the USD, appreciated somewhat against the CAD but the spread in September futures had reduced[31].

This speculator would make a loss if the spread widens irrespective of the way AUD/USD and CAD/USD rates move. For instance, if the September futures prices on September 10 are 0.7650 for the AUD contract and 0.8655 for the CAD, the profit in closing the CAD position would fall short of the loss in closing the AUD position producing an overall loss of 0.0065 per unit, the amount by which the spread has widened. The loss would amount to \$650 per contract.

Now consider another speculator. With the prices on February 12 as given above, she thinks that the market is **underestimating** the extent to which AUD is likely to depreciate against the CAD. In other words, in her view, the CAD/AUD rate implied by the September futures prices on February 12, **overvalues** the AUD relative to the CAD. To profit from her forecast, she must sell a September AUD future and buy a September CAD future – once again, buy what you think is relatively cheap and sell the relatively expensive commodity. You can convince yourself that this strategy will pay if the spread **widens** and produce a loss, if it narrows.

As a final example of an inter-commodity spread, consider the following data.

On February 14, we observe the following prices:

	GBP/USD	CHF/USD	Implied GBP/CHF
Spot	1.7380	0.6642	2.6167
March	1.7308	0.6620	2.6145
June	1.7060	0.6564	2.5990
September	1.6840	0.6520	2.5828

A speculator feels that the market is overestimating the extent to which the Sterling is likely to decline against the Swiss franc. He has no particular views about how they will individually move against the Dollar; both may appreciate or depreciate. He is reasonably certain that by September, sterling will not fall as much against the Swiss franc as implied in the above quotations. In other words, in his view, the September sterling is under-priced relative to Swiss franc. Equivalently, the franc is overpriced relative to sterling.

He, therefore, buys two September sterling contracts at \$1.6840 per sterling and sells a September Swiss franc contract at \$0.6520 per Swiss franc.

On September 10, the spot and futures prices are as follows:

Spot GBP/USD: 1.6810 September futures: 1.6780
Spot CHF/USD: 0.6490 September futures: 0.6480

He closes his position by selling two September sterling contracts at \$1.6780 per sterling and buying a September Swiss franc contract at \$0.6480 per Swiss franc. He loses \$0.0060 per sterling on the former and gains \$0.0040 per Swiss franc on the latter. His overall losses and gains are as follows:

[31]Obviously, if the AUD does indeed appreciate relative to the CAD as the speculator forecast, the spread ***must*** narrow and the speculator make profit irrespective of the movements in \$/AUD and \$/CAD rates.

$$\begin{aligned}\text{Loss on sterling futures} &= \$0.0060 \text{ per sterling}\\ &= \$(125000 \times 0.0060) = \$750\\ \text{Gain on Swiss franc futures} &= \$0.0040 \text{ per CHF}\\ &= \$(125000 \times 0.004) = \$500\end{aligned}$$

A net loss of $250 occurs over and above transaction costs and marking to market. Once again, define the spread as the price of CHF future minus the price of GBP future. The spread was –1.0320 on February 12 and increased (algebraically) or "widened" to –1.0300 by September 10. This is the cause of the speculative position resulting in a loss. The GBP/CHF rate implied in the September futures prices is 2.5895 which is above what was implicit in the September prices on February 12. The spot GBP/CHF rate is 2.5901. The speculator's forecast did indeed turn out to be right in as much as the GBP did not fall to the extent implied by the futures prices on February 12, but the spread still widened leading to a loss.

You might wonder whether the speculator would have been better off, if he had bought only one sterling future instead of two. The answer is yes, with the prices as they turned out. Suppose, however, that both GBP and CHF futures had strengthened to say 1.6920 and 0.6620, respectively, the basis again widening to –1.03. You can easily calculate that with two sterling futures the loss would be again $250 while with one sterling future the loss would be $750[32].

We will conclude this section with an illustration of an intra-commodity or time spread.

- **An Intra-commodity Spread**

On February 26, 2010, the following spot and futures CHF prices are observed:

Spot: 0.7698
March: 0.7693
June: 0.7680
September: 0.7681
December: 0.7688
March 11: 0.7699

It appears that the market expects a mild strengthening of the Swiss franc after some initial weakening. A speculator believes that US inflation is going to accelerate in view of looser monetary policy and the CHF is going to rise much more strongly towards the end of the year. One way to profit from the forecast is to buy a distant futures contract – say March 2011 – carry the open position till the CHF strengthens and close out at a profit. However, an open position involves greater risk (and of course larger expected profit). Our speculator is quite risk averse. So she decides to trade a spread. She is willing to bet that by December, the spread between the December 2010 and March 2011 contracts will have increased. She executes the following transactions:

Buy the relatively under-priced March 2011 contract at $0.7699 and sell the relatively overpriced December 2010 contract at $0.7688[33].

By December 7, 2010, her forecast has materialised. The futures prices are:

December 2010: 0.7825 March 2011: 0.7879

[32]With differing contract sizes, a speculative position such as the one in this example will yield a profit both with a widening and a narrowing of the spread provided the absolute amount of widening is within certain bounds which can be easily determined.

[33]Sale of a near-maturity contract and a purchase of a far-maturity contract is known as "selling a spread". Purchase of a near maturity and sale of a far maturity contract is termed "buying a spread".

The position is closed out by buying a December contract and selling a March contract. The loss on the former is:

$$0.7825 - 0.7688 = \$0.0137 \text{ per CHF}$$

and the gain on the latter is:

$$0.7879 - 0.7699 = \$0.0180 \text{ per CHF}$$

The net gain is \$0.0043 per CHF or \$(125000)(0.0043) or \$537.50 per contract since the each contract is for 125000 CHF. The spread has widened from 0.0011 to 0.0054 resulting in a gain of \$0.0043 per CHF. A loss would have resulted if the spread had narrowed irrespective of what happened to the CHF/USD rate. By contrast, an open long position in one March contract would have yielded a profit of \$2250 with the above prices but a loss, possibly a large one, if the CHF had weakened and the March contract had gone below 0.7699.

Speculation with futures has an added attraction, viz. it is a highly leveraged investment due to the fact that the margin required to be deposited is a small fraction of the value of the contract. If the margin requirement is, say, 10 per cent, a 5 per cent change in futures price produces a profit (or a loss) that is 50 per cent of the margin. Let us consider an example. Suppose on February 21, 2010, the June 2010 USD/JPY contract is trading at 0.008436. The dollar value of one contract would be:

$$(12500000) \times (0.008436) = 105450$$

A trader buys one contract and has to deposit 10 per cent margin, i.e. \$10545.

Suppose that by May 2010, the June 2010 futures price has moved to 0.0086469 from 0.008436. This represents a change of 2.5 per cent. The resulting profit would be

$$(12500000) \times (0.0086469 - 0.008436) = \$2636.50$$

This is 25 per cent of the margin amount. Of course, as with all leveraged investments, an adverse price movement would have resulted in an equally spectacular loss. Speculating with spreads is obviously less risky but with smaller profit potential.

9.5 CURRENCY FUTURES IN INDIA

Currency futures markets were launched in India in August 2008. The regulatory authorities, viz. RBI and SEBI issued guidelines for exchange traded currency futures in August 2008 and permitted the three major stock exchanges, viz. NSE, BSE and MCX to launch the US dollar-Indian rupee contract. The specifications of the contract are depicted in Exhibit 9.2.

Subsequently, in January 2010, futures contracts between rupee and euro, rupee and pound sterling, and rupee and yen have also been introduced on these exchanges. Specifications of these contracts as on NSE and MCX are given in the appendix to this chapter.

Exhibit 9.2 USD/INR Futures contract Specifications

Underlying	The exchange rate in Indian Rupees for a US Dollar
Unit of trading	1 (1 unit denotes 1000 USD)
Trading hours	9.00 a.m. to 5.00 p.m. (Mon to Fri)
Contract trading cycle	12 month trading cycle.
Contract expiration date	Last business day of the month

Tick size	0.25 paise or INR 0.0025
Last trading day	Two working days prior to the last business day of the expiry month at 12 noon
Final settlement day	Last working day (excluding Saturdays) of the expiry month. The last working day will be the same as that for Interbank Settlements in Mumbai.
Mode of settlement	Cash settled in Indian Rupees
Daily settlement price (DSP)	Calculated on the basis of the last half an hour weighted average price.
Final settlement price (FSP)	RBI reference rate

Table 9.2 Currency Futures Quotations INR vs. USD, EUR, GBP and JPY (NSE MUMBAI, INDIA, AUGUST 23, 2013)

USD (1000)

MTH	*OPEN*	*HIGH*	*LOW*	*LAST*	*VOL*	*OPINT*
US DOLLAR (1000)						
AUG 13	64.4000	64.7450	63.9375	63.9900	1602244	523437
OCT 13	65.1675	65.4675	64.6425	64.7225	35373	113131
NOV 13	65.5000	66.2000	65.0075	65.0675	10859	43624
FEB 14	66.7600	67.6925	66.2000	66.2900	1656	12016
MAR 14	67.1500	67.4175	66.7500	66.7525	297	26035
EURO (1000)						
AUG 13	85.9975	86.4350	85.4275	85.4975	70994	42098
SEP 13	86.6425	87.0300	85.9900	86.0250	13188	38463
OCT 13	86.9800	87.3900	86.4500	86.4750	751	4303
BRITISH POUND (1000)						
AUG 13	100.5375	100.9900	99.5525	99.7150	61930	27709
SEP 13	101.4075	101.6675	100.2625	100.3750	13884	19364
JAPANESE YEN (100000; INR PER 100 YEN)						
SEP 13	65.9800	65.9800	64.9800	65.0400	3031	4073
OCT 13	65.9500	66.1250	65.2500	65.2750	29	151

Source: NSE website.

Only Indian residents are allowed to trade in these contracts. Also, there is no requirement of underlying currency exposure so that individuals and companies can use them for currency speculation.

Table 9.2 illustrates some recent quotes for rupee futures against USD, EUR, GBP and JPY. Prices are stated as number of rupees per unit of the foreign currency for USD, EUR and GBP and rupees per 100 JPY for yen. The volume of trade is shown as number of contracts traded on the particular day. The NSE website also provides data on the value of total trade.

Commercial banks have to obtain RBI's approval to trade in currency futures.

RBI has set the eligibility for the banks in this regard. According to it, the qualified bank must be authorised by RBI, must have minimum net worth of ₹500 crore, minimum CRAR of 10 per cent, its net NPA should not exceed 3 per cent and it must have earned net profit for last three years.

9.6 INTEREST RATE FUTURES

Interest rate futures is one of the most successful financial innovations of 1970s vintage. The underlying asset is a debt instrument such as a treasury bill, a bond, a time deposit in a bank, and so on. For instance, the International Monetary Market (a part of Chicago Mercantile Exchange) has futures contracts on US government treasury bills, three-month eurodollar time deposits and US treasury notes and bonds. The LIFFE has contracts on eurodollar deposits, sterling time deposits and UK government bonds among others. The Chicago Board of Trade offers contracts on short-term interest rates such as the federal funds rate as well as on long-term US treasury bonds. Many other exchanges around the world, such as DTB, MATIF, SIMEX and so on, trade futures on short-term and long-term interest rates and debt instruments. Trading volumes in these products keep changing over time and some of the products such as US T-bill futures have more or less ceased to be of interest to market participants.

Interest rate futures are used by corporations, banks and financial institutions to hedge interest rate risk. For instance, a corporation planning to issue commercial paper in the near future can use eurodollar futures to protect itself against an increase in interest rate. A corporate treasurer who expects some surplus cash in the near future to be invested in short term instruments may use the same as insurance against a fall in interest rates. A fixed income fund manager might use bond futures to protect the value of her fund against interest rate fluctuations. Speculators bet on interest rate movements or changes in the term structure in the hope of generating profits.

We cannot provide a very detailed discussion of interest rate futures in this book. The interested reader can pursue the topic in greater depth by consulting some of the works cited in the bibliography at the end of this chapter. We will present a brief discussion of the basic features of a few of the contracts and illustrate some of their uses.

A meaningful discussion of interest rate futures requires familiarity with concepts such as discount yield, yield-to-maturity, forward interest rates, term structure of interest rates and the elementary mathematics of bond pricing. Readers who are unfamiliar with these ideas should read Appendix A at the end of the book which discusses the basic concepts of fixed income securities and the elementary mathematics of bond pricing and yield curves, before proceeding further.

9.6.1 Short-term Interest Rate Futures

The treasury bill (T-bill) futures contracts which at one time used to be actively traded and eurodollar futures which continue to be heavily traded on the IMM are examples of futures contracts on short term debt instruments. T-bills are discount instruments while interest on short-term eurodeposits is paid at maturity.

Treasury Bill Futures A futures contract on US treasury bills was traded on the CME. Its specifications were as follows:

Product and Trading unit: 13 Week Treasury Bill Futures
3-month (13-week) US Treasury Bills
having a face value at maturity of $1,000,000

Point Description: ½ point = 0.005 = \$12.50. A point here is one basis point or $(1/100)^{th}$ of 1 per cent. The dollar value of a point represents interest at 0.01 per cent p.a. on \$1 million for a period of 3 months, which works out to \$25.

Contract Listings: Mar, Jun, Sep, Dec,
Four months in March quarterly cycle plus 2 two months not in the March cycle (serial months).

Price Limit: No Limit. This means that there is no ceiling on price movements from one day to the next.

Tick size: 0.005 = \$12.50. This is the minimum step size of price movement.

Futures price is stated on an index basis:

T-bill futures price = 100.00 – Discount yield in percentage

This means that futures prices increase when interest rate falls and vice versa. Since a long position gains and short loses when price increases, a fall in interest rate benefits the long while a rise benefits the short.

From the formula for discount yield given in the appendix, the bill price is given by:

$$\text{Bill Price} = \$1000000 - \frac{\text{Discount Yield} \times \$1000000 \times 90}{360} \tag{9.15}$$

(Note that in this formula, the discount yield is to be taken as a fraction and not per cent).

Thus, suppose the settlement price on the last trading day is 91.45. This implies a discount yield of 8.55 per cent. A trader who has an open long position in one T-bill contract after trading ends must take delivery. The price he will have to pay for the bill can be calculated from (9.15) as:

$$1{,}000{,}000 - \frac{(0.0855)(1{,}000{,}000)(90)}{360} = \$9{,}78{,}625$$ [34]

Movement of 1 basis point (i.e. $1/100^{th}$ of 1 per cent) in the discount yield will cause the contract value to change by

$$\$(1{,}000{,}000)(0.0001)(90/360) = \$25$$

As shown above, the minimum size of price movements in T-bill contracts or the "tick" corresponds to movement of (1/2) basis point or \$12.50. After buying the futures contract at a price of 91.455, suppose I close my position by selling a contract at a later date when the futures price is 92.050. This corresponds to a gain of [(92.050 – 91.455)/0.005] or 119 "ticks". I would have made a profit of \$(12.50)(119) = \$1487.50, ignoring marking to market.

Table 9.3 presents some data on T-bill futures prices as of December 15, 2000 taken from CME website. The column headed "Pt Chge" gives the change in settlement price from the previous day. A trader holding a long open position in one March contract would have had his margin account credited by \$12.50 on the evening of December 15. An open short position in one contract would be debited by an equal amount.

[34] If a 91 or 92 day maturity bill is delivered, the price has to be adjusted by substituting 91 or 92 for 90 in this formula.

Table 9.3 T-bill Futures Prices

Treasury Bills (IMM) – \$1 mil. ; pts. of 100%								
CME U. S. Treasury Bills: Prices as of 12/15/00 11:30 AM								
MTH	*Session*				*PT*	*EST*	*Prior*	*Day-*
	Open	*High*	*Low*	*Last*	*CHGE*	*Vol*	*Vol*	*OpInt*
DEC00	94.13	94.145	94.13	94.145	+.5	5	61	1165
MAR01	—	94.41	94.38	94.41	+.5	2	15	1568

Source: www.cme.com

An important difference between a T-bill future and currency futures is that the asset to be delivered may not exist during the life of the contract. A June contract traded in December of the previous year calls for the delivery of a T-bill with 90 days to maturity from the date of delivery. There may be no such bill in existence at the time. To value the futures contract, it is necessary to hypothesise an asset which is in existence at the time and which will have the same value as a 90-day T-bill on the maturity date of the contract. Let the current date be t, the futures contract matures at T and $T1$ is a date 90 days after T. (As usual, time is measured in years staring from some arbitrary date before t). Then it is shown in the appendix that ignoring the marking to market feature, the futures price at time t is given by

$$FU_{t,T} = \frac{A}{(1+r_f)^{(T1-T)}} \tag{9.16}$$

where r_f is the forward interest rate, at time t, for the time period between T and $T1$. The T-bill futures contract while still listed on CME has had little or no trading activity during the last few years. Latest daily bulletins from CME do not mention the contract at all. Though the contract is still listed on CME there is no trading in it and for all practical purposes the contract can be treated as abandoned. The details provided here, illustrate how a contract on a short-term pure discount instrument would work.

The Federal Funds contract traded on Chicago Board of Trade (CBOT) has as its underlying the simple average of overnight Federal Funds rate for the delivery month. The contract is available for the current month up to 24 months in the future. The contract is cash-settled on the last day of the delivery month using the average of overnight Federal funds rate as reported by New York Fed. The size of the contract is \$5,000,000 and the tick size represents 30-day interest on this amount at one-half of one basis point. Table 9.4 shows some recent quotes for this contract. Prices are stated as (100.00 – the interest rate in percentage).

Table 9.4 30-Day Federal Funds Futures Prices June 30, 2010
Federal Funds 30D (CBOT) – \$5 mil.; pts. of 100 per cent

Month	*Session*						*Previous Day*	
	Open	*High*	*Low*	*Sett*	*Chg*	*Vol*	*Sett*	*OpInt*
Sep 10	—	99.7900	99.7900	99.7900	—	7367	99.7900	48992
Oct 10	—	99.7800	99.7800	99.7800	—	2296	99.7800	60278
Nov 10	—	99.7700	99.7700	99.7700	—	3405	99.7700	82775
Dec 10	—	99.7600	99.7600	99.7600	—	3565	99.7600	68023
Jan 11	—	99.7400	99.7400	99.7400	—	4437	99.7400	51230

(Contd.)

Feb 11	—	99.7000	99.7000	99.7000	—	4703	99.7000	44900
Mar 11	—	99.6650	99.6600	99.6650	0.0050	3311	99.6600	17970
Apr 11	—	99.6200	99.6200	99.6200	—	2524	99.6200	14673
May 11	—	99.5550	99.5550	99.5550	—	2139	99.5550	14187
Jun 11	—	99.5300	99.5300	99.5300	—	458	99.5300	6117
Jul 11	—	99.4850	99.4850	99.4850	—	521	99.4850	6524
Aug 11	—	99.4450	99.4400	99.4400	–0.0050	431	99.4450	3872
Sep 11	—	99.4100	99.4050	99.4050	–0.0050	610	99.4100	5817
Oct 11	—	99.3700	99.3600	99.3600	–0.0100	390	99.3700	5988
Nov 11	—	99.3000	99.2900	99.2900	–0.0100	187	99.3000	6105
Dec 11	—	99.2600	99.2500	99.2500	–0.0100	198	99.2600	2454

Eurodollar, Euribor, Euroyen and Sterling Deposit Futures These are short-term interest rate futures contracts traded on the IMM of CME and LIFFE. LIFFE also trades a eurodollar deposit contract. The underlying asset is a three-month eurodollar deposit of \$1 million for the eurodollar contract and a 50000 pound sterling three-month deposit for the sterling contract. The delivery cycle is March, June, September, and December.

As in the case of T-bill contracts, for the eurodollar contracts on the IMM and sterling time deposit contract on the LIFFE, the prices are stated on an ***index basis***. That is, price of the contract is stated as (100 – implied interest rate in percentage). Obviously, the implied interest rate is (100 – the futures price). However, here the interest rate is on an add-on basis and not a discount yield. Thus buying a sterling time deposit contract at 93.73 means, if held to maturity, the buyer will acquire a 3-month sterling time deposit in a bank at an effective interest rate of 6.27 per cent p.a.(= 100 – 93.73)[35]. If the interest rate increases, the price will decrease and the long position will lose. We will discuss this in greater detail below. The meaning of the various numbers in the quotations of interest rate futures is same as in the case of currency futures. The minimum price movement – one tick – is 0.01 per cent and corresponds to a change in contract value of \$25 for the eurodollar deposit contract. Table 9.5 presents an extract from futures prices for 3-month deposit rates for euro, sterling, US dollar and euroyen from LIFFE, CME and TIFFE. The eurodollar contract traded on the IMM is settled exclusively by cash settlement while LIFFE offers the option of taking physical delivery.

Table 9.5 Interest Rate Futures Quotations 7 JUNE, 2013

	Expiry Month	*Open*	*Sett*	*Change*	*High*	*Low*	*Open Interest*
Euribor	JUN13	99.79	99.785	—	99.795	99.775	531247
Euribor	JUL13	99.78	99.78	—	99.785	99.78	2642
Euribor	SEP13	99.765	99.755	—	99.77	99.745	394814
Sterling	UN13	9.49	9.50	—	9.50	9.49	63163
Sterling	EP13	9.48	9.48	—	99.49	9.48	14909
Sterling	EC13	9.45	9.45	—	99.46	9.44	38551

(Contd.)

[35]Actually, the long will acquire a deposit at a rate implied by the settlement price on the last trading day. In between he will have collected the difference between his purchase price and this settlement price in a series of positive and negative cash flows.

Euro$	UN13	9.7225	9.7250	—	9.7250	9.7225	67444
Euro$	EP13	9.6850	9.6850	–0.0050	99.6850	99.6850	752528
Euro$	EC13	99.6450	99.6450	–0.0050	99.6450	99.6450	869089
Euro$	MAR14	99.5950	99.5950	—	99.6000	99.5900	750846
Euro¥	SEP13	99.770	99.775	0.000	99.775	99.770	198979
Euro¥	DEC13	99.770	99.770	0.000	99.775	99.765	91040
Euro¥	MAR14	99.760	99.755	0.000	99.760	99.750	76693

Source: Global Derivatives website.

The cash settlement procedure is very simple as brought out by the following example:

- Cash Settlement in the Eurodollar Contract

  On day 1, a trader buys a eurodollar contract at 90.45. The initial margin requirement is \$2000 with a maintenance margin of \$1500.

  On day 2, settlement price is 90.32. The trader's loss is \$325 (= 13 ticks × \$25 per tick). His margin account drops to \$1675.

  On day 3, the settlement price is 90.38. The trader's margin account is credited with \$150. The balance is now \$1825.

  On day 4, the last trading day, the settlement price drops sharply to 90.05. The trader loses \$800. The balance in his account is \$1025. This is paid to him and his position is closed.

The LIFFE eurodollar contract has a provision for physical delivery, i.e. the long can, if he or she chooses actually acquire a eurodollar deposit in a eurobank by paying an amount calculated from the actual yield on the deposit. For details of the delivery process, see the appendix to this chapter. Fitzgerald (1983) explains why a long may prefer cash settlement.

9.6.2 Long-term Interest Rate Futures

Futures contracts on long-term debt instruments are traded on a number of exchanges. The US treasury bond or T-bond contract traded on the CBT is one of the most heavily traded financial futures contract. We will briefly describe this contract.

A US treasury bond is a coupon bond with original maturities in the range of 15-30 years. Most of them have a call provision with the first call date five years before maturity. Interest payments are semi-annual. The face or par value of the bond is \$100,000.

In the cash as well as futures market, bond prices are stated in the form of percent of par value with the digits coming after the hyphen denoting 64$^{\text{ths}}$ of 1 per cent. Thus, a price quoted as 90-19 means the buyer must pay an amount equal to 90(19/64) per cent of the face value, i.e.

$$\$(0.90296875)(100000) = \$90296.88$$

There is the added complication of accrued interest. The purchaser of the bond has to pay, in addition to the price quoted, the interest accrued since the last coupon date[36].

Table 9.6 gives an extract from CBT T-bond futures quotations. Let us see how to interpret these. **The notional asset underlying the CBT T-bond contract is a 6 per cent coupon bond with 30**

[36]This is easily calculated as :

$$\frac{\text{Days since last coupon payment}}{\text{No. of days in half-year}} \times \text{Semiannual interest}$$

years to maturity from the date of delivery. It is notional because no such T-bond may actually trade in the cash market. That is irrelevant for futures pricing. The settlement price of 141-05 for the September 2010 contract means that the market will pay 141(5/32) per cent of the par value for such a bond if it did exist. The next column headed "Chg" shows that the settlement price increased by (16/32) per cent from the previous day. The size of one "tick" is (1/32) per cent which represents a change in the value of the contract of:

$$\$[100{,}000 \times (1/32) \text{ of } 1\%] = \$(100{,}000 \times 0.0003125) = \$31.25$$

Table 9.6 30-Year T-Bonds Futures Quotations 7 June, 2013

Treasury Bonds (CBOT) - $100,000; pts 64ths of 100%						
Contract Month	***Open***	***High***	***Low***	***Settle***	***Chg.***	***Op.Int.***
JUN 13	141-09	142-04	141-09	142 04	16	28035
SEP 13	141-01	142-01	140-10	141-05	16	547467

Source : www.cbot.com

Thus, on June 7, 2013, the settlement price of both the contracts increased by $500 (= 16 × 31.25). The settlement yield can be calculated from the settlement price. **The settlement yield is the yield-to-maturity on a 30-year, 6 per cent coupon bond with price equal to the settlement price**.

Since the underlying asset is notional, the delivery process must be defined in terms of an asset which actually trades in the market. At any given time, a large number of treasury bonds are available with widely different coupons and remaining time to maturity. CBT delivery procedure specifies that any bond with a minimum of 15 years remaining to maturity or first call from the first eligible delivery date can be delivered against an open short position. To make it comparable to the notional bond, a ***Conversion Factor*** is calculated.

The price to be paid by the long for a bond which the short chooses to deliver is calculated as:

$$\$100{,}000 \times \text{Settlement price} \times \text{Conversion factor}$$

In addition of course, accrued interest has to be paid. **The conversion factor is essentially the price of the delivered bond (per $1 face value) so as to have a yield-to-maturity of 6 per cent.** The calculation of the conversion factor is explained in the appendix to this chapter. Table 9.7 shows some illustrative conversion factors as on May 30, 2013, for T-bond futures contracts expiring in September and December 2013 as reported on CBOT website:

Table 9.7 Conversion Factors for Selected T-Bonds on May 30, 2013 for Contracts Expiring in September 2013 and December 2013

Coupon Rate (%)	*Date of Issue*	*Maturity Date*	*Conversion Sept 10*	*Factor Dec 10*
6.25	15/02/2000	15/05/2030	1.0260	1.0256
5.25	16/02/1999	15/02/2029	0.9256	0.9265
4.50	15/02/2006	15/02/2036	0.8170	0.8181

As seen in the table, for bonds with coupon rates below 6 per cent, the conversion factors are below unity since the present value of their cash flows discounted at 6 per cent would be less than the face value whereas for bonds with coupon rates above 6 per cent the conversion factors exceed unity. But keep in mind that conversion factors would also depend upon the remaining life of the bond.

It turns out that in general, at any given time, among all the T-bonds eligible for delivery, one particular security is cheapest to deliver (CTD). This means that for the CTD security the gain on delivery, i.e. difference between the amount obtained on delivery and outlay required to buy it in the cash market is largest. (If negative, the loss on delivery is least). A thumb rule used by *practitioners is that if yields are greater than 6%, the bond with the longest duration is the cheapest to deliver bond while if the yields are less than 6%,* the bond with the shortest duration is cheapest to deliver. A partial justification for this is given in the appendix. For more on this see Fitzgerald (1983), Kolb (1985) and Siegel and Siegel (1990).

In addition to the T-bond futures contract, futures on treasury notes of various maturities are also traded on CBOT. These products are quite similar to the T-bond futures contract except that the underlying assets are treasury securities of much shorter maturity. Details of these products are available on CBOT website.

A few years ago the National Stock Exchange (NSE) introduced three interest rate futures contracts in the Indian market. These were futures on notional 91-day T-bills, notional 10-year treasury coupon bonds and notional 10-year treasury zero-coupon bonds. The contracts are cash settled and the settlement price is determined on the basis of the zero-coupon treasury yield curve estimated by NSE every day. However, there has virtually been no trading in these products right from the time of introduction. The details of these products – contract specifications, trading parameters, clearing and settlement process, etc. – are available on the NSE website.

9.7 HEDGING AND SPECULATION WITH INTEREST RATE FUTURES

We will illustrate the use of interest rate futures for hedging and speculation with some examples. The situations described are rather simple and a bit contrived but they serve to illustrate the principles involved. More complicated and realistic examples can be found in specialist texts devoted to financial futures such as Fitzgerald (1983), Siegel and Siegel (1990), Sundaresan (1997), Burghardt (2003) among others.

9.7.1 Hedging with Interest Rate Futures

In an environment of volatile interest rates, both borrowers and investors may wish to reduce or completely eliminate interest rate risk. Borrowers may wish to ensure that their borrowing cost does not exceed some ceiling rate while investors may want to lock-in a minimum rate of return on their investments. Banks may wish to reduce the risk arising out of maturity mismatch – borrowing short term and lending long term – and hedge their positions in OTC products like FRAs. Interest rate futures can be used to reduce the risk though not eliminate it except in rare cases.

Borrower's Hedge

- Hedging a Commercial Paper Issue
  In January a corporation finalises its plans to make an issue of \$50 million 90-day commercial paper around mid May. Paper of comparable quality is now yielding 6.10 per cent, a cost which the company finds acceptable. At this yield, the company hopes to realise \$49,237,500[37]. To

[37]Commercial paper like the T-bill is a discount instrument. The 6.10 per cent yield is a discount yield. The amount that can be realised from a \$50 million face value issue can be calculated from equation (9.16) above. CP Price = FV – FV * Disc Yield * (90/360) = 50000000[1.0 – (0.0610)(90/360)]

protect itself against the possibility that interest rates may rise before it makes the issue, it decides to use eurodollar futures. June 90-day eurodollar futures are trading at 95.25 implying a yield of 5.75 per cent.

January 15:
Company plans to issue $50 million of 90-day commercial paper in four months. Company's position will be adversely affected, if interest rates rise between now and mid-May. Hence, in futures market, it must take a position which yield positive profit, if rates rise. As seen above, eurodollar futures prices fall as rates rise. Hence, it must take a short position in these contracts. Sells 50 eurodollar June contracts at 95.25.

May 15:
Yields have risen. The company must issue its paper at a yield of 6.50 per cent. It will realise $49,187,500 from the issue, a shortfall of $50000.

June T-bill futures are trading at 94.95. The company buys 50 contracts for a profit of 30 ticks on each contract, each tick being worth $25. Total futures profit: $(30 × 25 × 50) = $37,500.

The gain on futures partially recoups the shortfall on the CP issue.

This example illustrates a cross-hedge. Since no futures contracts are available in commercial paper, the firm chooses a closely related instrument. The hedge is imperfect because of basis risk, viz. the difference between CP yield and eurodollar interest rate does not remain constant. In the example, the difference widened from 35 basis points to 45 basis points with CP yield rising more than the eurodollar interest rate. (Note, however, that we are comparing changes in discount yield of CPs with changes in add-on yield in the case of eurodollar contracts).

We can design a "Delta Hedge" by examining the historical correlation between CP yields and eurodollar rates. Suppose the data leads to the following regression equation:

$$\text{CP yield} = \alpha + \beta\,(\text{Eurodollar rate})^{38}$$

Then a delta hedge would imply that the firm should sell β contracts for every $1 million of planned CP issue[39]. Of course since β will in general not be an integer, some discrepancy will remain.

An Investor's Hedge Corporate treasurers from time to time have to invest short-term surplus funds in money market instruments. Portfolio managers invest funds on behalf of clients. These and other investors must plan in advance how they are going to deploy their funds. There is often a time gap between their deciding on an investment strategy and the actual execution of the transaction. If interest rates fall in the meanwhile, return on the investment is adversely affected. Futures can be used as partial protection against this risk.

In the case of a borrower, protection is required against a rise in interest rates. As we have seen, futures prices fall when interest rates rise and hence borrowers must take **short** positions in futures. Conversely, investors must take **long** positions to guard against a fall in interest rates. The following example illustrates a simple hedge for a bond investment.

- **A Simple Investment Hedge**
It is late February 2010. A bond portfolio manager is planning to buy in late May, $5 million face value of 7.5 per cent coupon T-bonds maturing in November 2030 on behalf of an

[38]This is the yield implicit in Eurodollar futures prices.

[39]If the firm were planning to issue 6-month commercial paper further adjustment would be necessary since a 0.01% change in interest rate means $25 for a 90-day $1 million face value instrument but $50 for a 180- day instrument.

institutional client. The bonds are currently available at a price of 94-25, i.e. $94781.25 per bond or $4,7,39,062.50 for the total purchase. At this price the YTM is 7.99 per cent. The price is equivalent to 100-04 for the CBT notional T-bond[40]. To guard against a fall in yields between now and May, the manager is considering T-bond futures. June futures are being quoted at 98-21. The conversion factor for the bond to be purchased is 0.9466.

The number of contracts to be purchased:

$$(5000000/100000) \times 0.9466 = 47.33$$

The manager buys 47 CBT T-bond contracts at 98-21.

The basis is 47 ticks (= 100 – 04 minus 98 – 21)

May 15:

The bond to be bought is now quoted at 98-20, i.e. $98,625.00 per bond. Fifty bonds will now cost $4,9,31,250, an extra expenditure of $1,92,187.50. The equivalent notional T-bond price is 104-06.

June T-bond futures are quoted at 102-20. The manager sells 47 contracts making a profit of 127 ticks (= 102-20 minus 98-21) per contract. His total futures gain is:

$$\$(127 \times 31.25 \times 47) = \$1,86,531.25$$

The futures gain almost compensates for the loss in the cash market. The small discrepancy is due to the widening of the basis from 47 ticks to 50 ticks (= 104-06 minus 102-20).

Note that for simplicity, we have ignored the accrued interest which will have to be paid. It does not change the conclusion significantly.

A near-perfect hedge was possible in this case because the asset which the portfolio manager wanted to acquire had futures available on it. If he had wanted to invest in say high grade corporate bonds, he could still hedge using T-bond futures but in that case the price correlation would be much weaker and the hedge efficiency would decrease.

In this example, we have used the conversion factor as the hedge ratio. Other approaches use the concept of duration. The idea is to match the duration of the cash market asset and the asset underlying the futures contract (which is taken to be the cheapest to deliver bond for that particular contract). Hedge ratios can also be estimated using the regression approach. For details, see Siegel and Siegel (1990).

9.7.2 Speculation with Interest Rate Futures

Like currency futures, interest futures can be used to speculate on absolute and relative interest rate movements. However, before we can discuss some of the speculative strategies, it is necessary to understand the concept of basis for interest rate futures and the relation between the yield curve and futures prices.

Basis and the Cost of Carry We saw above that for storable commodities used primarily for investment purposes, the basis, i.e. the difference between the spot price and the futures price is

[40]This is given by:

$$\frac{\text{Cash price}}{\text{Conversion factor}} = \frac{0.9478125}{0.9466} \times 100$$

converted to 32nds.

related to the cost of carrying the commodity forward in time. For a debt instrument, the cost of carry is the difference between the cost of financing and the interest yield on the instrument. As we will see below, unless the yields on cash instruments and futures yields stand in a particular relationship, arbitrage opportunities would arise.

- Consider the following situation:
  Today is March 22, 2013. Eurodollar LIBORS are

  180 days: 5.75% 90 days: 4.50%

  At the same time, June eurodollar futures are being quoted at 94.10 implying a eurodollar rate of 5.90 per cent for the 90-day period beginning June 22. The June contract will mature on June 22.

  Assume that a trader can borrow and deposit money at the eurodollar rates quoted above. The trader undertakes the following transactions:

  Borrow $1 million for 90 days at 4.50 per cent p.a.
  Deposit $1 million in a 180-day deposit at 5.75 per cent p.a.
  Sell a June Eurodollar futures contract.

  On June 22, consider the following two scenarios:

  1. 90-day eurodollar LIBOR is 3.00%
     The eurodollar futures contract will settle at a price of 97. The trader will have to buy it back at that price implying a loss of 290 ticks or $\$(290 \times 25) = \$7250$. He has to repay his 90-day loan which would require a sum of $\$[1000000(1 + 0.045 \times (90/360))]$ or $1011250. The total cash outlay would thus be $1018500. He borrows this amount for 90 days at the LIBOR rate of 3%.
     Ninety days later, he has to repay an amount:

     $$\$1018500[1 + 0.03(90/360)] = \$1026138.75$$

     His 180-day deposit acquired on March 22 would also mature at this time yielding a sum of:

     $$\$1000000[1 + 0.0575(180/360)] = \$1028750$$

     Thus, he makes a net gain of $2611.25.
  2. Now suppose on June 22, the 90-day LIBOR is 6.50 per cent.
     The Eurodollar futures contract will settle at 93.50. The trader will make a gain of 60 ticks in closing out his futures position. This would amount to $1500. He has to repay his 90-day loan, requiring a cash outlay of $1011250 as above. He borrows a sum of $(1011250 – 1500) or $1009750 for 90 days at the rate of 6.50 per cent.
     Ninety days later, he has to repay an amount:

     $$\$1009750[1 + 0.065(90/360)] = \$1026158.44$$

     His 180-day deposit acquired on March 22 yields as above $1028750, leading again to a net gain of $2591.56.

This is an example of "**cash-and-carry arbitrage**" with eurodollar futures. The trader arbitrages the discrepancy between the 3-month forward 3-month rate as implied by the cash market three- and six-month rates and the same rate implied by the futures price. By borrowing for three months and investing the money for six months he effectively locks in the return on a three-month deposit starting three months from now while at the same time he locks in a lower cost of funding by selling the eurodollar future. Why did this profit arise? The clue to the answer is in equation (9.16) above. The futures price should have been

$$1{,}000{,}000/(1 + r_f)^{\mathbf{90/360}}$$

where r_f is the forward rate for the 90-day period beginning 25 June, implied by the 82-day and 172-day T-bill rates on April 5. This can be calculated from the following equation:

$$[1 + 0.0575(180/360)] = [1 + 0.045(90/360)][1 + r_f(90/360)]$$

This gives $r_f = 0.0692$ or 6.92 per cent. The futures price quoted in the market, viz. 94.10, implies a 3-month forward 3-month rate of 5.90 per cent. Thus, the futures price was too high given the cash market 90-day and 180-day LIBORS.

Another way to look at it is to compute the 90-day rate implied by the 180-day rate and futures yield i.e. find the value of x which satisfies:

$$[1 + 0.0575(180/360)] = [1 + x(90/360)][1 + 0.0590(90/360)]$$

This is called "**the implied repo rate**"[41]. If the cost of borrowing funds is lower than the implied repo rate, the cash-and-carry arbitrage leads to profit. In this case r_f works out to 5.52 per cent while the cash market 3-month LIBOR is 4.5 per cent.

What if the futures yield was greater than the value of r_f ? Suppose the June futures contract is trading at 92.00 implying a 3-month forward 3-month LIBOR of 8 per cent. Again, arbitrage opportunity exists as seen below:

On March 22:
Borrow \$1 million for 180 days at the rate of 5.75 per cent. Invest the money in a 90-day deposit at 4.50 per cent. Buy one June contract at 92.00.
On June 22 consider again two scenarios.

1. 3-month LIBOR is 3.0 per cent.
   The June futures contract will settle at 97.00. The trader closes out his position at that price making a gain of \$(500 × 25) or \$12500. His 90-day deposit will have grown to:

   $$\$1000000[1 + 0.0450(90/360)] \text{ or } \$1011250$$

   He reinvests this amount plus his futures gain for 90 days at 3 per cent. Three months later, this deposit will grow to

   $$\$1023750[1 + 0.03(90/360)] \text{ or } \$1031428$$

   while the repayment of his 180-day loan will require

   $$\$1000000[1 + 0.0575(180/360)] \text{ or } \$1028750$$

   resulting in overall gain of \$2678.
2. Now suppose 3-month LIBOR is 10 per cent.
   The June contract will settle at 90.00. The trader has to incur a loss of \$(200 × 25) or \$5000 in closing out his futures position. As above his 90-day deposit will have grown to \$1011250. He can now invest \$1006250 for 90 days at 10 per cent. This will grow to \$1031406 90 days later while his loan repayment as shown above will be \$1028750 leading again to a gain of \$2656.

[41]The reason for calling it "repo" rate is that securities dealers who engage in arbitrage borrow and lend funds in the Repo market. "REPO" stands for Repurchase Obligations. This is a borrowing transaction in which the borrower "sells" securities to the lender with a promise to "buy" them back at a specified future date. In addition, the borrower pays interest on funds borrowed. Bulk of the activity is in the overnight segment though "term" Repos of longer tenor are also done. A large market exists in the US.

This is an example of "**reverse cash-and-carry arbitrage**". It leads to profit, if the futures yield is too high (futures price too low) given the cash market yields. The cash market transactions lock in a funding cost for the period 90-180 days, while buying the futures contract locks in a return for the same period. If the latter exceeds the former or, equivalently, the implied repo rate is lower than the borrowing cost, an arbitrage gain can be realised.

The conclusion is that at time t, the futures yield implied by the futures price of a contract maturing at T must obey the following relation[42]:

$$(1 + r_{t,T1})^{T1 - t} = (1 + r_{t,T})^{T - t} \times (1 + r_{FU\ t,T})^{T1 - T} \tag{9.16}$$

Where, $r_{t,T1}$: cash market yield for the period t to $T1$

$r_{t,T}$: cash market yield for the period t to T

$r_{FU\ t,T}$: futures yield

(Recall that the contract calls for delivery of a bill at T, maturing 90 days later at $T1$).

We have discussed above why futures prices in practice will not conform to the theoretical values arrived at from arbitrage arguments. To recapitulate, the main reasons are the fact that lending and borrowing rates are different, repo rates do not remain constant, transactions costs and possibly restrictions on short selling.

Now let us consider the question of what exactly we mean by basis in the case of interest rate futures. The futures price at time t today is the price of a bill which will mature 90 days from T (T being the expiry date of the futures contract). This is not the same thing as a bill which will mature 90 days from t. So we cannot compare the futures price with the cash market price of a 90-day bill today. Alternatively, we can select a bill which matures at approximately the same time as the bill deliverable on the contract, i.e. a bill maturing around $T1$ such that $(T1 - T)$ is 90, 91 or 92 days. Such a bill may not exist at time t and even if it does, the basis calculated as the difference between the futures price and the cash price of such a bill is hard to interpret. The meaning and interpretation of basis remains ambiguous. This is even more so in the case of T-bond futures where any one from a large collection of cash market instruments qualifies for delivery.

The Yield Curve and Futures Prices We will now examine the effect of changes in the slope of the yield curve on futures prices.

- Today is March 20. The cash market LIBORS are as follows:

Spot Rates

Maturity (Months)	Rate (%)
3	10.00
6	11.00
9	11.50
12	12.50

From these spot rates, 3-month forward rates 3, 6 and 9 months from today can be calculated as 12.00, 12.50 and 13.50. Correspondingly, futures prices are:

Contract	Time to Maturity (Months)	Price
June	3	88.00
September	6	87.50
December	9	86.50

[42]To the extent futures prices differ from forward prices because of daily marking to market the relation will not hold exactly.

The spread between June and September is 50 ticks while that between September and December is 100 ticks.

Consider now another yield curve.

Maturity (Months)	Rate (%)
3	10.00
6	10.50
9	10.75
12	11.00

This is a much flatter yield curve compared to the one above. You can easily calculate the implied futures prices which are:

June: 89.00
September: 88.75
December: 88.25

Thus, when the yield curve flattens, the spread between near and far contracts narrows. Conversely, when the yield curve becomes steeper, this spread widens. This concept is important for spread trading with interest rate futures.

We will conclude the chapter with some examples of open position and spread trading with interest rate futures.

- Open Position Trading

  On September 1, December eurodollar futures on the IMM is trading at 89.25. A trader believes that short term interest rates are going to rise very soon. He sells a December contract at 89.25. On subsequent days, the prices and consequent losses/gains are:

Day	Settlement	Price Profit
Day 2	89.50	–625
Day 3	89.30	+500
Day 4	89.20	+250
Day 5	89.23	–75
Day 6	89.05	+450
		+500

  On the sixth day he closes his position by buying a contract at 89.05. His speculative profit is $500 made up of two negative and three positive daily cash flows. If he had expected that the rates would fall, he would have bought a contract.

- An Intra-contract Spread

  On February 25, the following prices are quoted for Eurodollar futures on the IMM:

  March: 96.02
  June: 95.81
  September: 95.54
  December: 95.00

  A trader feels that the yield curve is going to become steeper. He has no particular ideas about how interest rates as a whole are going to change, but he is confident that long-term rates will be higher relative to short-term rates than they are now.

  As we saw above, if his prediction comes true the spread between near and far contracts will widen. To profit from this, he must buy a near contract and sell a far contract. (Recall that this is called "buying a spread"). He buys a September contract at 95.54 and sells a December contract at 95.00.

It is now August 25. The trader's forecast has materialised. Interest rates as a whole have risen and the yield curve has become steeper. The futures prices are:

September: 93.65
December: 92.79

The trader closes out by selling a September contract and buying a December contract. The loss on the former is 189 ticks, while the gain on the latter is 221 ticks for a net gain of 32 ticks or \$800.

You can convince yourself that the absolute movement of rates does not matter. Even if all rates had fallen, as long as the spread widens, the spread buyer will gain. As usual, once transaction costs are figured in, the gain may not be more than what is commensurate with the risk.

In the situation described in this example, an even better strategy is available. If long-term yields are expected to rise relative to short-term yields, the spread between futures prices of T-bonds and T-bills will widen even more than that between two T-bill futures. This is because a given change in interest rate affects a long-term debt instrument proportionately more than a short-term instrument. The trader can trade an ***inter contract spread*** by buying a December T-bill contract and selling a December T-bond contract. If the yield curve does become steeper, he will close his position at a profit by selling the T-bill contract and buying the T-bond contract at a later date.

9.7.3 Futures Yields and Expected Future Spot Yields

We have already alluded to the question as to whether futures prices are unbiased estimates of future spot prices. In the context of interest rate futures, the question resolves into two questions:

1. Are futures yields close enough to forward interest rates?
2. Are forward interest rates unbiased estimates of expected future spot rates?

The expectations theory of the term structure of interest rates answers the second question in the affirmative. However, competing theories such as the liquidity premium theory argues that market participants prefer to hold short-term instruments and hence, long-term instruments must offer a “liquidity premium”. If this is true, forward rates will not equal expected future spot rates. Empirically, there does seem to be some evidence for a small liquidity premium. As to the first question, we have seen that the discrepancy between futures and forward prices is due to the daily marking to market. However, the divergence appears to be small enough for it to be ignored in practice.

9.7.4 Interest Rate Futures in the Indian Market

In 2003, the government introduced three interest rate futures contracts in the Indian market to be traded on the major stock exchanges. These were futures contracts on notional 10-year 6 per cent coupon government bond, a contract on a notional zero coupon government bond with 10 years to expiry from the time of maturity of the futures contract and a contract on a 91-day T-bill. However, there has been virtually no trading in these contracts mainly for the reason that the largest holders of T-bills and government securities, viz. the commercial banks are not permitted to trade in these contracts except for hedging purposes. Unless this restriction is removed, the market is unlikely to see any activity.

Summary

Financial futures are one of the most interesting innovations of recent times. Currency and interest rate futures are now traded on a large number of exchanges around the world. Though the futures contract is superficially similar to the forward contract, there are significant differences between the two. Futures contracts can be a convenient hedging device for foreign exchange and interest rate risk in some situations.

Unlike forward contracts, an exact hedge is rarely, if ever, possible with futures contracts, but this disadvantage is often outweighed by the ease of access, liquidity and absence of credit risks in futures contracts. Also, futures contracts are an ideal device for speculating on the prices of the underlying assets with relatively small amount of capital.

Questions and Problems

1. Explain the key differences between futures and forward contracts on foreign currencies.
2. The following is an extract from futures price quotations in a financial newspaper. Explain the various terms and numbers in the table.

   British Pounds (IMM): 62,500 pounds; $ per pound

March	1.5060	1.5068	1.5053	1.5055	–0.0007	3454
June	1.4990	1.5020	1.4990	1.5010	–0.0006	5450
September	1.4920	1.4945	1.4910	1.4935	+0.0005	7864

3. Explain the meaning of the following terms:
   (a) Floor Trader
   (b) Dual Trader
   (c) Scalper
   (d) Market Order
   (e) Limit Order
   (f) Basis
   (g) Intracommodity Spread
   (h) Intercommodity Spread
4. On May 8, you took a long position in one June IMM CHF contract at an opening price of $0.6350. The initial margin was $1500 and the maintenance margin was $1200. The settlement prices for May 8, 9, 10 were $0.6280, $0.6355, $0.6335. On May 11 you closed out the position at $0.6365. Compute the cash flows on your account assuming that the opening balance was $1500 and there were no cash additions or withdrawals other than gains and losses from your futures position and any additional variation margin.
5. Today is March 1. A UK firm is planning to import chemicals worth $6 million from US. The payment is due on June 1. The spot $/£ rate is 1.5765 and the three-month forward rate is 1.5685. LIFFE $/£ futures are trading at 1.5695. Explain how the firm can hedge its payable by using futures. On June 1 the $/£ spot rate turns out to be 1.5875 and June futures price 1.5850. Explain why the futures hedge did not turn out to be a perfect hedge. In retrospect, would a forward hedge have been better?

6. A firm in Luxembourg makes fine crystal. On August 28 it has shipped an order worth $2 million to a US customer. The payment is due 3 months from that date. The spot LUFr/$ rate is 32.6500 and the 3-month forward rate is 32.6340. It decides to hedge using $/DEM futures on IMM. The spot DEM/$ rate is 1.6050 and December futures are trading at 0.6310 ($/DEM). Explain how the hedge is executed. On November 28, the spot LUFr/$ rate turns out to be 32.5225 and the price of December DEM futures is 0.6295. Compute the firm's gains and losses.
7. Explain the concept of "delta hedge" using futures. In practice what are the difficulties in using a delta hedge?
8. On a certain day in February a speculator observes the following prices in the foreign exchange and currency futures markets:

   £/$ spot: 1.6465
   March futures: 1.6425
   September futures: 1.6250
   December futures: 1.6130

   The speculator thinks that the markets are overestimating the weakness of sterling against the dollar. How can she act on this view to make a profit? Under what circumstances do her actions lead to a loss?
9. On April 14 1992, the following prices were observed on the IMM and the New York inter-bank foreign exchange market:

		CHF/$	¥/$
	Spot	0.6343	0.0080
Futures:			
	June	0.6380	0.0081
	September	0.6460	0.0082
	December	0.6504	0.0083
	March '93	0.6510	0.0084

   What do these prices imply regarding market's long-term view of CHF's prospects against the Yen? A speculator thinks otherwise, viz. he thinks the CHF is going to move in the opposite direction against the Yen. How can he profit from his forecast using a spread trading strategy?
10. On January 24, the following prices are observed:

		£/$	CAD/$
	Spot	1.7025	0.9010
Futures:			
	March	1.6990	0.9030
	June	1.6935	0.9070
	September	1.6905	0.9105

   A speculator believes that the market is underestimating the weakness of sterling because he thinks that the UK trade balance figures due in the first week of July will be far worse than what the market is expecting. He holds no particular views regarding how the sterling and the Canadian dollar will move against the US dollar. How can he exploit this forecast by (a) an open position trading and (b) a spread trade?
11. On April 17, 1992, a speculator observed the following spot and futures CHF/$ prices:

   Spot: 0.6520
   June: 0.6560
   September: 0.6610
   December: 0.6690
   March '93 0.6820

Most opinion polls about the US presidential election were predicting a swing for Mr. Clinton and the forex markets were said to have factored Mr. Bush's defeat into the $/DEM rates. The speculator thought that the polls were off the mark and Mr. Bush would rebound in October and the dollar would surge upwards after the election results are in November. She did not want to take undue risks but did wish to profit from her forecast. How would she go about it?

12. Explain the relationship between forward interest rates and futures prices. Explain why the usual definition of "basis" as the difference between the spot price and futures price is not applicable to interest rate futures.

13. On January 5, the T-bill futures on the IMM are trading at the following prices:

March: 89.50
June: 88.00

A trader believes that the yield curve is about to become steeper. He has no particular views about the level of interest rates. He wishes to profit from this forecast. How should he go about it? Under what circumstances will he make a loss? How should he act if he believes that the yield curve is about to become flatter?

14. On a certain day in April, Eurodollar and Sterling time deposit futures on LIFFE are trading at the following prices:

Eurodollar:	June 90.85	September: 89.90
Sterling:	June 88.65	September: 87.50

A trader believes that in a couple of months, sterling interest rates are going to rise relative to Eurodollar rates. How can she profit from such a forecast?

15. How do interest rates affect the amount of currency futures used in a delta hedge?

16. For two currencies X and Y, a regression of changes in the Y/$ futures prices on changes in X/$ futures prices yielded the following relation:

$$\Delta\$/Y = 0.80\ \Delta\$/X$$

The sample variances of $\Delta\$/X$ and $\Delta\$/Y$ were, respectively, 0.012 and 0.015. The variance of the regression residuals was 0.001. A US firm with a short position in Y creates a delta hedge with X futures using the above estimated relation. Estimate the risk in the hedged position compared to the risk in the original position.

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Other useful works

A good and accessible treatment of various financial derivatives including futures can be found in:

Redhead, K. (1997): ***Financial Derivatives***, Prentice-Hall India.

Futures and Options in the Indian context with emphasis on regulatory and institutional aspects, reports of various committees appointed by the government etc. can be found in:

Patwari, D.C. (2000): ***Financial Futures and Options in Indian Perspective***, Jaico Books.

As of now, the Indian market has stock index futures, individual stock futures, T-bill and T-bond futures. However, the volume of trading in the interest rate futures contracts is negligible. There are also some commodity futures.

APPENDIX

A.9.1 FUTURES PRICES AND FORWARD PRICES

In this section, we will demonstrate that when interest rates are constant, forward price equals futures price. The argument was proposed by Cox, Ingersoll and Ross (1981).

Consider a futures contract which lasts for N days and the price at the end of day n is F_n ($0 \leq n \leq N$). Define d as the risk-free rate of interest per day, compounded daily. We assume that d is constant. Consider the following strategy:

1. At the end of day 0 (start of the contract), go long $(1 + d)$ contracts.
2. At the end of day 1, increase long position to $(1 + d)^2$ contracts.
3. At the end of day 2, increase the long position to $(1 + d)^3$ contracts, and so on.

At the beginning of day n, the long position will be $(1 + d)^n$ contracts. At the end of the day this will lead to a profit (possibly negative) given by:

$$(F_n - F_{n-1})(1 + d)^n$$

Suppose that this profit is compounded daily at the rate d per day till the day N. Its value at the end of day N is:

$$(F_n - F_{n-1})(1 + d)^n(1 + d)^{N-n} = (F_n - F_{n-1})(1 + d)^N$$

Thus at the end of day N, the entire investment will have accumulated to:

$$\sum_{n=1}^{N}(F_n - F_{n-1})(1+d)^N$$

$$= (F_N - F_0)(1 + d)^N = (S_N - F_0)(1 + d)^N$$

The last equality follows because on the day the contract matures, the futures price must equal the spot price of the underlying asset.

The strategy above coupled with an investment of F_0 in a risk-free bond at the end of day 0, will give a terminal value of:

$$F_0(1 + d)^N + (S_N - F_0)(1 + d)^N = S_N(1 + d)^N$$

This combined strategy requires an investment of F_0 at the end of day 0 and no further investment.

Now suppose a forward contract is available on the same asset. Let the forward price at the end of day 0 be G_0. Consider the following strategy:

Invest G_0 in a risk-free bond and buy $G_0(1 + d)^N$ forward contracts.

At the end of day N, the investment will have matured to $G_0(1 + d)^N$. This is used to pay for the delivery on the forward contract. The investor has an asset worth $S_N(1 + d)^N$.

Thus, the combined risk-free bond and futures strategy and the risk-free bond plus forward strategy have identical terminal payoffs. To prevent arbitrage, the initial investment requirements must also be identical. Hence,

$$F_0 = G_0$$

i.e. futures and forward prices are identical.

A.9.2 SPECIFICATIONS OF FUTURES CONTRACTS FOR EURO, POUND STERLING AND YEN AGAINST RUPEE

Contract Specifications for EURO-INR	
Symbol	EURINR
Instrument type	FUTCUR
Unit of trading	1 (1 unit denotes 1000 EURO)
Underlying	EURO
Quotation/Price Quote	₹ per EUR
Tick size	0.25 paise or INR 0.0025
Trading hours	Monday to Friday 9:00 a.m. to 5:00 p.m.
Contract trading cycle	12 month trading cycle.
Settlement price	RBI Reference Rate on the date of expiry
Last trading day	Two working days prior to the last business day of the expiry month at 12 noon.
Final settlement day	Last working day (excluding Saturdays) of the expiry month. The last working day will be the same as that for Inter-bank Settlements in Mumbai.
Mode of settlement	Cash settled in Indian Rupees
Daily settlement price (DSP)	DSP shall be calculated on the basis of the last half an hour weighted average price of such contract or such other price as may be decided by the relevant authority from time to time.
Final settlement price	RBI reference rate

Contract Specifications for POUND STERLING-INR	
Symbol	GBPINR
Instrument Type	FUTCUR
Unit of trading	1 (1 unit denotes 1000 POUND STERLING)
Underlying	POUND STERLING
Quotation/Price Quote	₹ per GBP
Tick size	0.25 paise or INR 0.0025
Trading hours	Monday to Friday 9:00 a.m. to 5:00 p.m.
Contract trading cycle	12 month trading cycle.
Settlement price	Exchange rate published by the Reserve Bank in its Press Release captioned RBI Reference Rate for US $ and Euro.
Last trading day	Two working days prior to the last business day of the expiry month at 12 noon.
Final settlement day	Last working day (excluding Saturdays) of the expiry month. The last working day will be the same as that for Interbank Settlements in Mumbai.
Mode of settlement	Cash settled in Indian Rupees
Daily settlement price (DSP)	DSP shall be calculated on the basis of the last half an hour weighted average price of such contract or such other price as may be decided by the relevant authority from time to time.
Final settlement price (FSP)	Exchange rate published by the Reserve Bank in its Press Release captioned RBI Reference Rate for US $ and Euro.

Contract Specifications for Japanese YEN-INR	
Symbol	JPYINR
Instrument type	FUTCUR
Unit of trading	1 (1 unit denotes 100000 YEN)
Underlying	JPY
Quotation/Price Quote	₹ per 100 YEN
Tick size	0.25 paise or INR 0.0025
Trading hours	Monday to Friday 9:00 a.m. to 5:00 p.m.
Contract trading cycle	12 month trading cycle.
Settlement price	Exchange rate published by the Reserve Bank in its Press Release captioned RBI Reference Rate for US $ and Euro.
Last trading day	Two working days prior to the last business day of the expiry month at 12 noon.
Final settlement day	Last working day (excluding Saturdays) of the expiry month. The last working day will be the same as that for Interbank Settlements in Mumbai.
Mode of settlement	Cash settled in Indian Rupees
Daily settlement price (DSP)	DSP shall be calculated on the basis of the last half an hour weighted average price of such contract or such other price as may be decided by the relevant authority from time to time.
Final settlement price	Exchange rate published by the Reserve Bank in its Press Release captioned RBI Reference Rate for US $ and Euro.

A.9.3 THE PHYSICAL DELIVERY PROCESS FOR EURODOLLAR FUTURES

As mentioned in the text, the eurodollar contract on LIFFE has the option of physical delivery if the buyer wishes. Let us see how this works.

Suppose a trader has a long position in one eurodollar contract. Up to the day before the last trading day, he has been meeting his variation margin requirements. On this day the settlement price is 90.20 and his margin account has a credit balance of $1000. On the last trading day, the settlement price is 90.40. He demands physical delivery.

1. His margin account is credited with $500 which represents the 20 ticks price movement in his favour.
2. The long is informed that he has been alloted at XYZ bank a $1 million, 91 day eurodeposit with a yield of 9.70 per cent.
3. The long transfers $1 million to XYZ bank.
4. Long receives his $1500 margin money less an amount to compensate for the fact that as per last day's settlement price he is entitled to receive a eurodeposit with a yield of 9.60 per cent whereas in fact he is receiving a deposit with a yield of 9.70 per cent. He must refund the PV of the extra interest which in this case is

$$\frac{[\{91 \times (9.70 - 9.60) \times 1{,}000{,}000\}/(36000)]}{[1 + \{(9.60 \times 91)/36000\}]}$$

$$= \$246.79$$

The long thus receives a net amount of \$1253.21 plus the 91-day deposit at a yield of 9.70 per cent. If the actual yield had been less than that reflected by the settlement price on the last day, he would have received compensation for the difference in addition to the margin money.

A.9.4 THE RISK OF DELTA HEDGING

Delta hedging involves estimating the relation between changes in futures price and changes in the spot price of the underlying asset. We run a regression of ΔFU on ΔS:

$$\Delta FU = \beta \Delta S + u$$

The least squares estimator of β, denoted b is given by

$$b = \text{Cov}(\Delta FU, \Delta S)/\text{Var}(\Delta S)$$

The delta hedge consists of selling (buying) $1/b$ units of futures for every unit long (short) position in the underlying asset. The change in the value of the portfolio is:

$$\begin{aligned}\Delta P &= \Delta S - (1/b)\Delta FU \\ &= \Delta S - (1/b)(b\Delta S + e) = -(1/b)e\end{aligned}$$

where, e are least squares residuals. The variance of ΔP is the risk of the delta hedge. It is given by:

$$\text{Var}(\Delta \text{P}) = (1/b^2)\text{Var}(e)$$

With an unhedged position, the variance would be $\text{Var}(\Delta S)$. As mentioned in the text, the value of β may not remain constant. So unless the estimate is continuously updated and the hedge ratio adjusted, a delta hedge based on historical data may not work very well.

A.9.5 PROOF OF EQUATION (9.16) IN THE TEXT

Let F_t denote the forward price at time t of a contract that calls for delivery of a 90-day T-bill on maturity of the contract at time T. Let S_t be the price of a discount bond which has the same face value as the T-bill and matures at time $T1$ which is 90 days after T. As we saw in the text, this is the asset underlying the forward (or futures) contract. From our discussion, in the Appendix to Chapter 8, of forward prices of assets that pay no income during the life of the forward contract, we know that

$$F_t = S_t(1 + r)^{T - t}$$

where r is the risk-free interest rate applicable for the period t to T. But S_t in turn is given by

$$S_t = A/(1 + r_1)^{T1 - t}$$

where A is the face value and r_1 is the risk-free rate applicable for the period t to $T1$. Substituting this

$$F_t = \frac{A(1 + r)^{T-1}}{(1 + r_1)^{T1-1}}$$

But as our discussion of forward rates below shows

$$(1 + r_1)^{T1 - t} = (1 + r)^{T - t}(1 + r_f)^{T1 - t}$$

where r_f is the forward risk-free rate applicable to the period T to $T1$ implied by the spot rates r and r_1. Substitution immediately yields equation (9.8). The argument strictly applies to forward prices and not to futures prices. However, for all practical purposes the difference is insignificant.

A.9.6 THE CONVERSION FACTOR FOR T-BOND FUTURES

The T-bond futures contract on the CBOT affords two kinds of options to the seller. First, delivery can be made on any business day of the expiry month. This is a timing option. Second, the short can deliver any one of a collection of bonds which are eligible as per the exchange rules. The **conversion factor** attempts to make these different instruments equivalent to each other. **The conversion factor for any deliverable bond is simply the present value as of the first day of the delivery month, of all the associated cash flows using a discount rate of 6 per cent p.a. (with semiannual compounding) divided by its face value**.

The CBOT procedure works as follows. The remaining life of the bond is rounded down to the nearest quarter. After rounding, if the bond life is a whole number of half-years, the first coupon is assumed to be paid in six months; if there is an extra quarter, the first coupon is assumed to be paid after three months and accrued interest is subtracted. The following examples illustrate these calculations.

- Consider a bond which has 18 years and 2 months to maturity on the first day of the delivery month of a contract against which this bond can be delivered. The coupon is 12 per cent. The time to maturity is rounded down to 18 years, the first coupon is assumed to be paid after six months. Thereafter, coupon payments are every six months with redemption of face value at the end of 18 years. Assuming **face value to be 100, the PV at 6 per cent p.a. is given by**

  $$\sum_{k=1}^{k=36} \frac{6}{(1.03)^k} + \frac{100}{(1.03)^{36}} = 165.49$$

  The conversion factor is thus 165.49/100 = **1.6549**

- **Now consider a 5 per cent coupon bond with 20 years and 4 months left to maturity**. This is rounded down to 20 years and 3 months (one quarter). The first coupon is assumed to be paid 3 months later and then every six months, with principal redeemed with the last coupon. The PV as of 3 months from now is

  $$\sum_{k=0}^{k=40} \frac{2.50}{(1.03)^k} + \frac{100}{(1.03)^{40}} = 90.94$$

  The 3 month interest rate is √(1.03) – 1 = 1.4889%. The PV calculated above, discounted to the present at this 3 month interest rate gives 90.94/1.0149 which is 89.60. Subtracting the accrued interest for 3 months, viz. 1.25, gives 88.35. Hence, the conversion factor is 0.8835.

It is obvious that bonds with coupons in excess of 8 per cent will have conversion factor larger than unity while those with coupons less than 8 per cent will have conversion factors less than unity.

Conversion factors cannot produce an exact equivalence between all the deliverable bonds. The cash price of a bond at any time is affected not only by the current yields but also expectations regarding movements in yields. As we have seen above, bonds with different coupons and times to maturity have different durations and hence, different risk of capital gains and losses when yields move. For instance, in a rising rate environment, investors would prefer shorter duration bonds and vice versa. Hence, despite the conversion factor adjustment, one bond from the set of deliverable bonds emerges as "cheapest to deliver", i.e. the difference between the invoice price[43] and the cash price is the largest for this bond. Recall that the price received by the seller is given by

(Futures Settlement Price × Conversion Factor + Accrued Interest)

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[43]The invoice price is the amount the futures seller will receive when he delivers an acceptable bond. It is computed as follows:

Invoice price = (CF)(decimal futures settlement price)($100000) + accrued interest

where CF is the conversion factor of the bond being delivered.

To buy the bond in the market, the futures seller must pay its quoted cash market price plus the accrued interest. Hence, the net gain to the short is

(Futures Settlement Price × Conversion Factor – Cash Price).

The seller of the futures contract would like to choose that bond for delivery (from among the class of eligible bonds) for which the net gain would be maximum. Since all traders with a short futures position would attempt to do this, arbitrage would ensure that for the cheapest to deliver bond (CTD bond), the net gain would be zero while for any other eligible bond, it would be negative. This means that for the CTD bond

Futures Settlement Price × Conversion Factor – Cash Price = 0

or Futures Settlement Price = (Cash Price/Conversion Factor)

For any other eligible bond

Futures Settlement Price × Conversion Factor – Cash Price < 0

or Futures Settlement Price < (Cash Price/Conversion Factor)

(Cash Price/Conversion Factor) is known as Delivery Adjusted Price. The above analysis shows that among the class of deliverable bonds the CTD bond will have the smallest delivery adjusted price.

As mentioned in the text, practitioners use a rule of thumb which states that if yields exceed 8 per cent, the CTD bond would be one with highest duration while if yields are less than 8 per cent, the CTD bond would have the lowest duration among the eligible bonds. This rule would be valid under a flat yield curve and so is not accurate in all situations. It is very difficult to demonstrate it under general conditions, but some insight can be obtained by looking at a hypothetical case. Suppose the T-bond futures contract calls for delivery of zero-coupon bonds. The conversion factor is just the present value of all cash flows from the bond per unit face value e.g. per dollar face value using a discount rate of 8 per cent p.a. The conversion factor is given by

$$\text{Conversion Factor} = e^{-(0.08)(M)}$$

If the current yield is y, the cash price of the bond with face value F would be

$$\text{Cash Price} = Fe^{-yM}$$

Hence, the delivery adjusted price would be

$$\text{Cash Price/Conversion Factor} = Fe^{-yM}/e^{-0.08M} = Fe^{(0.08-y)M}$$

For CTD bond, this has to be minimum among the class of eligible bonds. It is easy to see that if $y > 0.08$, this would be achieved by maximising M, i.e. the bond with the longest maturity while if $y < 0.08$, it would be the eligible zero coupon bond with the shortest maturity. For zero coupon bonds, maturity equals duration and hence the thumb rule is valid in this case.

For further discussion about the determination of the cheapest to deliver bond before the maturity of the futures contract, consult Siegel and Siegel (1990).

Case Study

You are back in Mumbai after a gruelling day in New Delhi. You were called by the mandarins in the North Block to explain the cause of crash in the price of the stock of your company—a leading

Indian software MNC. The investors were aghast at the stock price crash. The main charge was simple: **your company used futures trading for speculation, instead of normal hedging.**

Before you can get out of your shining Merc (which might get auctioned soon) media-persons are already all over the place thrusting microphones in your face—waiting for a sound bite. You barely mumble 'no comments' to the gathering but promise to get back with a detailed description of events, to be transmitted live on the television, in a couple of hours.

As you sit down at your office table, and call for a RT (room-temperature) glass of *narial paanee* (coconut water)—since your friends tell that it is good when you have hyper-acidity; you need a strong stomach lining to digest all the vitriol being offered to you.

When you look at the documents spread in front of you, the following details emerge:

(a) Since the exposure of your company is in USD, you chose to buy 6-month USD futures at a price that was above spot price for a long time, and you sold GBP futures for 9-months since pricing was very attractive, and you were expecting to receive payments for services rendered in about 8-months time.
(b) As the maturity of USD futures approached, US of A attacked Iraq, leading to a jump in oil prices.
(c) Sensing trouble you immediately bought 3-month interest rate futures which were trading below spot.
(d) Within a week of your futures purchase, markets started stabilizing and returned to normal behaviour.
(e) But your board was uncomfortable with your position, and margin calls. They ask you to settle your position and face the jury, charging you for speculation in the markets with company money.

Question: What additional information will you need? How will you defend your case?

Chapter 10

Currency Options

10.1 INTRODUCTION

In Chapters 8 and 9, we have discussed currency forward and futures contracts. In both cases, the two parties to the contract – the buyer and the seller or the "long" and the "short" – have certain rights as well as obligations. The buyer has the right and the obligation to take delivery of the underlying asset at the specified price on the expiry date while the seller has the right and obligation to make delivery. Either party can of course cancel the contract (in case of forwards) or close out the position by entering into an opposite contract in case of futures, but if the position is held open till the expiry date, both parties are required to go through with the contract.

Thus, suppose on June 14 an exporter firm has entered into a 3-month forward contract to sell US dollars 500,000 at a price of ₹62.75 quoted by a bank. The delivery date would have been September 16. On September 14, the treasurer of the firm finds that the USD/INR spot is trading at 65.35. Can he ask the counter-party to forget about the forward contract and sell the dollars in the spot market? The answer is a clear "no" and such an action would constitute a legal default. The forward contract has given him the right to sell dollars at 62.75, but has also imposed on him an obligation to do so. Conversely, if the dollar has fallen to 61.50 on September 14, the bank cannot withdraw from the contract and has to buy 100000 dollars at the agreed upon price ₹62.75.

Continuing with the same example, suppose on June 14, the firm's treasurer had a view that three months later the dollar is going to be higher than the forward rate quoted by the bank, viz. 62.75; however, he was not willing to take the risk involved in leaving the exposure uncovered. Could he structure a deal in which he would derive additional benefit if his view turned out to be right, but at the same time limit his risk if it turned out to be wrong? One can view this as a desire to insure oneself against adverse movements in the market while retaining the freedom to benefit from favourable movements.

Options are financial instruments that confer upon the option buyer the right to execute a particular transaction, but without the obligation to do so. More specifically, an option is a financial contract in which the ***buyer*** of the option has the right to buy or sell an asset, at a pre-specified price, on or up to a specified date if he chooses to do so; however, ***there is no obligation for him to do so***. In other words, the option buyer can simply let his right lapse by not exercising his option. The ***seller*** of the option has an ***obligation*** to take the other side of the transaction, if the buyer wishes to exercise his option. The closest analogy is an insurance contract – you want to save or make money, if nature moves in your favour but want protection if nature moves against you. For such contracts you have to pay an insurance premium. Along the same lines, the option buyer has to pay the option seller a fee – a premium – for receiving such a privilege.

Options are available on a large variety of underlying assets including common stock, currencies, debt instruments, interest rates and commodities. Options on stock indices, on futures contracts (the underlying asset is a futures contract) and futures-style options are also traded on organised options exchanges. In a later chapter, we will study products known as financial swaps and options on such swaps. Compound options are options on options. While over-the-counter option trading has had a long and checkered history, option trading on organised options exchanges is relatively recent.

Options have proved to be a very versatile and flexible tool for risk management in a variety of situations arising in corporate finance such as managing risk associated with a portfolio of common stocks, interest rate and currency risk management and hedging of commodity price risk. By themselves and in combination with other financial instruments, options permit creation of tailor-made risk management strategies and a vast array of structured financial products.

Options also provide a way by which individual investors with moderate amounts of capital can speculate on the movements of stock prices, exchange rates, commodity prices and so forth. The limited loss feature of options is particularly advantageous in this context.

The principal focus of this chapter is on foreign currency options. Other types of options may be alluded to from time to time for the purposes of illustration.

As in the case of our discussion of futures, our treatment of options also is far from comprehensive and rigorous. Our purpose here is to clarify the nature of the instrument, explain the terminology, discuss the principles underlying its pricing and illustrate some of the important applications. Numerous references will be cited throughout the chapter to enable the interested reader to pursue the topic in greater depth. Apart from the journal articles cited in the bibliography, excellent book-length treatments are available. Many of them deal mainly with stock options but contain a substantial amount of material that is relevant to currency options. Among the more accessible ones are Ritchken (1987), Hull (2009), McDonald (2003) and Stulz (2003). The monograph by Bodurtha and Courtadon (1987) deals exclusively with currency options. Grabbe (1986, 1991) and Wang (2005) contain highly readable chapters on currency options. More advanced and rigorous expositions of option valuation, managing option risk and option trading strategies can be found in Alexander (2008).

During the couple of decades starting in 1980, the financial engineering wizards working for commercial banks, investment banks and other financial instruments have come up with a vast collection of highly structured financial products which are combinations of simple and exotic options and other financial derivatives. After the financial crisis in USA and Europe in 2007 and 2008, a debate has been going on as to whether these products have made financial markets and systems more fragile and hence prone to systemic crises. In India too there has been a feeling that sellers of these products, viz. commercial banks and some NBFCs oversell these products to their customers to earn the fees and premiums without adequately explaining to them the risks associated with these products. It has been argued that while big non-financial corporations have the in-house expertise to analyse these risks, small and medium enterprises may be misguided by financial institutions and do not have sufficient in-house talent to fully understand the risks. There is a view held by some practitioners that financial institutions should not be permitted to sell these products to firms below a certain size – say annual turnover less than fifty crores.

10.2 OPTIONS ON SPOT, OPTIONS ON FUTURES AND FUTURES STYLE OPTIONS

As mentioned above, the asset underlying an option contract can be a spot commodity or a futures contract on the commodity. Still another variety is the futures-style option.

An option on spot foreign exchange gives the option buyer the right to buy or sell a specified amount of a currency say US dollars at a stated price in terms of another currency say Swiss francs. If the option is exercised, the option seller must deliver US dollars against Swiss francs or take delivery of dollars against francs at the exchange rate agreed upon in the option contract.

An option on currency futures gives the option buyer the right to establish a long or a short position in a currency futures contract at a specified price. If the option is exercised, the seller must take the opposite position in the relevant futures contract. For instance, suppose you hold an option to buy a December CHF contract on the IMM at a price of \$0.58/CHF. You exercise the option when December futures are trading a 0.5895. You can close out your position at this price and take a profit of \$0.0095 per CHF or, meet futures margin requirements and carry the long position with \$0.0095 per CHF being immediately credited to your margin account. The option seller automatically gets a short position in December futures.

Futures-style options are a little bit more complicated. Like futures contracts, they represent a bet on a price. The price being betted on is the ***price of an option on spot foreign exchange***. Recall that the buyer of an option has to pay a fee to the seller. This fee is the price of the option. In a futures style option you are betting on changes in this price which, in turn, as we will see below, depends on several factors including the spot exchange rate of the currency involved. We will describe the mechanics of futures-style options after explaining some standard terminology associated with options.

Options on spot exchange are traded in the over-the-counter markets as well as a number of organised exchanges including the United Currency Options Market (UCOM) of the Philadelphia Stock Exchange (PHLX), the London Stock Exchange (LSE) and the Chicago Board Options Exchange (CBOE)[1]. Exchange-traded options can be both standardised as to amounts of underlying currency and maturity dates as well as customised. For instance, PHLX trades both standardised and customised options. Over-the-counter options are customised by banks.

Options on currency futures are traded at the Chicago Mercantile Exchange (CME) among others. Futures-style options are traded at the LIFFE.

Most of our discussion will be centred around options on spot exchange.

10.3 OPTIONS TERMINOLOGY

Before we proceed to discuss option pricing and applications, we must understand the market terminology associated with options. While our context is that of options on spot foreign currencies, the terms described below carry over to other types of options as well.

[1] PHLX and LSE trade American-style and European-style options while CBOE trades European-style options. The difference is explained in the next section.

The two parties to an option contract are the ***option buyer*** and the ***option seller also called option writer***. For exchange-traded options, as in the case of futures, once an agreement is reached between two traders, the exchange (the clearinghouse) interposes itself between the two parties, becoming buyer to every seller and seller to every buyer. The clearinghouse guarantees performance on the part of every seller.

Call Option

A call option gives the option buyer the right to purchase a currency *Y* against a currency *X* at a stated price *Y/X*, on or before a stated date. But unlike in a forward purchase contract, the call option buyer has no obligation to execute the contract. Thus, if you buy a 3-month call option on US dollar against rupees at a strike price of 64.00, you have the right to buy dollars at a rate of ₹64.00 during the next three months or at the end of that period The contract will also specify the "face value" i.e. how many dollars you can buy. You have no obligation to buy dollars, i.e. you may decide not to exercise your right. The up-front fee which you have paid to the option writer will not be refunded whether or not you exercise your option. For exchange-traded options, one contract represents a standard amount of the currency *Y*. The writer of a call option must deliver the currency *Y*, if the option buyer chooses to exercise his option.

Put Option

A put option gives the option buyer the right without the obligation to sell a currency *Y*, say euro, against a currency *X*, say Swiss franc, at a specified price such as CHF 1.92 per EUR on or before a specified date. The writer of a put option must take delivery of Euros and pay CHF to the option buyer at the rate of CHF 1.92 per EUR if the option is exercised.

Strike Price (also called Exercise Price)

The price specified in the option contract at which the option buyer can purchase the currency *Y* (call option) or sell the currency *Y* (put option) against *X*. Note carefully that this is not the price of the option, i.e. the premium the option buyer has to pay the option writer; it is the rate of exchange between *X* and *Y* that applies to the transaction, if the option buyer decides to exercise his option.

Thus, a call (put) option on GBP at a strike price of USD 1.6500 gives the option buyer the right to buy (sell) GBP at a price of USD 1.6500 if and when he exercises his option.

Maturity Date or Expiry Date

The date on which the option contract expires. Exchange traded options have standardised maturity dates.

American Option

An option, call or put, which can be exercised by the buyer on any business day from initiation to expiry date, i.e. at any time during the life of the option.

European Option

An option that can be exercised only on the expiry date.

Option Premium (Option Price, Option Value)

The fee that the option buyer must pay the option writer, usually "upfront", i.e. at the time the contract is initiated. This fee is like an insurance premium; it is non-refundable whether the option is exercised or not.

Intrinsic Value of the Option

Given its throw-away feature, the value of an option can never fall below zero. Consider an American call option on CHF with a strike price of \$0.8065. If the current spot rate CHF/\$ is 0.8205, the holder of such an option can realise an immediate gain of \$(0.8205 – 0.8065) or \$0.014 per CHF by exercising the call and selling the CHF in the spot market. This is the "intrinsic value" of the call option. Therefore, the market value or the premium demanded by the seller of the call must be at least equal to this. The intrinsic value of an option is the gain to the holder on immediate exercise. For a call option, it is defined as max $[(S - X), 0]$ where S is the current spot rate and X is the strike price. If $S > X$, the call has a positive intrinsic value. If $S \leq X$, intrinsic value is zero. Similarly for a put option, intrinsic value is max $[(X - S), 0]$. For European options, the concept of intrinsic value is only notional since they cannot be prematurely exercised. Their intrinsic value is meaningful only on the expiry date.

Time Value of the Option

The value of an American option at any time prior to expiration must be at least equal to its intrinsic value. In general, it will be larger. This is because there is some probability that the spot price will move further in favour of the option holder. Take the call option on CHF at a strike price of \$0.8065 when the spot rate is \$0.8205. Suppose the option has two months life left. Its market value would exceed its intrinsic value of \$0.014 because before the option expires, CHF may appreciate further, increasing the gain to the option holder. Suppose the spot rate is \$0.7990. There would be a loss if the option is exercised immediately. The intrinsic value of the option would be zero. Even then, the option would have a positive market value because the spot rate may move above \$0.8065 during the remaining life of the option. The difference between the market value of an option at any time t and its intrinsic value at that time is called the time value of the option. For European options, this argument does not hold. A European call on a foreign currency can at times have a value less than $(S - X)$[2] [assuming that this is positive] and a European put on a foreign currency can have a value less than $(X - S)$. The lower bound on European option values is zero.

At-the-Money, In-the-Money and Out-of-the-Money Options

This terminology indicates whether the option holder would make a gain, or loss or neither gain nor loss by exercising the option. Essentially, it captures the relationship between the current spot rate S and the strike price of the option, viz. X.

A call option is said to be ***at-the-money,*** if $S = X$, ***in-the-money,*** if $S > X$ and ***out-of-the-money,*** if $S < X$. Conversely, a put is at-the-money, if $S = X$, in-the-money, if $S < X$ and out-of-the-money, if $S > X$. An option will be exercised, if at all, only when it is in the money[3]. Consider a call option on USD at a strike price of GBP 0.5100. It is at-the-money if the spot USD/GBP rate is 0.5100, in-the-money if the rate is higher say 0.5300 and out-of-the money if the rate is lower say 0.5050. A put option on Euro at a strike price of USD 1.40 is in-the-money, if EUR/USD spot is below 1.40, say 1.36, out-of-the money, if it is above 1.40, at say 1.48. Essentially, the option buyer will make a gain by exercising the option, if it is ***in-the-***

[2]This is not true of a European call on a non-dividend paying stock.

[3]This terminology is not universal. For European options, the market practice is to compare the strike price not with the spot rate but with the forward rate for the same maturity as the life of the option. Thus, a 3-month European call is in the money, if the strike price is less than the 3-month forward rate, out of the money, if it is higher and in the money, if they are equal. Thus, one can talk of "in or out of the money spot" or "in or out of the money forward". For American options, "moneyness" is in comparison with the spot rate.

money, a loss, if it is ***out-of-the-money*** and neither loss nor gain, if it is ***at-the-money***. Note that the gain made by exercising an in-the-money option may or may not exceed the premium that the option buyer has paid to the option writer. Suppose you hold an American call option on US dollars with strike price ₹54.00. You have paid a premium of ₹2.00 per dollar to buy this option. If the spot exchange rate is 55.50, the option would be in-the-money; but if you exercise it, take delivery of dollar and sell the dollar in the spot market, the gain you make, viz. ₹1.50 per dollar will not recover the entire premium you have paid. If the spot rate is 56.75, you will make a net gain by exercising it.

With this background, we will briefly discuss how futures-style options work. Suppose an April call option on spot CHF with a strike price of \$0.8250 per CHF is at \$0.0125 per CHF. One option contract in CHF is CHF 1,25,000. Thus, the option premium is \$1562.50 per contract (= 0.0125 × ₹125000). A trader feels that the premium on this option is going to increase. He buys a futures-style call. The seller of this call is betting that the premium will go down. Unlike the option on spot ***the buyer does not pay the premium to the seller***. Instead, both post margins related to the value of the call on spot. Next day, the premium does increase to \$0.0129. This represents a gain of \$0.0004 per CHF or \$50 per contract for the buyer of the futures-style call. His margin account is credited with \$50 which can be withdrawn and his contract is marked to market as in futures. This process will continue till the position is closed out with marking to market and daily gains and losses as in a futures contract.

10.4 PRICE QUOTATIONS

Table 10.1 is an extract of option price quotations on the CME and PHLX options exchanges which trade physically settled currency options with standard contract sizes. Let us see how to interpret these data.

The first line gives the underlying asset and its amount in one option contract and the type of option. Thus, an option on British pounds is an American option for £10000 while for euro it is a European option and one contract is for EUR10000. The first column gives strike prices. On a given day, options with a range of strike prices are traded[4]. For the sterling, the table shows calls and puts expiring in September 2013 with strike prices ranging from \$1.5400 to \$1.5700 and calls expiring in March 2014 with strike prices ranging from 1.5100 to 1.5300. For the euro strike prices ranging from \$1.3100 to \$1.3500 per euro are shown (the actual strike price range available is wider than what is shown in the table). However, not all options are traded on all days and hence, quotes for some strike prices may not be available on a particular day.

The trading, clearance and delivery procedures vary from exchange to exchange. Since the option buyer pays the premium in full upfront, he does not have to post any security margin. The option writer must provide collateral in the form of cash or securities to ensure that the option writer will deliver in case the option is exercised.

As mentioned above, over-the-counter options are tailor-made as to strike price, maturity and the amount of currency. Typically the amount of currency involved tends to be much larger than in an exchange-traded contract. Dealers in OTC options – commercial banks, investment banks – use exchange traded options to offset their own positions in the OTC market.

Quotation practices and other conventions in the OTC market are discussed later in this chapter.

[4]The strike price intervals are standardised by the exchange. The range surrounds the current spot rate. As the spot rate changes, new strike prices are added.

Table 10.1 Currency Option Price Quotations (June 10, 2013)

GBP/USD American Options (Contract Size 10000)

Expiry	*Sep 2013*			*Mar 2014*
Strike Price	*Call*	*Put*	*Strike Price*	*Call*
1.5400	0.0338	0.0166	1.5100	0.0725
1.5600	0.0223	0.0246	1.5200	0.0657
1.5700	0.0174	0.0297	1.5300	0.0591

EUR/USD European Options (Contract Size 10000)

Expiry	*Sep 2013*		*Dec 2013*	
Strike Price	*Call*	*Put*	*Call*	*Put*
1.3100	0.0317	0.0143		
1.3200	0.0256	0.0180	0.0363	0.0274
1.3500	0.0114	0.0341	0.0209	0.0428

Source: CME website.
Note: Quotes are given as amount of USD per GBP and per EUR.

10.5 ELEMENTARY OPTION STRATEGIES

In this section, we will analyse some simple option strategies that illustrate the flexibility of options in creating a variety of payoff profiles. We will make extensive use of profit diagrams. Throughout the section, we will ignore transaction costs such as brokerage commissions, margins, etc., and assume that the option is not prematurely exercised (alternatively, assume that we are dealing with European options). Further, all exchange rates, strike prices, and premiums will be in terms of dollars per unit of some currency *X* and the option will be assumed to be on one unit of the currency *X*.

10.5.1 Call Options

Consider a trader who buys a call option on Swiss franc with a strike price of $0.8750 and pays a premium of 1.98 cents ($0.0198). The current spot rate, S_t, is $0.8694. His gain/loss at time *T* when the option expires depends upon the value of the spot rate, S_T, at that time:

S_T	**Gain(+)/Loss(–)**
0.8000	– $0.0198
0.8500	– $0.0198
0.8600	– $0.0198
0.8700	– $0.0198
0.8850	– $0.0098
0.8948	$0.0000
0.9000	+ $0.0052
0.9500	+ $0.0552
1.0000	+ $0.1052

For values of $S_T \leq 0.8750$, the option buyer lets the option lapse since Swiss francs can be bought at a lower price in the spot market. His loss is limited to the premium paid. For $S_T > 0.8750$, the option will be exercised. If S_T is between 0.8750 and 0.8948, the gain on the option will recover part of the premium. If S_T is above 0.8948, the option buyer will realise some net profit. In general, denoting the strike price by X and the call option premium by c, we have the following:

Call Option Buyer's Profit

Profit $= -c$ for $S_T \leq X$
$= S_T - X - c$ for $S_T > X$

For the writer of the call option, it is easy to see that the profit profile must be the mirror image of the call buyer's profit profile:

Call Option Writer's Profit

Profit $= +c$ for $S_T \leq X$
$= -(S_T - X - c)$ for $S_T > X$

Figure 10.1 shows the profit profiles for buying and writing a call option.

10.5.2 Put Option

In late February, a trader buys a June put option on pound sterling at a strike price of \$1.8500, for a premium of \$0.07 per sterling. The spot rate at the time is \$1.8465.

At option expiry, his gains/losses are as follows:

S_T	Gain(+)/Loss(–)
1.7500	+ \$0.0300
1.7600	+ \$0.0200
1.7800	\$0.0000
1.7900	– \$0.0100
1.8300	– \$0.0500
1.8500	– \$0.0700
1.8700	– \$0.0700
1.9000	– \$0.0700

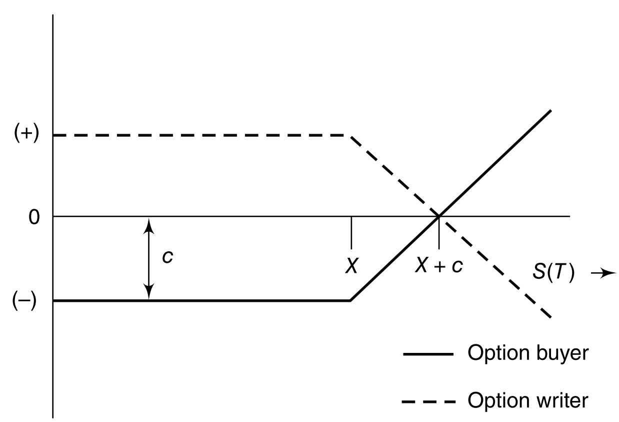

Fig. 10.1 Payoff Profiles of a European Call Option

For $S_T \geq 1.85$, the option will not be exercised since sterling has a higher price in the spot market. For $1.78 \leq S_T < 1.85$, the option will be exercised but there will still be a net loss. For $S_T < 1.78$, the option will be exercised and lead to a net profit. Denoting by p, the put premium we have:

Put Option Buyer's Profit

Profit $= -p$ for $S_T \geq X$
$= X - S_T - p$ for $S_T < X$

Put Option Writer's Profit

Profit $= +p$ for $S_T \geq X$
$= -(X - S_T - p)$ for $S_T < X$

Figure 10.2 shows these profit profiles.

These examples bring out the close analogy between options and purchase of insurance. Consider a put option buyer. This may be a firm with say a receivable in the foreign currency. By buying a put option, the firm is ensuring that the total value of its portfolio at expiry does not fall below X, the strike price. A house owner buys fire insurance to protect the value of the property. Suppose the amount insured is the current market value of the house. If the event of fire does not happen, he loses the premium; if it does take place, the insurance company compensates for the damage caused. For the put buyer, if the spot rate is above the strike, premium is foregone; if it falls below the strike, the option writer makes up the loss. The analogy can be carried further. The house owner can insure the property for a value below its current market value. In effect, the insurer will only pay for damages in excess of a "deductible" amount. The house owner pays a smaller premium. Table 10.1 shows that the put premium declines as the strike price decreases for a given maturity. Similarly, for obvious reasons, call premiums increase as strike price decreases for a given maturity.

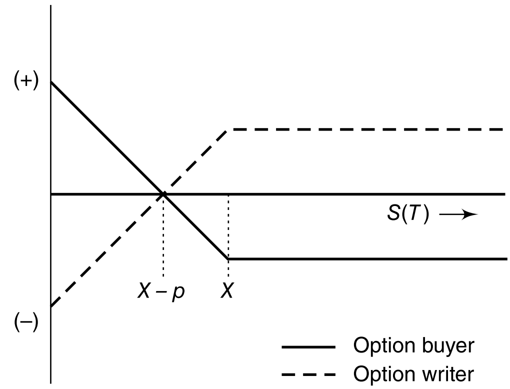

Fig. 10.2 Payoff Profiles of a Put Option

10.5.3 Spread Strategies

Like in the case of futures, spread strategies with options also involve simultaneous sale and/or purchase of two different option contracts. The motivation with option spreads is to realise a profit if the underlying price moves in a certain fashion, while at the same time limiting the loss if it does not. These are speculative strategies with limited profit potential, but also limited potential loss.

A Bullish Call Spread

The current CHF/USD spot rate is 0.80. April calls with strike 0.75 are trading at a premium of 0.07 and with strike 0.85 at a premium of 0.01. A bullish call spread consists of selling the call with the higher strike price and buying the call with the lower strike price. Profits at expiration are as below:

S_T	Gain/Loss on Short	Gain/Loss on Long	Net Gain/loss
0.6500	0.01	–0.070	–0.060
0.7000	0.01	–0.070	–0.060
0.7500	0.01	– 0.070	– 0.060
0.8000	0.01	– 0.020	– 0.015
0.8100	0.01	– 0.010	0.000
0.8150	0.01	– 0.005	0.005
0.8300	0.01	0.010	0.020
0.8500	0.01	0.030	0.040
0.9000	–0.04	0.080	0.040
0.9500	–0.09	0.130	0.040

Let us work out a couple of calculations. At any value of $S_T \leq 0.75$, neither call is exercised. The net loss is premium paid on the lower priced call minus the premium received on the higher priced call. At a price higher than 0.85, such as 0.90, both calls will be exercised.

Gain on the call sold: 0.01 – (0.90 – 0.85) = – 0.04
Gain on the call bought: (0.90 – 0.75) – 0.07 = + 0.080

Since a lower priced call is being bought and a higher priced call is being sold, initial net investment equal to the difference in the two premiums is required. In the example, this is 0.06. The maximum profit potential is given by the difference in the strike prices minus the initial investment. In the above example, this is

(0.10 – 0.06) = 0.04

The maximum loss is the initial investment. The breakeven value of S_T is given by the lower strike price plus the initial investment, (0.75 + 0.06) = 0.8100 in the example. The strategy, thus, yields a limited profit, if the foreign currency appreciates and a limited loss, if it depreciates. Figure 10.3 shows the profit diagram of a bullish call spread.

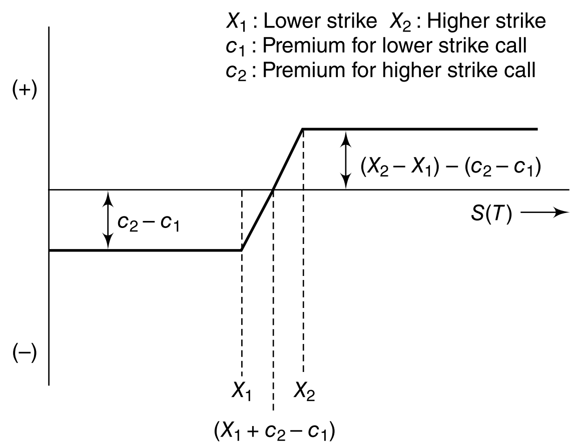

Fig. 10.3 Payoff Profile of a Bullish Call Spread

If the investor expects the foreign currency to depreciate, he can adopt the reverse strategy, viz. buy the higher strike call and sell the lower strike call. This is known as a ***bearish call spread.*** The reader can work out that the maximum gain will be difference in the two premiums. The maximum loss will be difference in premiums minus the difference in strike prices. Breakeven point will be same as above. A ***bullish put spread*** consists of selling puts with higher strike and buying puts with lower strike. Here, if there is a significant appreciation, neither put will be exercised nor the net gain will equal the difference in premiums. If there is a significant depreciation, the maximum loss will be difference in strike prices minus the difference in premiums. Figure 10.4 illustrates. A ***bearish put spread*** is the opposite of a bullish put spread.

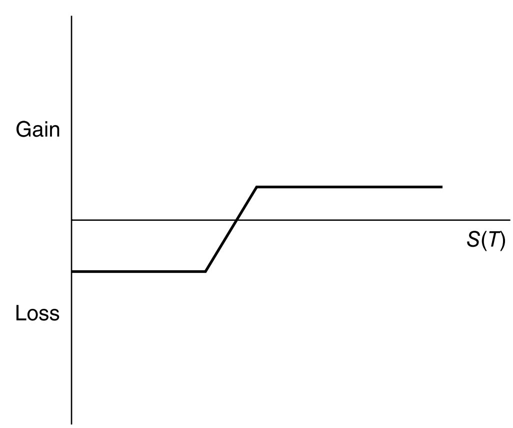

Fig. 10.4 Profit Profile of a Bullish Put Spread

These strategies, involving options with same maturity but different strike prices are called ***vertical or price spreads***[5]**.**

Butterfly Spreads

This is an extension of the idea of vertical spreads. Suppose the current spot rate CHF/USD is 0.8000. The following April call options are available:

Strike	Premium
0.78 (X_1)	0.05 (c_1)
0.82 (X_2)	0.02 (c_2)
0.86 (X_3)	0.01 (c_3)

A butterfly spread is ***bought*** by buying two calls with the middle strike price of 0.82, and writing one call each with strike prices on either side, 0.78 and 0.86. The payoff profile is shown below:

S_T	Gain on 0.82 call (long 2)	Gain on 0.78 call (short 1)	Gain on 0.86 call (short 1)	Net Gain
0.7000	– 0.04	0.05	0.01	0.02
0.7200	– 0.04	0.05	0.01	0.02
0.7600	– 0.04	0.05	0.01	0.02
0.7800	– 0.04	0.05	0.01	0.02
0.7900	– 0.04	0.04	0.01	0.01
0.8000	– 0.04	0.03	0.01	0.00
0.8100	– 0.04	0.02	0.01	– 0.01
0.8200	– 0.04	0.01	0.01	– 0.02
0.8400	0.00	– 0.01	0.01	0.00
0.8500	0.02	– 0.02	0.01	0.01
0.8600	0.04	– 0.03	0.01	0.02
0.8800	0.08	– 0.05	– 0.01	0.02

Figure 10.5 portrays the profit profile. Buying the butterfly spread yields a limited profit, if there is either a significant appreciation or a significant depreciation of the currency. For moderate changes, it results in a loss. The maximum gain is limited to the difference between the sum of the premiums for the calls sold and the total premium for the two calls bought, i.e. $(c_1 + c_3 - 2c_2)$. The maximum loss would be $[(X_2 - X_1) - (c_1 + c_3 - 2c_2)]$. This would occur, if the spot at expiry equals X_2. Profiles similar to this can be replicated by other combinations such as shorting one put each with the low strike X_1 and high strike X_3 while going long two puts with the middle strike X_2. The maximum gain would be $(p_1 + p_3 - 2p_2)$ while the maximum loss would be $[(X_3 - X_1) - (p_1 + p_3 - 2p_2)]$.

Selling a butterfly spread involves selling two intermediate priced calls and buying one on either side. You can easily work out the profit table for the above data. It yields a small profit for moderate movements in the exchange rate and a limited loss for large movements on either side. Such a strategy is adopted when one expects small changes in the exchange rate in either direction.

[5]"Vertical" because in option price quotations strike prices are listed vertically in a column while maturities are shown horizontally in a row.

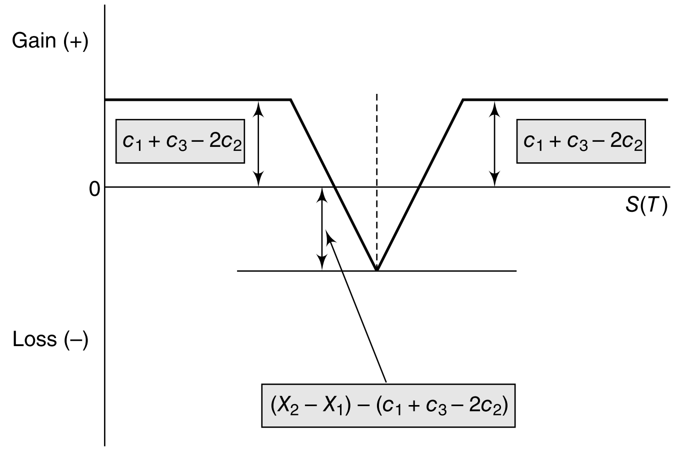

Fig. 10.5 Profit Profile of Long Butterfly Spread

Notice that the net investment in buying the butterfly spread was negative, i.e. there was a net cash inflow. There would be a net cash outflow on selling the butterfly. This is related to a property of option prices called "convexity" which is discussed later in this chapter.

Horizontal or Time Spreads

If you look at Table 10.1 carefully, you will notice that for both calls and puts, for a given strike price, premium increases as maturity increases. The reason for this will be explained in the section on option pricing. Horizontal spreads consist of simultaneous purchase and sale of two options identical in all respects except the expiry date. The idea behind it is that the time value of the short maturity option will decline faster than that of the longer maturity option. The difference in premiums between the two options will be moderate at the time of initiation, but will have widened at the time of expiry of the short-term option ***provided the underlying exchange rate has not moved drastically.***

Consider two pound sterling calls both with a strike price of, say 192½ cents ($1.9250). Suppose the spot rate is 1.9465. The March call is priced at 2.95 cents, while the June call is 5.70 cents. Suppose a trader buys a June call and sells a March call for a net cost of 2.75 cents per pound. Assume further that at the expiry of the March call, the spot rate is 1.9500. The March call will be worth its intrinsic value of 2.50 cents. As long as the June call is worth more than 5.25 cents, the trader can realise a net profit by buying the March call and selling the June call at that time. Ex-ante valuation of the strategy requires that we should be able to estimate, at the time of initiation of the strategy, what the value of the June call will be at the expiry of the March call. This requires knowledge of option pricing dealt with in sections 10.7 and 10.8.

Straddles and Strangles

A straddle consists of buying a call and a put both with identical strikes and maturity. If there is drastic depreciation, gain is made on the put, while in case of a drastic appreciation, the call gives a profit. For moderate movements, a net loss results. As an example, suppose GBP March call and put options with a strike of $1.7250 are priced at 2.95 cents and 1.24 cents, respectively. Profits for alternative values of S_T are listed below:

S_T	Gain on Call	Gain on Put	Net Gain
1.6500	– 2.95	6.26	3.31
1.6831	– 2.95	+2.95	0.00
1.7000	– 2.95	1.26	– 1.69
1.7250	– 2.95	– 1.24	– 4.19
1.7669	+ 1.24	– 1.24	0.00
1.8000	4.55	– 1.24	3.31

Figure 10.6 illustrates. Note that unlike the butterfly, the profit potential here is not limited. Maximum loss equals the sum of the premiums paid for the call and the put.

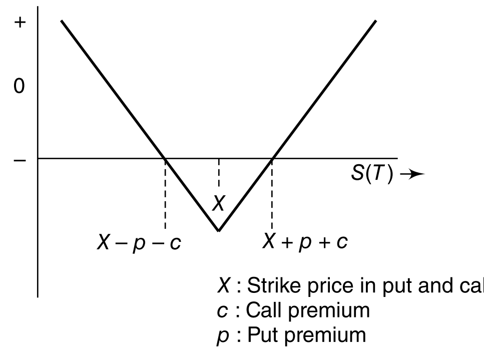

Fig. 10.6 Profit Profile of a Straddle

Strangle is similar to a straddle. It consists of buying a call with strike above the current spot and a put with strike below the current spot. For instance, suppose with £/$ spot at 1.8465, a March call with strike 1.8750 is priced at 1.75 cents, while the March put with strike of 1.7750 is priced at 0.80 cents. You can work out the profit profile for alternative values of S_T. It looks like Figure 10.7. Like the straddle, it yields net gain for drastic movements of the spot and a loss for moderate movements. Compared to the straddle, the loss is smaller, but it also needs larger movement in spot before it starts giving a net profit.

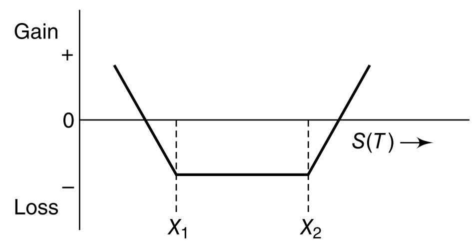

Fig. 10.7 Profit Profile of a Strangle

Both straddles and strangles are bets on changes in volatility. When you buy a straddle, or a strangle, you are betting that the volatility of the spot rate is going to increase. In option traders' jargon, you are "going long volatility".

These are some of the popular speculative strategies with options. A large number of other combinations are possible.

10.6 HEDGING WITH CURRENCY OPTIONS

Currency options provide the corporate treasurer another tool for dealing with foreign exchange risks arising out of the firm's operations. Unlike forward contracts, options allow the hedger to gain from favourable exchange rate movements while being protected against unfavourable movements. However, forward contracts are costless, while options involve upfront premium costs. The choice between the two hedging strategies for hedging anticipated foreign currency flows is discussed in Chapter 13. Here, we will illustrate hedging applications of exchange-traded and OTC options with some examples. The figures assumed for brokerage and other transaction costs are hypothetical.

Hedging a Foreign Currency Payable with Calls

In late June, an American importer anticipates a yen payment of JPY 100 million to a Japanese supplier sometime in October. The current USD/JPY spot rate is 110.22 (which implies a JPY/USD rate of 0.009073 or 90.73 cents per 100 yen). The forward rate for the settlement date is 90 cents per 100 yen. An October yen call option on the PHLX, with a strike price of \$0.0092 per yen or 92 cents per 100 yen is available for a premium of 2.25 cents per 100 yen or \$0.000225 per yen. Each yen contract is for JPY 6.25 million. Premium per contract is, therefore,

$$\$(0.000225 \times 6250000) = \$1406.25$$

The firm decides to purchase 16 calls for a total premium of \$22500. In addition, there is a brokerage fee of \$20 per contract. Thus, total expense in buying the options is \$22820. The firm has in effect ensured that its buying rate for yen will not exceed:

$$\$0.0092 + \$(22820/100{,}000{,}000) = \$0.0094282 \text{ per yen}$$

or $\quad$ \$0.94282 per 100 yen.

The price the firm will actually end up paying for yen depends upon the spot rate at the time of payment. We will consider two scenarios:

1. Yen depreciates to \$0.0087 per yen (\$/¥ = 114.94) in October when the payment becomes due.
   The firm will not exercise its option. It can sell 16 calls in the market provided the resale value exceeds the brokerage commission it will have to pay. (Recall that June calls will still command some positive premium). It buys yen in the spot market. In this case, the price per yen it will have paid is

   $$\$0.0087 + \$0.0002282 - \$\left[\frac{(\text{Sale value of options} - 320)}{100{,}000{,}000}\right]$$

   If the resale value of options is less than \$320, it will simply let the option lapse. In this case, the effective rate will be \$0.0089282 per yen or ¥112.0046 per dollar[6]. It would have been better to leave the payable uncovered. A forward purchase at \$0.0090 would have fixed the rate at that value and would be worse than the option.
2. Yen appreciates to \$0.0095 in October when the payment becomes due.
   Now the firm can exercise the option and procure yen at the strike price of \$0.0092. In addition, there will be transaction costs associated with exercise. Alternatively, it can sell the options and buy the yen in the spot market. With the exercise of the option, the total dollar expenditure including the premium and brokerage will be:

   $$920000 + 22820 = \$942820$$

   or $\quad$ \$0.0094282 per yen as calculated above.

   On the other hand, suppose the options can be sold in the market at a price of \$0.00032 per yen. Then the dollar outlay would be

   $$\$950000 - \$(0.00032 \times 16 \times 6250000) + \$22820 + \$320 = \$941140$$

   Including the premium, the effective rate the firm has paid is \$0094114. (We are again ignoring the interest foregone on the premium paid at the initiation of the option).

Hedging a Receivable with a Put Option

A Singapore firm has supplied goods worth £26 million to a British customer. The payment is due in two months. The current GBP/SGD spot rate is 2.8356 and two-month forward rate is 2.8050. An American put option on sterling with 3-month maturity and strike price of SGD

[6]To be strictly accurate, we must include the interest cost on the up-front premium.

2.8050 is available in the inter-bank market for a premium of SGD 0.03 per sterling. The firm purchases a put on £26 million. The premium paid is

SGD (0.03 × 26000000) = SGD 7,80,000

There are no other costs.

Effectively, the firm has put a floor on the value of its receivables at approximately[7] SGD 2.7750 per sterling (= 2.8050 – 0.03). Again, consider two scenarios:

1. The pound sterling depreciates to SGD 2.7550.
   The firm exercises its put option and delivers £26 million to the bank at the price of 2.8050. The effective rate is 2.7750. It would have been better off with a forward contract.
2. Sterling appreciates to SGD 2.8575. The option has no secondary market and the firm allows it to lapse. It sells the receivable in the spot market. Net of the premium paid, it obtains an effective rate of 2.8275 which is better than the forward rate. If the interest foregone on premium payment is accounted for, the superiority of the option over the forward contract will be slightly reduced.

Covered Call Writing

An American firm with substantial exports to Switzerland is expecting an inflow of CHF 200 million in six months time. It can hedge this by a forward sale, purchase of a put option or by a strategy known as covered call writing, i.e. ***writing call options on assets which you own.*** In this example, we will illustrate this strategy and compare it with a forward contract.

The current spot CHF/USD rate is 0.8205. The six-month forward rate is 0.8300. The following CHF call options are trading in the market:

Each option contract is for Swiss francs 62,500

Strike (CHF/USD)	Premium (cents/CHF)
0.8000	3.05
0.8200	1.10
0.8400	0.90

The firm decides to write 3200 calls. The brokerage fee is $20 per contract. Its premium income net of brokerage fee for the above three strike prices would be:

Strike	Premium Income	Fee	Net Income
0.8000	$6100000	$64,000	$6036000
0.8200	$2200000	$64,000	$2136000
0.8400	$1800000	$64,000	$1736000

Let us analyse the performance of this strategy under alternative exchange rate scenarios at maturity. In the calculations that follow we have ignored the interest income on the premium received up-front.

1. $S_T \leq 0.8000$
   The value of the position with long currency and written calls for various strike prices is:

Strike Price	Value ($)
0.8000	S_T (200,000,000) + 6036000
0.8200	S_T (200,000,000) + 2136000
0.8400	S_T (200,000,000) + 1736000

[7]Approximately because we are ignoring the interest foregone on premium payment.

The calls will not be exercised. The firm sells the CHF inflow at the maturity spot rate S_T. It keeps the premium received and interest earned on it which partially compensates for the loss on the receivable. It is easy to see that if the Swiss franc depreciates below a certain value, the firm would be better off with forward cover. If the firm has written a call with strike 0.8000, this value can be found from the equation:

$$S_T(200{,}000{,}000) + 6036000 = 0.8300(200{,}000{,}000)$$

The resulting value of S_T is 0.7998. (It would be slightly lower, if interest income on premium is accounted for).

2. $0.80 < S_T \leq 0.82$
In this scenario, calls with strike of 0.80 will be exercised. Let us assume that in the event of exercise, a further brokerage fee of \$100 per contract has to be paid. The value of the position with 0.76 written calls will be:

$$\$[0.80(200{,}000{,}000) + 6036000 - 320000] = \$165.716 \text{ million}$$

Positions with 0.78 and 0.80 calls will have values given by:

$$S_T(200{,}000{,}000) + 2136000 \text{ and}$$
$$S_T(200{,}000{,}000) + 1736000 \text{ respectively.}$$

If S_T exceeds 0.8179 (but is below 0.8200), the firm would be better off with 0.82 written calls. This value is found from:

$$S_T(200{,}000{,}000) + 2136000 = 165716000$$

3. $0.82 < S_T \leq 0.84$
Now calls with strikes of 0.80 and 0.82 will be exercised. Value of a position with 0.80 calls written will be same as in scenario (2). With 0.82 calls written, the value would be:

$$\$[0.82(200{,}000{,}000) + 2136000 - 320000] = \$165.816 \text{ million.}$$

The position with 0.84 calls will be worth:

$$S_T(200{,}000{,}000) + 1736000$$

For values of S_T up to 0.8204, the firm would be better off with 0.82 calls written. For values above 0.8204 up to 0.84, it would be better off with 0.84 calls.

4. $S_T > 0.84$
It is easily seen that for values of S_T up to 0.8487, the firm would be better off with 0.84 calls. For values above this, the firm would have been better off with an open long position in Swiss francs.

Optimal actions for various ranges of values of S_T are summarised below:

S_T	Optimal Strategy
$S_T \leq 0.7998$	Forward cover
$0.7998 < S_T \leq 0.8179$	Write 0.80 calls
$0.8179 < S_T \leq 0.8204$	Write 0.82 calls
$0.8204 < S_T \leq 0.8487$	Write 0.84 calls
$S_T > 0.8487$	Open position

Note that the "optimal strategy" is optimal only in retrospect. It is not known at the time the decision has to be taken. Forward cover removes all uncertainty and fixes the dollar value of the

CHF receivable. Covered call writing and leaving the receivable uncovered are both risky strategies with some probability of larger payoffs. The choice depends upon the firm's degree of risk aversion, i.e. its risk-return tradeoff.

Suppose put options on CHF with strike prices of 0.80, 0.82 and 0.84 are available with premiums of 0.40, 0.53 and 1.10 cents per CHF. We leave it as an exercise to the reader to work out the payoffs of puts under alternative exchange rate scenarios.

Some corporate treasurers believe that options are a good hedge against translation exposures. Suppose a US firm has a net asset position in a Mexican subsidiary. A popular hedge is to sell Mexican peso forward. Remember, however, that in the event of a appreciation of the peso, the translation exposure creates only bookkeeping entries – no cash gains – while the forward contract creates an adverse cash flow impact. Many treasurers believe that they can get around this problem by buying a put on MEP. If the translation exposure is a pure accounting exposure with no economic significance, then the long put position carries the risk of a purchased put; the firm would have taken on a cash flow exposure to hedge a pure accounting exposure. If the translation exposure is deemed to have economic significance like a long forward position, then as we will see later, a long forward plus a long put position is equivalent to a long call and carries the risk of such a position.

10.7 PRINCIPLES OF OPTION PRICING

The purpose of this section is to discuss some basic principles of pricing currency options. We wish to investigate the factors that determine option premiums, the nature of their influence on option values, and whether some upper and lower limits can be imposed on option values by means of simple arbitrage arguments. A voluminous literature exists on the subject of option pricing models, their analytical and numerical solutions, and their empirical performance. A rigorous exposition is beyond the scope of this book. In the text, we will confine ourselves to intuitive arbitrage arguments that allow us to narrow down the range of possible option values. In the appendix, we will present a brief outline of an option valuation model. Numerous references will be provided to the more advanced literature on the subject.

All option valuation models employ the concept of arbitrage. Arbitrage is an act of profiting from the discrepancies in the prices of identical (or economically equivalent) assets across space (not necessarily physical space but "virtual" space) or time. Thus buying an asset in one market at price $P1$ and selling it in another market at a price $P2$ high enough to cover all transaction costs and leave a profit is arbitrage. Suppose today an asset costs C_1 to buy and yields a net income of I_1 at time T_1 without uncertainty; if you could "create" or synthesize a position that also yields a net income of I_1 or higher without uncertainty at time T_1 but costs less than C_1 to put together, you have successfully engaged in arbitrage. The statement that efficient financial markets do not permit arbitrage can be interpreted to mean that assets with identical returns and risk profiles must command identical prices in the market. In the presence of transaction costs, small discrepancies may persist. Also, sometimes regulations such as restrictions on short sales may prevent arbitrage and give rise to price discrepancies.

Before we begin, let us set out the notation that will be used throughout this section. Unless otherwise indicated, subscripts H and F will denote, respectively, home and foreign currencies. All options will be on one unit of foreign currency. Exchange rates and option values will be in terms of units of home currency (HC) per unit of foreign currency (FC).

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t : The current time

T : Number of days from t to expiry of the option, i.e. the option expires at time $t + T$.

$C(t)$: Value at time t, measured in HC, of an American call option on one unit of spot foreign currency.

$P(t)$: Value in HC, at time t, of an American put option on one unit of foreign currency.

$c(t)$, $p(t)$: Values in HC of European call and put options on one unit of foreign currency

$S(t)$: The spot exchange rate at time t. $S(t + T)$ is thus the spot rate at option maturity. The spot rate is in terms of units of HC per unit of FC.

X : The exercise or strike price, units of HC per unit of FC

i_H : Domestic risk-free, continuously compounded annual money market interest rate. It is assumed to be constant.

i_F : Foreign risk-free, continuously compounded annual money market interest rate, assumed to be constant.

$B_H(t,T)$: Home currency price, at time t, of a pure discount bond that pays one unit of home currency at time $(t + T)$ with continuous compounding

$$B_H = e^{-i}H(T/360)$$

$B_F(t,T)$: Foreign currency price, at time t, of a pure discount bond that pays one unit of foreign currency at time $(t + T)$, with continuous compounding

$$B_F = e^{-i}F(T/360)$$

$\sigma(t)$: Standard deviation of the proportionate change in spot exchange rate over a small time interval. This is a measure of volatility of the exchange rate.

Where obvious, the time reference (t) will be omitted. Thus, C, P, c, p and S will denote the respective variables at time t.

As we will see below, call and put option values are determined by the following factors:

Determinants of Option Value:

1. The current spot rate S_t
2. The exercise price X
3. Time to maturity T
4. Home currency interest rate i_H
5. Foreign currency interest rate i_F
6. Exchange rate volatility σ.

$$C = C(S, X, T, i_H, i_F, \sigma) \quad P = P(S, X, T, i_H, i_F, \sigma)$$
$$c = c(S, X, T, i_H, i_F, s) \quad p = p(S, X, T, i_H, i_F, \sigma)$$

We will set out below, a number of basic principles of option valuation and the arguments underlying them.

Option values can never be negative. At any time t,

$$c(t), C(t), p(t), P(t) \geq 0 \qquad \textbf{(10.1)}$$

This should be obvious. The holder of the option, having paid the premium at the time of purchase can always throw away the option without any further obligation. Hence, option value can at worst fall to zero.

$$c_t, C_t \leq S_t \qquad p_t, P_t \leq X \tag{10.2}$$

The logic underlying these inequalities is straightforward. If a call option on a dollar costs more than a dollar, you would simply sell the option, buy one dollar and hold it; if the option buyer exercises the option, deliver the dollar and collect the strike price. Similarly, the maximum gain from a put option can be X, its strike price, in the event the price of the foreign currency falls to zero; hence, the option can never command a value higher than X.

On exercise date, the option value must equal the larger of zero and the intrinsic value of the option.

$$c(t+T), C(t+T) = \max[0, S(t+T) - X] \tag{10.3}$$

$$p(t+T), P(t+T) = \max[0, X - S(t+T)] \tag{10.4}$$

This again is an obvious rule. Consider a call option on dollar with an exercise price of CHF 1.25. If the spot rate on the expiry date is 1.25 or below, the option is worthless; if it is above 1.25, the option can be exercised and the dollars acquired can be sold in the spot market for a gain of $[S(t+T) - 1.25]$ or $[S(t+T) - X]$ per dollar. Value of the option must equal this gain else arbitrage opportunities will arise. Similarly, for a put option the value will be zero for $S(t+T) \geq 1.25$ and equal to $[1.25 - S(t+T)]$ or $[X - S(t+T)]$ for $S(t+T) < 1.25$.

At any time prior to maturity, an American option must have a value that is at least as great as the larger of its intrinsic value and the value of the corresponding European option.

$$C(t) \geq \max[c(t), S(t) - X] \tag{10.5}$$

$$P(t) \geq \max[p(t), X - S(t)] \tag{10.6}$$

Since an American option can be exercised at any time up to the expiry date, at any time prior to expiry it must have a value not less than the gain that can be made by immediate exercise. This does not hold for European options since they cannot be prematurely exercised. Further, since an American option can be held till maturity, it offers the holder everything that a European option offers and something more viz. the right to exercise before expiry. Hence, its value cannot fall short of the corresponding European option value with an identical exercise price and expiry date.

Consider two American options, calls or puts, which are identical in all respects except time to maturity. One matures at $t + T_1$ while the other at $t + T_2$ with $T_2 > T_1$. Let C_1, C_2 and P_1, P_2 denote the premiums. Then

$$C_2(t) \geq C_1(t) \tag{10.7}$$

$$P_2(t) \geq P_1(t) \tag{10.8}$$

for all $t \leq T_1$.

In the language of calculus,

$$\partial C/\partial T \geq 0 \qquad \partial P/\partial T \geq 0 \tag{10.9}$$

The logic of this is inherent in the exercise-at-any-time feature of American options. A six-month option can be exercised at any time during the first three months of its life and therefore is exactly like a three-month option during that time. The additional three months can never hurt the holder and may result in additional profit if the exchange rate moves favourably.

Consider the following strategy. Buy the call with longer life and sell the call with shorter life. The outlay involved is $(C_2 - C_1)$. At time $t + T_1$, when the shorter life call matures, two alternative scenarios are possible. If the spot rate S_{t+T1} is less than the strike price X, the shorter life call which we have sold will expire worthless; we will still be holding the longer life call which will have some positive value. If S_{t+T1} exceeds X, the holder of the shorter call will wish to exercise it. His net gain would be $(S_{t+T1} - X)$; we can pay him this either by exercising the longer life call option which we hold or selling it in the market. Recall that the value of this option will be at least $(S_{t+T1} - X)$. Thus, our net payoff will be at worst zero and sometimes positive. Hence, no matter what happens at time $t + T_1$ our position yields a non-negative payoff. Therefore, the outlay involved in acquiring that position today must be non-negative to prevent arbitrage. In other words, the cost of buying the longer life option must exceed the revenue from selling the shorter life option. This reasoning does not hold for European options since at time $t + T_1$ the longer life option cannot be exercised and may have a market value below its intrinsic value. A longer maturity European option can have a value which is smaller than the value of a shorter maturity European option with the same exercise price.

We now examine the effect of varying the strike price on option values.

Between two call options, American or European, which are identical in all respects except the exercise price, the one with the higher (lower) exercise price has lower (higher) value at any time. Between two puts, the one with the higher (lower) exercise price has higher (lower) value.

$$C(X_2, t) < C(X_1, t);\ c(X_2, t) < c(X_1, t) \tag{10.10}$$

$$P(X_2, t) > P(X_1, t);\ p(X_2, t) > p(X_1, t) \tag{10.11}$$

where X_1 and X_2 are strike prices with $X_2 > X_1$.

$$\partial C/\partial X,\ \partial c/\partial X < 0 \tag{10.12}$$

$$\partial P/\partial X,\ \partial p/\partial X > 0 \tag{10.13}$$

The reasons for this are obvious. A call with a higher strike price requires the holder to pay more for a unit of foreign currency, if and when exercised. Hence, for any value of the spot rate at the time of exercise, the payoff from this option is less than or equal to the payoff from a call with a lower strike price. Similarly, a put with a higher strike means the holder will obtain a larger amount of home currency per unit of foreign currency sold, if and when the option is exercised.

In the appendix, we will demonstrate a property of option values known as "convexity in strike prices". Consider three European calls on USD in terms of INR with strike prices X_1, X_2 and X_3 such that X_2 is a weighted average of X_1 and X_3:

$$X_2 = wX_1 + (1 - w)X_3\ ,\ 0 \le w \le 1$$

If c_1, c_2 and c_3 are prices of these calls, then it can be shown that

$$c_2 \le wc_1 + (1 - w)c_3$$

Recall the butterfly spread with USD/CHF calls. We had three call options with strike prices $X_1 = 0.78$, $X_2 = 0.82$ and $X_3 = 0.86$. The purchase of two calls with strike X_2 and sale of one call each with strikes X_1 and X_3 is equivalent to using a weight w of 0.5. In the example, $c_1 = 0.07$, $c_3 = 0.01$ so that

$$wc_1 + (1 - w)c_3 = 0.5(0.07) + 0.5(0.01) = 0.04$$

while $c_2 = 0.03$ which is less than $[wc_1 + (1 - w)c_3]$. Consider what happens to this option portfolio for various values of the spot rate at maturity. For all values of S_T at or below $X_1 = 0.58$, all the calls expire worthless; the option portfolio has a value of zero. For values of S_T between X_1 and X_2, the option portfolio produces a loss since the option with strike X_1 will be exercised against the butterfly buyer while the purchased options with strike X_2 will expire worthless. Now consider $X_1 < X_2 \leq S_T < X_3$. The gain from the purchased calls is $2(S_T - X_2)$ while the loss from one of the sold calls is $(S_T - X_1)$ for a net gain of $(S_T - 2X_2 + X_1)$. Now recall that $2X_2 = X_1 + X_3$ and by assumption $S_T < X_3$ so that the option portfolio again produces a loss. You can convince yourself that for $S_T > X_3$, the long butterfly combination also gives a negative cash flow. Thus, irrespective of the spot rate at maturity, the option combination in long butterfly produces a loss or at best a zero gain; to induce anyone to hold it, the holder must be compensated by a positive cash flow at the time of purchase. This means

$$c_2 < wc_1 + (1 - w)c_3 = 0.5c_1 + 0.5c_2 \text{ or } 2c_2 < c_1 + c_3 \text{ as seen in the example.}$$

The above principles involved rather simple arguments based on the inherent characteristics of American and European options. We can say something more about option values by employing somewhat more complicated arbitrage arguments.

Consider the following two portfolios:

Portfolio I (PI):

(i) At time t, buy a European call with strike price X which matures at $t + T$.

(ii) Buy X domestic currency pure discount bonds maturing at $t + T$, priced at $B_H(t, T)$ per bond. In other words, invest an amount of home currency in the zero-coupon risk-free asset such that the maturity value of the investment will equal the strike price X.

Total outlay in home currency = $c(S,X,T) + XB_H(t,T)$

Portfolio II (PII):

At time t, buy one foreign currency pure discount bond maturing at $t + T$, priced at $B_F(t, T)$ units of foreign currency.

$$\text{Outlay in home currency} = S(t)B_F(t, T)$$

At time $t + T$, the spot rate $S(t + T)$ will either exceed X or be less than or equal to X. In the former case, the value of the call will be $[S(t + T) - X]$; in the latter case, the value of the call will be zero. Each domestic discount bond will pay one unit of home currency and each foreign discount bond will pay one unit of foreign currency. Consequently, the values, in home currency, of the two portfolios I and II will be as shown below:

	Value of PI	Value of PII
$S(t + T) \leq X$	X	$S(t + T)$
$S(t + T) > X$	$S(t + T)$	$S(t + T)$

Thus, irrespective of what happens to the spot rate at time $(t + T)$, value of portfolio PI is equal to or higher than portfolio PII. To prevent arbitrage, the value of PI at time t must be equal to or greater than that of PII. This leads to the following lower bounds on the values of European and American calls:

At any time *t* we must have

$$c(S, X, T) + XB_H(t, T) \geq S(t)B_F(t, T) \tag{10.14}$$

or, equivalently,

$$c(S, X, T) \geq S(t)\mathrm{B_F}(t, T) - XB_H(t, T) \tag{10.15}$$

and therefore,

$$C[S(t), X, t, T] \geq c[S(t), X, t, T] \geq S(t)B_F(t, T) - XB_H(t, T) \tag{10.16}$$

The last of these, (10.16), follows from the principle stated earlier that at any time an American option must command a value equal to or greater than a European option with identical features.

Let us work out an example. Suppose the CHF/USD spot is 0.8200.

90-day Eurodollar and CHF interest rates (annualised) are 5% and 3%, respectively. Consider a 90-day call on one CHF with a strike price of $0.8100. The values of $B_H(t, T)$ and $B_F(t, T)$ are:

$$B_H = 1/[1 + 0.05(90/360)] = 0.9877$$
$$B_F = 1/[1 + 0.03(90/360)] = 0.9926$$

The two portfolios above are:

Portfolio I: A European call with strike price $0.8100 and premium *c* plus home currency, i.e. USD pure discount bonds with face value $0.8100 maturing 90 days from now, currently valued at

$0.81(0.9877) = $0.800037. Total outlay ($c$ + 0.800037) dollars.

Portfolio II: One foreign currency, i.e. CHF pure discount bond face value CHF 1.0, maturing in 3 months, currently priced at

CHF 0.9926. Total dollar outlay 0.9926(0.8200) = 0.813932 dollar.

Suppose at maturity, the spot rate is $0.8000 per CHF. The call option is worthless and portfolio I is worth $0.8100. Portfolio II is worth one CHF which is equivalent to $0.8000. Thus, portfolio I performs better than portfolio II. On the other hand, suppose maturity spot is 0.86. Then the call is worth $0.05, while the USD bond is worth its face value of $0.8100. Thus, portfolio I is worth 0.8600 whereas portfolio II is again worth 1 CHF, i.e. $0.8600. So, the two portfolios give identical payoffs. Hence, we must have

$$c + 0.800037 \geq 0.813932 \quad \text{or} \quad c \geq 0.013895$$

This in turn equals

$$S(t)B_F - XB_H = 0.82(0.9926) - 0.81(0.9877) = 0.013895$$

which is the lower bound on the European call value.

For an American option, recall from (10.4) above that its value must be at least as large as the intrinsic value at all times. In addition, we have the lower bound just obtained. Hence, at any time during its life, its value must be greater than or equal to higher of these two bounds:

$$C[S(t), X, t, T] \geq \max\{[S(t) - X], [S(t)B_F(t, T) - XB_H(t, T)]\} \tag{10.17}$$

Note that depending upon the values of $\mathrm{i_H}$ and $\mathrm{i_F}$, $[S(t) - X]$ will be smaller or larger than $[S(t) B_F - XB_H]$. Thus, $[S(t) - X]$ represents an independent constraint on the value of an American call.

This inequality also provides a clue regarding possibility of early exercise of an American option. If foreign interest rate is very low (implying that B_F is close to unity) and home currency interest rate is high (implying that B_H is much less than unity), the second lower bound, viz. $(SB_F - XB_H)$ becomes operative. The foreign currency would be at a high forward premium suggesting that it will appreciate strongly between current time and option expiry. It will not be optimal to exercise the option prematurely; it would be better to sell it in the market. For European calls, the only lower bound is $(SB_F - XB_H)$.

An exactly analogous argument leads to the following result:

For European and American put options, we have

$$\boldsymbol{p[S(t), X, t, T] \geq XB_H(t, T) - XB_H\ (t, T)} \qquad \textbf{(10.18)}$$

$$\boldsymbol{P[S(t), X, t, T] \geq \max\ \{[X - S(t)], [XB_H(t, T) - SB_F(t, T)]\}} \qquad \textbf{(10.19)}$$

Now recall the interest parity relation discussed in Chapter 8. Let $F_{t,\,T}$ denote the forward rate at time t, expressed as units of home currency per unit of foreign currency, for a forward contract maturing at $t + T$. Then, in the notation of this chapter (remember that here we are using continuous compounding)

$$F_{t,T} = S(t)\ \frac{B_F(t, T)}{B_H(t, T)} \qquad (10.20)$$

Using this in (10.16)–(10.19), we get the following results.

$$\boldsymbol{C[S(t), X, t, T] \geq c[S(t), X, t, T] \geq B_H(t, T)(F_{t,\,T} - X)} \qquad \textbf{(10.21)}$$

$$\boldsymbol{P[S(t), X, t, T] \geq p[S(t), X, t, T] \geq B_H(t, T)\ (X - F_{t,\,T})} \qquad \textbf{(10.22)}$$

The intuition behind these results is easy to see. Consider a call option with strike price X, maturing at $t + T$. If $F_{t,T} > X$, holder of a call can sell one unit of foreign currency forward and ensure a profit of $(F_{t,\,T} - X)$ at time $t + T$. The value of the call today must be at least as much as the discounted present value of this riskless gain. This explains (10.21). Similar reasoning leads to (10.22).

We will now derive a relationship between European call and put values known as the ***put-call parity***. The argument again uses comparison between payoffs from two portfolios.

<u>Portfolio PI</u>:

At time t (today) buy a European put option on one unit of foreign currency with strike price X, maturing at $t + T$.

Outlay in home currency to acquire portfolio PI: $p[S(t), X, t, T]$

<u>Portfolio PII</u>:

(i) Buy a European call option with strike price X maturing at $t + T$. The cash outlay would be the call option premium $c[S(t), X, t, T]$.

(ii) Buy X domestic pure discount bonds maturing at $t + T$. Recall that each such bond pays one unit of domestic currency on maturity. The market value of these bonds today would be $XB_H(t,T)$. This would be the cash outlay to acquire these bonds.

(iii) Issue one foreign currency discount bond, i.e. borrow the present value of one unit of foreign currency. This will amount to $B_F(t,T)$ units of foreign currency. Sell the foreign currency so acquired in today's spot market at the rate $S(t)$. This generates a cash inflow of $S(t)\ B_F(t,T)$ which can be used to partly finance the purchase of the call option and home currency bonds.

Total outlay in home currency to acquire portfolio PII :

$$c[S(t), X, t, T] + XB_H(t,T) - S(t)B_F(t,T)$$

At time $t + T$, i.e option expiry, if $S(t + T) > X$, the put option is worthless, the call value is $[S(t + T) - X]$, each of the domestic pure discount bonds purchased will pay one unit of home currency so that X bonds will pay X units of home currency. One unit of foreign currency will have to be acquired to redeem the foreign bond. This will cost $S(t + T)$ in home currency. If on the other hand $S(t + T) \leq X$, the call option is worthless, the put is worth $[X - S(t + T)]$, and the bonds involve cash flows as before. The values in home currency of the two portfolios are as shown below:

Spot Rate at time $(t + T)$	Value of PI	Value of PII
$S(t + T) > X$	Value of put with Strike $X = 0$	$[S(t + T) - X] + X - S(t + T) = 0$
$S(t + T) \leq X$	Value of put with Strike $X = X - S(t + T)$	$0 + X - S(t + T) = X - S(t + T)$

Thus irrespective of the spot rate outcome, both portfolios have identical values at expiration. Hence, their values at time t also must be identical to prevent arbitrage. This leads to

Put-Call Parity Relationship for European Options

$$p[S(t), X, t, T] = c[S(t), X, t, T] + XB_H(t, T) - S(t)B_F(t, T) \quad \textbf{(10.23)}$$

Using the interest parity relation in

$$p[S(t), X, t, T] = c[S(t), X, t, T] + B_H(t, T)(X - F_{t,T}) \quad \textbf{(10.24)}$$

Let us look at a numerical example. Suppose spot AUD/USD rate is 0.8000, a three month European call on one AUD with a strike price of USD 0.7800 is available for a premium of USD 0.048, i.e. 4.8 cents. Three-month interest rates are 4% for USD and 6% for AUD. To get USD 0.78 at expiry we would have to invest USD[0.78/1 + 0.04(0.25)] or USD 0.7723 in a USD pure discount bond. The amount of AUD that can be borrowed such that the repayment would be AUD 1.0 at expiry would be {1/[1 + 0.06(0.25)]} or AUD 0.9852. From this information, we wish to derive the value of a European put on one AUD, strike price USD $0.78 and maturity of three months. The two portfolios are:

Portfolio I: Buy a put on 1 AUD. Outlay p dollars.

Portfolio II: Buy a call on 1 AUD, invest USD 0.7723 and borrow AUD 0.9852.

If the maturity spot is USD 0.76 per AUD, the put option on one AUD is worth $0.02. In portfolio II, the call is worthless, the USD investment matures to USD 0.78, and the repayment of AUD borrowing requires repayment of AUD 1.0 which can be bought at USD 0.76. Thus portfolio II is also worth USD 0.02.

If maturity spot is say USD 0.8200 per AUD. Portfolio I – the put on one AUD – is worthless. Consider Portfolio II:

The USD deposit will have grown to \$0.78. Use it to exercise the call option and acquire AUD 1.0. This will have to be used to repay the AUD loan. In other words, the market value of the call exactly equals the difference between the USD outlay for repaying the AUD borrowing and the USD inflow from the investment in pure discount USD bonds. Thus, Portfolio II also has zero value.

Again the two portfolios have identical values. Hence, we must have

$$p = 0.048 + 0.7723 - (0.9852)0.80 = 0.0321$$

which is the value given by the put-call parity.

Note that the put-call parity relation can be manipulated in various ways to arrive at several interesting implications. Let us re-write it compactly as follows:

$$p = c + XB_H - SB_F$$

As it stands it says that a "synthetic" long put position can be created by doing the following three transactions:

1. A long call (i.e. buy a call)
2. Investing XB_H units of home currency
3. Borrowing B_F units of the foreign currency.

Another form is

$$c - p = SB_F - XB_H$$

This says that a long call plus a short put (i.e. a written put) is equivalent to borrowing XB_H units of domestic currency and lending B_F units of foreign currency[8]. Still another interpretation is that purchase of a foreign currency bond (i.e. an investment in foreign currency) can be replicated by purchase of a home currency bond, a long call and a short put:

$$c - p + XB_H = SB_F$$

Finally, consider two European calls and two puts with strikes X_1 and X_2, $X_2 > X_1$. Denote their values by c_1, c_2, p_1 and p_2. Using the put-call parity it is easily seen that no riskless arbitrage requires:

$$c_1 - c_2 + p_2 - p_1 = B_H(X_2 - X_1)$$

If this condition is violated, a trade known as "box" gives riskless arbitrage gains. For instance, suppose:

$$B_H(X_2 - X_1) - (c_1 - c_2 + p_2 - p_1) > 0$$

Then execute the following transactions:

1. Buy the call with strike X_1 and the put with strike X_2.
2. Sell the call with strike X_2 and the put with strike X_1.
3. Borrow a sum $B_H(X_2 - X_1)$ at the riskless rate.

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[8]Note that by interest parity theorem

$$SB_F = FB_H \text{ as seen above.}$$

This implies that if the call and the put both have identical maturities and strike price for both equals the current forward rate for a forward contract maturing at the same time as the options (i.e. at T) they must have identical values. You can also see this by examining the payoff of a portfolio consisting of a long call and a short put with identical strike price X. You will see that the payoff is identical to a long position in a forward contract with forward rate equal to X.

This is known as "buying the box". The total cash inflow at initiation is:

$$[B_H(X_2 - X_1) - (c_1 - c_2 + p_2 - p_1)]$$

By assumption this is positive, i.e. a net cash inflow. At maturity of the options, irrespective of the spot rate, you can convince yourself that there will be a net inflow of $(X_2 - X_1)$. In the reverse case, the trader "sells the box", i.e. sells the call with strike X_1 and the put with strike X_2, buys the call with strike X_2 and the put with strike X_1 and lends a sum $B_H(X_2 - X_1)$.

The put call-parity also helps dispel some mistaken notions about certain option strategies prevalent among corporate treasurers and CFOs. For instance, many treasurers believe that writing covered calls is a riskless strategy. Suppose a UK company has a 90-day USD receivable of USD 500,000. The treasurer writes USD calls with face value $500,000 at a strike price of USD 1.8800 per GBP. He claims that he has not exposed the firm to any risk since he will have USD to deliver in case the option buyer chooses to exercise the option.

Is his claim justified? Look at the put call parity again. It can be written as:

$$-p = -c - XB_H + S_tB_F$$

Recall that $S_tB_F = F_{t,T}B_H$ where $F_{t,T}$ is the market forward rate today (at time t) for delivery at time T which is the expiry date of the option.

The right-hand side of the above equation can thus be written as

$$-c + B_H(F_{t,T} - X).$$

But $B_H(F_{t,T} - X)$ equals the cash flow that would arise, if you entered into a forward contract expiring at T, to buy one unit of foreign currency at the rate X when the market forward rate for the same delivery date is $F_{t,T}$[9]. The right-hand side is thus equivalent to a position in which you have sold a call on one unit of foreign currency at a strike price X, and agreed to buy one unit of the currency forward at a price X at the same time as the option matures – a long forward position plus a short call. This is same as writing a covered call. The above equation shows that this is equivalent to a short position in a put on the foreign currency and subject to the same risk as that faced by the writer of such a put. As another example, suppose a German firm hedges a yen receivable by buying a JPY/EUR put. From the put-call parity, it is seen that

$$S_tB_F - XB_H + p = c$$

Or, as above $(F - X)\,B_H + p = c$

In other words, a long forward position at a forward rate equal to the strike price in the call and put options plus a purchased put is equivalent to a long call and subject to exactly the same risks as holding a call option on a currency. The lesson here is that each option position when coupled with positions arising out of the firm's regular operations gives rise to a unique risk profile that must be clearly understood before the hedge is put on. Other interpretations of the put call parity are left to the reader[10].

Let us recapitulate. We started by asserting that the value of a call or put option on spot foreign currency depends upon six variables, viz. the spot rate, the strike price, time to maturity, domestic and foreign interest rates and volatility of the exchange rate. We then used simple arbitrage arguments to put lower bounds on option values. Along the way we also examined the effect of changes in exercise

[9]Recall equation A.8.5 from the Appendix to Chapter 8.

[10]A put-call parity relationship for American foreign currency options can be derived but in only serves to bound the value of an American put: $C + X - SB_F \geq P \geq C + XB_H - S$. An arbitrage argument is provided in the appendix to this chapter.

price and time to maturity on option values. Finally we derived a relationship between call and put values for European options.

What about the other determinants of option values? How do changes in spot rate, interest rates and volatility affect option values?

Consider exchange rate volatility first. An increase in the variance of spot rate implies greater probability of larger appreciation and depreciation of the foreign currency. A call option holder benefits without limit, one-for-one, from appreciation of the foreign currency whereas he is protected from depreciation beyond a point since he need not exercise the option – at worst he loses the premium paid. Similarly, a put option holder benefits from depreciation till the underlying currency becomes "worthless" while his loss from appreciation is limited. Thus, in either case, increased volatility of the underlying spot rate implies greater upside potential for the option holder with limited downside risk. Hence, options must become more valuable when volatility increases.

Next consider changes in the spot rate. Other things remaining constant, an increase in the spot rate will increase the value of a call and decrease the value of a put. A call (put) to buy (sell) dollars at a strike price of 62 rupees will be more valuable (less valuable) when the spot rate is 65 than when it is 63. Figures 10.8a and 10.8b show the effect of changes in the spot rate on call and put values. Notice the rate of change of option values as the spot rate changes. For deep out-of-the-money options, option values hardly change as spot rate changes, whereas for deep in-the-money options, option values change one-for-one with the spot rate. The rate of change of option value with respect to the spot rate is an important consideration in hedging option positions.

The effects of changes in the domestic and foreign interest rates are not intuitively obvious. One can argue as follows. An alternative to holding a call option on a foreign currency is to hold the currency itself either by borrowing an equivalent amount of home currency or by liquidating a domestic deposit. In either case, as domestic interest rate increases, the opportunity cost of the alternative of holding the currency itself increases and the call option becomes more attractive. Or look at it from

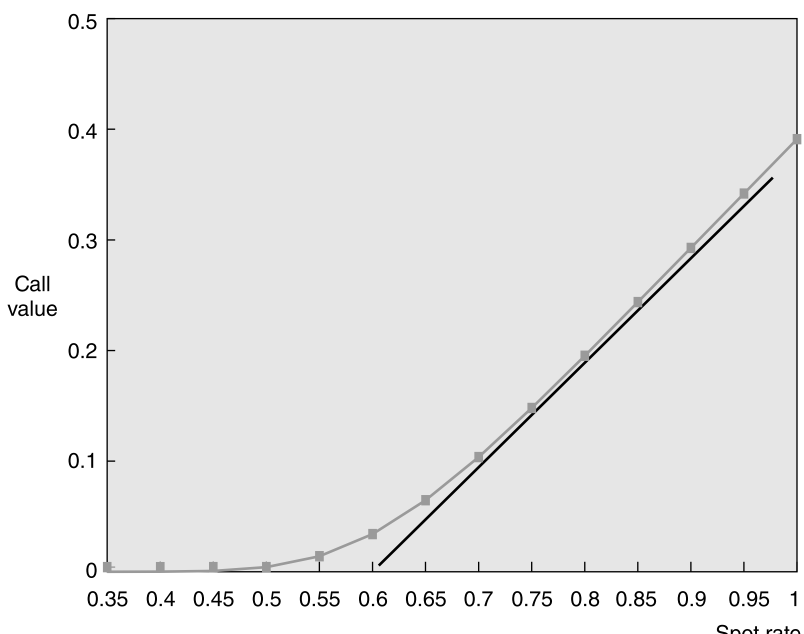

Fig. 10.8(a) Effect of Spot Rate on Call Value

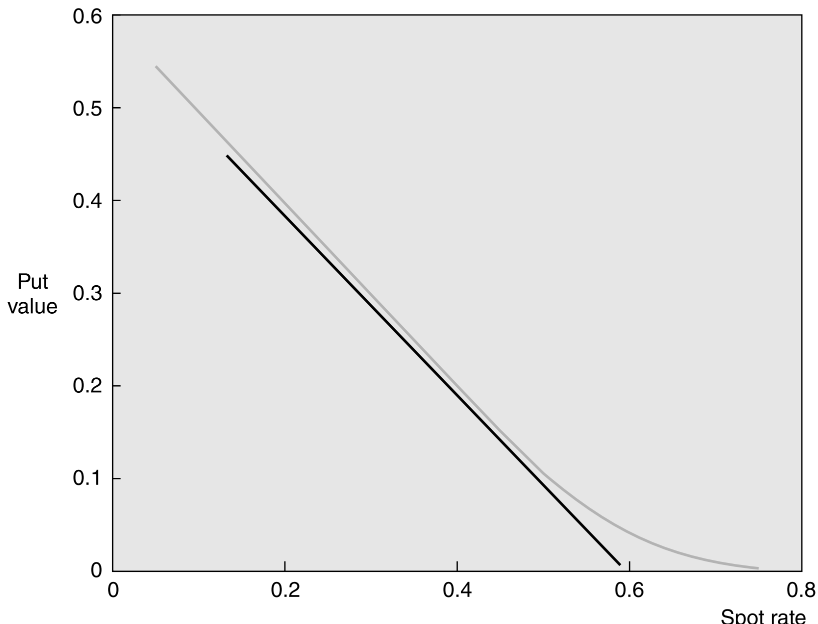

Fig. 10.8(b) Effect of Spot Rate on Put Value

the option writer's point of view. Having sold a call on foreign currency how does she protect herself from the possibility of a loss if the currency appreciates steeply? One way would be to borrow home currency, convert spot to foreign currency and hold the foreign currency in an interest earning deposit. The cost of this strategy increases as home currency interest rate increases. This should increase call value. An increase in the foreign interest rate makes the alternative of holding the foreign currency itself more attractive (interest income on the foreign currency deposit increases) and therefore should reduce the value of a call. A similar but opposite argument can be made for put options.

Changes in interest rates also have implications for the extra value commanded by American options over their European counterparts. You are asked to investigate this in Problem 16 at the end of this chapter.

The effect of increasing the time to maturity on the values of European options is ambiguous. An intuitive argument is as follows. Consider a call option. Increasing maturity increases the probability of further favourable movements in exchange rate. However, this factor becomes less important, if the option is already in the money. On the other hand, if foreign interest rate is high, having the foreign currency in hand early is more profitable as more interest income can be earned. This factor tends to reduce the value of the call as maturity increases. Thus, for deep in-the-money options and very long-term options, the net effect could go either way. Similarly, for puts, longer maturity means exercise price will be obtained later; if domestic interest rate is high, this means foregone interest income. This factor tends to reduce the put value whereas, as in the case of a call, probability of further favourable movement in exchange rate tends to increase it. The net effect is again ambiguous.

For American options, there is no ambiguity. A six-month option offers everything that a three-month option does including the right to exercise it at the end of three months, if it is optimal to do so; further, the extra three months life means a positive probability of favourable movements in the price of the underlying asset. Hence, for American options, increase in time to maturity always increases the option value. In the appendix, we will look at an arbitrage argument to prove this.

Note, however, that we are examining changes in the underlying variables ***one at a time***. In practice, recall that the interest parity relation ties the four variables, viz. the spot rate, the forward rate and the two interest rates together. A change in any one of them will be accompanied by changes in one or more of the remaining three. The net impact on option premiums cannot be predicted in advance.

10.8 OPTION PRICING MODELS

A variety of analytical models have been proposed in the finance literature to value call and put options. The main difference between various models arises from the assumptions made about the stochastic behaviour of exchange rates and interest rates. All currency option valuation models have their origins in similar models for pricing options on common stock—the most famous among them being the Black-Scholes option pricing model, Black and Scholes (1973). Models for European options have closed-form solutions while for American options, leaving aside some special cases, numerical methods have to be used.

The central idea in all these models is **risk neutral valuation.** We construct a riskless, self-financing portfolio consisting of the underlying asset and borrowing or lending the risk-free asset. The portfolio is so constructed that it would reproduce the payoff from the option at maturity regardless of the value of the underlying spot rate. It is self-financing in the sense that no cash flows are involved after the portfolio is initially put together till the expiry date of the option. Any increase in the holdings of the underlying asset is financed by more borrowing, while any decrease is used to pay off a part of the borrowing. To prevent arbitrage, the current value of the portfolio must equal the current value of the option being priced. However, it turns out that the composition of the portfolio, viz. the proportion in which the two components – the underlying asset and borrowing – have to be combined, is not fixed but itself is a function of the underlying variables. This means that the portfolio has to be continuously adjusted. By specifying the stochastic evolution of the underlying variables – more specifically the spot price of the underlying asset – the models derive a partial differential equation for the option price which together with the boundary conditions derived in the previous section can be analytically solved in certain cases. The theoretical models typically assume frictionless markets. This means that there are no transactions costs such as bid-offer spreads and brokerage commissions associated with buying and selling assets, in the debt markets, lending and borrowing rates are equal and they are independent of the amount and time horizon of borrowing and there is continuous trading. In practice, existence of transactions costs and impossibility of continuous trading imply that it would be costly to continuously adjust the portfolio[11]. This implies, as usual, that actual option prices can depart from their theoretical values without giving rise to arbitrage opportunities[12]. Another source of discrepancies between the actual and model values is in the fact that the volatility of the spot rate does not remain constant. If historical spot rate data are used to estimate future volatility, in general the model values will not exactly agree with actual option values observed. More advanced models are available which allow for non-constant dynamic volatility. Also, the models make assumptions about the stochastic evolution of the underlying spot

[11]Impossibility of continuous trading also implies that there can be discrete jumps in exchange rate. Thus, between close of the market for the weekend and reopening on Monday, some news which arrived over the weekend can cause a large jump in the rates.

[12]In addition of course, the actual behaviour of exchange rates, interest rates and their volatilities will not in general strictly conform to the assumptions made in the model. Whether a particular model predicts option prices within the margin of error imposed by transaction costs is an empirical matter to be discussed later in the chapter.

rates which may not correspond to reality. Finally, the models assume that the risk-free interest rates are constant whereas, in fact, they are not[13]. We will illustrate this approach to option pricing in the appendix.

An equivalent approach is to construct a riskless portfolio consisting of the option itself and the underlying asset. It is riskless in the sense that its payoff at option maturity is the same regardless of the value of the spot rate. The current value of such a portfolio must equal its terminal value discounted at the riskfree rate of interest. Once again, the composition of the portfolio has to be dynamically adjusted as the spot rate changes.

We will illustrate the construction of such a riskless portfolio and its relevance to option pricing by means of a simple numerical example. Suppose the current spot CHF/USD rate is 0.7800, USD interest rate is 5 per cent and CHF interest rate is 3 per cent. We make a very simple assumption about exchange rate behaviour. At the end of the year, the spot rate will be either 0.8300 or 0.7500.

We wish to value a one-year European call option on one CHF with strike price of 0.7900 USD per CHF.

Let us set up the following portfolio:

- Borrow H units of foreign currency (CHF) for one year at the foreign interest rate of 3 per cent.
- Convert to dollars at the rate of 0.7800 dollars per CHF and invest the dollars at 5 per cent.
- Buy a European call option on one CHF, strike price \$0.79, expiring in one year. The premium to be paid for this option is *c*.

We wish to determine *c*.

The cash outlay involved in this is *c* dollars. At the end of the year, the dollar value of the portfolio depends upon the spot rate. If the spot rate is 0.8300, the value is:

$$0.78H(1 + 0.05) + 0.04 - 0.83H(1 + 0.03)$$

The first term is proceeds from domestic dollar investment, the second term is the value of the call on expiry date and the last term is the dollar value of the repayment of the foreign currency loan with interest. If the spot rate is 0.75, the value is:

$$0.78H(1 + 0.05) - 0.75H(1 + 0.03)$$

The option is now worthless. We wish to choose H so that these two values would be identical. This implies

$$0.04 - 0.83H(1 + 0.03) = -- 0.75H(1 + 0.03)$$

or $$H = (0.04/0.08)(1/1.03) = 0.4854$$

You can check that with this value of H, the end-of-the year value of the portfolio will be 0.0226 irrespective of whether the end-of-the year CHF/USD spot rate is 0.83 or 0.75. Thus, we have created a riskless portfolio which is worth \$0.0226 at the end of the year with certainty. To prevent arbitrage, its current value must be (0.0226/1.05), the discounted present value at the riskfree rate of interest. Recall now that the portfolio cost us \$*c* to set up. Hence, *c* must equal:

\$(0.0226/1.05) = \$0.0215, i.e. 2.15 cents.

This example will have shown that H depends upon the current and end-of-the-year values of the spot rate and the foreign interest rate while *c*, the option value, depends upon these three items and the domestic interest rate. The portfolio is risk-free only for an instant in time; the moment interest rates and spot rate change, the value of H and option value, viz., *c* change.

[13]It is possible to allow for stochastic interest rates.

From this risk-neutral valuation argument, we conclude that under the conditions of frictionless markets and continuous trading, options can be valued as if we are living in a risk-neutral world. Thus, the current value of a European option must equal its expected terminal value discounted to the present at the risk-free rate of interest.

A complete derivation of an option pricing model is beyond the scope of this book. In the appendix to this chapter, we will briefly indicate an outline of such a proof. Here, we present the final expressions for European call and put values based on Grabbe (1983). Some of the other works dealing with pricing of currency options are Biger and Hull (1983), Garman and Kohlhagen (1983) and Hilliard, Madura and Tucker (1991). A good treatment of the underlying mathematics and development of various models can be found in Lipton (2001) and Wang (2005). Grabbe's model assumes that changes in natural logarithms of S, B_H and B_F follow a normal distribution.

European Call Option Formula:

$$\boldsymbol{c(t) = S(t)B_F(t, T)N(d_1) - XB_H(t, T)N(d_2)} \qquad \textbf{(10.25)}$$

$$\boldsymbol{d_1 = \frac{\ln (SB_F/XB_H) + (\sigma^2/2)T}{\sigma\sqrt{T}}}$$

$$\boldsymbol{d_2 = \frac{\ln (SB_F/XB_H) - (\sigma^2/2)T}{\sigma\sqrt{T}}}$$

Here the notation $N(d)$ denotes the standard normal cumulative distribution function given by:

$$N(d) = \int_{-\infty}^{d} \left(\frac{1}{\sqrt{2\pi}}\right) e^{(-z^2/2)dz}$$

The symbol **s** in the above formula denotes the standard deviation of log-changes in the spot rate. Its square, called the variance is a measure of the volatility of the spot rate. B_H and B_F have been defined above. Using the interest parity condition

$$S(t)B_F(t, T) = F_{t,T}B_H(t, T)$$

(10.25) can be expressed in a different form:

$$\boldsymbol{c(t) = B_H(t, T) \qquad [F_{t,T}N(d_1) - XN(d_2)]} \qquad \textbf{(10.26)}$$

$$\boldsymbol{d_1 = \frac{\ln (F_{t,T}/X) + (\sigma^2/2)T}{\sigma\sqrt{T}}}$$

$$\boldsymbol{d_2 = \frac{\ln (F_{t,T}/X) - (\sigma^2/2)T}{\sigma\sqrt{T}}}$$

The symbol **s** in the above formulas is identical to the σ in the definitions of $\boldsymbol{d_1}$ and $\boldsymbol{d_2}$ following equation (10.25). It is important to note that $\sigma\sqrt{T}$ is a dimensionless quantity. This means that if time to maturity T is measured in years, σ^2 must be yearly variance, if measured in months, it must be monthly variance, etc. In the appendix, we will discuss estimation of volatility.

We will illustrate the use of these formulas with some numerical examples.

- Consider the following data:
  Current spot rate CHF/USD, $S(t)$: 0.78
  Strike price of an European call, X: \$0.80 per CHF
  Time to maturity, T: 90 days (0.25 year)
  USD interest rate, i_H: 5% p.a.
  CHF interest rate i_F: 3% p.a.
  Standard deviation σ: 0.20

  With these data we get,

$$B_H = \frac{1}{[1 + i_H(T)]} = \frac{1}{[1 + 0.05(0.25)]} = 0.9877$$

$$B_F = \frac{1}{[1 + i_F(T)]} = \frac{1}{[1 + 0.03(0.25)]} = 0.9926$$

$$d_1 = \frac{\ln [0.78(0.9926)/0.80(0.9877)] + [(0.2)^2/2](0.25)}{0.20(\sqrt{0.25})}$$

$$= -0.1537$$

$$d_2 = d_1 - \sigma\sqrt{T} = -0.2537$$

  From the normal distribution tables,

$$N(d_1) = 0.4389 \; N(d_2) = 0.3999$$

  Substituting these values in (10.24),

$$c(t) = \$[(0.78)(0.9926)(0.4389) - (0.80)(0.9877)(0.3999)]$$
$$= \$(0.0238) = 2.38 \text{ cents per CHF.}$$

The formulas for European put option values can be easily obtained from those for call values and the put-call parity relation:

European Put Option Value:

$$\boldsymbol{p(t) = XB_H(t, T)N(D_1) - S(t)B_F(t, T)N(D_2)} \quad \textbf{(10.27)}$$

$$\boldsymbol{= B_H(t, T)[XN(D_1) - F_{t,T}N(D_2)]} \quad \textbf{(10.28)}$$

where, $\boldsymbol{D_1 = -d_2}$ **and** $\boldsymbol{D_2 = -d_1}$

Parameters $\boldsymbol{d_1}$ and $\boldsymbol{d_2}$ have been defined above.

Using the data given above for the CHF call option example, you can check that the value of a put on one CHF with strike price of 0.80 and maturity of 90 days when the spot rate is 0.78, works out to be \$0.0398 or 3.98 cents.

The problem of valuing American options is more complicated because of the possibility of premature exercise. As we have seen above [equations (10.4) and (10.5)], the value of a European option provides one of the lower bounds on the value of a corresponding American option. However, in addition, for an American option, the value must also be greater than or equal to its immediate exercise value. For sufficiently high values of $S(t)$, early exercise of an American call can become optimal. Similarly, for sufficiently low values of $S(t)$, early exercise of put becomes optimal. It can be shown that higher (lower) the foreign interest rate relative to the domestic interest rate, greater (smaller) is the probability of early exercise of a call (put). Correspondingly, larger (smaller) is the differential between the value of an American call (put) and the corresponding European call (put).

Leaving aside some highly special cases of little practical relevance, no analytical solutions are available to the problem of pricing American options. Analytic approximations and efficient numerical procedures are available which appear to perform better than using the above formulas as approximation. In the appendix to this chapter, we will briefly describe the basic ideas underlying some of these methods.

Another option pricing model assumes that the spot price follows a binomial distribution, i.e. starting with a value S_t at time t, the exchange rate can take one of the only two possible values at time $t + 1$. This model is presented in the appendix.

10.9 OPTION DELTAS AND RELATED CONCEPTS: THE "GREEKS"

Financial institutions such as commercial banks offer their customers a variety of products related to foreign currencies such as forward contracts and currency options. The resulting exposure must be managed to protect the value of the institution's portfolio. Since the contracts offered are often tailor-made to a customer's requirements, the bank cannot simply use exchange-traded futures and options to hedge its position. In this section, we will briefly examine some concepts which are relevant in designing hedges for positions arising from buying and writing options.

10.9.1 The "Delta" of an Option

The ***delta*** of an option, denoted by Δ, is defined as the rate of change of the option's price (value) with respect to the spot rate of the underlying currency. More formally,

$$\begin{aligned} \Delta &= \partial c/\partial S \text{ for a European call option} \\ &= \partial p/\partial S \text{ for a European put option} \end{aligned}$$

and analogous definitions for American options.

The concept of delta helps in answering the following question:

> Having taken a position in a European option, long or short, what position in the underlying currency will produce a portfolio whose value is invariant with respect to small changes in the spot rate?

Consider the case of an investor who has written a European call on one unit of the foreign currency. He wishes to buy and hold H units of the currency to hedge his position. The total investment in the portfolio in terms of home currency is

$$V = S(t)H - \text{c}$$

A small change dS in S will change the value of the portfolio by

$$\text{d}V = HdS - (\partial c/\partial S)dS$$

Obviously, if $H = \partial \text{c}/\partial S = \Delta$, "delta" of the call option, $dV = 0$ and the portfolio is perfectly hedged. This is called a "delta-neutral hedge". The delta of the portfolio consisting of a short call and H units of the underlying asset is zero. If more than H units of the currency are held, the net delta of the portfolio will be positive, equivalent to a net long position in the underlying asset. Conversely, a portfolio with net negative delta would be equivalent to a net short position in the underlying asset.

By definition, the delta of the underlying asset is unity. Recall that we had come across a value-invariant portfolio above when we discussed the central notion underlying option pricing models.

From (10.24) the delta of a European call is given by $B_F N(d_1)$. Consider again the data given above for the call option on CHF with a strike price of USD 0.80. At the given values, the delta of the call option works out to $(0.9926 \times 0.4389) = 0.4357$. This means that if the CHF/USD spot rate increases by 1 cent per CHF, the value of the call will increase by (approximately)[14] 0.4357 cents. A short position in one call can be hedged by holding 0.4357 units of the foreign currency. You can confirm this by recalculating the call value c with the same numbers except $S(t) = 0.79$ instead of 0.78.

From (10.26), the delta of a European put option is given by $-B_F N(D_2)$ which can be expressed as $B_F[N(d_1) - 1]$ since $D_2 = -d_1$. Suppose a bank has written a 6-month put option on £1,000,000 at a strike price of \$1.80. The current spot rate GBP/USD is 1.82, US interest rate is 10% and the UK interest rate is 12%. The volatility σ is estimated to be 0.15. We have

$$B_F = 1/1.06 = 0.9434. \qquad B_H = 1/1.05 = 0.9524$$

$$d_1 = [\ln(1.82 \times 0.9434/1.80 \times 0.9524) + (0.0225)/4]/[0.15\sqrt{0.5}]$$

$$\approx 0.07$$

$$N(d_1) = 0.5279 \qquad B_F[N(d_1) - 1] = -0.445$$

This is the delta of a ***long*** position in a put on £1. The bank is ***short*** in put on £1,000,000. The delta of this position is + 445000. Therefore, to hedge, the bank must set up a ***short*** position in sterling of £4,45,000, for instance, a sterling loan. As time goes by, this position must be adjusted for reasons discussed below.

It is clear that the delta of an option does not remain constant but is itself a function of the underlying variables, viz. S, i_H, i_F and the volatility. Even if the last of these is assumed to remain fixed, the other variables change continuously, necessitating a continuous re-balancing of the hedge. Look at Figures 10.8(a) and 10.8(b). For a call option, as it goes deep out-of-money, there is virtually no change in its value for small changes in the spot rate; its delta is practically zero. As it goes deep in-the-money, its value increases almost one-for-one with the spot rate. Its delta is practically unity. When it is at-the money its delta is about 0.50. For a put this is reversed. As the spot rate appreciates, the put goes out-of-the-money and its delta approaches zero; as the spot rate goes down, the put goes deep in-the-money and its delta approaches unity. In practice because of transaction costs, continuous re-balancing is infeasible. To that extent, the hedge will be less than perfect.

The delta of a portfolio of currency and option positions is simply the sum of deltas of individual positions.

$$\Delta P = \Sigma \alpha_i \Delta_i$$

where, α_i is the amount of security i in the portfolio and Δ_i is its delta.

In practice, an option position is often hedged by taking an opposite position in currency futures rather than the spot currency itself. The required hedge can be worked out from the relation between the spot price and the futures price.

The ***Elasticity*** of an option is defined as the ratio of the proportionate change in its value to the proportionate change in the underlying spot rate. For a European call, elasticity would be $[(\partial c/c)/(\partial S/S)]$. Roughly, this is the percentage change in the option value per one per cent change in the underlying spot rate.

[14]"Approximately" because the delta is valid only for "infinitesimal" changes in the spot rate. Remember we are using the concept of partial derivative.

10.9.2 The "Gamma" of an Option

The ***gamma*** of an option is defined as the rate of change of its ***delta*** with respect to the spot rate. Formally,

$$\Gamma = \partial\Delta/\partial S = \partial^2 c/\partial S^2 \text{ for a European call}$$

and, similarly, for other options and, in general, for portfolios containing currencies and currency options. From the expressions for Δ of (a long position) in a European call and put options given above, the gamma of a long position in both a call and a put is given by

$$\Gamma = B_F N'(d_1)/S\sigma\sqrt{T}$$

To interpret gamma, notice that if it is small in magnitude, the delta of a position changes slowly and hedge adjustment can be done relatively infrequently[15]. With a large gamma, it is highly risky to leave a delta-neutral hedge unchanged for any significant length of time. Thus, gamma can be said to measure the risk inherent in a delta hedge. Notice further that if gamma is positive, delta increases with increasing spot rate and vice versa. We have seen above that a positive delta corresponds to a long position in the underlying currency while a negative delta is equivalent to a net short position. A positive gamma is, thus, a desirable feature since it means that net long position increases when price is rising and decreases when it is falling. The risk of a delta-neutral hedge can thus be controlled by maintaining a positive gamma position. A hedge which is delta neutral ***as well as gamma neutral*** will provide protection against larger movements in the spot rate between readjustments.

Like the delta, the gamma of a portfolio also varies with the underlying variables. From the behaviour of delta discussed above, it is clear that gamma is maximum for options at-the-money; it declines and approaches zero as the option moves deep into money or out of money. Thus, a gamma-neutral hedge is only so instantaneously.

Consider the call option on one CHF against EUR with a strike price of EUR 0.60 per CHF, maturity 90 days. Here EUR is to be taken as HC and CHF as FC. The current spot is 0.58 and the EUR and CHF interest rates are 5 per cent and 4 per cent respectively. Volatility is estimated to be 0.20. The value of B_F is (1/1.01) or 0.9901 and d_1 works out to –0.264. The value of $N(d_1)$ is 0.3959 and hence the delta of such a call, $B_F N(d_1)$ is 0.392. With a short position in one PHLX call option (recall that the amount in one PHLX CHF option is CHF 62,500), a delta neutral hedge would require a long position of CHF (0.392)(62500) = CHF 24498.79. For the given values, the gamma of the call option is 0.066 per one cent increase in the spot rate. Thus, when the spot rate increases from 0.58 to 0.59, the delta of the call option will increase from 0.392 to 0.458. With one short call, the long position in the currency will have to be increased to CHF 28,625 [= 0.458 × 62500] to maintain a delta neutral hedge. [Notice that we have given the value of gamma for each ***one cent*** change in the spot rate. Value of gamma depends on units of measurement. Since we are measuring spot rates and option values in dollars, gamma should be strictly given as 6.6.]

Viewed from the long side, i.e. from the point of view of the option buyer, all options have positive gammas. To an option writer, gamma is negative. Thus, holder of a call can increase his ***short*** position in the currency when the spot rate increases (the underlying currency appreciates) while the writer of a call must increase his long position. The holder of a put can reduce his long position while the writer must increase his short position to maintain delta neutrality.

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[15]See Figures 10.8a and 10.8b. Delta is nothing but the slope of the option value curve. When an option is deep out-of-the money, delta changes very slowly. Again, when it is deep in-the-money, delta changes very slowly. The change in delta i.e. gamma is maximum for options at the money.

We have mentioned above the notion of a gamma-neutral position. However, unlike delta neutrality, gamma neutrality cannot be achieved simply by taking a position in the underlying asset. It can be achieved by taking an appropriate position in another option.

10.9.3 The "Theta" of an Option

The ***theta*** of an option is the rate of change of its value with respect to time, other things remaining constant. Formally,

$$\Theta = \partial c/\partial t \text{ for a European call}$$

and analogous definitions for other options and portfolios.

With a few exceptions[16], theta of an option is always negative. That is, to the option holder, the value of the option decays over time and this decrease in value accrues to the option writer as income.

10.9.4 The "Lambda" of an Option

The ***lambda***[17] of an option is the rate of change of its value with respect to the volatility of the underlying asset price. As we have seen above, this is always positive. The lambdas of otherwise similar European call and put options are equal while this need not be so for American options.

Lambdas are very important in practice. All the results derived or mentioned so far assume that the volatility of the underlying price remains constant. In practice, this in general is not true. Any option position valued on the basis of an estimate of volatility from historical data will generally not perform as indicated by theoretical models because volatility may not – and usually will not – remain constant. While methods have been proposed to model and forecast temporal behaviour of volatility, it remains a tricky business.

In this context, an important concept is that of ***implied volatility***. The idea is as follows. Suppose we ask the following question:

> "An option trader is quoting a premium of \$0.02 for a 90-day European call on GBP with a strike price of \$1.9200. The GBP/USD spot rate is 1.9150 and the USD and GBP interest rates are 3 per cent and 5 per cent p.a., respectively. What must be his estimate of GBP/USD spot rate volatility over the coming 90 days for him to arrive at this option price?"

The option pricing models such as (10.24) and (10.25) above can be used to calculate option values given S, X, T, i_H, i_F and an estimate of σ. We can reverse the process. Suppose, for given values of S, X, T, i_H and i_F, there is a traded option with a market price quoted by an options trader. Instead of using the valuation model to calculate the option value given S, X, T, i_H, i_F and σ, we can use the model to compute the value of σ which, when input into the model, will yield a model option value equal to the observed market price[18]. This is the implied volatility. Implied volatilities can be used in many ways. Suppose one wants to compare two options on the same currency which are identical in all respects except one, say the strike price. How does one determine whether they are priced correctly ***relative to each other***? One can compute the implied volatilities and see if one

[16]For instance, an in-the-money European call on a currency with a very high interest rate can have a positive theta.

[17]Also known as "Vega" or "Kappa" of an option.

[18]This can be done by an iterative trial and error method. Start with an arbitrary value of σ. Compute the model value. If it exceeds (is less than) the actual value, decrease (increase) the value of σ. This is because model values increase with σ. Continue till convergence. We assume that the market is also using the valuation model which we are using.

gets identical values. If one does not, one must then compare the implied volatilities with one's own judgement of actual volatility to decide which one of the two options is relatively overpriced. You should consider the option with an implied volatility lower than your estimate of volatility as under-priced and buy it. Conversely, if you find an option with implied volatility higher than your estimate of volatility, you should consider it as over-priced and sell it. In a similar fashion, we can carry out temporal comparison.

Note that the usefulness of this procedure is conditional upon the correct model being used to compute the model values. Also, as mentioned in the previous paragraph, one cannot escape making judgements about volatility.

Market practitioners often speak of "volatility smiles" and "volatility skews". The former refers to the pattern of implied volatilities of options with a given maturity but different strike prices. It is observed in practice that deep out-of-the money and deep in-the money options tend to have higher implied volatilities than at-the-money options. This implies that the market prices them higher than what the Black-Scholes model would indicate with the same estimate of volatility as implied by the market price of an at-the-money option. Volatility skew refers to the observation that sometimes this is more so with in-the-money options while out-of-the money options have implied volatility similar to that of at-the-money options. Figure 10.9 schematically illustrates volatility smile for a call option.

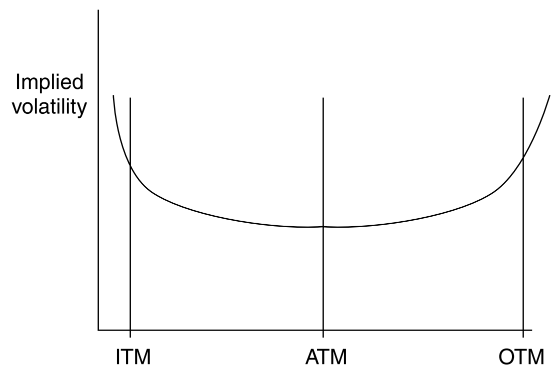

Fig. 10.9 Volatility Smile

As we will see below, the OTC market practice is to quote options in terms of implied volatility. This means that traders do not quote the option premium but instead quote a volatility figure which is then plugged into an option pricing model such the Black-Scholes model to compute the premium. This of course implies that both the parties to the transaction are using the same option pricing model (and other parameters such as the spot rate, interest rates). The Black-Scholes model has become the industry standard at least for quoting European options. The exhibit below shows implied volatility quotes for 1-month and 12-month options taken from Financial Times website.

FT.com Data available at www.ft.com/marketsdata

■ OTC OPTIONS - implied volatilities

23 Mar		ATMF Vols %	Day's chge	Month chge	25 delta R/R* %	Day's chge	Month chge	25 delta Butterfly%
€/$	1 mth	6.00	-5.70	-5.70	0.40	-0.50	-0.50	0.15
	12 mth	6.50	-0.10	0.25	0.45	-0.03	0.10	0.20
€/£	1 mth	5.05	0.00	0.52	0.40	0.00	0.48	0.10
	12 mth	4.80	0.00	0.23	0.50	0.00	0.33	0.13
$/Yen	1 mth	8.25	-0.28	1.25	-1.55	0.15	-0.63	0.23
	12 mth	7.18	-0.13	0.38	-1.73	0.02	-0.55	0.28
£/$	1 mth	6.35	-0.35	0.07	-0.13	0.00	-0.18	0.18
	12 mth	6.45	-0.13	0.03	0.25	0.00	-0.18	0.18

*R/R data is in favour of the 1st currency. All rates fixed at 3pm UK time. Source: GFI (www.Gfigroup.com).

All the option pricing models are derived with the assumption of constant volatility. Allowing for varying volatility makes the models mathematically very complex. In practice, option traders use the models but periodically update estimates of volatility as a rough-and-ready way of incorporating uncertainty about volatility.

For a lucid discussion and intuitive understanding of the "Greeks" – deltas, gammas, lambdas – the reader should refer to Chance (1994). Arditti (1996) also contains an accessible treatment. Hicks (1998) discusses how option traders manage the risk of their option portfolios.

10.10 OVER-THE-COUNTER (OTC) MARKET PRACTICES[19]

The OTC options markets are made up of many different types of financial institutions including banks. Like in the foreign exchange market, they trade directly with each other and through brokers. Trading is done via dealing systems such as Reuters and on telephones.

Unless a quote for a specific option – call or put – is requested, the market practice is to quote a two way-price in terms of implied volatility for an At-the-Money-Forward (ATMF) straddle for a given period. An example will elucidate this practice:

Mammothbank calls Giantbank on the Reuters dealing system. The conversation would proceed something along the following lines:

Mammothbank: HI FRDS (HI FRIENDS OR SOME SIMILAR GREETINGS)
3 MONTHS EUR/USD IN USD 25M A LEG?

(Mammothbank is asking for a quote on a 3 month straddle – a call plus a put – with principal amount USD 25 million in each)

Giantbank: HI THERE.
8.9-9.1

(Giantbank is conveying that it is willing to buy a 3-month straddle, i.e. buy a call and a put, both with a strike price equal to the current 3 month forward at a premium such that the implied volatility would be 8.9 per cent (0.089) and sell the same straddle at a premium which would imply a volatility of 9.1 per cent. The face value of the option would be USD 25 million. On which of the two currencies – Euro and USD – are these calls and puts? The practice would vary across markets. In the US, when one of the currencies in the pair is USD, it is understood that the call and the put are on the non-USD currency. Thus here, Giantbank is willing to buy a call and a put on Euro against USD, strike rate in both equal to the current 3-month EUR/USD forward, at an implied volatility of 8.9 per cent and sell the same at an implied volatility of 9.1 per cent.)

Assume that Mammothbank finds the quotation acceptable and would like to sell the straddle at an implied volatility of 8.9 per cent. The conversation might continue as follows:

Mammothbank: AT 8.9, YOURS.

Giantbank: DONE. SPOT 0.9650. I BUY 25M A LEG STRADDLE,
STRIKE 0.9575, 19/21 SEPTEMBER (THE 3-MONTH FORWARD DATE),
PREMIUM 1.00 PC CALL, 1.00 PC PUT.
(The call and put premia are 1 per cent each of the principal value of the contract, i.e. a total of 2 per cent of $25 million or $500,000)

[19]This section draws on Hicks (1998).

Mammothbank: PLEASE PAY USD 500,000 MY ACCOUNT MAMMOTHBANK NY VALUE 21 JUNE (SPOT DATE). TKS FOR THE DEAL BI FN. (THANKS FOR THE DEAL, BYE FOR NOW.)

Giantbank: TKS FOR CALLING BI FN.

Sometimes the option trader may receive a request for a quote for a particular option, call or put. In such cases, again he would quote the price in terms of volatility. If the deal goes through, two parties also undertake a hedging transaction to remove the risk of immediate movement in the spot rate. Here is an example:

Mammothbank: HI FRDS. 1 MONTH GBP CALL-YEN PUT 175.80 FOR GBP 20 MIO DELTA AROUND 30 PL.

(Mammothbank is asking for a quote for a call on GBP against JPY, strike JPY 175.80 per GBP, principal amount 20 million GBP, expiry one month which has a delta of around 30 per cent or 0.30. Normally volatility quotes assume ATM strike with delta approximately 50 per cent. Specifying delta would help the quoting bank adjust the implied volatility quote quickly.)

Giantbank: SURE, SEC PLS.
9.5-10.0
(Giantbank requests a few seconds to come up with the quote. Then gives a quote in terms of volatility, 9.5 per cent bid and 10 per cent ask.)

Mammothbank: MINE.
(Mammoth agrees to buy the call at Giant's offer rate of 10 per cent volatility.)

Giantbank: OK. SPOT 176.30 I SEE 0.25 PC OF GBP WITH DELTA 28 USING FWD -15.
(Giantbank quotes a premium of 0.25 per cent of the face amount. It specifies that it is using a spot rate GBP/JPY 176.30 and 15-point premium on the yen. With these values and volatility as specified, the option delta is 28.)

Mammothbank: AGREED. I BUY GBP CALL AT 175.80 IN GBP 20 MIO 19/21 APRIL PREMIUM GBP 50,000 TO GIANTBANK LONDON.
(Mammoth agrees to the price.)

Giantbank: I BUY GBP 5.6 MIO AT 176.30. GIANTBANK LONDON FOR MY GBP. WHERE FOR YOUR JPY?
(Giantbank is delta-hedging its short call on GBP by buying GBP equal to [delta × face amount]. Payment instructions have to be exchanged.)

Mammothbank: MAMMOTH TOKYO FOR MY JPY. TKS FOR THE DEAL BI FN.

As in the forex markets, deals are sometimes made through brokers with both the parties paying a commission to the broker. Exercise procedures and other practices are governed by conventions in each market centre which have evolved over a number of years.

Standard terms and conditions for OTC options and guidelines for trading practices are governed by ICOM (International Currency Options Market) terms or under ISDA (International Swap Dealers' Association Inc.). However, market participants are free to trade on their own terms. Exchange traded options are governed by rules and procedures laid down by the exchange authorities. For details of these matters, see Hicks (1998).

10.11 FUTURES OPTIONS

In Section 10.1, we mentioned that options on futures contracts are traded on many different exchanges. The underlying asset in this case is a futures contract. A call option on a futures contract, if exercised, entitles the holder to receive a long position in the underlying futures contract plus a cash amount equal to the price of the contract at that time minus the exercise price. A put option on being exercised gives the holder a short position in the futures contract plus cash equal to the exercise price minus the futures price.

- Suppose you hold a call on a Swiss francs December futures contract which calls for delivery of CHF 125000 at an exercise price of \$0.75 per CHF. Suppose the current futures price is \$0.80 per CHF. If you exercise your call, you will receive a long position in a futures contract to buy CHF 125000 in December plus a cash amount equal to \$6250 (= 125000 $\times$ 0.05). You can immediately close out your futures position at no further cost or you can decide to hold it in which case the necessary margin has to be posted.

The American-European distinction applies in this case too. Similarly, most of the principles we derived above for options on spot foreign exchange carry over to options on currency futures with the spot exchange rate replaced by current futures price.

The maturity date of futures options is generally on or a few days before the earliest delivery date of the underlying futures contract. For instance, the IMM currency futures options expire two business days before the expiration of the futures contract itself. We have seen in the last chapter that on the expiry date of a futures contract, the futures price must equal the spot price of the asset. Consequently, a European option on spot currency and a European option on futures where the option expires on the same day as the underlying futures contract, will have identical payoffs and therefore must have the same value at any time prior to expiration. This does not apply, if the options are American.

Exchange-traded futures options are usually American options. Like in the case of options on spot, American futures options are worth more than the corresponding European futures options.

10.12 INNOVATIONS WITH EMBEDDED OPTIONS

In recent years, many innovative over-the-counter products have been offered in the market which are essentially portfolios of options. We will briefly discuss three of them here. Our presentation is based on Courtadon (1990) and Stapleton and Thanassoulas (1990). All of these options are European options.

10.12.1 Range Forwards (Cylinder Option, Tunnel Option)

In a ***range forward contract***, two prices F_1 and F_2 are agreed upon at the inception of the contract. At the maturity of the contract, the buyer of the range forward is entitled to (and obligated to) buy the foreign currency at the price F_1 if the then spot rate is less than F_1; at the price F_2, if the then spot rate is greater than F_2; and at the then spot rate, if it is between F_1 and F_2. Correspondingly, the ***seller*** of the range forward is assured a minimum price of F_1, maximum of F_2. The values of F_1 and F_2 are set such that no up-front payment is involved from either party to the other. It is easy to see that F_1 must be less than the outright forward rate while F_2 must be greater than the outright forward[20].

[20]If both F_1 and F_2 are less than the forward rate F, the range forward buyer makes riskless profit; if both are greater than F, the seller makes riskless profit.

Suppose the current CHF/USD spot is 0.8150, and the three-month forward is 0.8210. A three-month range forward agreement is bought with $F_1 = 0.8050$ and $F_2 = 0.8325$. If at the end of three months, the CHF/USD spot is say 0.78, the buyer must pay \$0.8050 per CHF; if the spot is 0.8400, the seller must sell CHF at \$0.8325 per CHF and if the spot is 0.8250, the transaction takes place at that price.

It is easy to see that the purchase of the range forward is equivalent to a portfolio of options consisting of a long position in a call with strike price F_2 and a short position in a put with strike price of F_1. In other words, the buyer of a range forward buys a call with strike F_2 from the seller and sells a put with strike F_1 to the range forward seller. The seller is doing the reverse – buying the put with strike F_1 and selling the call with strike F_2. Values for F_1 and F_2 are determined by finding a call with strike of F_2 which has the same value as the put with strike of F_1. The two premiums, thus, cancel out. If the maturity spot is between F_1 and F_2, neither option is exercised; if less than F_1, the seller of the range forward exercises his put option and if greater than F_2, the buyer exercises his call option. Figure 10.10 shows the diagram of a range forward.

10.12.2 Participating Forwards

In an outright forward contract, the buyer cannot benefit from a depreciation of the foreign currency while the seller cannot benefit from an appreciation. In a call (put) option, the buyer can benefit from a depreciation (appreciation), but must pay an up-front fee. A ***participating forward*** agreement is designed so that the buyer can reap part of the benefit of depreciation and the seller can reap part of the benefit of appreciation with no up-front fee. The contract thus guarantees a floor price to the seller, and an opportunity of doing better than this. As to the buyer, while there is no specified ceiling price, he gets some protection against a sharp appreciation of the foreign currency.

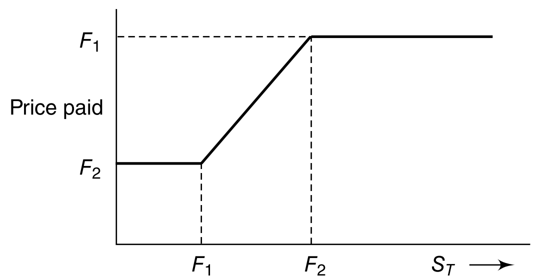

Fig. 10.10 Range Forward

Consider first the sale of a participating forward. The seller is assured a minimum price F_1 which is less than the current outright forward rate for the same maturity. If at maturity, the spot rate, S_T, is greater than F_1, the seller gets a price of $[F_1 + \mu\,(S_T - F_1)]$, where m is a positive fraction, $0 < \mu < 1$. If $S_T < F_1$, the seller gets F_1. The seller's floor price is F_1 while the buyer is not guaranteed a specific ceiling price but will always do better than buying it spot at expiry if the spot exceeds F_1.

With an outright forward, the seller is guaranteed a price of F (the current outright forward rate), the present value of which is $Fe^{-r(T-t)}$ where r is the risk-free interest rate, t is current time and T is maturity date. With a participating forward, the seller gets:

$$F_1 + \mu \max[0, (S_T - F_1)].$$

But recall that a European call option with strike of F_1, maturing at T, also gives a payoff of max $[0, (S_T - F_1)]$ at T. The current value of such an option is $c(S_t, F_1, T)$. The present value of the participating forward is thus:

$$[F_1 e^{-r(T-t)} + \mu\, c(S_t, F_1, T)]$$

Since both the outright forward and the participating forward are costless to enter into, their present values must be identical.

Thus, the following relationship must hold:

$$Fe^{-r(T-t)} = F_1 e^{-r(T-t)} + \mu\, c(S_t, F_1, T)$$

Given S_t, F_1 and T (and of course an estimate of volatility), the call value c can be determined and the above relation can be used to determine μ, the participation rate.

The case of participating forward purchase can be analysed in the same fashion. The buyer is assured of a ceiling price of F_2 which is greater than F and, if S_T is below F_2, will have to pay $F_2 - \theta(F_2 - S_T)$. The buyer's cost is thus $\{F_2 - \theta \max [0, (F_2 - S_T)]\}$. But $\max [0, (F_2 - S_T)]$ is the payoff of a European put with a strike price of F_2. Thus,

$$Fe^{-r(T-t)} = F_2 e^{-r(T-t)} - \theta\, p(S_t, F_2, T)$$

This relationship can be used to determine θ, the buyer's participation rate given F_2. Figure 10.11 shows the price the buyer has to pay for various values of S_T.

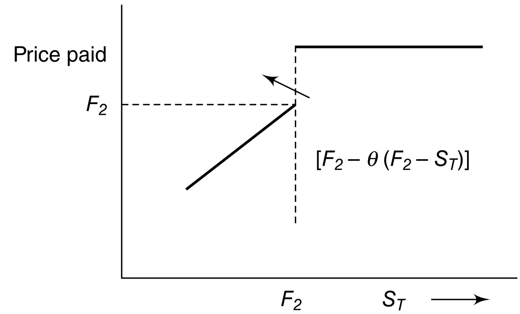

Fig. 10.11 Participating Forward

10.12.3 Conditional Forward (Forward Reversing Option)

A third kind innovative contract is the ***forward reversing option***. It is same as a straight option except that the option premium is paid in the future and is only paid, if the price of the foreign currency is below a specified level. Thus, suppose a customer is not willing to pay more than CHF 1.7500 for a dollar. He buys a conditional forward in which the seller quotes a premium which is to be paid, if and only if the price of a dollar plus the premium is less than 1.7500. Thus, suppose the maximum amount of currency A the option buyer is prepared to pay for a unit of currency B is X and the option writer quotes premium Φ units of A. At expiry the option buyer has to pay an amount of A per unit of B given by:

$$\text{Min } \{[(S_T(B/A) + \Phi], X\}$$

i.e. smaller of $(S_T + \Phi)$ and X.

The payoff of this option can be replicated by buying the currency at the spot rate at expiry and receiving the value of a portfolio consisting of (1) A long European call with strike X plus (2) A long European put with strike $(X - \Phi)$ plus (3) A short put with strike X, i.e.

$$\text{A long forward reversing option } (X, \Phi) = S_T + c(X) + p(X - \Phi) - p(X)$$

where X is the ceiling price specified by the buyer, Φ is the premium quoted by the seller of the forward reversing option, c, p are the premiums for straight European call and put options[21]. You can check this out for yourself. Figure 10.12 shows the price paid by the buyer for various values of maturity spot rate.

[21]Note that this can also be viewed as a combination of a forward contract at price X and a put option at strike price $X - C$.

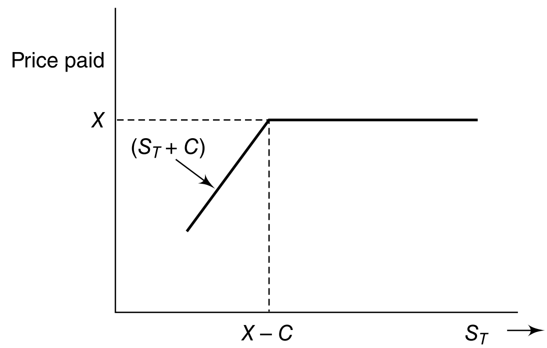

Fig. 10.12 Conditional Forward

10.12.4 Barrier Options

A group of options known as ***Barrier Options*** have a conditionality clause built into them, i.e. they either cease to exist or come into existence when the spot price of the underlying asset moves in a certain direction and touches a certain "trigger" level. The direction of movement is usually opposite to the movement desired for profitable exercise of the option, i.e. the direction of movement built into the condition usually takes the option out-of-the-money.

We will consider the main varieties. The principal advantage of these options is their smaller up-front premiums compared to standard options.

- **Up-and-Out or Knock-out Put Option**
  Consider a European put option on GBP against USD at a strike price of USD 1.80 per GBP. If we build into it an additional condition that the option ceases to exist or is "knocked out", if the spot GBP/USD goes above 2.00 at any time during the life of the option irrespective of what the spot rate is on the expiry date, it becomes a Up-and-Out put or a Knock-out put. An American firm with a GBP receivable might buy such an option to protect the dollar value of its asset with some side arrangement with the bank that the moment the spot goes above 2.00, a forward sale contract will come into effect. The advantage of this option is its lower up-front premium compared to a standard European put.
- **Up-and-In Put Option**
  This is opposite of the up-and-out put. Here the option comes into existence, if the spot rate goes above a certain level. In the above example, a put with a strike of USD 1.80 and a condition that the put becomes effective only if the spot rate goes above 2.00 makes it a up-and-in put. If the rate never goes above the barrier level before expiry date, the put never comes into existence. If the outlook for GBP is bullish in the short to medium run but bearish in the long run, a hedger or trader might use such an option; alternatively, he could buy short-maturity calls and longer-maturity puts.

  The up-and-in put is a cheaper alternative.
- **Down-and-Out Call Option**
  This is a call with the condition that the option ceases to exist, if the spot rate moves below the barrier level. A Swiss firm with USD payable might buy a call on USD with a strike price of CHF 1.60 per USD with a knock-out at 1.55. It might have an arrangement to buy USD forward the moment the dollar moves below 1.55. This call would be cheaper than a standard call with the same strike and maturity.

- **Down-and-In Call Option**
  This is opposite of a down-and-out call. The down-and-in call comes into existence only if the spot rate moves below the barrier level. This option will be used when the view is bearish in the short run, but bullish in the long run.

It is easy to see that the payoff profile of an up-and-out put plus an up-and-in put will be identical to that of a standard European put with the same strike and maturity. Hence, the value of the standard put must be equal to the sum of values of the two barrier puts. Similarly, the payoff profile of a standard call will be identical to that of down-and-out call plus a down-and-in call and hence, their premiums should be the same. Other types of barrier options also exist. For instance, one can have up-and-in and up-and-out calls as well as down-and-in and down-and-out puts. In some of the barrier knock-out options, the option buyer may receive a small rebate when the option is knocked out. Similarly, in a knock-in option, the holder may receive a small rebate if the underlying price never touches the barrier and the option never comes to life. For further details of these options, see Derman and Kani (1993)[22].

There are further innovations along these lines such as barrier discontinuity options and digital options[23] to name just two. Barrier options can be built into other simpler structures such as a range forward. Consider this example:

- A company with dollar inflows and CHF outflows enters into the following deal on September 8:
  The current CHF/USD spot: 0.8720. 6-month forward: 0.8792
  The face amount of the deal is CHF 1 million. The payoffs are as follows:
  (a) If the spot rate never touches 0.8288 or 0.9300 during the life of the option then if at maturity, the spot rate is below 0.8700 but above 0.8288, the customer buys CHF, sells USD at 0.8700. If the maturity spot is between 0.8700 and 0.8892, the customer buys CHF at the spot rate and if the spot is above 0.8892 but below 0.9300, customer buys at 0.8892. This is exactly like the range forward contract described above.
  (b) If the spot remains above 0.8288 but 0.9300 is seen during the life of the option: If the maturity spot is between 0.8288 and 0.8700, the customer buys CHF at 0.8700. If the maturity spot is at or above 0.8700, customer pays the market spot.
  (c) If the spot remains below 0.9300 but 0.8288 is seen during the life of the option: If the spot rate at maturity is at or above 0.8892 but below 0.9300, the customer pays USD 0.8892 per CHF. If the maturity spot is below 0.8892, the customer pays the market rate.
  (d) If both 0.8288 and 0.9300 are seen during the life of the option, the customer buys at maturity spot.

Customer pays no premium up-front.

It easy to see that this structure can be constructed as follows:

The client buys a European call on CHF, strike rate 0.8892, with an up-and-out barrier at 0.9300 and sells a European put to the bank, strike rate 0.8700 with a down-and-out barrier at 0.8288. If the exchange rate stays within the barriers 0.8288 and 0.9300, this structure works like a range forward with 0.8892 and 0.8700 as the ceiling and floor as in case (a). If 0.9300 is touched but not 0.8288, the customer's call gets knocked out while the bank's put remains alive (case b); if 0.8288

[22]Derman, E.Na I.Kani (1993): "The Ins and Outs of Barrier Options" Goldman Sachs Quantitative Strategies Research Notes, New York. Cited in Arditti, F. (1996): ***Derivatives*** Harvard Business School Press, Boston, Mass.

[23]In a barrier discontinuity option, the comparison between the spot rate and the barrier rate (knock-out or knock- in) is made not continuously during the life of the barrier option but on specific days only. In a digital option, the amount of pay-out in case the option finishes in-the-money is pre-specified and does not depend upon how deep in-the-money it expires.

is touched but not 0.9300, the bank's put gets knocked out but customer's call remains alive (case c) and if both barriers are touched, both the options get knocked out and customer buys at market at maturity (case d).

10.12.5 Breakforward Contracts

In a breakforward deal, the buyer has the right but not an obligation to cancel an existing forward contract at a predetermined price. We will illustrate with an example.

Suppose the following rates are currently ruling:

USD/INR Spot: 63.60 6-month Forward: 63.90
Fixed Rate: 64.25 Breakforward Rate: 64.00 at 3 months

1. Company agrees to buy USD at 64.25 six months forward. This is worse than the 6-month forward rate quoted in the market.
2. Company has the right, but no obligation to break this contract three months later. It does this by entering into a three-month forward at that time to sell USD to bank 3-month forward at 64.00. If it exercises the right, it would owe the bank ₹0.25 per USD three months later since it had agreed to buy at 64.25 three months later.

Three months later, suppose USD/INR spot is 63.10, 3-month forward is 63.30, company breaks the original forward. Buys USD 3-month forward in the market at ₹63.30. It owes the breakforward bank ₹0.25, three months later. Its total cost is 63.55 which is cheaper than ₹63.90, the original six-month forward rate.

10.12.6 Other Innovations

A Double Knock-In ("DKI") has two barriers, one below and one above the current spot. There are two possible outcomes:

1. Neither barrier is touched and the option does not become alive.
2. One of the barriers is triggered and the option becomes a regular European option.

In an early Double Knock-in option, there are two barriers like the above double knock-in option. If these are hit during the monitoring period, the option will knock-in and become a Vanilla option, otherwise the option has no pay out. The monitoring period starts at the beginning of the trade and ends sometime before the trade expires.

A **Quanto option** is an option on a random number of units of the foreign currency. Suppose a US investor is investing in the stock of INFOSYS, an Indian firm. He will liquidate his position six months from now. He faces two risks, viz. performance of the stock in the Indian market over the next six months and the fluctuations in USD/INR exchange rate. He would like to hedge the latter risk. A standard forward, futures or a vanilla option deal does not meet his requirement because he does not know what the rupee value of his portfolio would be six months later. Suppose he has invested USD 1 million in this stock and would like to protect the dollar value of his investment at that level. He can buy a quanto option which has the following payout:

$$\text{Max}\{[1000000 - S(T) * P^{\textbf{INFOSYS}}(T) * (N)], 0\}$$

Here, $S(T)$ is the INR/USD exchange rate, dollars per rupee, six months from today when he liquidates his position, $P^{\textbf{INFOSYS}}(T)$ is the rupee price of the INFOSYS stock at that time and N is the number of shares he has acquired. In effect, he has bought a put option on the USD value of a random amount of rupees, viz. $P^{\textbf{INFOSYS}}(T) * (N)$.

A very large number of such innovative structures have been traded. Further innovations will keep coming as option market makers seek to tailor-make their products to meet specific needs of their clients. The option trader's imagination and innovativeness are the only limiting factors.

Less common types of option contracts such as ***contingent options***[24] and ***compound options***[25] are also available in the OTC market. An option to buy an option is a compound option. For instance, one can have a European call option expiring three months from today to buy at that time a European call option on US dollar expiring three months thereafter, i.e. six months from today with strike price of INR 45.00 per USD at a premium of ₹1.10 per USD. This would be a call on a call. Similar combinations can be designed with European and American calls and puts. These and other uncommon types of options are described in Stapleton and Thanassoulas (op.cit.), and Nelken (2000).

Option-like features are also embedded in other instruments which have appeared in the market. ***Conditional forward contracts*** allow one side of the agreement to pull out of the commitment on maturity date by paying a fee to the other side. The pricing of such a contract, i.e. determining the fee, is discussed in Courtadon (1990). The option forward contract discussed in Chapter 7 allows one of the parties to settle the contract during a specified period prior to the maturity date. Kraizberg (1990) has analysed the valuation of such a timing option.

Recent years have seen the emergence of a number of "exotic" options to cater to specific user needs. A contract called ***preference option*** gives the option buyer the right to designate whether it is a put or a call option after passage of a predetermined interval of time. In an ***Asian option***, the payoff is based on the average price of the underlying asset over a specified interval of time rather than the spot price on a specific date. In a ***look-back option***, the payoff is determined by the most favourable price (from the option buyer's point of view) that occurred during a specified interval, e.g. for a call option on a currency the payoff would equal the difference between the highest price that occurred over an interval and the strike price (provided this difference is greater than zero). A ***Bermudan option*** allows the holder a finite number of exercise opportunities at discrete time intervals, e.g. every Friday, between start and maturity. Naturally such options are more expensive than standard options. In some options, the strike price itself is left unspecified to begin with. At exercise, the strike price is set equal to the average of spot prices that occurred over a specified interval.

The possibilities for designing innovative exotic combinations of options as well as combining options with other derivative products are almost limitless. A survey of some of these exotic products can be found in ***Euromoney***[26]. Valuation of some of these products is a topic of current research.

In Chapter 13, we will look at how banks combine some of these innovations to offer tailor-made hedging products to their clients.

Following the financial crisis in the US and Europe in 2007-08, financial engineering has been strongly criticised as the main cause of such crises. It is argued that banks and other financial institutions are overselling such exotic-structured products to their clients to earn large up-front fees without adequately explaining the risks associated with them. Michael Spence has argued[27] that as the complexity of the system increases, gaps and asymmetries in terms of information, knowledge and expertise are multiplying. Such gaps and asymmetries may create an incentive to exploit the advantages that one of the two parties to a transaction has. There is a school of thought which recommends that banks should not be allowed to sell such products to their corporate customers,

[24]These options are contingent upon the occurrence of a particular event, e.g. the customer winning a foreign contract.
[25]Among these are options on options, e.g. a call option to buy a call option and an option on the maximum of two assets.
[26]"Derivatives Sprout Bells and Whistles" ***Euromoney*** August 1992, p. 29-46.
[27]"In Finance We Distrust" ***The Economic Times*** July 19, 2010.

particularly small and medium enterprises, most of whom do not have adequate in-house expertise to fully understand the risks associated with such exotic products.

10.13 EMPIRICAL STUDIES OF OPTION PRICING MODELS

There have been a number of investigations into the empirical performance of currency option pricing models. There is substantial evidence of pricing biases in case of the Black-Scholes as well as alternative models[28]. Goodman et al. (1985) found that the actual market prices on the PHLX are generally higher than those predicted by the models. Tucker et al. (1988) found that an alternative model performs better than the Black-Scholes model for short prediction intervals, but for longer intervals, there is little difference. Bodurtha and Courtadon (1987) found that the American option pricing models investigated by them underprice out-of-the-money options relative to at-the-money and in-the-money options. Shastri and Tandon (1986) have investigated the efficiency of currency option markets.

Recent research has focused on relaxing some of the restrictive assumptions of the Black-Scholes model. Some models employ stochastic processes which allow higher probabilities of large changes in the spot rate than the log-normal distribution underlying the Black-Scholes model. Some incorporate trading costs ignored by Black-Scholes. The possibilities are almost limitless.

10.14 CURRENCY OPTIONS IN INDIA

In January 1994, the RBI started permitting Indian banks to write "cross-currency" options including barrier options and other innovations. They were required to cover themselves on a back-to-back basis.

Currency options between the Indian rupee and foreign currencies were launched with effect from July 7, 2003. Only banks are allowed to write currency options.

Corporates can only buy options and that too only for hedging, underlying exposures. They cannot write options; more correctly, they cannot receive premium in any structured deal.

After an initial period of low activity due to unfamiliarity with the product on the part of corporate treasurers, the market has now picked up and trading volumes are reasonably high. The daily turnover ranges between equivalent of US dollar 50 to 150 million.

The following table illustrates some rupee-dollar one-month and three-month option quotes on July 13, 2005, given as bid/offer implied volatilities for an at-the-money-forward straddle:

Bank	**Quotes**	
	1-Month	**3-Month**
HDFC	2.30-2.80	2.45-2.95
ICICI	2.30-2.80	2.40-2.90
IDBI	2.30-2.60	2.45-2.80
UTIB	2.30-2.80	2.40-2.90

The following quotes for rupee-dollar options were taken from e-Mecklai website. These are given as rupees per dollar

[28]Alternative models have been proposed which differ from the Black-Scholes formulation in the specification of the stochastic process followed by the spot rate. A few of the relevant references are Shastri and Wethyavivorn (1987), Tucker, Peterson and Scott (1988) and McCulloch (1989).

last updated: 13th Jul, 05				
Spot: 43.5125	***Premiums (INR/USD)***			
Expiry	1 m	3 m	6 m	12 m
Strike	**43.25**	**43.25**	**43.50**	**43.75**
Call	0.36	0.53	0.56	0.70
Put	0.03	0.09	0.23	0.41
Strike	**43.50**	**43.50**	**43.75**	**44.00**
Call	0.18	0.36	0.42	0.57
Put	0.10	0.17	0.33	0.52
ATM strike	**43.58**	**43.70**	**43.84**	**44.09**
Call	0.14	0.23	0.36	0.53
Put	0.14	0.24	0.36	0.56
Strike	**43.75**	**43.75**	**44.00**	**44.25**
Call	0.07	0.22	0.30	0.45
Put	0.24	0.28	0.45	0.64
Strike	**44.00**	**44.00**	**44.25**	**44.50**
Call	0.02	0.13	0.21	0.36
Put	0.44	0.43	0.61	0.78

On July 30, 2010, RBI issued a circular informing the market that recognised stock exchanges will be permitted to trade USD-INR currency options on their currency derivatives segment.

Standardised exchange traded currency options shall have the following features:

(a) The underlying for the currency option shall be US Dollar-Indian Rupee (USDINR) spot rate.
(b) The options shall be premium styled European call and put options.
(c) The size of each contract shall be USD 1000.
(d) The premium shall be quoted in Rupee terms. The outstanding position shall be in USD.
(e) The maturity of the contracts shall not exceed twelve months.
(f) The contracts shall be settled in cash in Indian Rupees.
(g) The settlement price shall be the Reserve Bank's Reference Rate on the date of expiry of the contracts.

The circular stated that only 'a person resident in India', as defined in section 2(v) of the Foreign Exchange Management Act, 1999 (Act 42 of 1999) shall participate in the exchange traded currency options market.

NSE launched currency option trading in October 2010. Subsequently, MCX-SX launched currency options in August 2012. Table 10.2 shows some quotes for the USD/INR options traded on MCX-SX.

Table 10.2 MCX-SX USD/INR Option Quotes (June 16, 2013)

Expiry Date	*Strike Price*	*Option Type*	*Open*	*High*	*Low*	*Close*	*Settle-Ment*
26-Jun-13	56	CE	2.48	2.544	2.06	2.113	1.979
26-Jun-13	56.75	CE	1.68	1.68	1.178	1.311	1.311
26-Jun-13	57.25	CE	1.223	1.45	0.85	0.851	0.851
26-Jun-13	57.25	PE	0.13	0.218	0.09	0.199	0.199
29-Jul-13	56	PE	0.14	0.14	0.12	0.12	0.175
29-Jul-13	58	CE	0.96	0.978	0.76	0.83	0.83
29-Jul-13	59	CE	0.5	0.5	0.5	0.5	0.617
29-Jul-13	60	CE	0.305	0.35	0.22	0.22	0.319
25-Sep-13	56.5	PE	0.38	0.38	0.11	0.22	0.22

CE: European Call PE: European Put

The size of the USD/INR option contract is 1000 dollars. The expiry date of the contract is given in the first column. The open, high, low, close and settlement prices are option premia in rupees per dollar which evolved during the trading day. The appendix contains detailed features of the rupee-dollar option traded on USE (United Stock Exchange). Exhibit 10.1 shows the price and volume information about a Rupee-Dollar call option traded on NSE.

Exhibit 10.1

Instrument	*Underlying*	*Expiry Date*	*Option Type*	*Strike Price*
OPTCUR	USDINR	25SEP2013	CE	62.00
Open	***High***	***Low***	***Prev. Close***	
1.8275	2.0300	1.5000	1.4800	

Implied Volatility	21.08
Last Traded Price	1.8000
Number of contracts traded	1009

As on 17-SEP-2013 17:00:00 Hours IST

No scheduled bank or such other agency falling under the regulatory purview of the Reserve Bank under the Reserve Bank of India Act, 1934, the Banking Regulation Act, 1949 or any other Act or instrument having the force of law shall participate in the exchange traded currency options market without the permission from the respective regulatory Departments of the Reserve Bank.

Entities falling under the regulatory purview of any other regulators established by law shall participate in the exchange traded currency options market only with the prior permission of their regulators concerned and participation of such entities as members or clients shall be in accordance with the guidelines issued by the regulator concerned.

From time to time, RBI imposes certain restrictions on banks pertaining to their participation in the currency derivatives markets.

In July 2013, seeking to arrest the declining value of rupee, the Reserve Bank imposed restrictions on banks with regard to trading in currency futures and options with immediate effect. Under the new norms, the banks were barred from trading in currency futures and exchange traded currency options market on their own. They would, however, be allowed to trade on behalf of their clients.

On a review of the evolving market conditions, it was decided that... banks should not carry out any proprietary trading in the currency futures/exchange traded currency options markets. "In other words, any transaction by... banks in these markets will have to be necessarily on behalf of their clients," RBI said in a late night notification on Monday, July 22, 2013.

Summary

In this chapter, we have presented an introduction to currency options which permit limited risk taking. An option buyer can retain the freedom to benefit from favourable movements in the spot rate while at the same time limiting his loss in case of adverse movements. Options, thus, have a close analogy with insurance and require the option buyer to pay a premium to the seller.

A variety of approaches and models have been proposed for valuation of options. The critical input in all these models is the volatility of the underlying spot rate. In addition to options on spot exchange rate, options on currency futures are also traded on futures exchanges.

Options are both exchange traded as well as traded over the counter. They can be combined in several ways to create financial engineering products with unique payoff profiles. A large number of innovative and exotic options have been brought to the market to cater to specific requirements of corporate clients.

In the Indian market, options between the rupee and foreign currencies have been permitted since 2003. However, only banks are allowed to write options. Companies can only buy options and that too only for hedging their currency exposures.

Questions and Problems

1. Suppose you had purchased 3 March British Pound calls with a strike price of 1475 ($1.475 per £) at the price shown in the following extract from a financial newspaper:

Foreign Currency Options
Monday November xx 20xx
British Pounds (PHLX) 25,000 Pounds; Cents per pound

Strike Price	*Calls-Settle*			*Puts-Settle*		
	Dec-C	*Mar-C*	*Jun-C*	*Dec-P*	*Mar-P*	*Jun-P*
1425	6.40	7.05	7.75	0.05	2.00	3.65
1450	3.95	5.35	6.35	0.10	2.85	4.60
1475	1.65	4.20	4.15	0.35	4.00	5.70
1500	0.50	3.20	4.20	1.65	r	r

(a) How much up-front fee would you have paid? (Ignore brokerage fees)
(b) What is the ceiling cost of £75,000 that you would have locked in?
(c) Suppose after holding the options for 45 days, you had sold them at a price of "5.20" (cents per pound). What would be your net profit? Assume that you have to pay a brokerage of $10 per option both when buying and selling and that your interest cost is 8% p.a. (360 days).

2. Discuss and explain the various determinants of European foreign currency call and put option values. Explain the influence of each of the factors separately.

3. A Swiss firm buys a call on $1,000,000 with a strike of CHF 1.60 per $ and a premium of CHF 0.03 per $. The interest opportunity cost is 6% p.a., and the maturity is 180 days.
   (a) What is the breakeven maturity spot rate beyond which the firm makes a net gain?
   (b) Suppose the six month forward rate at the time the option was bought was DEM 1.62/$. What is the range of maturity spot rate for which the option would prove to be better than the forward cover? For what range of values would the forward cover be better?
4. A French exporter to UK has 90-day USD receivable. He purchases a put option on £2,50,000 at a strike of EUR 1.6500 per £ at a premium of EUR 0.02 per pound. The current spot rate is GBP/EUR 1.6710 and the 90-day forward is 1.6550. The interest opportunity cost for the firm is 5% p.a.
   (a) Calculate the maximum GBP/EUR rate at the end of 90 days below which the firm will make a net gain from the put.
   (b) Calculate the range of maturity spot over which the option would be better than the forward and vice versa.
5. The current $/¥ spot rate is 123.00. 6-month European calls with strike 0.0087 and 0.0083 ($ per JPY)) are trading at premia of ¢0.015 per ¥ and ¢0.02/$ (cents per Yen) respectively. A speculator is expecting a fairly strong appreciation of the yen over the next six months. What option strategy should he adopt to profit from this forecast? What is the breakeven rate? How much is the maximum possible profit? Ignore brokerage fees and interest costs/gains.
6. The current CAD/$ spot rate is 0.5410. The following 2-month calls and puts are available:

Strike	*Call Premium*	*Put Premium*
0.50	0.06	0.04
0.55	0.02	0.015
0.60	0.008	0.02

   A speculator expects the CAD/$ rate to hold fairly steady over the coming quarter with only small movements around the current spot rate. What strategy should he adopt to profit from this view if at the same time he wishes to limit his maximum loss? What is the range of maturity spot rate over which he makes a profit? How much is the maximum possible profit? How much is the maximum loss?
7. Consider another speculator. She looks at the same data as in Problem 6. Her expectations are same as that of the speculator of Problem 6 but she is more adventurous and is willing to risk large losses. What would be her strategy? What would be her maximum possible gain? What is the range of maturity spot rates over which she gains?
8. You are given the following data:
   USD/CHF spot: 1.5850 3-month Euro $ rate: 8.50%
   3-month Euro CHF rate: 5.25%
   Work out the floors on the values of a European and an American call on CHF both with strike price of $0.6100 per CHF and 90 days to maturity.
9. With same data as in Problem 8, a European call on CHF with strike price 0.62 and 90 days to maturity is trading at 2.5 cents per CHF. What must be the price of a 90-day put with the same strike price?
10. Explain in what sense a long call and a short put on a currency with strike X and maturity T are equivalent to a forward contract at contract price X and maturity T.
11. You have a 12-month payable of CHF 1,00,000. The current CHF/INR spot rate is ₹20, rupee interest rate is 21% p.a. and CHF interest rate is 10% p.a. You are considering a forward hedge

at the current forward rate of ₹22. A friend tells you that he recently brought a call on CHF 1,00,000 at a strike price of ₹20 and is willing to sell it to you at the historic premium of Re 1 per CHF or ₹1,00,000 for the entire contract. The call matures at the same time as your payable and is a European call. What should you do?

12. The current $/₹ spot rate is 48.00 and 3-month forward is ₹49.00. A friend offers to sell you a put on $25,000 with a strike price of 48.80 in return for your selling him a call on $25,000 for the same strike and same maturity. Would you accept such an offer? What will induce you to accept it?

13. Consider a call expiring at time T where the underlying asset is a forward purchase contract maturing at T with a contract price of X (units of home currency per unit of foreign currency). When you exercise this option, you become the holder of a forward contract which obliges you to buy the foreign currency at a price X, for delivery at T. If the option is European, it can be exercised only at T. You will exercise it only if $S_T > X$. At expiry therefore, the value of this option is max $[0, S_T - X]$, just as in the case of a call option on the foreign currency itself. Thus a European option on a forward contract where both expire at the same time, will be priced like a standard option on cash foreign currency. What if the option is American? Will the option on forward and option on cash forex be priced identically? In other words, can you prove that the American option will never be exercised early?

14. Now consider a European call option maturing at T on a forward purchase contract which matures at $T_1 > T$ and contract price is X. Future interest rates are known. (Thus home and foreign currency interest rates for the period from T to T_1 are known with certainty). How will this option be priced relative to an option on cash foreign currency maturing at T? What about an American option?

15. If a foreign currency has a very large forward premium, an American option on that currency almost becomes a European option. Can you explain why? Can you infer a similar relationship between American and European puts?

16. The table below gives daily data on $/₹ and CHF/₹ spot rates for the months of January and February 2002. Use the data to derive estimates of volatility of the two exchange rates. Suppose on March 1 the spot rates were ₹47.60 for USD and ₹28.40 for CHF. The rupee interest rate was 9% p.a., dollar interest rate was 3% p.a. and the CHF rate was 2% p.a. Use the Black-Scholes formula and normal distribution tables available in any introductory statistics textbook to compute the values for the following European options:

Currency		*Call or Maturity Put*	*Strike Price (Days)*
USD	Call	90	47.00
USD	Call	90	47.50
USD	Call	180	48.00
USD	Put	90	47.00
USD	Put	90	47.50
USD	Put	180	48.00
CHF	Call	60	28.00
CHF	Call	90	28.50
CHF	Put	180	30.00
CHF	Put	90	29.00
CHF	Call	90	27.00
CHF	Put	60	29.50

Exchange Rates

Date	*$/₹*	*CHF/₹*
4/1/02	46.46	27.90
5/1	46.38	27.86
6/1	47.72	27.99
7/1	47.47	27.86
8/1	47.02	27.74
11/1	47.69	27.87
12/1	47.77	27.85
13/1	47.46	27.84
14/1	47.69	27.98
15/1	47.37	27.96
18/1	47.28	27.82
19/1	47.83	28.09
20/1	47.69	28.13
21/1	47.64	28.25
22/1	47.00	28.15
25/1	47.30	28.37
27/1	47.40	28.55
28/1	48.12	28.04
29/1	47.96	28.90
1/2/02	47.60	28.20
2/2	47.84	28.26
3/2	48.05	28.40
4/2	47.80	28.40
5/2	47.95	28.62
8/2	48.05	28.67
9/2	47.94	28.65
10/2	48.09	28.77
11/2	48.28	28.04
12/2	48.31	28.19
15/2	48.39	28.22
16/2	48.54	28.90
17/2	48.25	28.83
18/2	48.38	28.95
19/2	48.58	28.81
22/2	48.83	28.79
23/2	48.88	28.84
24/2	48.77	28.86
25/2	48.73	28.94
26/2	48.69	28.92

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Other Useful Works

A recent, mathematically accessible textbook treatment of option valuation is:

Gibson, R. (1991): ***Option Valuation: Analyzing and Pricing Standardised Option Contracts***, McGraw-Hill, New York.

A practitioner-oriented treatment can be found in:

Derosa, D.F. (1992): ***Options on Foreign Exchange*** Probus Publishing Co. Chicago, Ill.

Some relevant papers on option pricing:

Shastri, K. and K.Tandon (1987): “Valuation of American Options on Foreign Currency”, ***Journal of Banking and Finance***, 11, 245–269.

Hilliard, J., J. Madura and A.Tucker (1991): “Currency Option Pricing with Stochastic Domestic and Foreign Interest Rates”, ***Journal of Financial and Quantitative Analysis***, 26, No. 2, 139–151.

Empirical tests of option pricing models and of efficiency of currency option markets can be found in: Adams, P.D. and S.B.Wyatt (1987): “Biases in Option Prices : Evidence from the Foreign Currency Option Market”, ***Journal of Banking and Finance***, 11, 549–62.

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Valuation of options on futures contracts is dealt with by:

Ogden, J.P. and A.L.Tucker (1988): “The Relative Valuation of American Currency Spot and Futures Options : Theory and Empirical Tests”, ***Journal of Financial and Quantitative Analysis***, 23, No. 4, 351–368.

Valuation of exotic options such as lookback options and average rate options is dealt with in the following papers. The mathematics is quite advanced:

Conze, A. and Viswanathan (1991): "Path Dependent Options: The Case of Lookback Options", ***The Journal of Finance***, XLVI, No.5, 1893-1907, American Finance Association.
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APPENDIX

A.10.1 THE BINOMIAL OPTION PRICING MODEL

In this section, we will provide an exposition of a simplified option pricing model. The presentation here is drawn from Bodurtha and Courtadon (1987) who extend the stock option pricing model of Cox, Ross and Rubinstein (1979). This approach uses the binomial distribution to model exchange rate movements. The model converges to the famous Black-Scholes model under certain conditions. The virtue of the simplified approach is that it shows clearly how the construction of a hedge portfolio allows us to value options.

- Model Assumptions

  Apart from the assumption about spot exchange rate movements discussed below, the model makes the following additional assumptions:
  1. Foreign and domestic interest rates are constant.
  2. No taxes, transaction costs, margin requirements and restrictions on short sales.
  3. Required hedging instruments are readily available.

A Single Period Option We will consider a European call option on Singapore dollar against the US dollar with a single period (say, a year) to maturity. USD is treated as the home currency and SGD as the foreign currency. The following notation is defined:

S_0 : The current SGD/USD spot rate
X : The strike price in a European call option on one SGD
T : Time to maturity in years (taken to be one year)
r_d : Continuously compounded domestic risk free interest rate (i.e. USD interest rate)
r_f : Continuously compounded foreign risk free interest rate (SGD interest rate)
σ : Volatility, i.e. standard deviation of the spot rate on an annual basis
u : The multiplicative factor by which the spot rate will increase at the end of the year if SGD appreciates
d : The multiplicative factor by which the spot rate will decline at the end of the year if SGD depreciates.

We are assuming that at option maturity, there can be one of the only two possible outcomes, viz. the spot rate will be either uS_0 or dS_0. The following condition must be imposed on u and d:

$$d < \frac{(1+rd)}{(1+rf)} < u \quad \text{(A.10.1)}$$

Violation of this leads to arbitrage opportunities[29]. Later we will have to impose further conditions on u and d.

Now consider a European call option on one SGD. Let its current value be denoted c_0. At expiry, depending upon the spot rate outcome, the option will be worth either c_{1u} or c_{1d} defined as follows:

c_{1u} = max [0, $uS_0 - X$] if the spot rate has gone up by factor u

or c_{1d} = max [0, $dS_0 - X$] if it has gone down by factor d

Let us construct a portfolio the payoff from which will be identical to the payoff from the call option at option expiry. The portfolio consists of B_d units of domestic currency (in this case US dollars), invested in domestic risk-free bonds and B_f units of foreign currency SGD invested in foreign risk-free bonds. B_d and B_f must be chosen so as to satisfy the following two conditions:

$$e^{r_d} B_d + uS_0 B_f e^{r_f} = c_{1u} \quad \text{(A.10.2)}$$

$$e^{r_d} B_d + dS_0 B_f e^{r_f} = c_{1d} \quad \text{(A.10.3)}$$

The left-hand side in equations (A.10.2) and (A.10.3) is the payoff from the portfolio with up and down movements, respectively in the spot rate. The right-hand side is the value of the option in the two cases.

Solving the above two equations, we get

$$B_d = \frac{(uc_{1d} - dc_{1u})}{(u-d)e^{r_d}} \quad \text{(A.10.4)}$$

and

$$B_f = \frac{(c_{1u} - c_{1d})}{(u-d)S_0 e^{r_f}} \quad \text{(A.10.5)}$$

Since the portfolio and the call option have identical payoffs at the end of the period, they must have identical values at the beginning of the period. Hence,

$$c_0 = B_d + S_0 B_f \quad \text{(A.10.6)}$$

The right-hand-side of (A.10.6) is simply the cash outlay necessary to acquire the hedge portfolio at the beginning.

Substituting for B_d and B_f from above

$$c_0 = \frac{[pc_{1u} + (1-p)c_{1d}]}{e^{r_d}} \quad \text{(A.10.7)}$$

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[29]By interest parity condition

$$F = S[(1 + r_d)/(1 + r_f)]$$

where S is the spot rate and F is the one-year forward rate.

Suppose we have: $d < u < [(1 + r_d)/(1 + r_f)]$

Riskless profit can be made by selling the currency forward and buying it spot when the contract matures. When r_d and r_f are continuously compounded, the condition must be replaced by:

$$d < e^{(rd - rf)} < u$$

where $$p = \frac{e^{(r_d - r_f)} - d}{(u - d)} \tag{A.10.8}$$

From the restrictions on u and d in equation (A.10.1), it is easy to see that $B_d < 0$ and $B_f > 0$. Thus, a portfolio consisting of a foreign currency, i.e. SGD deposit partly financed by a home currency, i.e. US dollar loan, and is equivalent to a long position in a call on one SGD. Also, p, defined in equation (A.10.8) satisfies $0 < p < 1$ and can be interpreted as a probability. In fact, if q is the probability of an upward movement in the spot rate and $(1 - q)$ is the probability of a downward movement, then it can be shown that in a risk-neutral world p equals the value q must take[30].

Let us take a numerical example. Consider the following data pertaining to a call option on one Singapore dollar (SGD):

$$S_0 = 0.60 \qquad r_d = 12\% \qquad r_f = 8\% \qquad u = 1.07$$
$$d = 0.85 \qquad X = 0.62 \qquad T = 1 \text{ year.}$$

At the end of the year, the option will be worth either

$$c_{1u} = \max[0, (1.07)(0.60) - 0.62] = 0.022$$

or $$c_{1d} = \max[0, (0.85)(0.60) - 0.62] = 0$$

From (A.10.4) and (A.10.5), the equivalent portfolio can be computed as:

$$B_d = \frac{[-(0.85)(0.022)]}{(1.07 - 0.85)\, e^{0.12}}$$
$$= - \text{US } \$0.0754$$

and

$$B_f = \frac{(0.022)}{(1.07 - 0.85)(0.60)\, e^{0.08}}$$
$$= \text{SGD } 0.1539 = \text{US } \$0.0923$$

Thus, to reproduce the option payoff, buy and deposit SGD 0.1539 financing this acquisition partly by a USD loan of 0.0754 and own cash outlay of US \$0.0169.

Let us check whether this portfolio reproduces the performance of the call option at maturity.

At maturity, the US dollar repayment is

$$B_d e^{r_d} = 0.0754 \times e^{0.12} = 0.0850$$

If the spot rate has moved up, the value of the SGD investment is

$$uS_0 B_f e^{r_f} = (1.07)(0.60)(0.1539)(e^{0.08}) = 0.1070$$

The value of the portfolio is therefore 0.022, identical to the payoff from the call option, c_{1u}. If the spot rate has moved down, the SGD investment yields \$0.0850, exactly enough to repay the dollar borrowing. The value of the portfolio is zero, same as c_{1d}.

The current value of this one-year call option on one SGD must, therefore, equal the own cash outlay involved in acquiring the portfolio, viz. US \$0.0169 i.e. 1.69 cents.

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[30]In a risk-neutral world, an investor would be indifferent between investing S_0 dollars at home and one CHF abroad if $S_0 e^{r_d} = quS_0 e^{r_f} + (1 - q)dS_0 e^{r_f}$. A little manipulation would show that q must equal p defined in equation (A.10.8) in the text.

Extension to a Multi-Period Option

Now suppose the interval T which was assumed to be one year is divided into n "periods", each of length T/n. During each period, the spot rate either moves up by a factor u or moves down by a factor d.

A clear idea of how the binomial model works in a recursive fashion can be obtained by considering $n = 2$. Panel (a) of Figure A.10.1 shows the tree diagram of exchange rate values while panel (b) call option values. In the former, the notation S_{2u2} means the value of the spot at the end of period two, if there have been two up-movements;

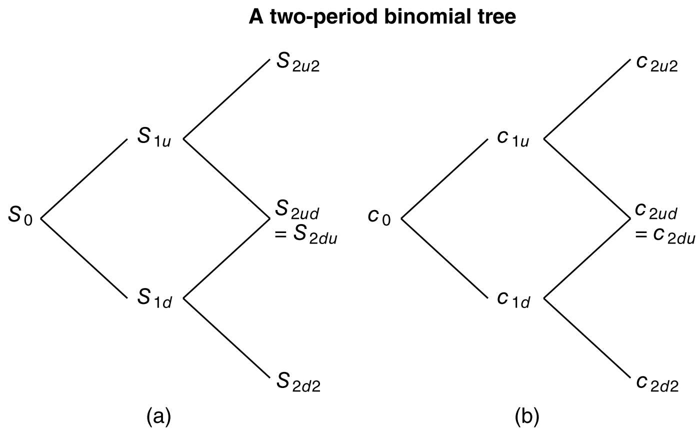

Fig. A.10.1 A Two-Period Binomial Tree

S_{2ud} and S_{2du} mean, respectively, spot rate at the end of period two, if there has been one up followed by one down or one down followed by one up movement, etc. In panel (b), c_{2u2} is the value of call at maturity, if the spot rate is S_{2u2}, etc. Since option value at expiry is higher of zero and intrinsic value, we must have:

$$c_{2u2} = \max[0, (S_{2u2} - X)] \qquad c_{2d2} = \max[0, (S_{2d2} - X)]$$
$$c_{2ud} = \max[0, (S_{2ud} - X)] \qquad c_{2du} = \max[0, (S_{2du} - X)]$$

Now consider call values at the end of period 1. They are denoted c_{1u} and c_{1d} as before. We now apply the one period analysis at the end of period 1. From c_{1u}, the option value can go to c_{2u2} with spot rate moving up in period 2 or to c_{2ud}, if spot rate moves down. To find c_{1u}, we must construct a portfolio which will pay c_{2u2}, if the spot rate moves up or c_{2ud}, if it moves down. Following this procedure, we will obtain an equation like (A.10.7),

$$c_{1u} = \frac{pc_{2u2} + (1 - p)c_{2ud}}{e^{(r_d)/2}} \tag{A.10.9}$$

and similarly,

$$c_{1d} = \frac{pc_{2ud} + (1 - p)c_{2d2}}{e^{(r_d)/2}} \tag{A.10.10}$$

Note that the discounting factor has changed from $e^{(-rd)}$ to $e^{(-rd/2)}$ to account for the fact that r_d is the interest rate per annum whereas now each of our "periods" is half-year. You can easily see that the definition of p has to be changed to:

$$p = \frac{e^{(r_d - r_f)/2} - d}{(u - d)} \tag{A.10.11}$$

Now work back to period 0. The current value of the call is as given in (A.10.7) with c_{1u} and c_{1d} obtained in (A.10.10) and (A.10.11):

$$c_0 = \frac{p^2 c_{2u2} + 2p(1-p)c_{2ud} + (1-p)^2 c_{2d2}}{e^{r_d}} \tag{A.10.12}$$

The numerator of (A.10.12) consists of the sum of possible call values at maturity, each weighted by the probability of its occurrence[31]. Thus, the current value of the call is its expected value at maturity discounted at the risk-free domestic rate of interest.

Now consider n periods to maturity each of length T/n. Let $c_{nu(j)d(n-j)}$ denote the value of the call at maturity, if there have been j up-movements and $(n - j)$ down-movements in the spot rate. The probability of this is given by[32]

$$[n!/j!(n-j)!]p^j(1-p)^{n-j}$$

where the notation $n!$ denotes n-factorial which equals the product

$$n(n-1)(n-2)...1.$$

The payoff from the call is

$$c_{nu(j)d(n-j)} = \max[0, (u^j d^{n-j} S_0 - X)]$$

Hence, the current value of the call option is given by

$$c_0 = \frac{1}{e^{r_d T}} \sum_{j=0}^{j=n} \frac{n!}{j!(n-j)!} p^j (1-p)^{n-j} \max[0, u^j d^{n-j} S_0 - X] \tag{A.10.13}$$

The value of p is given by

$$p = \frac{e^{(r_d - r_f)T/n} - d}{(u - d)} \tag{A.10.14}$$

This can be simplified further by recognizing that for sufficiently low values of j, say $j < k$,

$$\max[0, u^j d^{n-j} S_0 - X] = 0$$

i.e. if the number of upward movements in the spot rate is smaller than some critical value k, the option will finish out-of-the-money and will be worthless at maturity. Hence, the summation in the above equation need go only from $j = k$ to $j = n$. Further, define p' as

$$p' = ue^{-(r_d - r_f)(T/n)}p \tag{A.10.15}$$

and

$$(1 - p') = de^{-(r_d - r_f)(T/n)}(1 - p) \tag{A.10.16}$$

[31] Thus, the call will have value c_{2u2} if the spot rate goes up in each of the two periods. The probability of this is p^2. Similarly, probability of both down moves is p^2. The other two possibilities are an up move followed by down and a down move followed by up. The probabilities are $p(1 - p)$ and $(1 - p)p$ respectively.

[32] This is the probability of j occurrences of an event in n independent trials if the probability of occurrence in any single trial is p and the probability of non-occurrence is $(1 - p)$. This formula is derived in almost all introductory probability and statistics texts.

$$\frac{u^j p^j (1-p)^{n-j} d^{n-j}}{e^{r_d T}} = e^{-r_f T}[upe^{-(r_d - r_f)T/n}]^j [d(1-p)\, e^{-(r_d - r_f)T/n}]^{n-j} \tag{A.10.17}$$

With these modifications, equation (A.10.13) can be rewritten as

$$c_0 = S_0 e^{-r_f T}\Psi(k, n, p') - Xe^{-r_d T}\Psi(k, n, p) \tag{A.10.18}$$

where the function Ψ is the cumulative binomial probability[33]

$$\Psi(k, n, p) = \sum_{j=n}^{j=n} \frac{n!}{j!(n-j)!}\pi^j (1-\pi)^{n-j} \tag{A.10.19}$$

A.10.2 CHOOSING THE PARAMETERS FOR THE BINOMIAL MODEL

The implementation of the binomial lattice model discussed above requires that we specify the parameters u, d, the probability p and the number of intervals into which the period till option expiration is to be divided. This choice cannot be arbitrary because these values imply an expected rate of return per unit time and its variance; these implied values must agree with values estimated from actual data. We now discuss how to choose values for u, d and p.

To begin, the continuously compounded rate of change in the spot rate per period is defined by

$$\rho_{0,1} = \ln(S_1/S_0)$$

Over n periods, $\rho_{0,n} = \ln(S_n/S_0)$

$$= \rho_{0,1} + \rho_{1,2} + \ldots + \rho_{n-1,n}$$

In the binomial model, the one period change from t to $t + 1$ is either

$\ln(uS) - \ln S = \ln(u)$ with probability p, or
$\ln(dS) - \ln S = \ln(d)$ with probability $(1 - p)$

The expected value of the one-period change is

$$E(\rho_{t,\,t+1}) = p\ln(u) + (1-p)\ln(d)$$

and its variance is[34]

$$\mathrm{var}(\rho_{t,\,t+1}) = p(1-p)[\ln(u) - \ln(d)]^2$$

Since the expected n-period change is just the sum of n one-period changes (which are statistically independent) the expected n-period change and its variance are given by

$$E(\rho_{t,\,t+n}) = n[p\ln(u) + (1-p)\ln(d)]$$
$$\mathrm{var}(\rho_{t,\,t+n}) = np(1-p)[\ln(u) - \ln(d)]^2$$

Now suppose we wish to value at time t an option which expires at time $t + T$ with T = 3-month or 0.25 year. We divide the option life into n periods each of length $h = (T/n)$ year.

The expected per annum change in the spot rate is estimated to be μ and its standard deviation to be σ. We must choose values for u, d and p such that over the life of the option, the expected

[33]It is the probability of occurrence of the event at least k times in n trials.

[34]Here we use the well-known result that for a random variable y

$\mathrm{var}(y) = E(y^2) - [E(y)]^2$

(log) change in exchange rate is μT and its standard deviation is $\sigma\sqrt{T}$. This is achieved by choosing the following values:

$$\ln(u) = \sigma\sqrt{h} \qquad \ln(d) = -\sigma\sqrt{h}$$

i.e. set $u = e^{\sigma\sqrt{h}}$ and $d = 1/u$ and

$$p = (1/2) + (\mu\sqrt{h}/2\sigma)\ (1 - p) = (1/2) - (\mu\sqrt{h}/2\sigma)$$

The reader can verify that with this choice, the expected change in the spot rate and its variance over option life do indeed coincide with the desired values[35].

Thus, suppose the estimated proportionate change in exchange rate, μ, is 15% per annum, its standard deviation, σ is 6% and we wish to value a six month option. We decide to divide the six month period into 24 weekly periods so that $h = 0.02083$. The appropriate values for u, d and p are

$$u = e^{\sigma\sqrt{h}} = e^{\mathbf{0.06(0.144326)}} = 1.0087$$

$$d = 1/u = 0.9914$$

$$p = (1/2) + (\mu\sqrt{h}/2\sigma) = (1/2) + [0.15(0.144326)]/0.12 = 0.68$$

As we will see below, the Black-Scholes model assumes that the exchange rate follows a geometric Brownian motion with instantaneous drift rate of μ and standard deviation σ. Then if we choose the following values for u and d, the binomial model with the risk-neutral probability p tends to the Black-Scholes continuous time log normal model:

$$u = e^{[(r_d - r_f)T/n] + \sigma\sqrt{T/n}} \tag{A.10.20}$$

$$d = e^{[(r_d - r_f)T/n] - \sigma\sqrt{T/n}} \tag{A.10.21}$$

This is an extension of a result that has been proved by Cox ***et al.***(1979) in the context of stock option pricing models [See Bodurtha and Courtadon (1987)].

The Black-Scholes model for currency options, derived in Garman and Kohlhagen (1983) also assumes constant domestic and foreign interest rates and leads to the following valuation equation for a European call:

$$c_0(St, t) = Ste^{-r_f(T-t)}N(d_1) - Xe^{-r_d(T-t)}N(d_2) \tag{A.10.22}$$

Here the current time is t, the option matures at time T, time to maturity is $(T - t)$ measured in years[36] and S_t is the current spot rate. As in the text d_1 and d_2 are defined by

$$d_1 = \frac{\ln(S_t/X) + [r_d - r_f + (\sigma^2/2)](T - t)}{\sigma\sqrt{(T - t)}} \tag{A.10.23}$$

$$d_2 = d_1 - \sigma \notin (T - t) \tag{A.10.24}$$

A binomial model for put options can be developed along the same lines. The resulting formula for a European put is

$$p_0 = Xe^{-r_d T}[1 - \Psi(k, n, p)] - S_0 e^{-r_f T}[1 - \Psi(k, n, p')] \tag{A.10.25}$$

where p and p' are as defined above and Ψ is the cumulative binomial function. You can check that the put-call parity relation is satisfied. The continuous time formula is given in the text.

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[35] Actually, the agreement is not exact in the case of variance. However, as h becomes small the discrepancy approaches zero.

[36] This is slightly different from the notation in the text where the current time is t and the option matures at time $t + T$ so that the length of the life of the option is T. The difference has no substantive significance.

It must be noted that in choosing the risk-free interest rates r_d and r_f some care must be exercised. In practice, Treasury bill rates are taken to be risk-free rates. The maturity of the chosen rate must be close to the life of the option, i.e. if the option life is three months, the appropriate rate is that on T-bills with maturity close to 90 days. This is particularly important, if the yield curve is steeply upward sloping. Also remember that T-bill yields are quoted as discount yields and must be converted into their equivalent investment yields before using them in the option pricing models.

A.10.3 AN INTUITIVE APPROACH TO THE BLACK-SCHOLES MODEL

A.10.3 A Valuation with a Discrete Distribution of the Exchange Rate

We have seen that for a European option, the current value is given by the expected value at maturity discounted at the risk-free rate of interest to the current time. Consider a call option on 1 US dollar at a strike price of CHF 1.50. The current spot rate is CHF 1.5000 and the option expires 90 days from now. The risk-free interest rate is 6 per cent p.a. The USD/CHF spot rate at maturity has the following discrete distribution:

S_T	Probability $P(S_T)$
1.30	0.05
1.35	0.08
1.40	0.10
1.45	0.20
1.50	0.20
1.55	0.20
1.60	0.07
1.65	0.05
1.70	0.05

The value of the call option for any S_T is max $[0, S_T - X]$ where X is the strike price. For the above distribution, the expected value of the call at maturity is given by:

$$(1.55 - 1.50)[P(S_T = 1.55)] + (1.60 - 1.50)[P(S_T = 1.60)] + (1.65 - 1.50)[P(S_T = 1.65)] + (1.70 - 1.50)[P(S_T = 1.70)]$$

Recall that for values of S_T below 1.50, the call value is zero.

This expression can be broken down into two parts:

$$\{1.55 \times P(1.55) + 1.60 \times P(1.60) + 1.65 \times P(1.65) + 1.70 \times P(1.70)\} - (1.50)\{P(1.55) + P(1.60) + P(1.65) + P(1.70)\}$$

In general, this can be written as

$$\underset{S_T > X}{\Sigma} S_T P(S_T) - (X)\,[\underset{S_T > X}{\Sigma} P(S_T)] \tag{A.10.26}$$

where, as indicated, both summations are taken over values of $S_T > X$. The first sum is nothing but the mean of the **truncated** distribution of S_T, i.e. mean of S_T over values of $S_T > X$; the second sum is just the cumulative probability of $S_T > X$, i.e. the probability that the option will be in-the-money and hence, will be exercised at maturity. Thus, the first term is the expected inflow on the exercise of the option while the second term is the expected outflow. The difference is simply the expected intrinsic value of the option at expiry.

A.10.3B Valuation for Continuous Distribution

Now let us apply these ideas when the spot rate at maturity, S_T, has a continuous probability distribution with density function $f(S_T)$. Further, S_T can take any non-negative value. If a random variable Y has a continuous distribution with density function $f(Y)$, the probability that $a \le Y \le b$ for given constants a and b is given by

$$\int_a^b f(Y)dY$$

The sums in (A.14.1) are now replaced by the corresponding integrals. The expected value of the call at maturity is given by

$$Et(c_t) = \int_X^\infty S_T f(S_T)dS_T - X\int_X^\infty f(S_T)dS_T \qquad \text{(A.10.27)}$$

The first integral is the mean of the truncated distribution of S_T, over values of $S_T \ge X$ while the second integral is just the probability that the option will be exercised at maturity, i.e. probability that $S_T \ge X$.

The Black-Scholes model assumes that the spot rate S evolves according to the following stochastic process[37]:

$$dS/S = \mu dt + \sigma dz \qquad \text{(A.10.28)}$$

where $dz = \varepsilon\sqrt{dt}$

Here μ and σ are parameters and ε is a random variable which has a normal distribution with mean zero and variance equal to unity (this is known as the "standard normal distribution"). Let us understand the significance of this. On the LHS of (A.10.28) we have the proportionate change in S during a short time interval dt. This consists of two components. The first is a deterministic "drift" equal to μdt; without the random term σdz, we would have

$$dS/S = \mu dt \qquad \text{(A.10.29)}$$

which would give us[38]

$$S_t = S_0\, e^{\mu t}$$

Thus, without the random component, μ can be simply interpreted as the proportionate rate of change of S, i.e. the return on the foreign currency per unit time. However, the second component is random and is superimposed on the deterministic part; it consists of a random drawing from the standard normal distribution multiplied by $\sigma\sqrt{dt}$. Now (dS/S) is itself a random variable and μ has to be interpreted as the **expected** proportionate change in S, i.e. the expected return per unit time. The variance of (dS/S) is $\sigma^2 dt$ and (dS/S) also has a normal distribution.

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[37]This is known as "geometric Brownian motion". It is a special case of a more general class of processes known as "Ito processes".

[38]Equation (A.10.2) is a simple differential equation. dS/S is $d(\ln S)$ where ln is natural logarithm. Thus, the equation becomes

$$d(\ln S)/dt = \mu$$

which has the solution $\ln S = \mu t + k$. Let $S = S_0$ at $t = 0$. Then,

$$k = \ln S_0 \text{ and hence } S_t = S_0\, e^{\mu t}$$

This means that the distribution of the spot rate is lognormal, i.e. the natural logarithm of the spot rate is normally distributed[39]. If S_t is the current spot rate and S_T is the spot rate at time T, then

$$\ln S_T \sim N(\mu_{t,T}, \sigma_{t,T})$$

where $\mu_{t,T} = \ln S_t + [\mu - (\sigma^2/2)](T - t)$

$\sigma_{t,T} = \sigma\sqrt{(T - t)}$

and μ and σ are the mean and standard deviation of the expected proportionate change in exchange rate per unit time.

Now using the properties of the lognormal distribution and after some algebra, it can be shown that

$$\int_X^\infty S_T f(S_T) dS_T = E_t(S_T) N(d_1') \tag{A.10.30}$$

where $E_t(S_T)$ is the expected value at the current time t of the spot rate at maturity (time T), $N(d_1')$ is the cumulative standard normal density – i.e. area under the standard normal density curve to the left of d_1' – and d_1' is given by

$$d_1' = \frac{\ln \dfrac{E_t(S_T)}{X} + \dfrac{1}{2}\sigma^2 t,T}{\sigma_{t,T}} \tag{A.10.31}$$

and

$$\int_X^\infty f(S_T) d(S_T) = N(d_2') \tag{A.10.32}$$

where $d_2' = d_1' - \sigma_{t,T}$

To arrive at the Black-Scholes call option price formula given in the text, we now proceed as follows:

1. Under the assumption that perfectly riskless portfolios can be constructed which replicate option payoff, $E_t(S_T)$ can be replaced by $F_{t,T}$ the forward rate at time t for a contract maturing at T[40].
2. As seen above, $\sigma_{t,T} = \sigma\sqrt{(T - t)}$
3. Using the interest parity theorem, with continuously compounded domestic and foreign interest rates r_d and r_f,

   $$F_{t,T} = S_t e^{(r_d - r_f)(T - t)}$$

4. Finally, the current value of the call option is given by its expected value at maturity discounted at the domestic riskless interest rate r_d over the time interval $(T - t)$. The discount factor is $e^{-rd(T-t)}$.

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[39]To see this, note that (dS/S) is d(ln$S$), the differential of natural log of S – the change in ln$S$ over a small time interval dt. The change in lnS over any finite interval of time (t, T) can be viewed as the sum of such changes and since the sum of normally distributed random variables is also normally distributed, $(\ln S_T - \ln S_t)$ will have a normal distribution.

[40]This assumption permits risk-neutral valuation, i.e. an option can be valued as if all investors are risk-neutral. In such a world, the expected value of the future spot rate must equal the relevant forward rate.

Making these substitutions and using (A.10.29) – (A.10.31) leads to the Black-Scholes call pricing formula given in equation (A.10.22)[41].

A.10.4 VALUATION OF AMERICAN OPTIONS

American options can be exercised before maturity. Under certain conditions, it is optimal to exercise the option rather than keep it alive. This feature complicates valuation of American currency options. In this section, we will provide a brief review of the difficulties and some proposed valuation procedures.

Early exercise becomes optimal when interest rate effects on the option's time value dominate the risk component of time value. Consider a put option on 50000 USD against INR with a strike price of ₹48.00. Suppose the spot rate declines substantially say to ₹40 and the option goes deep into money. On the one hand, the holder can exercise it immediately, realize the intrinsic value of ₹8.0 per USD or a total of ₹400000 and invest this amount to earn interest; on the other hand, he can wait to profit from further possible decline in the spot rate. If the interest foregone is sufficiently large and the option is deeply in the money, so that the probability of it going further into money is very small, the first factor can dominate the second and early exercise becomes optimal. To look at it another way, a long position in a put option on a foreign currency is hedged by borrowing domestic currency, converting it to foreign currency and investing the foreign currency. The net cost of this hedge is the interest paid on home currency loan minus the interest earned on the foreign currency deposit. If the interest rate on domestic currency is considerably higher than the interest rate on the foreign currency, if the American option has gone deep in-the-money option and the expiry date is very close, higher is the probability of early exercise. Similarly, a long call is hedged by borrowing the foreign currency and investing the domestic currency. Higher the foreign interest rate relative to domestic rate, deeper in-the-money option and closer the maturity date, higher the probability of early exercise.

Thus, throughout the life of an American option, the holder must monitor the intrinsic value in relation to the value of the unexercised option. If the former is larger, the option must be exercised. In the text, we said that at any time before maturity, the American call and put must satisfy

$$C_t \geq \max[S_t - X, c_t] \qquad \text{and} \qquad P_t \geq \max[X - S_t, p_t]$$

where C and P denote American option values and c and p denote corresponding European option values. There exists a sufficiently high (low) value of S_t beyond which the intrinsic value of an American call (put) exceeds the value of keeping it alive.

The possibility of early exercise precludes, as of now, closed form solutions to the problem of valuing American options. A variety of numerical procedures have been proposed. Some relevant references are listed in Hull (1989). We will briefly examine the basic idea underlying one of these. [See Buttler (1989)].

The binomial model is eminently suited to application of a numerical solution technique[42]. We begin at maturity and work our way backwards, at each stage comparing the intrinsic value with the value of the option kept alive. Consider a call option with n periods to maturity. Using the notation

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[41]The formula given in the text [equation (10.24)] and the one given in equation (A.10.22) in the appendix are equivalent. You can see this by remembering that $\ln(B_F/B_H) = r_d - r_f$. With this substitution the d_1 and d_2 of equation (10.24) in the text reduce to d'_1 and d'_2 of equation (A.10.30) once $F_{t,T}$ has been substituted for $E(S_T)$.

[42]The technique involves the well known ***dynamic programmimg*** approach.

of the binomial model above, the call value at expiration (end of period n) is:

$$C(n, j) = \max[0, u^j d^{n-j} S_0 - X]\ j = 0,1,...,n \tag{A.10.33}$$

Let $C(n - k, j)$ denote the call value at the end of period $n - k$. From our analysis of the European option, we know that if the option is kept alive,

$$C(n - k, j) = \frac{p[C(n-k+1, j+1] + (1-p)[C(n-k+1, j)]}{e^{r_d^*}}\ j = 0, 1, \ldots n - k \tag{A.10.34}$$

Working backwards, when we arrive at $n - k$, we have already worked out $C(n - k + 1, j + 1)$ and $C(n - k + 1, j)$. Note that the discount factor is based on the interest rate applicable to the single period, denoted as r^*_d. The intrinsic value of the option at n - k, after j up-movements and $n - k - j$ down movements is:

$$(u^j)(d^{n-k-j})S_0 - X \quad j = 0, 1, \ldots n - k$$

Hence, the value of the American call at the end of the period $n - k$ is

$$\boldsymbol{C(n-k, j) = \max\left[u^j d^{n-k-j} S_0 - X, \frac{pC(n-k+1, j+1) + (1-p)C(n-k+1, j)}{e^{r_d^*}}\right]}$$

$$j = 0, 1, \ldots n - k \tag{A.10.35}$$

The process works as follows. At maturity, we know the option value for each value of j. One period prior to maturity, for each value of j, the call value is the maximum of the intrinsic value and the discounted value of the expected value the option will have at maturity starting from that particular state. [Starting from any state at the end of a period, the option, if not exercised, can take two values at the end of the next period depending upon whether the spot rate moves up or down]. Then, we proceed to two periods before maturity and so on till we arrive at the current time.

Other numerical approaches such as finite difference methods and analytic approximations have been proposed. The reader should consult the bibliography at the end of the chapter for relevant references. A number of computer routines are available to implement the numerical procedures. Bodurtha and Courtadon (1987) provide the listing of one such programme.

The cumulative normal function $N(z)$ has to be approximated. There are several approximation formulas available. The following one taken from Figlewski (1990) is very accurate.

$N(z)$ is the probability of getting a value less than or equal to z. The probability of getting a value greater than z is $[1 - N(z)]$. First define:

$w = +1$, if z is positive or zero
$\quad = -1$, if z is negative

$$y = \frac{1}{1 + 0.231649 \times w \times z}$$

To prevent computer overflow, set $z = -6$ if $z < -6$ and $z = 6$, if

$z > 6$.

Then define the following constants:

$C_1 = 2.506628 \qquad C_2 = 0.3193815 \qquad C_3 = -0.3565638$
$C_4 = 1.7814779 \qquad C_5 = -1.821256 \qquad C_6 = 1.3302744$

Then

$$N(z) = 0.5 + w\Big(0.5 - (e^{-z^2}/C_1)\, y\Big(C_2 = y\Big(C_3 + y\Big(C_4 + y\Big(C_5 + yC_6\Big)\Big)\Big)\Big)\Big)$$

A.10.5 PUT-CALL PARITY FOR AMERICAN OPTIONS

In the case of American options, the put-call parity relationship does not lead to an identity. This is due to the possibility of early exercise. We can only derive an upper and a lower bound on the value of an American currency put. At any time t we have the following relationship:

$$C_t + X - S_t B_F \geq P_t \geq C_t + XB_H - S_t$$

To prove this, let us take the first of these inequalities:

$$C_t + X - S_t B_F \geq P_t$$

We will prove this by contradiction. Suppose the contrary is true, i.e.

$$C_t + X - S_t B_F < P_t$$

Form the following portfolio:

1. Sell a put which expires at T.
2. Buy a call expiring at T.
3. Invest X units of home currency in a savings account which pays interest at the going rate.
4. Borrow an amount B_F of foreign currency, i.e. sell a foreign currency discount bond which pays one unit of foreign currency at T.

The total outlay on this, in terms of home currency is

$$-P_t + (C_t + X - S_t B_F)$$

which by assumption is negative, i.e. there is a net gain in acquiring the portfolio. Now we have to deal with two possibilities:

1. The put is exercised before maturity at some time t^* between t and T.
   We liquidate the domestic investment, use X units to buy the unit of foreign currency delivered by the put holder. We are still left with the interest earned on the domestic investment from t to t^*.
   We use a part of the foreign currency obtained to buy back the foreign bond. The price of the bond at time t^* will be less than one unit of foreign currency since the bond pays one unit at T. Thus, we are left with a net profit.
2. The put is held till maturity. The cash flows under the two possibilities, $S_T < X$ and $S_T > X$ are:

	$S_T < X$	$S_T > X$
Value of the short put	$-(X - S_T)$	0
Value of the long call	0	$S_T - X$
Repay the foreign loan	$-S_T$	$-S_T$
Liquidate the domestic investment	X/B_H	X/B_H
Net cash flow	$X[(1/B_H) - 1]$	$X[(1/B_H) - 1]$

Thus, irrespective of the outcome, we end up with a positive cash flow.

Thus, if the inequality $C_t + X - S_t B_F \geq P_t$ is not satisfied, riskless arbitrage profits can be earned. Arbitragers will want to sell puts, buy calls and borrow foreign currency. This would drive down put prices, drive up call prices and raise foreign currency interest rate i.e. drive down B_F. This would drive the markets to restore the inequality $C_t + X - S_tB_F \geq P_t$. Hence, the upper bound on the value of the American put. In an exactly analogous manner, the lower bound can be demonstrated.

A.10.6 CONVEXITY OF OPTION PRICES

Consider three European call options on a foreign currency, all of which expire at the same time T, with strike prices X_1, X_2 and X_3, $X_1 < X_2 < X_3$ and such that X_2 is a linear combination of X_1 and X_3. This means that there is a positive fraction k such that

$$X_2 = kX_1 + (1 - k)X_3 \text{ with } 0 \leq k \leq 1$$

Let c_1, c_2 and c_3 be the premiums of these options. Then we show that

$$c_2 \leq kc_1 + (1 - k)c_3$$

Consider the following strategy:

1. Sell a call on one unit of foreign currency with strike price X_2.
2. Buy a call on k units of foreign currency, strike X_1 and $(1 - k)$ units of foreign currency with strike price X_3. We are assuming that options on fractional amounts can be bought.

The total cost of the option portfolio is $[kc_1 + (1 - k)c_3 - c_2]$.

At maturity suppose

(a) $S_T \leq X_1$

All the three options expire worthless. The payoff to the option portfolio is zero.

(b) $X_1 < S_T \leq X_2 < X_3$

We will exercise the option with strike X_1 which we have bought. The payoff to the portfolio would be $k(S_T - X_1) > 0$, a positive payoff.

(c) $X_1 < X_2 < S_T \leq X_3$

Now we will exercise the option with strike X_1 which we have bought and the option with strike X_2 which we have sold will be exercised against us.
The payoff from the portfolio is

$$k(S_T - X_1) - (S_T - X_2) = X_2 - [kX_1 + (1 - k)S_T]$$

Now recall that $X_2 = kX_1 + (1 - k)X_3$ and $S_T \leq X_3$ by assumption. Hence, the payoff from the portfolio is again positive. Finally, suppose

(d) $X_1 < X_2 < X_3 < S_T$

We will exercise the options with strikes X_1 and X_3 which we have bought; the option with strike X_2 sold by us will be exercised against us. The portfolio payoff will be

$$k(S_T - X_1) + (1 - k)(S_T - X_3) - (S_T - X_2) = X_2 - [kX_1 + (1 - k)X_3] = 0$$

Thus, whatever may be the value of the spot rate at expiry, our portfolio always yields a non-negative payoff, with positive value in some cases. Hence, to prevent arbitrage, it must cost us a positive sum to acquire it today. This means

$$kc_1 + (1 - k)c_3 > c_2, \text{ the result we wished to prove.}$$

As an illustration, suppose we have three European calls on GBP against USD with strike prices 1.5000, 1.7500 and 2.0000. The middle strike price is halfway between the lower and the higher strike i.e. $X_2 = 0.5X_1 + 0.5X_3$. Then the premium for the call with strike $X_2 = 1.75$ will be less than the average of the premiums for the calls with strike prices 1.5000 and 2.0000.

A.10.7 ESTIMATION OF VOLATILITY

In all option pricing models, the standard deviation of the spot rate, σ, is a crucial parameter. Volatility estimation may be done using historical data or implied volatilities can be calculated using observed option prices in conjunction with an option pricing model. Bodurtha and Courtadon (1987) discuss a number of ways to estimate volatility. The discussion below is based on their work.

Historical volatility estimates require an assumption about the probability distribution of exchange rates. The commonly used assumption is that changes in natural logarithm of the spot rate are normally distributed.

Table A.10.1 gives hypothetical daily closing price data on the SGD/USD exchange rate for one month.

Table A.10.1

S_t	$\ln S_t$	$R_t = \ln(S_t/S_{t-1})$
0.6050	–0.5025	
0.6085	–0.4968	0.0057
0.6110	–0.4927	0.0041
0.6092	–0.4956	–0.0029
0.6230	–0.4732	0.0224
0.6145	–0.4869	–0.0137
0.6123	–0.4905	–0.0036
0.6205	–0.4772	0.0133
0.6089	–0.4961	–0.0189
0.6127	–0.4898	0.0063
0.6179	–0.4814	0.0084
0.6334	–0.4567	0.0247
0.6358	–0.4529	0.0038
0.6429	–0.4418	0.0111
0.6278	–0.4655	–0.0237
0.6289	–0.4638	0.0017
0.6560	–0.4216	0.0422
0.6554	–0.4225	–0.0009
0.6479	–0.4340	–0.0115
0.6422	–0.4428	–0.0088
0.6357	–0.4530	–0.0102

Closing price volatility can be calculated as follows:

S_t : closing rate on day t

S_{t-1} : closing rate on day $t-1$

R_t : $\ln S_t - \ln S_{t-1}$

The estimated mean and variance of daily proportionate changes is

$$\hat{\mu} = \frac{\sum_{t=1}^{t=n} Rt}{n}$$

and

$$\hat{\sigma}^2 = \frac{\sum_{t=1}^{t=n} (Rt - \hat{\mu})^2}{n-1}$$

The historical estimate of volatility is the square-root of the estimated variance. For the data in Table A.10.1, it is 0.0157. This is daily volatility. To annualise the estimate, we must multiply it by the square root of 365 (calendar year) or 252 (business year). The resulting values are 0.30 and 0.25, respectively. (Volatility is often referred to in percentages. Thus, these values will be referred to as 30% or 25% volatility.)

These estimates assume that the volatility is constant over the month. An estimate of the expected annual rate of change, continuously compounded is simply 365μ (or 252μ).

In order to allow for changes in volatility some ad-hoc adjustments are suggested. Instead of weighting each observation equally, we can attach greater weight to more recent observations. A simple weighting scheme uses observation numbers as weights when the observations are listed from the oldest to the most recent. Thus, observation number t is given a weight

$$Wt = \frac{t}{\sum_{1}^{n} t} = \frac{t}{\frac{n(n+1)}{2}}$$

The weighted volatility estimate is then

$$\hat{\sigma}^2 w = \frac{\sum_{t=1}^{t=n} [W_t (R_t - \hat{\mu})^2]}{\sum_{t=1}^{t=n} W_t}$$

For the data in the table, this works out to 0.0022. Annualised for a calendar year, it is 0.042.

Still another method suggested by Parkinson (1980) uses the daily high-low price data. This can be used with or without weighting.

Implied volatilities can be calculated from observed market prices. Implied volatilities for different options can be combined into a single weighted measure which can be used to price other options. However, the weighting procedures must be carefully applied to avoid violations of rational arbitrage conditions such as put-call parity.

US Dollar-Rupee Currency Options Contract (USE)

<table>
<tr><td>Symbol</td><td>USDOPT</td></tr>
<tr><td>Instrument Type</td><td>OPTCUR</td></tr>
<tr><td>Size of Contract</td><td>1 contract is for 1000 USD (Lot size)</td></tr>
<tr><td>Underlying</td><td>US Dollar – Indian Rupee spot rate</td></tr>
<tr><td>Quotation</td><td>Premium in Rupee terms. Outstanding position in USD terms</td></tr>
<tr><td>Type of option</td><td>Premium styled European Call and Put options</td></tr>
<tr><td>Tick size</td><td>0.25 paisa or INR 0.0025</td></tr>
<tr><td>Trading hours</td><td>Monday to Friday (9:00 a.m. to 5:00 p.m.)</td></tr>
<tr><td>Available contracts</td><td>Three serial monthly contracts followed by three quarterly contracts of the cycle March/June/September/December</td></tr>
<tr><td>Last trading day</td><td>Two working days prior to the last business day of the expiry month at 12 noon.</td></tr>
<tr><td>Strike price</td><td>Minimum of twelve in-the-money, twelve out-of the-money and one near-the-money strikes would be provided for all available contracts</td></tr>
<tr><td>Strike interval</td><td>25 paise or INR 0.25</td></tr>
<tr><td>Final settlement day</td><td>Last working day (excluding Saturdays) of the expiry month. The last working day would be taken to be the same as that for Interbank Settlements in Mumbai. The rules for Interbank Settlements, including those for ‘known holidays’ and ‘subsequently declared holiday’ would be those as laid down by FEDAI.</td></tr>
<tr><td>Exercise at Expiry</td><td>On expiry date, all open long in-the-money contracts, on a particular strike of a series, at the close of trading hours would be automatically exercised at the final settlement price and assigned on a random basis to the open short positions of the same strike and series.</td></tr>
<tr><td>Position limits *</td><td><table>
<tr><th>Clients</th><th>Trading Members</th><th>Banks</th><th>Clearing Member Level</th></tr>
<tr><td>Lower of 6% of total open interest or USD 10 million across all contracts (both futures and options)</td><td>Lower of 15% of the total open interest or USD 50 million across all contracts (both futures and options)</td><td>Lower of 15% of the total open interest or USD 100 million across all contracts (both futures and options)</td><td>The clearing member shall ensure that his own trading position and the positions of each trading member clearing through him is within the limits specified here</td></tr>
</table></td></tr>
<tr><td>Initial margin *</td><td>The initial margin requirement would be based on a worst scenario loss of a portfolio of an individual client comprising his positions in options and futures contracts on the same underlying across different maturities and across various scenarios of price and volatility changes. In order to achieve this, the price range for generating the scenarios would be 3.5 standard deviation and volatility range for generating the scenarios would be 3%. The sigma would be calculated using the methodology specified for currency futures in SEBI circular no. SEBI/DNPD/Cir-38/2008 dated August 06, 2008 and would be the standard deviation of daily logarithmic returns of USD-INR futures price. For the purpose of calculation of option values, Black-Scholes pricing model would be used. The initial margin would be deducted from the liquid net worth of the clearing member on an online, real time basis.</td></tr>
</table>

(Contd.)

Extreme loss margin	Extreme loss margin equal to 1.5% of the Notional Value of the open short option position would be deducted from the liquid assets of the clearing member on an online, real time basis. Notional Value would be calculated on the basis of the latest available Reserve Bank Reference Rate for USD-INR.
Calendar spreads	A long currency option position at one maturity and a short option position at a different maturity in the same series, both having the same strike price would be treated as a calendar spread. The margin for options calendar spread would be the same as specified for USD-INR currency futures calendar spread. The margin would be calculated on the basis of delta of the portfolio in each month. A portfolio consisting of a near month option with a delta of 100 and a far month option with a delta of – 100 would bear a spread charge equal to the spread charge for a portfolio which is long 100 near month currency futures and short 100 far month currency futures.
Net Option Value	The Net Option Value is the current market value of the option times the number of options (positive for long options and negative for short options) in the portfolio. The Net Option Value would be added to the Liquid Net Worth of the clearing member. Thus, mark to market gains and losses would not be settled in cash for options positions.
Settlement of Premium	Premium would be paid in by the buyer in cash and paid out to the seller in cash on T + 1 day. Until the buyer pays in the premium, the premium due shall be deducted from the available Liquid Net Worth on a real time basis.
Mode of settlement	Cash settled in Indian rupees.

Case Study

I

You are a young derivatives trader. This is your first month on a corporate desk. A long time client with substantial exports to Australia calls up. The client is expecting an inflow of AUD 200 million in six months time.

During the discussion, it transpires that there are no direct options contracts for the dates the client is looking for. The client has burnt his fingers in earlier options contracts, when the market moved against and an American Put got exercised.

You suggest that the client can hedge this by a forward sale, purchase of a put option or by a strategy known as covered call writing. After the day's trading is over you meet the chief trader and discuss this deal. The chief trader is not amused.

Question: Why? Compare the possibilities and explain using options algebra.

II

You succeed in convincing your client to take a suitable option on AUD 100 million and a 6-month forward on remaining AUD 100 million through USD. You are able to make a neat sum through this deal for your company. Once again your chief trader is not happy with you. He is asking what if the portfolio of the client sees large movements. You say you have tested it for delta neutrality.

Question: How will you convince the chief trader?

III

It seems that the chief trader is out to test your knowledge. Now, you are asked to report the impact of cross currency movement on all the greeks of this client's portfolio.

Question: What information do you need? What analysis will you carry out? How will you communicate with client and chief trader?

Chapter 11

Exchange Rate Determination and Forecasting

11.1 INTRODUCTION

An exchange rate is the relative price of one currency in terms of another. It is one of the most important financial variables in a country's macroeconomic scenario and policy agenda along with variables like interest rate and money supply. It influences trade and capital flows across national boundaries, relative profitability of various industries, real wages of workers and, in the final analysis, allocation of resources within and across countries.

Theoretical investigations of determinants of exchange rates have had a long history in international economics. During the Bretton Woods era of fixed exchange rates, the economics profession was preoccupied with analysing the effects of discrete, policy induced changes in levels of exchange rates. It was also an era of segmented capital markets and moderate international capital flows. Effects of exchange rate changes – devaluations and revaluations – were investigated mostly from the point of view of their impact on trade flows and hence on balance of payments. Exchange rate was treated as an exogenous variable, and current account balance as an endogenous variable.

With the advent of floating rates in 1973, attention once again shifted to determinants of exchange rates themselves. Since then, economists and finance theorists have produced a prodigious output of theoretical studies and mountains of (often conflicting and confusing) empirical evidence. New theories continue to be formulated old ones re-examined and more and more sophisticated statistical techniques continue to be employed in empirical investigations. The net result has been more a sense of frustration and general dissatisfaction with the state of exchange rate economics than a clearer understanding of exchange rate behaviour. We now seem to understand, individually, several separate dimensions of the problem of exchange rate determination – role of current account balances, relative monetary growth, inflation differentials, capital flows and asset composition, expectations, "news", and so on – but not how they all tie together. Occasionally, economists seem to despair of ever being able to formulate a comprehensive theory of exchange rates that will explain and predict actual behaviour of exchange rates in the short and the long run. This mood is reflected in the following quotation from Frankel and Rose:

> "….we, like much of the profession, are doubtful of the value of further time-series modeling of exchange rates at high or medium frequencies using macroeconomic models."[1]

With this background, this chapter has a modest goal. We want to provide the reader with a none-too-technical survey of exchange rate determination theories and their empirical performance. We will also examine approaches that eschew all "fundamentals" and try to model exchange rates as a stochastic process. Finally, we want to review exchange rate forecasting methodologies and their forecasting performance.

A corporate finance manager need not necessarily undertake the task of forecasting exchange rates himself or herself. Exchange rate forecasts can be "purchased" from professional forecasting services provided, usually, by commercial banks. However, the manager must have sufficient familiarity with the basics of exchange rate economics to be able to evaluate the forecasts provided by the professionals.

This chapter attempts to equip you with such an understanding.

11.2 SOME FUNDAMENTAL EQUIVALENCE RELATIONSHIPS

Before proceeding to complex theoretical models, we must understand the basic interrelationships between exchange rates, inflation rates and interest rates. One of these, viz. the relation between interest rates and forward premia/discounts has been thoroughly analysed in Chapter 8. We will review the other relations here.

11.2.1 Purchasing Power Parity and Real Exchange Rates

On June 14, 2013 it was reported that on the previous day, the INR exchange rates against some of the major currencies were as follows:

USD/INR: 58.05 EUR/INR: 77.32 GBP/INR: 91.04 JPY/INR: 0.6090 CHF/INR: 62.81

What is the simplest answer one can think of to the question: **Why was a dollar worth ₹58.05, or 95.32 Yen or 0.9242 Swiss franc or 0.6376 Pound sterling on June 14, 2013?**

One possible answer is that these exchange rates reflect the purchasing powers of the currencies, i.e. the basket of goods and services that could be purchased with say one hundred dollars in the US would have cost CHF 92.42 in Switzerland, ₹5805 in India, ¥9532 in Japan and £63.76 in UK. Value of money is determined by what and how much you can buy with it.

One of the oldest doctrines in international economics is the so-called ***Purchasing Power Parity (PPP)*** theory of exchange rates attributed to the Swedish economist Gustav Cassel. It comes in two versions, viz. the ***absolute*** version and the ***relative*** version. We will examine both the versions.

Absolute Purchasing Power Parity

Consider the hypothetical data given below pertaining to the cost of buying a specified basket of goods and services in the USA and Switzerland:

	USA	*Exchange Rate USD/CHF*	**Switzerland**
3/1/2012	A basket costs \$100	1.1054	Same basket costs CHF 110.54
3/1/2013	The basket costs \$104	0.9621	Same basket costs CHF 100.06

[1]Frankel Jeffrey and Andrew Rose (1995): "A Survey of Empirical Research on Nominal Exchange Rates" cited in Obstfeld Maurice (1995): "International Currency Experience: New Lessons and Lessons Relearned", **Brookings Papers on Economic Activity 1:1995.**

On January 3, 2012,

$$S(\text{USD/CHF}) = 1.1054 = P_{\mathbf{SW}}/P_{\mathbf{US}} = 110.54/100$$

On January 3, 2013,

$$S(\text{USD/CHF}) = 0.9621 = P_{\mathbf{SW}}/P_{\mathbf{US}} = 100.06/104$$

Here $P_{\mathbf{SW}}$ and $P_{\mathbf{US}}$ denote price indices[2] in Switzerland and the US respectively, which measure costs of a specified basket of goods and services in those countries in their respective currencies. S is the spot rate expressed as Swiss franc price of a dollar. As a corollary, we must have

$$[1 + (\Delta S/S)] = (1 + \pi_{\mathbf{SW}})/(1 + \pi_{\mathbf{US}}) \tag{11.1}$$

where $(\Delta S/S)$ denotes the proportionate change in the exchange rate and $\pi_{\mathbf{SW}}$ and $\pi_{\mathbf{US}}$ denote inflation rates in Switzerland and the US, respectively over the same period.

This is an instance of absolute purchasing power parity. This is formalized in the following relationship:

$$S = \frac{P_{\text{TRH}}}{P_{\text{TRF}}}$$

Here S is the spot rate expressed as number of units of home currency per unit of foreign currency, $P_{\mathbf{TRH}}$ is the price index in the home country and $P_{\mathbf{TRF}}$ is the price index in the foreign country, both price indices with reference to a common starting point or base year[3]. The ***level*** of exchange rate at any time equals the ratio of purchasing powers of the two currencies.

Underlying the absolute version of PPP is the "law of one price", viz. that commodity arbitrage[4] will equate prices of a good in all countries when prices are expressed in a single common currency. Obviously, this "law" is not valid in practice. Apart from the difficulties of defining a "good" – quality differences, different standards, stylistic differences, etc. – there are transport costs, tariffs and other trade barriers which will prevent equalisation of prices even for goods that are traded between nations. For goods that cannot enter international trade – e.g. construction, services like transportation, personal services, etc. – commodity arbitrage cannot equalise prices even if there are no tariffs[5] and other trade barriers. Thus, presence of such "non-tradable" will cause deviations of the exchange rate from PPP. Anyone who has had a haircut or a visit to a dentist in a city like New York and also in say Mumbai, knows that when translated at the ruling rupee-dollar exchange rate the prices of these services in New York are several times their prices in Mumbai. A haircut in an ordinary salon in New York would probably cost 25 dollars. Translated at the current exchange rate – say about ₹60 per dollar – one can have ten to fifteen haircuts in Mumbai with the corresponding amount of rupees.

[2]These are not really price indices in the usual sense of the word. They are costs of a specified basket in the two countries in their respective currencies. Price indices are also constructed by comparing costs of specified baskets of goods and services between two points in time.

[3]Since the value of both the home and foreign price indices in the base year is taken as 100, the exchange rate in the base year is normalised to unity. S_t therefore is the ratio of the exchange rate in year t to the base year exchange rate.

[4]Commodity arbitrage means transactions involving purchases and sales of a given commodity in different markets to profit from price differences. In the absence of transport costs and trade barriers, if price of a given good differs in two countries, arbitragers would buy where it is cheap and sell where it is more expensive. Such transactions would equalise the prices. Even the possibility of such arbitrage would be enough to keep prices equal without any arbitrage actually taking place.

[5]It is said that even in these cases, cross border movement of ***consumers*** of the commodity can keep prices in line. For instance, if doctors' consultation fees are much lower in Brussels than say Paris, it might be worthwhile for Parisians to drive to Brussels for a medical consultation.

There is another reason why absolute PPP will not, in general hold when the usual price indices such as the Consumer Price Index (CPI), the Wholesale Price Index (WPI) or the GNP deflator are used to measure price levels. Price indices are formed by weighting price changes of individual commodities by weights that reflect the importance of each commodity in the representative basket, e.g. a typical consumption basket in the case of the CPI. Even if the law of one price held without exception, absolute PPP will not hold if consumption patterns and consumer preferences differ across countries as they certainly do[6]. A given product group will receive different weights in different countries and hence a given change in the price of that group will have different impact on the overall index in different countries.

Another factor leading to PPP not being valid is attributed to the so-called Harrod-Balassa-Samuelson effect. It is argued that in richer and faster growing countries productivity tends to be higher than in less developed countries and this productivity difference occurs predominantly in the tradable goods sector due to international competition. However, in these countries wage rates are uniform across tradable and non-tradable goods sectors. When productivity and wage rates rise in the tradable goods sector, price levels in non-tradable goods sector have to rise more than productivity increases to nullify the effect of higher wages not compensated by higher productivity. Since CPI or WPI contain both tradable and non-tradable goods, CPI in developed countries tends to be higher than what is warranted by PPP.

Thus to summarise, apart from the empirical question of whether commodity arbitrage really works in practice, there are a *priori* reasons to expect that the absolute version of PPP will not hold.

Generalized versions of the PPP relationship can be derived to incorporate some of these factors. Thus, suppose the domestic price index P_H is constructed as a weighted average of the prices of non-tradable and tradeables as follows:

$$P_H = \alpha P_{\text{NTH}} + (1 - \alpha)P_{\text{TRH}}$$

Here P_{NTH} and P_{TRH} are, respectively price indices of non-traded and traded goods in the home country and α is the weight attached to non-traded goods in the home country overall price index. Similarly, for the foreign country

$$P_F = \beta P_{\text{NTF}} + (1 - \beta)P_{\text{TRF}}$$

Dividing the home index by the foreign index, we get

$$\frac{P_H}{P_F} = \frac{\alpha P_{\text{NTH}} + (1-\alpha)P_{\text{TRH}}}{\beta P_{\text{NTF}} + (1-\beta)P_{\text{TRF}}}$$

[6]For example, the well-known Laspeyres price index is defined as:

$$P_t = \frac{\Sigma P_{it}Q_{it}}{\Sigma P_{i0}Q_{i0}}$$

where P_{it}, P_{i0} are prices of item i at time t and time 0 respectively with time 0 being the "base" period for the index. Q_{it} and Q_{i0} are quantities consumed in the two periods. This can be written as:

$$P_t = \Sigma W_i\,(P_{it}/P_{i0})$$

Here W_i is the share of item i in the total budget in the base period i.e. $W_i = (P_{i0}Q_{i0}/\Sigma P_{i0}Q_{i0})$. A similar index P_t^* is formed for the foreign country with weights W_i^*. Absolute PPP will hold if

$$S_t = \frac{P_t P_0}{P_t^*/P_0^*}$$

For this it is not enough that $P_{it} = S_t P_{it}^*$ at all t. We also require that $W_i = W_i^*$.

Divide the numerator by P_{TRH} and denominator by SP_{TRF}. According to PPP relation stated above, these two are equal and hence should not change the value of the ratio:

$$\frac{P_H}{P_F} = S\left\{\frac{[\alpha(P_{\text{NTH}}/P_{\text{TRH}}) + (1-\alpha)]}{[\beta(P_{NTF}/P_{TRF}) + (1-\beta)]}\right\}$$

This can be further rearranged to give:

$$S = \frac{P_H}{P_F}\left\{\frac{[\beta(P_{\text{NTF}}/P_{\text{TRF}}) + (1-\beta)]}{[\alpha(P_{\text{NTH}}/P_{\text{TRH}}) + (1-\alpha)]}\right\}$$

Thus, PPP does not hold in terms of overall price indices. The relative prices of tradeables and non-tradeables will have an impact on the exchange rate. For instance, if domestic price of non-tradeables, P_{NTH}, falls relative to tradeables, the home currency will depreciate. This is because if P_{NTH} falls while P_H has remained constant, P_{TRH} must have risen leading to an increase in S according to the PPP relation. An increase in S implies a depreciation of the home currency.

The *Economist*, a widely read business-finance-economics magazine has devised an index known as "The BigMac Index" to assess PPP. Data are collected on the prices of a product called BigMac – a snack marketed by the famous American firm MacDonald's around the world. Its unique feature is that wherever it is sold, the product characteristics are identical so that there is no ambiguity about product quality differences. The price in each country, measured in its own currency is converted into its US dollar equivalent using the spot exchange rate at the time and compared with the price in US on the same day. If the USD price in a country is lower than the price in US, the currency is undervalued vis-à-vis US dollar according to the PPP doctrine. If it is higher, the currency is regarded as overvalued. Exhibit 11.1 gives an extract from such a calculation as of May 2013.

Exhibit 11.1 BigMac Index May 2013

Country	*Big Mac Price*		*Implied PPP rate +*	*Today's Exchange Rate 1 USD =*	*Over(+) / Under(–) Valuation against the USD, % ++*
	in Local Currency	*in US dollars*			
United States	$ 4.20	4.20	—	1.0000	—
Argentina	Peso 20.00	4.64	4.77	4.31	10.67
Australia	A$ 4.80	4.94	1.14	0.97	17.61
Brazil	Real 10.25	5.68	2.44	1.81	35.30
Britain	£ 2.49	3.82	0.59	0.65	–8.91
Canada	C$ 4.73	4.63	1.13	1.02	10.38
India	₹84	1.62	20.01	51.91	–61.44
China	Yuan 15.40	2.44	3.67	6.32	–41.90
Colombia	Peso 8400	4.54	2001.32	1852.15	8.05
Japan	¥ 320	4.16	76.24	76.92	–0.88
Malaysia	Ringgit 7.35	2.34	1.75	3.14	–44.22
South Korea	Won 3700	3.19	881.54	1158.75	–23.92
Euro Area	EUR 3.49	4.43	0.83	0.79	5.56
Singapore	SGD 4.85	3.75	1.16	1.29	–10.62
Switzerland	SFr 6.50	6.81	1.55	0.96	62.14

The third column in this exhibit gives the price of BigMac in the country converted to US dollars at the actual exchange rate ruling at the time. The last column gives what should have been the exchange rate of the currency of the country listed in the first column if PPP as measured by prices of BigMac was valid. Thus, for Argentina, given the price of 20.00 pesos, when the price in US was 4.20 US dollars, the exchange rate dictated by PPP should have been (20.00/4.20) or 4.77 pesos per USD while the actual exchange rate was 4.31 pesos per USD. Hence, we say that the Argentinian peso is overvalued to the extent of [(4.77 – 4.31)/4.31] = 0.1067 or 10.47% as shown in column 5.

Relative Purchasing Power Parity

Consider now the following hypothetical data.

	USA	*Exchange Rate USD/CHF*	*Switzerland*
3/1/12	Basket costs \$100	1.2938	Basket costs CHF 155.26 (=\$120.00)
3/1/13	Basket costs \$105	1.2263	Basket costs CHF 154.51 (= \$126)

Now it is no more true that

$$S_t = P_{\mathbf{SW}\mathrm{t}}/P_{\mathbf{USt}}$$

but it is still true that

$$[1 + (\Delta S/S)] = (1 + \pi_{\mathbf{SW}})/(1 + \pi_{\mathbf{US}}).$$

On both January 3, 2012 and January 3, 2013, we have

$$S_t = k(P_{\mathbf{SWt}}/P_{\mathbf{USt}})$$

with $k \approx (1.0/1.20)$ or 0.8333. Price level in Switzerland is 20% higher than what is required by absolute PPP but it is so ***in both periods***. The ***proportionate change*** in the exchange rate still reflects the inflation differentials between the two countries. Note that (11.1) can be written as

$$\begin{aligned}(\Delta S/S) &= (\pi_{\mathbf{SW}} - \pi_{\mathbf{US}})/(1 + \pi_{\mathbf{US}})\\ &\approx \pi_{\mathbf{SW}} - \pi_{\mathbf{US}} \qquad (11.2)\end{aligned}$$

for reasonably small values of $\pi_{\mathbf{US}}$. In the above example, the US and Swiss inflation rates are, respectively, 5% and –0.48%. Hence $(\pi_{\mathbf{SW}} - \pi_{\mathbf{US}})$ works out to –5.48%. The USD/CHF rate has declined with percentage appreciation of the Swiss franc being 5.22%.

This result is known as relative PPP. In words, it says that the proportionate or percentage change in exchange rate between two currencies *A* and *B* between two points of time (approximately) equals the difference in the inflation rates in the two countries over the same time interval. Transport costs, tariffs, etc. may prevent absolute PPP from holding but the discrepancy remains constant over time.

The fact that some goods do not (and cannot) enter international trade means that even the relative version of PPP can be expected to hold only for traded goods. Therefore, if the price indices used to measure inflation differentials are aggregate price indices, empirical performance of the relative PPP theory would also be adversely affected.

Related to the notion of PPP is the concept of ***Real Exchange Rate***. It is a measure of exchange rate between two currencies adjusted for relative purchasing power of the currencies. Since purchasing power of money is measured with reference to a given time period, it is only the ***changes*** in real exchange rate that have significant economic implications. Let us examine the concept more closely.

At the end of January 2007, the USD/INR exchange rate was 44.01 while at the end of January 1997 it was 35.90. This implies that in nominal terms, i.e. without adjusting for inflation, the rupee depreciated by a little over 22.5% in ten years. But suppose we wish to answer the following question:

> In January 2007, how many rupees worth of purchasing power had to be given up to acquire one dollar worth of purchasing power when both purchasing powers are measured with reference to January 1997?

The following data are available:

> The consumer price index (CPI) in India at the end of January 2007, with January-end 1997 as the base stood at 171 while the CPI in the US with reference to the same base was 128.

This means that ₹44.01 in January 2007 was worth ₹(44.01/1.71) or ₹25.74 of January 1997 purchasing power while $1 in January 2007 was worth $(1/1.28) = $0.7812 of January 1997 purchasing power. Thus, in January 2007, we had to give up ₹25.74 worth of 1997 purchasing power in India to acquire $0.7812 worth of 1997 purchasing power in the US. The real exchange rate in January 2007, with reference to January 1997 was therefore (25.74/0.7812) = 32.95. By definition, the real exchange rate in January 1997 was equal to the nominal rate which was 35.90. ***Thus, in inflation adjusted terms, the rupee has actually appreciated by a little over 8% between start of 1997 and start of 2007*** whereas in nominal terms it has depreciated by over 22% as we saw above. To understand what this implies for competitiveness of exports, consider the following example.

Suppose an Indian exporter was selling a product in US in 1997 priced at 100 US dollars. His rupee revenue would have been ₹3590 which was enough to cover his costs and give him adequate operating margin. Suppose we are now in 2007 and his operating costs have kept pace with Indian inflation. To maintain his operating margin in inflation-adjusted terms, his revenue from exports must increase by a factor equal to the increase in Indian price level between 1997 and 2007. Thus, his export revenue per unit must climb to ₹(1.71*3590) or ₹6138.90. To achieve this at the exchange rate of ₹44.01 ruling in January 2007, he must raise his dollar price in the US market to $(6138.90/44.01) or $139.49. But suppose that competitive pressures in the US market are such that he can at best raise the price by a factor by which US CPI has gone up between 1997 and 2007, i.e. a multiple of 1.28. Thus, if the exporter does not want to be driven out of the US market and maintain his market share he can at best raise the price to $128. At the spot rate ruling in January 2007, $128 brings him rupee revenue of only ₹5633.28. Exporting to US is no more an attractive business proposition.

Define the real exchange rate between currencies A and B as follows:

$$R_t(B/A) = S_t(B/A)\frac{P_t^B}{P_t^A} \tag{11.3}$$

Here, $S_t(B/A)$ denotes, as usual, the nominal exchange rate at time t expressed as units of A per unit of B while P_t^A and P_t^B are price indices (say CPIs) in countries A and B with reference to a common base year. The real exchange rate R_t is also expressed as an index with reference to the same base year. As defined here, an increase in R_t implies **real depreciation** of currency A while a decrease implies **real appreciation**. To understand this, consider this example. Suppose currencies A and B are INR and USD. Suppose between 1997 and 2007, the CPI in US had gone up by 30% while in India it had gone up by 80%. Over the same time period, the USD/INR rate had gone up from 36.00 to 45.00. With 1997 as the base, the real exchange rate in 1997 would be same as the nominal exchange rate viz. 36.00. The real exchange rate in 2007 with 1997 as the base would have been

$$(45.00)[130/180] = 32.50$$

This means that after adjusting for changes in purchasing powers of rupee and dollar, from 1997 to 2007 dollar had declined from ₹36.00 to 32.50 – rupee had appreciated in real terms.

From equation (11.3), it is easily seen that R_t will remain constant if relative PPP holds at all times after the base period[7]. If one can select the base period such that at that time the exchange rate did reflect the relative purchasing power parities of the two currencies and thereafter real exchange rate remains stable, one can conclude that commodity arbitrage is effective in keeping changing exchange rates in line with changes in price levels.

The importance of the real exchange rate concept lies in the fact that changes in it have implications for the relative competitiveness of a country's exports and import substitutes. Recall the example of the jeans exporter from Chapter 3 and the illustrative example worked out above. We saw there that if the exporter can raise the foreign currency price in line with the foreign inflation, if his costs increase in line with domestic inflation **and if the home currency depreciates by an amount equal to the excess of home inflation over foreign inflation,** the exporter's competitiveness in the export market remains unchanged. We now see that the last of these conditions means that the real exchange rate must remain unchanged.

The case of a firm which makes import substitutes can be analysed along similar lines. A real appreciation of the home currency hurts real profitability of producing import substitutes and will channel resources into production of home goods – goods which face no international competition because they are not traded. Thus, real exchange rate determines not only relative competitiveness of exports but also relative attractiveness of producing for international markets versus producing for home markets.

Alternative definitions of real exchange rate are possible each of which is appropriate for analysing a certain class of problems. We discuss the concept of real exchange rate in greater detail in the appendix to this chapter. Dornbusch and Helmers (1988) provide an illuminating discussion of the various concepts and their uses. Hinkle and Montiel (1999) provide a discussion of the various concepts in the context of measuring exchange rate misalignment.

Also, the nominal and real exchange rates we have considered are **bilateral** rates. Changes in $R_t(B/A)$ defined above have implications for competitiveness of A's exports to B vis-à-vis local goods made in B. What about the competitiveness of A's exports in third country markets as well as competitors other than B? The concept of **Effective Exchange Rate (EER)** is utilized to make multilateral comparisons. The concept known as **Nominal Effective Exchange Rate (NEER)** is a measure of the nominal exchange rate of currency A with reference to a basket of currencies. **Real Effective Exchange Rate (REER)** takes into account the changes in nominal exchange rates of the currency A against each currency in the basket as well as differences in inflation rates between the country of currency A and the countries of all the currencies in the chosen basket. Thus, **REER** attempts to capture changes in competitiveness vis-à-vis a group of competitors in world markets rather than pair-wise comparisons. These ideas are briefly discussed in the appendix to this chapter where we also present RBI's methodology for constructing NEER and REER for the Indian rupee.

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[7]From (11.3)

$$\ln R_t = \ln S_t + \ln P_t^B - \ln P_t^A$$

where "ln" denotes natural log. Totally differentiate this to get

$$d\ln R_t = d\ln S_t + d\ln P_t^B - d\ln P_t^A$$

This implies that $d\ln R_t = 0$ if

$$d\ln S_t = d\ln P_T^A - d\ln P_t^B$$

i.e. proportionate change in the nominal exchange rate equals the inflation differential.

Table 11.1 presents data on the nominal and real effective exchange rates of the rupee with 1993-94 as the reference point. The basket includes thirty six countries. Figure 11.1 shows the trends in REER of Indian rupee and Chinese Yuan from 1997 both with reference to a much broader basket consisting of 18 OECD currencies and 30 developing economy currencies mostly from Asia and Latin America. The way this has been constructed, an increase in REER indicates a real appreciation or a fall in the country's export competitiveness and vice versa. This aspect is explained in the appendix to this chapter. As seen in this figure, the REER of the rupee has shown an increasing trend during late 2009 and early 2010 while that of Yuan has remained flat.

11.2.2 Purchasing Power Parity as a Model of Exchange Rate Behaviour

Purchasing power parity is one of the simplest and intuitively most appealing models of exchange rate behaviour. What are its theoretical underpinnings? How does it perform in explaining the past behaviour of exchange rates and predicting future exchange rates? Let us discuss the former question first.

In a world in which there are no transport and other trading costs, no trade barriers, all goods are tradeable and consumers in all countries have identical tastes, PPP is true by definition at least in the long run. In the short run, the question of how rapidly prices of goods and services adjust to real and monetary disturbances has to be settled. If goods prices are "sticky" in the short run – and they are – PPP can still be retained as a **long-run** equilibrium condition as many of the exchange rate models we examine below do.

Once frictions like transport and other trading costs and trade barriers are introduced and consumers' preferences are allowed to vary across countries, things become more complex. PPP as a long-run relationship between nominal exchange rate and the two countries' price levels itself may be open to question[8]. Some of the asset market models of exchange rate also do not require that PPP holds even in the long run[9]. In a world where cross-border capital flows far outweigh financial flows on account of trade in goods and services, the role of exchange rate movements as an equaliser of goods prices does not remain very important.

Table 11.1 Effective Exchange Rates of the Rupee (Annual Average)

Year	*Export-based Weights*		*Trade-based Weights*	
	REER	*NEER*	*REER*	*NEER*
1	**2**	**3**	**4**	**5**
(Base: 1993–94 = 100)				
1993	100.10	99.62	100.10	99.61
1994	103.60	99.30	103.30	99.86
1995	102.60	93.41	101.00	94.07
1996	97.55	88.16	95.41	88.42
1997	102.60	91.72	100.40	91.85
1998	96.36	90.23	94.52	89.11

(Contd.)

[8]Sercu, Uppal and Van Hulle (1995) and Apte, Sercu and Uppal (1999) present equilibrium models of exchange rate in which the long-run relationship involves other variables such as aggregate consumption in the two countries.

[9]On this see Argy (1994): ***INTERNATIONAL MACROECONOMICS*** Routledge, London and New York chapters 8, 19, 20, 30, 31.

1999	94.85	90.58	95.29	90.89
2000	98.07	90.57	99.30	92.19
2001	98.90	89.25	100.90	91.52
2002	96.40	87.57	98.90	90.08
2003	98.17	87.68	99.04	87.60
2004	98.28	87.87	99.68	86.83
(Base: 2004–05 = 100)				
2005	102.45	101.97	102.64	101.90
2006	100.97	98.61	101.23	98.36
2007	107.51	104.39	107.60	103.73
2008	101.34	97.42	101.18	96.48
2009	93.22	90.56	93.04	90.23
2010	102.44	94.80	101.44	93.85
2011	102.34	91.04	100.81	89.62

Note: 1 Data for 2010 and 2011 are provisional.
Source: Reserve Bank of India Report on Currency and Finance 2012-13

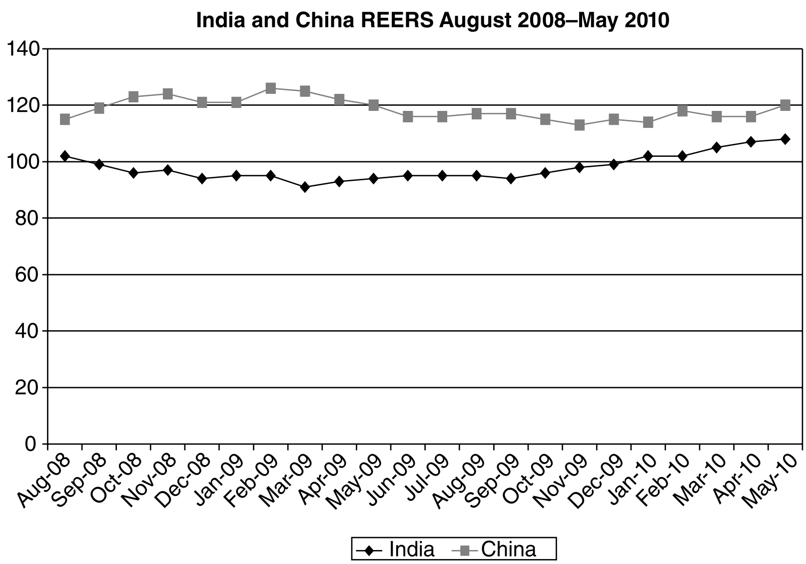

Fig. 11.1

We turn now to evaluation of PPP as an explanatory and forecasting model. Since non-tradable goods are a fact of life, one must first settle the question of which price index should be used to measure the purchasing power of a currency. An index which includes only tradeable goods[10] would be the best but as a practical matter of easy data availability, the Wholesale Price Index (WPI) or Consumer Price Index (CPI) may have to be used as a proxy.

[10]There is a slight complication here. A good may be "tradable" but not actually traded between two countries because of some exogenous constraint.

Next, since prices in goods markets are typically sticky, PPP can be expected to hold, if at all, only in the long run. Also, price indices and nominal exchange rates are non-stationary. Hence, powerful econometric techniques including recent developments in cointegration analysis are needed to test its validity.

There have been numerous empirical investigations of both the absolute and relative versions of PPP. As a description of a (very) long-run relationship, it seems to hold up for a cross-section of currencies. Table 11.2 reproduces an exercise originally worked out in Argy (1994). It provides adequate qualitative support for PPP. According to PPP, countries which have experienced faster inflation than the US over the period 1999-2006 should have experienced their currencies depreciating against the US dollar while currencies of those with slower inflation should have appreciated against the USD. In Table 11.2, if the (CPIR/CPIRUS) ratio is less than (more than) unity, it means that the country has experienced slower (faster) inflation than US. PPP requires that in this case US dollar should have depreciated (appreciated) against that currency over the same period, i.e. the exchange rate stated as amount of USD per unit of that currency should have increased (decreased) and the ERATERATIO reported in the last column should be greater than (less than) unity. Out of the eighteen cases reported in the table, this is violated only in four cases – Japan, Korea, Portugal and Spain. Figure 11.2 provides visual evidence of the long-run validity of PPP. Tests of relative purchasing power parity are often carried out by estimating an equation like (11.4) below[11]:

$$\ln S_t - \ln S_{t-1} = a + b\left[\ln\left(\frac{P_t}{P_t^*}\right) - \ln\left(\frac{P_{t-1}}{P_{t-1}^*}\right)\right] \tag{11.4}$$

and testing the hypotheses that $a = 0$ and $b = 1$. The test can be carried out using time series data for pairs of currencies or using a cross-section sample of currencies. Pilbeam (1998) provides results of estimating equation (11.4) for a number of currency pairs over various time intervals. The results are very mixed with currency pairs involving USD as one of the two currencies showing poor results while currency pairs with DEM as one of the two yielded better results.

Obstfeld (1995) has carried out a test using a cross-section sample. He has estimated the following equation:

$$\log\left(\frac{E_i^{1993}}{E_i^{1973}}\right) = a + b\log\left(\frac{P_i^{1993}/P_i^{1973}}{P_{US}^{1993}/P_{US}^{1973}}\right)$$

Here E_i is the exchange rate of currency i vs. the US dollar defined as units of currency i per US dollar, P_i is the consumer price index for country i and P_{US} is the CPI for US. Over the sample period of 1973-1993, the estimated value of the coefficient b is 1.15 and the coefficient of determination, R^2 is 0.82. Statistically speaking, relative PPP seems to hold up well over horizons as long as 15-20 years. However, over shorter periods of time and using high-frequency time series data, the performance of PPP is quite poor. Figure 11.3 provides informal visual evidence of poor short-run performance of PPP. In this figure, we have plotted monthly (log) changes in the USD/CHF exchange rate and the price ratio $CPI_{Switzerland}/CPI_{US}$ over the period February 2002 to December 2006. It can be seen from the figure that the exchange rate is far more volatile than the relative price ratio. There are significant departures from PPP in the short run.

The literature on testing of PPP over shorter horizons is voluminous. The reader is referred to Obstfeld (1995) for a comprehensive listing of important contributions. Macdonald and Marsh (1999) provide a survey including more recent literature. A brief survey can be found in Salvatore (2001).

[11]This follows from (11.3) since validity of relative PPP implies constant real exchange rate.

The general verdict is that, in the short-run even relative PPP does not hold up well and there are substantial swings in real exchange rates. In fact, over the short to medium term, nominal and real exchange rates seem to be strongly correlated as one would expect if goods' prices respond slowly to real and monetary shocks.[12] Some investigators have estimated that departures from PPP may take as long as 6-8 years to be corrected.

Table 11.2 Inflation and Exchange Rate vs US Dollar 1999-2006

Country	*CPI 1999*	*CPI 2006*	*CPI RATIO*[1]	*CPIR/ CPIRUS*[2]	*ERATE RATIO*[3]
Belgium	97.371	112.854	1.159010383	0.95777825	1.1392
Canada	97.335	114.417	1.175496995	0.97140238	1.3176
Denmark	97.164	112.317	1.155952822	0.95525155	1.1371
France	98.205	112.661	1.147202281	0.94802036	1.1392
Germany	98.62	110.187	1.117288582	0.9233004	1.1392
Greece	97.189	122.733	1.262828098	1.04357075	1.1392
Italy	97.489	115.336	1.183066808	0.97765794	1.1392
Japan	100.366	97.717	0.9736066	0.80456507	0.9656
Korea	97.791	120.475	1.231964087	1.01806548	1.2704
Netherlands	97.713	116.811	1.19544994	0.98789106	1.1392
New Zealand	97.428	116.8	1.198834011	0.99068758	1.2867
Norway	97.006	111.564	1.150073191	0.95039281	1.2055
Portugal	97.273	120.636	1.2401797	1.02485466	1.1392
Singapore	98.67	104.29	1.056957535	0.87344427	1.0723
Spain	96.633	121.171	1.253929817	1.03621743	1.1392
Sweden	98.726	110.716	1.121447238	0.92673701	1.1431
Switzerland	98.465	105.422	1.070654547	0.88476315	1.1452
United Kingdom	99.141	109.909	1.108612986	0.91613109	1.1898
United States	96.743	117.069	1.210103057	1.00000005	

1. The CPIRATIO for each country is the ratio of its 2006 CPI to 1999 CPI. The base year for CPI is 2000.
2. CPIR/CPIRUS is the ratio of CPIRATIO for each country to CPIRATIO for US.
3. The ERATERATIO is the ratio of the exchange rate of the country against USD in 2006 to the exchange rate in 1999. The exchange rate is stated as number of USD per unit of the currency.

It has also been argued that even in the long run, PPP can be expected to hold only if the long-run equilibrium real exchange rate is stationary. This implies that current account balance can be

[12]There is a possibility that the poor empirical performance may be due to biases in measuring movements in price levels. See Apte, Sercu and Kane (1993).

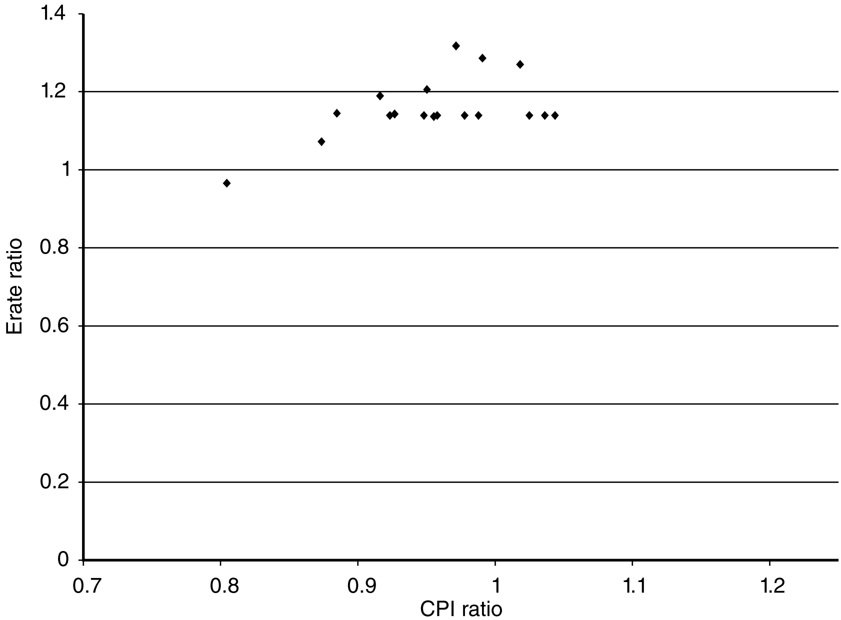

Fig. 11.2 Long-run Behaviour of Exchange Rates and Relative Price Levels

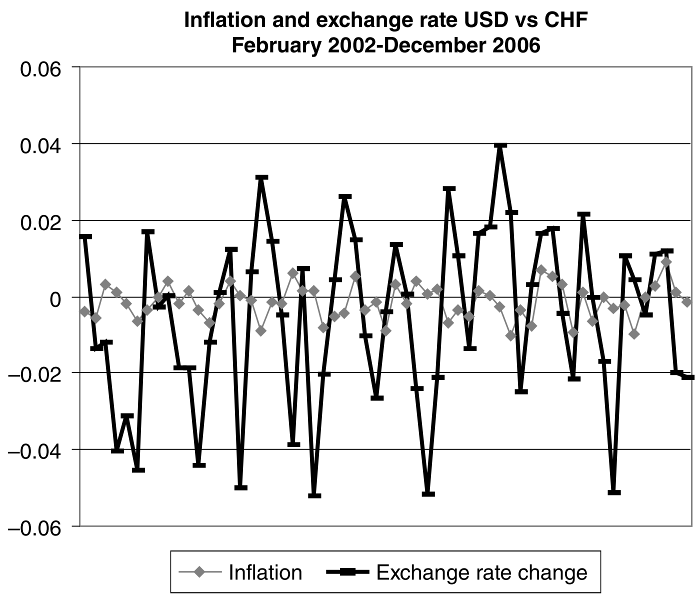

Fig. 11.3

maintained over the long run with a constant real exchange though short-run swings around this long-run equilibrium level may occur.

However, real shocks like productivity improvements, resource discoveries and movements in terms of trade may require that the equilibrium real exchange rate – i.e. the real exchange rate that will lead to a balanced current account – not be stationary but follow an upward or downward trend. In such cases, nominal exchange rate obeying PPP will not restore current account balance.

For instance, suppose Japan persistently experiences productivity improvements faster than its trading partner, say the US. In this case, it is not enough that the JPY/USD exchange rate obey PPP for Japan to have a balanced current account; Japanese yen must appreciate in real terms vis-à-vis US dollar for restoring current account balance. For more detailed discussion of this aspect, the reader can consult Rosenberg (1996).

It is obvious, therefore, that PPP can at best provide some clues for assessing long-run behaviour of currencies. Corporate risk managers have little use for such long-run views; they need to guess currency movements from day to day, week to week and month to month. Traders in banks and other financial institutions have to make guesses about currency movements from hour to hour or even minute to minute. Purchasing power parity is not of much help to them as a currency forecasting model over such short time horizons. Despite this, PPP continues to be an ingredient of many modern theories of exchange rate as we will see below. This is because it provides a theoretically acceptable anchor for the concept of long run equilibrium exchange rate. Also the notion that the "price" of money must be related to what the money can buy has great intuitive appeal.

A questionnaire survey of opinions and views of currency traders in the US reported in Cheung and Chinn (2001) indicates that most of them do not think that PPP is valid over the short term – horizons up to six months – while a larger proportion though not a majority believe that for longer term prediction PPP is a useful concept.

11.2.3 Covered Interest Parity

In Chapter 8, we have examined in detail the relationship between interest differentials and spot-forward margins. We restate here the covered interest parity relation in the absence of transaction costs:

$$\frac{(1+ni_A)}{(1+ni_B} = \frac{F_n(B/A)}{S(B/A)} \tag{11.5}$$

Here i_A and i_B are annualised euromarket interest rates on n-year deposits, $F_n(B/A)$ is the n-year forward rate and $S(B/A)$ is the spot rate both expressed as units of A per unit of B.

11.2.4 Uncovered Interest Parity

Consider a risk-neutral investor. In deciding whether to invest in assets denominated in currency A versus currency B, he will be guided by expected returns after allowing for exchange rate changes. One unit of currency A invested in an n-year deposit would grow to an amount of A equal to $(1 + ni_A)$. If, instead, it is converted to currency B at the current spot rate $S(B/A)$, invested in a n-year B deposit, it would grow to an amount of B equal to $[1/S(B/A)](1 + ni_B)$. If the spot rate expected to rule n-years later is $S^e{}_n(B/A)$, this would translate into an amount of A equal to:

$$\{[1/S(B/A)][(1 + ni_B)]\ S^e{}_n(B/A)\}$$

In a world of perfect capital mobility and risk neutral investors who are guided solely by expected returns, the following condition must hold:

$$(1 + ni_A) = \{[1/S(B/A)][(1 + ni_B)]\ S^e{}_n(B/A)\}$$

which leads to

$$[(1 + ni_A)/(1 + ni_B)] = S^e{}_n(B/A)/S(B/A)$$

Subtracting 1 from both sides

$$[(ni_A - ni_B)/(1+ ni_B)] = [(S^e{}_n(B/A) - S(B/A)]/S(B/A)$$

Since i_B is generally a very small fraction, this can be approximated by the following relationship:

$$ni_A - ni_B = \frac{S_n^e(B/A) - S(B/A)}{S(B/A)} \tag{11.6}$$

Here, S_n^e is the spot rate ***expected*** to rule n years from now and i_A and i_B are interest rates on A and B assets. This is the **Uncovered Interest Parity (UIP)** relationship.

It is to be noted that as in the case of covered interest parity, the UIP condition is ***not*** a causal relationship. It is a capital market equilibrium condition under perfect capital mobility[13]. It only says that in equilibrium, if investors do not care about risk, returns on the two assets and expected exchange rate change must obey a certain relation. Neither is the cause of the other.

Now let us combine the UIP condition with the relative PPP condition. For this purpose, relative PPP must be cast in an **ex-ante** form, i.e. it must be viewed as a relationship between **expected** change in exchange rate and the **expected** inflation differential. Let $\hat{S}^e$ denote the expected proportionate change in the exchange rate[14]. Then relative PPP can be written as

$$\hat{S}^e = \pi_A^e - \pi_B^e \tag{11.7}$$

The famous Fisher equation is a relationship between the nominal interest rate i, the real interest rate r and the expected rate of inflation π^e in any economy:

$$i = r + \pi^e \tag{11.8}$$

Now take the Fisher equation for each of the two countries A and B and the UIP with $n = 1$. Then

$$i_A - i_B = \hat{S}^e = r_A - r_B + \pi_A^e - \pi_B^e \tag{11.9}$$

Using the expected version of relative PPP, viz. (11.7), this implies

$$r_A = r_B \tag{11.10}$$

i.e. perfect capital mobility coupled with risk-neutrality will equalise real rates of interest across countries. This is sometimes called the **Fisher open relation**.

The UIP condition together with the covered interest parity condition implies that the forward rate is an unbiased predictor of the future spot rate[15]. Later in this chapter, we will briefly look at the empirical support for this.

---

[13]Perfect capital mobility requires not only unrestricted cross-border capital flows but also risk-neutral speculation. The A and B country investments e.g. government securities must be regarded as perfect substitutes by the investors. If there is a risk premium in favour of one or the other currency UIP will not hold. This forms the basis of the portfolio balance theories of exchange rate determination discussed later in this chapter. For instance, if there is a positive risk premium in favour of currency B, we have with $n = 1$

$$i_A - i_B = [(S^e - S)/S] + RP$$

where RP is the risk premium.

[14]That is, $\hat{S}^e = (d\ln S)^e$ where the superscript "e" denotes "expected".

[15]Again taking $n = 1$, the covered interest parity condition can be stated as

$$i_A - i_B = \ln F(A/B) - \ln S(A/B)$$

The UIP says: $i_A - i_B = \ln[S^e(A/B)] - \ln S(A/B)$

where S^e denotes expected future spot rate. These are obtained by using the approximation $\ln(1 + x) = x$. These two together imply $S^e(A/B) = F(A/B)$.

Coming back to the UIP condition (11.6), with $n = 1$, let us re-write it as:

$$S(A/B) = \frac{S^e(A/B)}{1+(i_A - i_B)} \tag{11.11}$$

This says that the current spot rate is determined by the expected future spot rate and the interest rate differential. Can this help us predict how the spot rate will respond to changes in interest rates? Let *B* refer to Euro and *A* to US dollar. Suppose the European Central Bank (ECB) hikes the discount rate i_B; can we say that this will lead to appreciation of the Euro against the US dollar? The answer is, it depends upon what impact this policy action has on market's expectation regarding the future spot rate viz. $S^e(A/B)$. If the market interprets the ECB action as a sign of monetary tightening which will lead to slower inflation in the Eurozone, the expectations effect will reinforce the interest rate hike and the Euro will appreciate. However, if the increase in i_B is interpreted as a signal that ECB is anticipating faster inflation in the months to come, and therefore tightening monetary policy, $S^e(A/B)$ may rise and negate the interest rate effect; currency *B*, Euro, may in fact depreciate.

There are at least four reasons why perfect capital mobility cannot hold and hence the UIP condition would be violated. First, investors are risk averse and therefore would not be guided only by expected returns. Since exchange rate changes are uncertain, they would be willing to sacrifice some return in order to reduce risk. Thus suppose dollar assets pay 4% p.a. while pound assets pay 8%. The ***expected*** appreciation of the dollar against the pound is 6% p.a. Risk neutral investors would put all their wealth in dollar assets and even borrow pounds to invest in dollars; however risk-averse investors would diversify their portfolios. Second, even if all investors are risk-neutral, they could have differing views about future exchange rate movements. In the above example, there might be a group of risk neutral investors who expect the dollar to appreciate by more than 4% while another group might expect the appreciation to be less than 4%. The former would shift their entire wealth to dollar assets while the latter would shift to pounds. UIP would not be required to achieve equilibrium. Third, transaction costs and liquidity needs would force people to hold some of their wealth in the currency of their operating habitat even though the expected return on a foreign currency is higher. Finally, exchange controls may prohibit portfolio shifts between currencies and interfere with realization of UIP.

Tests of UIP have at best produced weak evidence in its support. This has been primarily attributed to the existence of risk aversion on the part of global investors. Further, it is argued that the magnitude and sign of the risk premium they demand varies over time. Hence, we must have a model to explain this time-variation of risk premium. This has been a topic of considerable empirical investigation for many years.

11.3 STRUCTURAL MODELS OF EXCHANGE RATE DETERMINATION

Exchange rate theory has occupied some of the best minds in the economics profession during the last couple of decades. At one end of the spectrum, there are relatively simple flow models that view exchange rate as the outcome of the equilibrium between flow demands and flow supplies of foreign exchange arising out of imports and exports. At the other extreme, there are very sophisticated (and complicated) asset market models which focus on investors' expectations and risk-return preferences which govern their asset allocation decisions. Exchange rate theory presents the student with a vast and bewildering menu to choose from. Some attempts have been made to synthesise the various partial models into a comprehensive account of exchange rate determination.

Detailed and rigorous discussion of the various exchange rate determination theories is beyond the scope of this book. Nor is it required for our purposes. Victor Argy's comprehensive work [Argy (1994)] is an excellent reference for obtaining a broad perspective on the rich variety of structural models of exchange rate. A survey can be found in MacDonald and Taylor (1993). More recent literature has been surveyed in MacDonald and Marsh (1999). A very lucid discussion of some of the modern theories of exchange rate movements is contained in De Grauwe (1989). A recent exposition of exchange rate forecasting techniques which also discusses the standard exchange rate models is Moosa (2000). Rosenberg (2003), Gandolfo (2004) and Copeland (2005) provide a comprehensive and accessible treatment of all the major theories of exchange rate. We will give brief, mostly non-technical exposition of the key ideas in the text and provide some technical details in the appendix to this chapter.

An exchange rate is the relative price of one currency in terms of another. In a world of market determined floating exchange rates, like all prices, it should be determined by forces of supply and demand. The problem is to correctly model all the factors that influence the demand for and the supply of a currency. An added complication is the fact that foreign exchange is an asset with negligible storage costs. Like all such assets, its price at any time–the spot exchange rate–is heavily influenced by expectations regarding the future course of the price and these expectations in turn are very sensitive to economic events, political developments, resource discoveries, technological developments and so forth. The markets may be subject to occasional speculative bubbles that defy all fundamental analyses. Due to availability of highly sophisticated communications technology, information spreads to all the participants very rapidly and the reaction time of market participants is very short. Highly efficient electronic funds transfer systems permit huge movements of funds in and out of a currency in a very short time. Of course, sometimes this can prove to be a double-edged sword. Technology is neutral between information and misinformation and will disseminate both "at the speed of thought". The following story narrated by a very senior and experienced foreign exchange expert illustrates how badly forex dealers can occasionally get misled and how fortunes could be lost (or made) on account of such misunderstanding:

> " ... I will never forget the day in 1982 when the news screens issued a warning that their news carrier service was not updating. American systems transmitted 'carrier down' across their screens. At that time Britain was at war with Argentina and had a number of aircraft carriers involved in the South Atlantic. The sterling trader in our office saw this message and incorrectly took it to mean that one of these vast ships had been sunk. 'Sell! sell! sell!' he cried and rapidly sold 200 million pounds before discovering it had nothing to do with the navy."[16]

One wonders whether the resulting losses to the bank might have been enough to finance a new aircraft carrier!

Getting back to demand-supply analysis of exchange rate determination, demand for a foreign currency originates in:

1. Residents of home country wanting to import foreign goods and services.
2. Residents of the home country wishing to acquire assets, both real and financial denominated in the foreign currency and wishing to service foreign currency liabilities incurred earlier.
3. Central banks intervening in the foreign exchange market to buy the foreign currency perhaps because the central bank thinks that currency of its own country is overvalued.

[16] John Bowen quoted in "Technology and Global Financial Markets – A Marriage Made in Heaven or a Witches' Brew?" IIMB Management Review, March 2000, Indian Institute of Management Bangalore

In a more general setting, one can say that demand for any given currency in the world markets arises from private sector entities – households and firms – wishing to hold assets (including transaction balances to pay for goods and services) denominated in that currency, central banks wishing to hold a part of their reserves in that currency or intervene in the market to prevent the fall of that currency against their home currency.

Similarly, supply of the foreign currency originates in foreigners wishing to buy home country goods and services, acquire home currency denominated assets or service liabilities and central bank intervention. Exchange rate is the equilibrium price that equates these demands and supplies.

Different models of exchange rates differ in the emphasis they put on the different components of demand for and supply of a currency. Early theories, proposed and developed in the days when cross-border capital flows were rather small, emphasise demand and supply arising out of current account transactions, viz. imports and exports of goods and services. Later, as restrictions on capital flows were gradually eliminated, it became obvious that at least the short run behaviour of exchange rates is dominated by capital account transactions, i.e. asset allocation and portfolio reshuffling by international investors. More recent theories of exchange rate behaviour, therefore, have tended to emphasise the view of exchange rates as prices of assets denominated in different currencies which equilibriate asset demands and supplies. The need to integrate the two approaches has been recognised. After all, just as income statement of a firm is linked to the balance sheet, balance of payments surpluses and deficits alter distribution of wealth and hence, influence asset demands and supplies in the long run[17]. Attempts at synthesis have been directed at taking account of this link.

11.3.1 Flow Models of Exchange Rate Determination

A simple model of exchange rate determination with floating rates is depicted in Figures 11.4, 11.5(a) and 11.5(b).

Figure 11.4 shows the equilibrium in the Rupee-Dollar market. The demand for dollars arises from imports of goods and services from US into India. The supply curve arises from India's exports to the US. The figure shows the case when the price elasticity of demand for Indian goods and services in US is greater than unity.

Figures 11.4(a) and 11.4(b) show the case when it is less than unity[18].

The former yields a stable equilibrium while the latter may lead to an unstable equilibrium[19]. It must

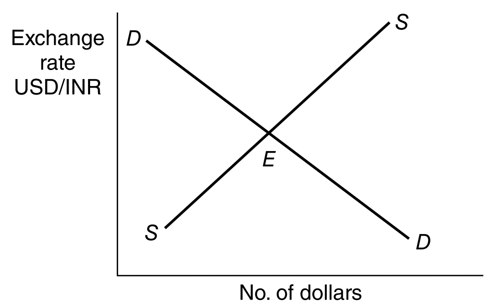

Fig. 11.4 Demand-Supply Model of Exchange Rate

[17]Balance of payments disequilibria may also alter expectations regarding the future course of exchange rates and have an impact effect on exchange rates.

[18]The importance of demand elasticity can be understood by examining what happens to the number of dollars Americans would spend on Indian goods and services as the INR-USD exchange rate changes. Assume that INR prices of Indian goods remain fixed and the INR depreciates. Dollar prices of Indian goods in the US decrease. From elementary microeconomic theory, we know that if the elasticity of Americans' demand for Indian goods is less (more) than one, the number of dollars spent by Americans on Indian goods will decrease (increase).

[19]The equilibrium is stable if a small movement away from it sets up forces which push the price back to equilibrium. This is true of the cases shown in Figures 11.4 and 11.5a. If price of dollars increases above the equilibrium, supply of dollars exceeds demand and price moves back to equilibrium. Similarly, if price falls below equilibrium, it is pushed back to equilibrium. This is not the case in Figure 11.5b. Here as price rises above (falls below) equilibrium, supply decreases (increases) more than the demand and price rises (falls) further. This is an unstable equilibrium.

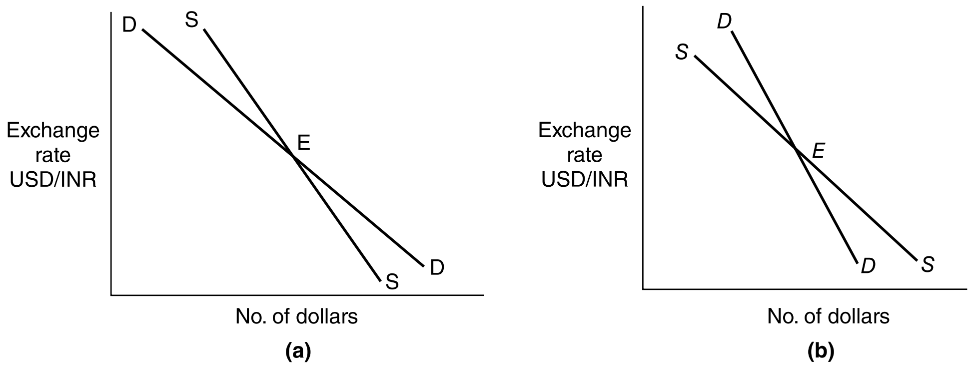

Fig. 11.5 Demand Supply Model with Reverse Supply Curve

be pointed out here that not all flows on current account arise out of exports and imports. Interest payments and receipts on foreign liabilities and assets belong to the current account but do not depend upon current exchange rate; similarly items like unilateral transfers also do not depend upon exchange rate. Flows arising on this account must be added to the flows arising out of merchandise trade.

The main difficulty with this account of exchange rate determination is its total neglect of capital account. Also, being a static model, it neither allows for lags nor for influence of expectations on exchange rate.

The well-known Mundell-Fleming model attempts to correct the first of these omissions by including capital flows. Capital flows are viewed as depending upon the interest rate differential between the home country and the rest of the world. The domestic economy is assumed to be characterised by Keynesian unemployment so that output can be expanded at a fixed price level. The model then determines the exchange rate and the interest rate to achieve simultaneous equilibrium in the goods market, the money market and the balance of payments (current plus capital account). The model represents extension of the conventional IS-LM analysis to an open economy. The appendix to this chapter provides a more detailed exposition of the Mundell-Fleming model and some of its extensions.

This account of exchange rate determination too is unsatisfactory. The assumption of fixed domestic price level is questionable, but can be easily relaxed. A more serious difficulty is the specification of capital flows. The simple version of Mundell-Fleming model assumes that a given interest rate differential in favour of (against) the home country will lead to continuing capital inflows (outflows) year after year. This cannot be so. As we know from portfolio choice theory, a given configuration of returns and risk on various assets results in a specific allocation of investor wealth; a change in expected return caused, for example, by a change in home country interest rate will give rise to a reshuffling of portfolios – a one time adjustment that will give rise to a temporary capital inflow or outflow and not continuing capital flows. Finally, as we have seen in our discussion of UIP, asset allocation is influenced by nominal interest rates **and exchange rate expectations.** Like the current account model above, the Mundell-Fleming model also allows no role for expectations or at best, permits exogenous expectations.

The basic Mundell-Fleming model can be extended in various ways to remove some of its drawbacks. The interested reader can consult Argy (1994).

11.3.2 Asset Market Models

In contrast to the flow-equilibrium models, asset market approach to exchange rate determination, which gained prominence in the late 1970s stresses that the equilibrium exchange rate is that rate at which the market as a whole is willing to hold the given stocks of assets denominated in different currencies. This approach treats the foreign exchange market like any other highly organised market for financial assets such as the stock market or the bond market.

The asset market approach has given rise to a variety of formulations. We will look at three important models which by now have become part of the received wisdom in exchange rate economics.

The Current Account Monetary Model

This approach to exchange rate determination is a reformulation of the famous monetary approach to balance of payments which originated at the University of Chicago in the early seventies and, for some time, was the official creed espoused by the IMF.

The central ideas of a simple version of this approach can be summarised as follows[20]:

- There is only one asset, viz. money. Domestic money is held only by domestic residents and foreign money by foreign residents.
- Purchasing Power Parity holds. The foreign price level is exogenous (home country is "small"). In other words, developments in the home country have no effect on the price level in the foreign country.
- In each country, there is a stable demand-for-money function. This means that demand for real money balances depends upon a few variables like real income and nominal interest rate, and the parameters of this relationship do not fluctuate over time. Foreign real income and interest rate are exogenous.
- Fully flexible exchange rates keep balance of payments in continuous equilibrium. Consequently there are no changes in foreign exchange reserves. Nominal money supply is therefore determined entirely by domestic credit creation which is totally under the control of monetary authorities.

Given these assumptions, the core of the model is the assertion that domestic residents, when faced with a discrepancy between the stock of (domestic) money they wish to hold and the actual stock of money created by the monetary authority, will attempt to correct it by running a balance of payments deficit or surplus. If there is excess supply of domestic money – for instance, the central bank creates money to finance large fiscal deficits of the government – they will try to get rid of it by purchasing domestic goods as well as importing foreign goods and services and vice versa. This will instantaneously lead to a pressure on the domestic price level and depreciation of the exchange rate. In the reverse case, if there is excess demand for home currency due to rising real income or low interest rate, domestic currency will appreciate. The detailed derivation of the monetary model is provided in the appendix. Here we only reproduce the final equation:

$$s = k + (m_A - m_B) - \varphi(y_A - y_B) + \lambda(i_A - i_B) \tag{11.12}$$

Here, s denotes the (natural) logarithm of the exchange rate stated as amount of home currency (currency of country A) per unit of foreign currency (currency of B), m_A, y_A are, respectively logarithms of nominal money stock and real income in country A while i_A is the nominal interest rate in country A. Similarly, m_B, y_B and i_A denote the same variables for country B.

[20] What we are presenting here is the simplest version of the monetary approach. More sophisticated versions exist. See for instance Frenkel and Mussa (1985).

When money supply in country A rises, other things remaining the same, s rises, i.e. currency of A depreciates. What is the mechanism? Real income in A is assumed to be unchanged so that the demand for real balances is unchanged; as money stock rises, A residents attempt to get rid of the excess money by acquiring foreign goods (and non-money assets). This increases the demand for the foreign currency B and leads to its appreciation, i.e. S rises. Given foreign prices P_B, home currency prices of foreign goods SP_B rise; goods arbitrage leads to an increase in the domestic price level P_A to restore PPP. Rise in P_A brings the stock of real balances, viz. (M_A/P_A) into equality with demand for real balances[21]. You might wonder as to why the domestic nominal interest rate does not fall increasing the demand for real balances. The answer will be given shortly.

An increase in domestic interest rate i_A, according to equation (11.11), **depreciates** the A-currency. This result is counterintuitive and opposite of what one reads in many financial media, viz. governments increase interest rates to prevent depreciation of their currency, hoping to attract foreign capital. The resolution of the apparent paradox lies in the implicit assumption of the model, viz. that UIP holds[22]. The nominal interest rate in A can rise (given i_B), only if the expected depreciation of the A currency increases[23], i.e. in the monetary model, the nominal interest rate cannot change independently of exchange rate expectations. If expected depreciation of A-currency increases when i_A rises, there would then be no incentive to switch into A-denominated assets and no capital inflow. The reduction in demand for real balances caused by the increase in i_A, results in depreciation of A's currency.

The current account monetary model has been subjected to extensive empirical testing. The results have been generally disappointing. However, it has been found that during episodes of hyperinflation, the model works quite well since money supply changes tend to swamp all other influences on exchange rates and prices. Since PPP forms an important ingredient of the model, it has been independently subjected to tests by a large number of investigators. Once again, both in the absolute and relative form, PPP performs poorly. Deviations from PPP appear to take a long time to be corrected. MacDonald (1988) and Macdonald and Taylor (1992) provide a review of the empirical evidence.

The model can be extended in a number of ways. The term $(i_A - i_B)$ in equation (11.12) can be replaced by the spot-forward margin since as we have seen that the interest rate differential approximately equals the forward premium/discount. Alternatively, using UIP, the same term can be replaced by expected change in the spot rate. As we will see below, introduction of expectations can lead to a forward-recursion relation in which today's spot rate is related to today's "fundamentals" such as money stocks and real incomes as well as to expectations about the future evolution of these fundamentals.

Capital Account Monetary Model

The assumption of PPP even in the short run as well as the counterintuitive prediction about the effect of interest rate changes on exchange rate have often been cited as serious weaknesses of the current account monetary model. Extensions of the monetary model allow for short run departures from PPP and attempt to distinguish between those changes in interest rate which only compensate for changes in inflationary expectations and those which are due to changes in monetary tightness.

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[21] Actually the price level in the home country depends both on the price of home goods P_A and the price of imported good P_B. However, this does not affect the analysis in the text.

[22] The argument that follows is attributed to Haache and Townsend (1981).

[23] Thus, i_A might have risen because of an upward revision of expected inflation in A. By PPP, this would also lead to higher expected depreciation of A.

The short-run "stickiness" of goods prices can produce what is known as "overshooting" of exchange rate beyond its long-run equilibrium value.

We will describe here a model along these lines due to Frankel (1979). A precursor of this model is the famous "Dornbusch overshooting model" [Dornbusch (1976)] which is briefly discussed in the appendix.

The main ingredients of the Frankel model are:

- PPP holds in the long run.
- There is a stable demand-for-money function in each country.
- Uncovered interest parity and the Fisher open conditions hold.
- Expected change in the exchange rate in the short run depends upon perceived departures from long run equilibrium exchange rate and expected inflation differentials.

The final equation of the Frankel model is given below. In the appendix, we have provided the details of its derivation and its relation with the Dornbusch overshooting model.

$$s = \hat{m}_A - \hat{m}_B - \theta\varphi(\hat{y}_A - \hat{y}_B) + \alpha\alpha(i_A - i_B) + \beta(\pi_A^e - \pi\pi_B^e) \tag{11.13}$$

In this equation symbols with a "^" over them denote the long run values of the corresponding variables, e.g. $\hat{y}$ denotes long run real income. In empirical implementation of this model, current values of real incomes and money supplies are used in place of long run values.

The Frankel model predicts (like the current account monetary model) that an increase in money supply will depreciate the exchange rate in the long run while an increase in real income will lead to an appreciation. The effect of an increase in interest rate depends upon whether it is caused by "monetary tightness" or by an upward revision of inflationary expectations. In the former case, the home currency appreciates while in the latter case it depreciates.

Portfolio Balance Models

The monetary approach ignores all other assets except money. It is implicitly assumed that markets for domestic and foreign bonds always clear. The assumption of UIP implies that domestic and foreign bonds are regarded as perfect substitutes by the investors in both the countries. In contrast, portfolio balance models recognize first, that asset choice must be modeled as a portfolio diversification problem i.e. given total wealth, investors divide it between various assets – domestic and foreign money, domestic and foreign bonds, etc. – based on their expected returns and, second, that assets denominated in different currencies are not perfect substitutes. A non-zero risk premium will generally exist in favour of (or against a currency) so that UIP does not hold. Full-blown versions of the portfolio balance model also take account of the link between current account balance and asset demands.

The various versions of the portfolio balance theories of exchange rate utilise the well-known mean-variance portfolio selection framework.

Risk-averse investors diversify their portfolios across the available assets so that risk-adjusted return is equalised between different assets. The key is to recognize that in a well-diversified portfolio, an asset's contribution to portfolio risk depends upon the covariance of its return with the portfolio return. Hence, the proportion of total wealth invested in a particular risky asset depends upon its expected return and its covariance with portfolio return. The technical details of the mean-variance approach can be found in the appendix to this chapter. As the supply of an asset changes, its expected return is altered and investors reshuffle their portfolios. This leads to changes in demands for individual assets and, given their supplies, changes in their prices.

In an international framework, the expected return from a foreign currency asset is determined by its expected return in its own currency plus the expected change in the exchange rate. Suppose an American investor holds risk-free[24] domestic assets, e.g. US treasury bills and bonds, risky domestic assets, e.g. stocks in US firms and risk-free GBP assets, e.g. UK gilts. Now suppose the British government issues fresh bonds. Under what conditions would the investors be willing to hold the increased supply of UK bonds denominated in GBP? At the old exchange rate, US investors will find that if they purchase more UK bonds, they are holding too large a proportion of their wealth in foreign assets and too small a proportion of domestic assets. In their attempt to rebalance their portfolios, they will sell UK government bonds and buy US risk free and risky assets. This will drive down the GBP against the US dollar and/or raise interest rates in the UK and lower interest rates in the US. The changes in interest rates would alter the desired holdings of dollar and sterling assets. This would restore the relative weights of the two assets in investors' portfolios. The change in the supply of foreign assets affects not only the returns on all assets denominated in their own currencies but also the expectations regarding the future movements in the exchange rate. As we have seen above, such changes in exchange rate expectations immediately impact the spot rate.

The link with current account should also be obvious. When Japan runs a current account surplus versus the US, Japanese investors' total wealth as well as their ownership of US dollar assets rise. In their attempts to rebalance their portfolios, they will affect US and Japanese interest rates and the JPY/USD spot rate.

We will not discuss formal portfolio balance models here. In the appendix to this chapter, we will present a simplified portfolio balance model due to Branson. The reader can consult, among others, Argy (1994) and MacDonald and Taylor (1992). We will bring out the difference between portfolio models and monetary models by a couple of examples.

Consider first an open market sale of government securities by the monetary authority. In the monetary model, the resulting contraction of money supply leads to an appreciation of the home currency. In the portfolio balance approach too, the home currency appreciates, but via two distinct channels. Reduction in domestic money supply raises its price in terms of foreign currency as in the monetary model; also an increase in the supply of domestic bonds reduces their price, i.e. increases domestic interest rate. This causes demand for domestic bonds to increase to maintain asset allocation equilibrium. This causes further appreciation of the home currency[25].

Now consider an increase in real income. In the monetary approach, this increases demand for domestic money and hence appreciates the exchange rate. In the portfolio balance approach, there is a counteracting factor. Total savings increase causing a greater increase in demand for domestic bonds than foreign bonds. The price of domestic bonds increases more than that of foreign bonds. Hence, domestic interest rate falls more than the foreign interest rate causing investors to switch from domestic to foreign bonds which depreciates the currency.

Unfortunately, there have been few satisfactory, operational and empirically testable versions of the portfolio balance approach. Their empirical performance in predicting exchange rate movements has also been not significantly better than other structural models.

Expectations, the Efficient Markets Hypothesis and the Role of "News"

As stated above, foreign currency is a durable asset with insignificant storage cost and which is continuously traded in a spot market. In this respect currencies are very similar to, for example,

[24]By risk-free, we mean here free of default risk, e.g. government securities.

[25]Note here that there is no net increase in the supply of domestic bonds.

common stock[26]. For such assets, current prices are heavily influenced by expectations regarding future price movements. Any new pertinent information alters traders' views regarding future course of prices and is immediately reflected in the current price.

The last sentence in the previous paragraph underlies the **Efficient Markets Hypothesis (EMH)**. A market is said to be efficient if the current price fully and instantaneously reflects all available information[27]. If the market is efficient, the current price would immediately "jump" in view of the changes in expectations as new information arrives; if it did not, excess profit opportunities would arise.

In efficient markets, prices will be heavily influenced by "news." Recall the "carrier down" story cited above. In our context "news" means any **unanticipated event.** The following brief analysis brings out the importance of expectations and unanticipated events[28].

Assume for a moment that the current account monetary model is the "true" model of exchange rate determination[29].

Reproduced below is the final reduced form of equation (11.12): $s_t = k + (m_{At} - m_{Bt}) - \varphi(y_{At} - y_{Bt}) + \lambda(i_{At} - i_{Bt})$ (11.12) reproduced

We have put an explicit time index on all variables with "t" being the current time. Using UIP, replace $(i_{At} - i_{Bt})$ by $(s_t^e - s_t)$ where

$$s_t^e = E_t(s_{t+1})$$

i.e. the expectation at time t, of the spot rate at time $(t + 1)$.

$$s_t = k + (m_{At} - m_{Bt}) - \phi(y_{At} - y_{Bt}) + \lambda[E_t(s_{t+1}) - s_t] \tag{11.14}$$

This can be re-written as

$$s_t\,(1 + \lambda) = [k + (m_{At} - m_{Bt}) - \phi\,(y_{At} - y_{Bt})] + \lambda E_t\,(S_{t+1})$$

which implies

$$s_t = \frac{1}{(1+\lambda)} Z_t + \frac{\lambda}{1+\lambda}[E_t(s_{t+1})] \tag{11.15}$$

where by Z_t we denote the "current fundamentals" viz. $[k + (m_{At} - m_{Bt}) - \phi\,(y_{At} - y_{Bt})]$.

Now if the exchange rate model (11.12) is believed to be true, then traders will expect s_{t+1} to be determined by the same model, i.e. by an equation like (11.15):

$$E_t(s_{t+1}) = \frac{1}{(1+\lambda)} E_t(Z_{t+1}) + \frac{\lambda}{(1+\lambda)} E_t(S_{t+2}) \tag{11.16}$$

[26]However, as pointed out by Levich (1985), there are important differences. The capital asset pricing framework used for common stock valuation which has also been adapted for explaining exchange rate behaviour assumes that the supply of individual securities is fixed which is not true of foreign currency assets. Secondly, it assumes that there are a very large number of securities with a small supply of each while in the case of foreign currencies, probably half a dozen currencies account for most of the asset holdings. Foreign currencies also provide liquidity services as medium of exchange.

[27]There are various notions of efficiency. A market is said to be *weakly efficient* if the current price fully reflects the entire price history, i.e. knowledge of past prices in addition to the current price cannot improve predictive performance; efficiency in *semi-strong form* requires that all *publicly available information* should be reflected in the current price. *Strong form* efficiency requires that *all* information is incorporated in the current price. For further discussion, see any advanced finance text such as Copeland and Weston (1988).

[28]This analysis is due to Mussa (1984) though its origins are in earlier works.

[29]This assumption is only for the sake of concreteness of illustration. The argument to follow is applicable whatever be the "true" model of exchange rate determination.

Applying this reasoning repeatedly we obtain an expression for the current spot rate involving the current and the expected future values of the "fundamentals":

$$s_t = \left[\frac{1}{1+\lambda}\right]\sum_{j=0}^{j=\infty}\left[\frac{\lambda}{1+\lambda}\right]^j E_t(Z_{t+j}) \tag{11.17}$$

Thus, the current exchange rate depends not only on the current values of money supplies, real incomes, etc. but also on their **expected future values.**

To understand the role of "news" consider the actual change in exchange rate from t to $t + 1$. The total change $(s_{t+1} - s_t)$ can be decomposed into two parts:

$$\begin{aligned} s_{t+1} - s_t &= [E_t(s_{t+1}) - s_t] + [s_{t+1} - E_t(s_{t+1})] \\ &= \text{Expected change} + \text{Unanticipated change} \end{aligned} \tag{11.18}$$

Using equation (11.17), the first of these is given by:

$$E_t(s_{t+1}) - s_t = \left[\frac{1}{1+\lambda}\right]\sum_{j=0}^{j=\infty}\left[\frac{\lambda}{1+\lambda}\right]^j E_t(Z_{t+j+1} - Z_{t+j}) \tag{11.19}$$

i.e. the **expected change** in the spot rate is a discounted sum of **expected changes** in the fundamentals (both expectations formed at time t). Based on all information available up to time t, investors form expectations about values of various "fundamentals" such as GDP, money supply, etc. at all future times. For instance, on the basis of information available at time $t = 1$, an investor expects the GDP to be say ₹200000 crore at $t = 4$ and ₹210000 crore at $t = 5$. Then $E_1[Y_{(1+4)} - Y_{(1+3)}]$ is ₹10000 crore. This and similar expected changes in other variables for all time to come influence the investor's expectations about the exchange rate at time $t = 2$. The unanticipated component is given by

$$s_{t+1} - E_t(s_{t+1}) = \left[\frac{1}{1+\lambda}\right]\sum_{j=0}^{j=\infty}\left[\frac{\lambda}{1+\lambda}\right]^j [E_{t+1}(Z_{t+j+1}) - E_t(Z_{t+j+1})] \tag{11.20}$$

i.e. **the unanticipated change in exchange rate from *t* to *t* + 1** is due to the **changes in expectations between *t* and *t* + 1, about future values of the fundamentals.** These changes in expectations can be attributed to "news" arriving between t and $t + 1$. The information base at $t + 1$ has expanded and may lead to a revision of expectations about one or more factors thought to be relevant in determining exchange rates which in turn has an impact on the actual rate at time $t + 1$.

Implicit in this analysis are clues to an understanding of exchange rate volatility and "overshooting". Even though the current fundamentals may be quite sluggish and insensitive to current events, **expectations** about **future values** of the fundamentals can be very sensitive to current information. Consequently, any new information may lead to a "jump response" in current exchange rate and, as expectations are altered, the exchange rate can fluctuate rather wildly in the short run.

Also implicit in the above analysis is the notion that expectations are formed "rationally", i.e. traders know the "true" model and base their expectations of future exchange rates on such a model. In general, the efficient markets approach assumes rational expectations.

Equation (11.17) also helps explain the high correlation observed between changes in the spot rate S_t and the contemporaneous one-period ahead forward rate. If the forward rate is a guess about next period's spot rate based on all information currently available, changes in the forward rate caused by new information should be correlated with changes in the spot rate which also depends upon expectations of future course of fundamentals. Further, since the weights decline as we go farther into the future, the correlation will be much closer for near-maturity forward rates than for longer-term forward rates.

All modern theories of exchange rate assume some version of rational expectations, often "perfect foresight". This hypothesis requires that economic agents should know the "true" structural model of the economy and future values of exogenous variables driving the economy. Many economists find these requirements overly strong and therefore unrealistic. In a world of floating rates, governments have considerably more freedom to pursue independent monetary and fiscal policies. This implies a lot more uncertainty about future paths of policy variables such as money supply. In such a world, models which rely on "perfect foresight" are not very useful. Alternative approaches which require only "limited rationality" have been proposed. A lucid discussion of such an approach can be found in DeGrauwe (1989).

There have been numerous investigations of efficiency of foreign exchange markets both spot and forward. In the spot markets, efficiency is often investigated by testing whether the spot rate exhibits "random walk"[30]. As Levich (1985) points out, this is not an appropriate test in all circumstances. In the forward markets, there have been two types of investigations. First, researchers have examined whether there are significant departures from covered interest parity over and above those caused by transactions costs. The general verdict is that using Euromarket interest rates, there are no such departures whereas if we use interest rates on domestic assets in the two currencies, deviations can be found which may be attributable to factors like political risks. Second, a large number of investigators have examined whether the forward rate is an unbiased predictor of future spot rate. As is always the case in all tests of market efficiency, this is actually a test of a joint hypothesis viz.(1) traders have rational expectations and (2) they are risk-neutral. The former implies

$$s_{t+1} = E_t(S_{t+1}) + u_t$$

where u_t are serially independent random variables with zero mean and constant variance[31]. The latter (i.e. risk neutrality) together with covered interest parity implies

$$f_{t,\,t+1} = E_t(s_{t+1})$$

where $f_{t,\,t+1}$ is the one-period-ahead forward rate at time t.

The hypothesis of unbiasedness of forward rate as a predictor of future spot rate can be tested by estimating the following regression:

$$S_{t+1} = A_1 + A_2 F_{t,\,t+1} + u_t$$

And jointly testing the hypotheses $A_1 = 0$ and $A_2 = 1$. Results reported by Levich (1978) and Frenkel (1982) appear to support the hypothesis but Cumby and Obstfeld (1984) have pointed out certain methodological shortcomings in their approach, viz. non-stationarity of exchange rates and suggested that tests should be carried out using a model such as:

$$S_{t+1} - S_t = A_1 + A_2\,(F_{t,\,t+1} - S_t) + u_t$$

i.e. regress the actual change in spot rate from t to $t + 1$ on the forward margin at time t and carry out the same tests, viz. $A_1 = 0$ and $A_2 = 1$. Boothe and Longworth (1986) have employed this approach and have found that data do not support the hypothesis of efficiency. They also provide a brief survey of empirical literature on this topic. The general verdict seems to be that the forward

[30]A stochastic variable X_t is said to follow random walk if the successive changes in X_t are independent random variables with zero mean and constant variance. In such a case, the best forecast for tomorrow is the actual value observed today.

[31]This means that expectations can be wrong but there is no discernible pattern in the mistakes. Traders do not systematically under- or over-estimate. They are right "on average".

margin is a poor predictor of spot rate changes, not only the magnitude of change but often even the direction of change[32].

Attempts have also been made to determine whether the poor performance of the forward rate as a predictor of future spot rate is due to existence of time-varying risk premiums or non-rationality of expectations. Pope and Peel (1991) discuss some of these studies.

The results appear to be sensitive to the specification used. Some studies have pointed out serious statistical problems with the tests. [See Barnhart and Szakmary (1991), Apte (1992)]. The hypothesis of risk-neutrality appears to be suspect and the debate about the nature of risk premia continues.

A number of studies have utilised survey data on market participant's expectations to address the question of whether the poor performance of the forward rate as a predictor of the future spot rate is due to time-varying risk premium or some biases in expectation formation. Frankel and Froot (1996) based on their own work and that of others tend to favour the latter explanation[33].

The "peso problem" refers to the situation surrounding the Mexican peso before its devaluation in the third quarter of 1976. Market participants had been expecting devaluation for a long time and their expectations were reflected in the forward discount on the peso. However, as long as the devaluation did not actually take place, these expectations turned out to be wrong and data from this period would suggest that the forward rate is not an unbiased predictor of the future spot rate. Some investigators attribute this not to market inefficiency but departures of sampling distributions from their population counterparts.

Central bank intervention if large in relation to the market size can support the forward rate at a level that bears no relation to the market participants' expectations about the future spot rate.

Finally, if real interest rates differ across countries and relative PPP holds, forward rate would not equal expected future spot rate.

Thus, the departure of the forward rate from expected future spot rate can be attributed to many factors other than market inefficiency.

What do the practitioners – currency traders – think of all these macroeconomic factors as forces driving exchange rates? Cheung and Chinn (2001 *op cit*) in a survey found that currency traders in the US market believe that:

1. News about macroeconomic "fundamentals" gets incorporated in market rates in a matter of minutes.
2. The relative importance of different macroeconomic factors shifts over time though interest rates always appear to be important. Money supply is not a very important factor.
3. Economic fundamentals are perceived to be more important at longer horizons while in the short run excessive speculation and manipulation by institutional customers or hedge funds drives exchange rates away from fundamentals.
4. Speculation by and large increases market efficiency and liquidity though it may lead to increased volatility.
5. Market intervention by central banks does not have significant impact though it increases volatility.

Currency movements in the short run are strongly influenced by publicly available information. Economic data releases by domestic and foreign governments, circulars and other public releases by central banks of home and foreign countries regarding monetary policies, political developments,

[32]It has also been observed that volatility of period-to-period changes in the spot rate is much larger than the volatility in forward margins. This was more so during the eighties than the seventies. [See DeGrauwe (1989)]

[33]The bias may not necessarily be attributed to "irrationality" in expectation formation.

natural disasters and perceptions about how they will impact economies of various countries, changes in commodity prices particularly oil and gold and many other factors can have significant influence on short-run movements in exchange rates.

11.4 EXCHANGE RATE FORECASTING[34]

Exchange rate forecasts are an important input into a number of corporate financial decisions. Whether and how to hedge a particular exposure, the choice of currency for short- and long-term borrowing and investment, choice of invoicing currency, pricing decisions, all require some estimates of future exchange rates. Financial institutions such as mutual funds, hedge funds and even some non-financial corporations may wish to generate trading profits by taking positions in the spot and forward markets. A treasurer may have access to in-house forecasting expertise or may buy forecasts from an outside service. Even in the latter case, some evaluation of the forecasting methodology and the forecasts themselves is unavoidable.

Exhibit 11.2 epitomises a practitioner's view of the forces impinging on exchange rates and the consequent difficulty of short-run forecasting of exchange rates.

Exhibit 11.2 (Toyoo Gyohten in Volcker, P. and T. Gyohten (1992):

Changing Fortunes: The World's Money and the Threat to American Leadership, Times Books, New York)

The factors that market practitioners take into consideration have certainly changed over time, and on the whole they have multiplied almost beyond our calculations. In the early days of the floating regime, we thought that medium- and long-term elements such as purchasing power parities and balance of payments adjustments would still have a major influence. But then short-term capital flows and interest differentials became very important. But aside from that, there was the explosion of information technology, which promoted quick shifts of focus. At one moment, the market will be focusing on interest rates, the next on balance of payments data, and then on political developments. So, it is difficult to pinpoint the decisive factors in short-term movements. Recently I was talking to one of Japan's best foreign exchange dealers, and I asked him to name the factors he considers in buying and selling. He said, "Many factors, sometimes very short-term, and some medium, and some long-term". I became very interested when he said he considered the long-term and asked him what he meant by that time-frame. He paused a few seconds and replied with genuine seriousness, "Probably ten minutes". That is the way the market is moving these days.

Forecasting methodologies can be divided into two broad categories. The first is the class of methods which have a structural economic model of exchange rate determination such as the PPP or the monetarist model. The model is econometrically estimated and used for prediction. Note that this approach requires forecasts of variables which are thought to be determinants of the exchange rate – no easy task in itself. The other category of methods eschews all fundamentals and aims to discover patterns in past exchange rate movements which can be extrapolated to the future. These are called "pure forecasting models". Within this broad class are included time series methods which try to

[34]A more extensive discussion can be found in Levich (1988).

model the stochastic process which is supposed to be generating successive exchange rate values and "technical analysis" using charts and/or some statistical procedures such as averaging and smoothing.

While some success has been achieved in explaining cross-sectional exchange rate differences – why a dollar is worth say CHF 1.30 and ¥110 – and long-term exchange rate trends, short-term exchange rate forecasting – day to day, week to week – has proved to be a very difficult undertaking. Further, for operating exposure management, long-term financing and investment decisions, real exchange rate forecasts are needed. It is not difficult to cite numerous episodes when nominal and real exchange rates have shown divergent movements.

As an example of an "economic" forecasting model consider the PPP. Assuming PPP to hold the forecast of the spot rate n-periods from now is

$$S^e_{t+n}(A/B) = S_t(A/B)\frac{(P^A_{t+n})^e/(P^B_{t+n})^e}{P^A_t/P^B_t} \tag{11.21}$$

where the superscript "e" denotes forecast values. As noted before, we need forecasts of price levels in A and B to obtain a forecast of the exchange rate.

Similarly, the current account monetary model can be used for forecasting. An equation like (11.16) can be estimated from past data. Then, provided we can obtain reliable forecasts of the right-hand side variables m_A, m_B, y_A, y_B, etc., we can get forecasts of the exchange rate.

Note the difficulties: the equation must explain past data well, it must be assumed that the relationship will continue to hold in the future, i.e. it must fit the out-of-sample data well too *and* reliable forecasts of the determinant variables must be available. Of course the estimated equations can also be used to generate alternative scenarios under different assumptions about the evolution of the determinant variables.

We have briefly mentioned above that the explanatory power of most economic-structural models has not been found to be uniformly satisfactory[35]. Their out-of-sample predictive performance also is quite disappointing [see Meese and Rogoff (1983)]. Finally, obtaining reliable forecasts of the independent variables in the model is by no means an easy task. Consequently, economic-structural models have proved to be of limited use for forecasting particularly in the short and medium term[36].

Pure forecasting models have not fared much better either. Time series models using mostly the ARIMA model approach of Box and Jenkins attempt to estimate the parameters of the underlying stochastic process. Once again, assuming the process to be stable, the estimated equation can be used for forecasting[37]. One advantage of this approach is that it requires no data other than past values of the exchange rate nor forecasts of any other variables.

Technical or chartist methods fall in the same category, but are more informal in nature, relying more on visual patterns in plots of past exchange rates. Many technical analysts claim to have discovered

[35]A particular model might do quite a good job of explaining a particular exchange rate episode. For instance, the monetary models fit the data very well during hyperinflationary periods.

[36]We want to caution the reader that we might have erred on the side of excessive pessimism in summarising the performance of structural models. Some researchers have reported that carefully estimated portfolio balance models do outperform simple random walk models. Also, allowing for variation in the parameters of the model may improve the explanatory power of the model.

[37]A good exposition of Box-Jenkins ARIMA model methodology can be found in a number of books devoted to time series analysis such as Nelson (1973), Pankratz (1983). Essentially, it involves estimating an equation of the general form:

$$x_t = \Sigma\theta_i x_{t-i} + u_t - \Sigma\psi_i u_{t-i}$$

where x_t is the series to be forecast, u_t are serially independent random variables with zero mean and constant variance and θ_i and ψ_i are parameters to be estimated. The series x_t may be the original series of interest, e.g. logs of spot exchange rates or its differenced version, if the original series is non-stationary.

and successfully applied a variety of "filter rules"[38]. Whether such trading strategies produce profits in excess of what is commensurate with the associated risk is not clear. A good discussion of technical analysis can be found in Hexton (1993). Surveys by ***Euromoney*** indicate that technical analysis has become the dominant methodology at least among professional currency forecasters.

Work with survey data [see Frankel and Froot (1996)] seems to indicate that market participants extrapolate past trends in forming expectations over the short horizon while for longer horizons, they appear to believe in some notion of "reversion to equilibrium" with "equilibrium exchange rate" being judged with reference to some fundamental relation such as PPP. Also, there is considerable dispersion in market participants' forecasts of future exchange rate and the amount of dispersion increases as forecast horizon becomes longer.

Recent developments in modeling and predicting financial time series have applied mathematical tools imported from biological and physical sciences. ***Chaos theory*** is an approach to modeling highly non-linear processes which are extremely sensitive to initial conditions. The underlying process is supposed to be deterministic, but very complex and as a result appears to be random or stochastic. Sensitivity to initial conditions implies that even a tiny measurement error in recording the starting value can produce large divergence between forecasts and actual values. Also, the underlying "true" model is difficult to extract from observed data. ***Neural networks*** is another approach to modeling deterministic nonlinear processes that allows the data to "speak for itself" rather than imposing a particular parametric structure. These approaches have been imported into economics and finance literature rather recently and judgment about their forecasting ability must be deferred. A good introduction to these tools in the context of forecasting exchange rates can be found in Moosa (2000).

Instead of relying on a single forecast, a composite forecast can be arrived at as a weighted sum of forecasts from different models/sources. The weights can be chosen so as to minimise the forecast error variance.

Whatever be the source of forecasts, a corporation must have a framework in which to evaluate forecast performance. The value of a forecast depends upon:

- The use to which the forecast is put.
- The corporation's "loss function", i.e. the cost incurred when forecasts turn out to be wrong.
- How much does the forecast contribute to better decision making given that the firm has its own sources of information and is able to generate its own forecasts.

In some contexts, only the correctness of the direction of the forecast may matter and not the amount of error. For instance, suppose the firm enters the foreign exchange market only to manage its exposures arising out of its operations and does not aim to profit from foreign exchange transactions as such. In such a case, it should look at the forecast only in relation to the forward rate. Suppose it has a receivable and wishes to protect itself against a depreciation of the currency of the receivable. Assume that the currency is at a forward discount. Only if the depreciation implicit in the forecast is less than the forward discount, it will matter to the firm's decision – if it believes the forecast, it may decide to leave the exposure open.

Consider an example which brings out why in many cases correct prediction of the direction of exchange rate movement is more important than the accuracy. An Indian firm has a 3-month dollar payable. The spot rate is ₹54.00–the 3-month forward is 55.30 and two forecasts are available. One

[38]Filter rules are designed to identify exchange rate momentum. It is a mathematical rule, applied mechanically to generate buy and sell signals. Thus, an $x\%$ filter rule says the following: whenever a currency rises $x\%$ above its most recent low point, buy it; when it falls $x\%$ below its most recent high, sell it. {Levich (1987)].

predicts the future spot to be 55.75, while the other's prediction is 53.30. The actual spot three months later turns out to be 54.80. While the first prediction is closer to the actual spot rate, the second would have led to the correct decision, viz. do not cover with a forward purchase contract.

On the other hand, in a budgeting exercise, the magnitude of forecast errors may be of relevance and not just the direction. The user must then estimate how the cost of errors varies with their magnitude, i.e. the loss function. If the cost is proportional to the absolute size of the error, a forecasting method that minimises the mean absolute deviation of forecast errors would be suitable.

In other cases, the accuracy of forecasts may be important because the forecasts are used to generate speculative profits in the foreign exchange market. A firm may follow an active strategy aiming not only to manage exposures arising from operations but also to take positions to profit from superior forecasts. In such cases, the user must have some idea about the risk-return tradeoff. How does one judge whether unusual profits generated by using a particular forecast are commensurate with the risk? In the absence of a foreign exchange risk pricing model, performance must be compared with some benchmark, e.g. the risk-return profile of a portfolio of equities.

Note that the forward rate is always available, and virtually costless as a forecast of the future spot rate. While the forward rate cannot be asserted to be an unbiased predictor of the spot rate, any forecast which is not costless must do at least as well as the forward rate.

To conclude, exchange rate forecasting continues to be an undertaking fraught with serious theoretical difficulties and statistical pitfalls. Expectation formation, presence and behaviour of risk premiums and the role of "news" are still not well understood. The possibility of rational speculative bubbles cannot be ruled out. While the theories do offer some guidelines to assess the long-term trends in exchange rates, short- to medium-term prediction is a tricky business. The user of forecasts must supplement the prediction with his or her own analysis and, perhaps, intuition.

11.5 THE EXCHANGE RATE OF THE RUPEE

The exchange rate system in India has had a chequered history[39]. During the Bretton Woods era, Indian rupee was pegged to the pound sterling. After the collapse of the fixed rate system, there was a brief interval when it was pegged to the US dollar. The sterling link was restored toward the beginning of 1972 and maintained till September 1975 when the rupee went on a "basket peg". Initially, the authorities maintained a margin of ± 2.25% around the central rate vis-à-vis the basket. The limits were widened to ± 5% in 1979. This gave the authorities considerable room to manoeuvre the exchange rates[40]. Since both the constituents of the basket and discretionary adjustments within the bands were confidential, it is very difficult to discern what were the authorities motivations in manipulating the basket link. It could have been achieving stability in a particular bilateral rate (e.g. ₹/$), maintaining a constant real effective exchange rate or engineering a steady real depreciation of the rupee. There were two discrete, steep devaluations in July 1991. The informal dual rate system introduced with EXIM Scrips was formalised in March 1992 when the Liberalised Exchange Rate Management System (LERMS) was put in place as explained in Chapter 7 and, finally, in February 1993 a unified market determined exchange rate system was adopted. In August 1994, based on the report of the Sodhani Committee, the Reserve Bank of India announced that the Indian Rupee will be made convertible on current account. Proposals to gradually lift restrictions on capital account were submitted to the government in 1997 by the Tarapore Committee, but were relegated

[39]See RBI's Report on Currency and Finance (2006) Chapter VI for a brief historical account.

[40]Till 1979, IMF used to classify India as a case of "basket peg"; thereafter it was designated as "managed float".

to the backburner after the Asian currency crisis of 1997 and the Russian collapse in 1998. Various ad-hoc measures have been taken to liberalise exchange controls during the last few years. An Internal Technical Group on the Foreign Exchange Markets was set up in 2005 and some of their recommendations such as freedom to cancel and rebook forward contracts of any tenor, etc. have been implemented. Capital account is being gradually liberated including foreign investments by Indian companies and holding of foreign currency balances by residents.

Determinants of exchange rate movements in India are difficult to assess during the period of managed float since as mentioned above, the authorities may have had different policy goals at different times. Current account considerations must have played a role. However, other factors such as the desire to keep the cost of imports low cannot be ruled out. After the introduction of the dual rate, the rupee remained fairly steady for nearly eight months after which there was a sharp depreciation which was explained as due to anticipation of a move to a unified market-determined rate. After that event, the rupee strengthened and continued to hold steady against the US dollar for nearly two and a half years though it was fluctuating against other currencies. Thereafter, there was a sharp depreciation in September 1995 and the rupee touched a low of 38 against the dollar in February 1996, before recovering back to under 35. The rupee weakened during the aftermath of the Asian crisis in the summer of 1997 and the collapse of the Russian ruble in 1998, but remained pretty much stable till early 2000 when it again came under downward pressure as a result of widening current account gap and sluggish capital inflows–both portfolio and direct investments. The Reserve Bank of India responded both by tightening monetary policy as well as imposing certain administrative controls on foreign exchange transactions. To clarify its policy stance vis-à-vis exchange rate management, the RBI on August 3, 2000 issued a statement. The following are some extracts from it which provide some clues to the conduct of exchange rate policy:

> " ... As pointed out in statements, RBI does not use short-term movements in Real Effective Exchange Rates (REER), or any other similar variable, as an indicator of appropriateness or otherwise of exchange rate movements in the short-run.... As explained in the Monetary and Credit Policy Statement for the year 2000-2001:
>
> "The policy for reserve management is judiciously built upon a host of identifiable factors and other contingencies. Such factors inter alia include: the size of the current account deficit; the size of short-term liabilities (including current repayment obligations on long-term loans); the possible variability in portfolio investments and other types of capital flows; the unanticipated pressures on the balance of payments arising out of external shocks (such as, the impact of the East Asian crisis in 1997-98 or increase in oil prices in 1999-2000); and movements in the repatriable foreign currency deposits of Non-Resident Indians."

It was further pointed out that:

> "Unanticipated domestic or external developments, including undue volatility in asset prices in equity/bond markets, can create disproportionate pressures in the foreign exchange market in emerging economies. It is, therefore, essential to continue with the pursuit of realistic and credible exchange rate policies, in addition to vigorous implementation of domestic and external sector reforms to further strengthen the balance of payments position over the medium term."

The reserve management policy pursued by India in the last few years has stood us well and enabled us to cope with various unanticipated events, such as the East-Asian crisis, imposition of sanctions by several industrial countries a couple of years ago, the Kargil conflict, and changes in government at home. Our reserves at the present level are strong, and are high enough to take care of any temporary adverse developments in demand as well as capital flows, particularly if unnecessary and unwarranted "panic" is avoided. The Government has also take several measures to enhance the flows of capital, particularly foreign direct investments, and as a result of these efforts, it is expected that we will see a substantial increase in these inflows during the course of current year.

> ... In earlier statements as well as the statement made by the Reserve Bank on May 25, 2000 (and in the annual and half-yearly monetary policy statements), it has been stated that, RBI does not "target" a specific exchange rate in determining its intervention policy or the timing of monetary policy and other measures announced by it from time to time. Yet, whenever rupee reaches or is close to a "round number" or a particular level (such as, "the lowest ever in this year" or "in the recent past" in terms of the dollar), it is presumed by analysts that RBI would or should intervene strongly to defend that particular level. If RBI's action at that level is absent or mild, this adds to certain element of speculation about RBI's comfort level or intentions, which in turn creates uncertainties and a rush to the market. This issue, therefore, deserves some further clarification.
>
> ... The simple point is that when RBI says that it does not "target" a particular level of the exchange rate, it is intended to convey that there is no specific level which it is prepared to defend, through unlimited sales of foreign currency and/or through introduction of strong monetary and other measures. The RBI's view is that past international experience has abundantly made it clear that the defence of a "fixed" previously set target by central banks in developing, as indeed in industrial countries, is simply not practical or desirable in a regime of flexible exchange rates. This was abundantly brought out during the East Asian crisis in 1997 and in Latin America in 1998 (as well as in India's case in November 1997 in the wake of the Asian crisis). It has also been the experience of several industrial countries at different times, including Japan. The announcement of a pre-fixed "target", or a commitment to this effect, leads to one way speculation in the currency and can result in a surge in the demand for foreign currency. The erosion in foreign exchange reserves may become unsustainable, leading to abandonment of the pre-announced peg.

The fact that RBI does not target a particular exchange rate does not mean that movements in the exchange market, irrespective of the pace and its level, are matter of no concern and can be ignored. It is also possible that at some levels, which happen to be round numbers, certain measures can be taken. These are, however, not designed to defend the rate at that particular level. (It may be mentioned that while the July 21 measures were taken when rupee was close to a round number, May 25 statement by RBI was made when rupee-dollar value was 44.29. At that time, interestingly, nobody observed that this is a "Lakshman Rekha" which RBI must defend to maintain its credibility!)"

Till a few years ago, behaviour of the spot rate in India was largely governed by trade related flows since the capital account was strictly controlled. However, in recent years restrictions on capital inflows – both portfolio investments and direct investments – have been significantly liberalised. As a result, in the very short run, portfolio decisions of FIIs can generate significant volatility in the rupee exchange rate. The government has been steadily increasing the ceiling on FII's holding in a company–the most recent such change announced in the 2001-02 budget raising it to 49% from 40%. As the capital account is further opened up, the rupee exchange rate will become more sensitive to capital flows and less tied to trade related flows. The intervention policy of the central bank also plays an important role. The influence of capital flows and expectations cannot be entirely neglected since commercial capital including non-resident deposits do respond to interest rate differentials and exchange rate expectations. During the closing months of 1993, large inflows of foreign capital through portfolio investments by foreign financial institutions as well as funds raised by Indian companies in foreign capital markets coupled with a satisfactory export performance and depressed imports would have led to an appreciation of the rupee had the RBI not intervened on a large scale in the foreign exchange market. These inflows had reduced to a trickle by the end of 1994 and a substantial inflation differential had built up against the rupee. This coupled with a revival in imports, slowdown in export growth and some technical factors were responsible for the sharp drop in rupee in September 1995. The weakness of the rupee during the first half of 2000 has also been attributed to weak capital inflows. The USD/INR rate peaked at a little over 49.0 in mid-2002. In more recent times, viz. 2003-2006, rupee has generally shown a rising tendency against the dollar mainly on account of significant increase in foreign portfolio investment in the Indian stock market. The weakness of the US dollar against the rupee – as against many other currencies – continued in 2006 and in early 2007 the dollar fell below ₹41. The trend reversed in 2008-09 and the daily average of USD/INR rate which had declined to ₹40.24 during 2007-08 climbed back to ₹45.92 during 2008-09. During 2009-10 the rate has been hovering around 46-47. Table 11.3 gives a summary of rupee-dollar exchange rate movements between 1993-94 and 2010-11 based on daily data during each financial year.

Table 11.3 Movements of Indian Rupee 1993-94 to 2010-11

Year	*Range*	*Average Exchange Rate*	*Daily Average Change*	*Standard Deviation*
1993-94	31.21-31.49	31.37	0.03	0.05
1994-95	31.37-31.97	31.40	–0.11	0.12
1995-96	31.37-37.95	33.46	–6.17	0.56
1996-97	34.34-35.96	35.52	–5.77	0.21
1997-98	35.70-40.36	37.18	–4.47	0.37
1998-99	39.48-43.42	42.13	–11.75	0.24
1999-2000	42.44-44.64	43.34	–2.79	0.10
2000-01	43.61-46.89	45.71	–5.19	0.15
2001-02	46.56-48.85	47.69	–4.15	0.13
2002-03	47.51-49.06	48.40	–1.48	0.07
2003-04	43.45-47.46	45.92	5.40	0.19
2004-05	43.36-46.46	44.95	2.17	0.31
2005-06	43.30-46.33	44.28	1.51	0.22
2006-07	43.14-46.97	45.28	–2.22	0.89
2007-08	39.26-43.15	40.24	12.53	0.83
2008-09	39.89-52.09	43.92	–12.36	3.58
2009-10	44.94-50.54	47.42	–3.16	1.34
2010-11	44.03-47.58	45.38	4.04	1.03

Source: Pami Dua & Rajiv Ranjan (2012)

Note: The daily average change is in percentage.

During the last couple of years, rupee has depreciated significantly against the major global currencies. Exhibit 11.2 shows the history of the USD/INR exchange rate from June 26, 2011 to June 16, 2013.

Exhibit 11.2

The average daily turnover in the forex market increased significantly during 2007-08 compared to earlier years. As seen in Table 11.4, compared to other emerging market economies, the volatility of rupee-dollar exchange rate has been low. Also, over the period 1993-94 to 2008-09, the REER of the rupee has shown stability despite considerable volatility in capital flows and trade flows.

There have been some attempts to estimate structural models of the rupee exchange rate. More research is needed before pronouncing any judgment on their relative performance.

Table 11.4 Daily Exchange Rate Volatility in Some Emerging Economies (Annualised in Per cent)

Currency	*1993-95*	*1996-00*	*2001*	*2003*	*2004*	*2005*	*2006*
Indian Rupee	7.5	4.3	1.6	2.1	4.7	3.5	4.0
South Korean Won	2.6	22.2	8.1	8.3	6.5	6.8	6.9
South African Rand	5.3	11.4	20.2	20.9	21.4	15.4	16.0
Turkish	29.3	5.4	63.1	16.2	12.2	10.4	16.6
New Lira							
Indonesian Rupaiah	2.1	43.4	21.7	6.8	7.7	9.1	8.9

(Contd.)

Thai Baht	1.7	18.3	4.9	4.4	4.3	4.7	6.2
New Taiwan Dollar	3.7	5.3	3.6	2.7	4.9	4.9	4.9
Singapore Dollar	3.7	7.4	4.5	4.5	4.6	4.4	3.9
Philippine Peso	6.8	12.9	17.6	4.1	3.1	4.1	4.6

Note: Volatility has been calculated by taking the standard deviation of percentage change in daily exchange rates.
Source: Dr. Arabi U (2007) "Foreign Exchange Market Behaviour and its Management in the Post-Reform Period: The Indian Experiences" IGIDR.

Summary

This chapter has provided a perspective on the theoretical underpinnings of exchange rate determination and a brief introduction to major exchange rate models. The overall conclusion from an examination of these models is that most of them are of little use for short-term forecasting of exchange rates. Recent developments like chaos theory and neural networks are claimed to be a significant improvement over traditional models but we must wait for sufficient evidence about their performance to accumulate before pronouncing judgment.

The chapter also discusses methods of exchange rate forecasting and the uses of exchange rate forecasts. It concludes with a brief historical overview of the evolution of the rupee exchange rate.

Questions and Problems

1. In a free market, what factors influence exchange rates? Which of them apply mainly to long-run exchange rate behaviour and which to short-run exchange behaviour?
2. What predictions does the purchasing-power-parity theory make concerning the impact of domestic inflation on the home country's exchange rate? What are some limitations of the purchasing-power-parity theory?
3. What impact will an overvalued rupee have on India's trade balance? Will it affect the capital account at all? What if the home currency becomes undervalued?
4. What is the essence of the monetary approach to exchange-rate determination? What are its major predictions concerning exchange-rate movements?
5. Explain how the following factors affect the exchange rate of a country under a system of market-determined exchange rates: (a) a rise in the domestic price level with the foreign price level held constant; (b) tariffs and quotas placed on imports into the country; (c) increased demand for the country's exports by foreigners and decreased demand for imports by the country's residents; (d) rising productivity in the country relative to other countries; (e) rising real-interest rates overseas, relative to the country's rates; (f) an increase in the rate of money supply growth in the country.
6. What is meant by exchange-rate overshooting? What is the economic explanation underlying such behaviour?

7. Explain why you agree or disagree with each of the following statements:
   (a) "*A* country's currency will appreciate if its inflation rate is higher than that of its trading partners".
   (b) "*A* country whose interest rate are rising more rapidly than that of other nations can expect the exchange value of its currency to depreciate".
   (c) "*A* country whose economy grows faster than its major trading partners can expect the exchange value of its currency to appreciate".
   (d) "*A* country's currency will depreciate if its interest rate falls relative to that of its trading partners and its income level rises relative to that of its trading partners".

8. Suppose the dollar/Swiss franc exchange rate equals \$0.50 per franc. According to the purchasing-power-parity theory, what will happen to the dollar's exchange value under each of the following circumstances?
   (a) The US price level increases by 10 per cent and the price level in Switzerland stays constant.
   (b) The US price level increases by 10 per cent and the price level in Switzerland increases by 20 per cent.
   (c) The US price level decreases by 10 per cent and the price level in Switzerland increases by 5 per cent.
   (d) The US price level decreases by 10 per cent and the price level in Switzerland decreases by 15 per cent.

9. Suppose that the nominal interest rate on 3-month Treasury bills is five percent in the United States and six per cent in the United Kingdom, and the rate of inflation is 2.5% in the United States and 3% in the United Kingdom.
   (a) What is the real-interest rate in each nation?
   (b) In which direction would international investment flow in response to these real-interest rates?
   (c) What impact would these investment flows have on the GBP/USD exchange rate?

10. During the shopping spree in Singapore, Hero Hiralal has bought a Sony CD Boom Box (with Woofers and Tweeters) for SGD 1,000, Jade Jewellery for SGD 3,000, and 4 custom-made suits for SGD 5,000. The spot exchange rate is HKD/INR 25.
   (a) If PPP held, what should the same boom box, jewellery and suits cost in India?
   (b) Suppose Mr. Hiralal is (unexpectedly) stopped at customs as he arrives in Mumbai, and must pay import duties of 50 per cent. If the same boom box, jewellery and suits cost INR 40,000, INR 1,50,000 and INR 60,000 in India, respectively, was his shopping spree worth at least the SGD 5,000 paid for airfare and hotels during his trip?

11. Suppose that, during the 70s, the consumer price indices in Antarctica and Greenland went up by 80% and 70%, respectively, while the indices of production costs went up by 65% and 60% respectively. Greenland's exchange rate appreciated by 10%. Antarctica's trade unions claim that this means that the export sector is hugely profitable, implying that wages should rise. Do you agree?

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APPENDIX

A.11.1 NOMINAL AND REAL EFFECTIVE EXCHANGE RATES

The notion of nominal effective exchange rate is closely tied to that of currency baskets. In a world of floating rates, a currency may appreciate against some and depreciate against others. Can one say whether **on the whole** it has appreciated or depreciated? The problem is similar to constructing a price index to measure overall movements in a price level where some prices have increased while others have decreased or, in general, different prices change by different proportionate amounts.

Let $S_{\mathbf{UK}}$ denote the nominal bilateral GBP/INR rate and $S_{\mathbf{US}}$ the USD/INR rate. Define the **Nominal Effective Exchange Rate (NEER)** of the rupee as follows:

$$\text{NEER} = S_E = (S_{\text{UK}})^{W_{\text{UK}}} (S_{\text{US}})^{W_{\text{US}}} \tag{A.11.1}$$

with $W_{\mathbf{UK}} + W_{\mathbf{US}} = 1$

then the proportionate change in the effective exchange rate is given by

$$\hat{S}_E = W_{\text{US}}\hat{S}_{\text{US}} + (1 - W_{\text{US}})\hat{S}_{\text{UK}} \tag{A.11.2}$$

where the notation "^" denotes proportionate changes or logarithmic derivatives.

The proportionate change in the effective exchange rate is a weighted average of changes in the two bilateral rates, where the weights might be chosen to reflect the share in India's external trade of the countries whose currencies are included in the effective exchange rate definition.

In a regime of managed exchange rate, the bilateral rates can be chosen so as to achieve some target change in the effective nominal rate. To see this, let

$$S_{\mathbf{USUK}} = (S_{\mathbf{UK}})/(S_{\mathbf{US}}) = \text{£/\$ bilateral rate}$$

then

$$\hat{S}_{\text{USUK-}} = \hat{S}_{\text{UK}} - \hat{S}_{\text{US}} \tag{A.11.3}$$

Putting together (A.11.1)–(A.11.3), we get

$$\hat{S}_{\text{US}} = \hat{S}_E - (1 - W_{\text{US}})\hat{S}_{\text{USUK}} \tag{A.11.4}$$

Thus, given the change in the GBP/USD bilateral rate, the USD/INR rate can be adjusted so as to achieve any target change in the effective exchange rate. Thus, suppose the weights $W_{\mathbf{US}}$ and $W_{\mathbf{UK}}$ are both 0.5. The starting rates are ₹47 per dollar and ₹68 per pound. The corresponding effective rate is ($47^{\mathbf{0.5}}68^{\mathbf{0.5}}$), i.e. 56.5332. The implied £/\$ rate is 1.4468. Now suppose dollar appreciates against the pound to 1.3889, i.e. by 4%. If the objective is to keep S_E constant, then the \$/₹ rate must increase by 2% to 47.94. The £/₹ rate would be 66.5839[41].

Note that the absolute value of S_E at any point in time does not have much significance. It is the change in S_E relative to a reference point that matters. Therefore, the nominal effective exchange rate is usually given in the form of an index with reference to a base period. Also, in choosing the weights, one can use shares of the partner countries in the home country's exports, imports or total trade.

More generally, the NEER with export shares as weights is defined as

$$\text{NEER} = \prod_{i=1}^{i=n} (S_i)^{W_{ix}} \tag{A.11.5}$$

where S_i is the bilateral nominal rate of the home currency versus the i^{th} currency (units of home currency per unit of i) and W_{ix} is the share of country i in home country's exports. An import weighted NEER can be defined in an exactly analogous manner. An increase in NEER indicates an overall depreciation of the home currency. If bilateral rates are defined as units of foreign currency per unit of home currency, an increase would signal an overall appreciation of the home currency.

Real Exchange Rate Concepts

The economics literature defines two different but related concepts of real exchange rate. The first, known as "external RER" focuses price level differences between countries whereas the second known as "internal RER" is concerned with relative prices of tradeables and non-tradeables within a country. Thus, external RER looks at competitiveness of a country's exports and import substitutes in its own markets and markets of its trading partners. Internal RER looks at allocational or incentive effects – the relative attractiveness from the domestic producers' point of view, of producing and consuming tradable goods and services versus non-tradeables. Within each category, there are multiple RER concepts.

[41]These calculations will not be exactly accurate. Equation (A.11.4) is valid for infinitesimal changes while we are considering finite changes.

External Real Exchange Rates

The simplest external RER concept is the bilateral PPP-based RER defined by

$$\text{BRER}_H = S(\text{FC/HC})P_F/P_H \tag{A.11.6}$$

Here BRER_H is the bilateral real exchange rate of "home country" vis-à-vis a "foreign country", S(FC/HC) is the nominal exchange rate defined following the ACI convention explained in Chapter 7, viz. as units of home currency per unit of foreign currency and P_F and P_H are Consumer Price Indices (CPIs) in foreign country and home country, respectively defined with respect to a common base year. BRER is usually reported as an index with value of 100 (or 1.00) for the base year. Thus, at the end of April 2005, the USD/INR rate was 43.48, CPI in India with 1985 as the base was 443 and the CPI in the US with the same base was 178, then BRER for the rupee versus the dollar was [43.48(178)/443] or 17.47. At the end of 1985, the USD/INR rate was 12.15. Thus, the BRER index with 1985 as the base had risen to 143.79.

As defined in (A.11.6), an increase in BRER_H signals real depreciation of the home currency and vice versa. Thus, the calculation above indicates that between end of 1985 and April 2005, the rupee had declined against the dollar in real terms by nearly 44%. In nominal terms over the same period the rate had risen from 12.15 to 43.48 indicating nominal depreciation by over 350%. Sometimes the reciprocal of BRER_H defined by $(1/S)(P_H/P_F)$ is used; in that case an increase represents a real appreciation.

The multilateral version of PPP-based external RER, known as Real Effective Exchange Rate (REER) is defined by:

$$\text{REER}_H = \prod_{i=1}^{n} [S_i(\text{FC/HC})\ P_{Fi}]^{W_i}\ (1/P_H) \tag{A.11.7}$$

Here S_i(FC/HC) denotes the nominal exchange rate of the home currency against the currency of the ith country, P_{Fi} is the CPI in that country and W_i is the weight assigned to country i. Once again, increase in REER_H denotes a real depreciation. It is easy to see that

$$\text{REER}_H = \prod_{i=1}^{n}\ [\text{BRER}_{Hi}]^{Wi} \tag{A.11.8}$$

where BRER_{Hi} is the bilateral RER against country i. Alternatively,

$$\text{REER}_H = \text{NEER}_H\ P_{\text{ALL}}\ /\ P_H \tag{A.11.9}$$

Here NEER_H is the nominal effective exchange rate of the home currency:

$$\text{NEER}_H = \prod_{i=1}^{n} [S_i(\text{FC/HC})]^{Wi} \tag{A.11.10}$$

and P_{ALL} is the "world consumer price index" defined by

$$P_{\text{ALL}} = \prod_{i=1}^{n} [P_{Fi}]^{Wi} \tag{A.11.11}$$

Once again, all price indices are with reference to the same base year and the REER is also stated as an index with reference to the same base year.

The reciprocal of REER_H can be defined by

$$1/\text{REER}_H = \prod_{i=1}^{n} [S_i(\text{HC/FC})\ /\ P_{Fi}]^{Wi}\ (P_H) \tag{A.11.12}$$

Now S_i(HC/FC) denotes the nominal exchange rate stated as units of foreign currency i per unit of home currency. The REER of the Indian rupee published by RBI uses the reciprocal version.

The weights W_i used in (2) and (3) can be shares of the selected countries in home country's exports, imports or total trade, i.e. exports plus imports. Still another possibility is to let W_i be the share of the ith country in the total trade of all the $(n + 1)$ countries – the home country plus its n trading partners.

The PPP-based external RER defined above compares the costs of purchasing typical consumption baskets converted to a common currency. Another version of external RER focuses on the cost of production of a given basket of goods and services instead cost of buying. This is done by using the GDP deflators in place of the CPIs in the above formulas. This is the one-good Mundell-Fleming version of RER.

A third version of external RER compares the cost of production of "traded goods" in the home and foreign countries measured in a common currency. This requires a price or cost of production index of traded goods in the home country and its trading partners. Since such indices are rarely constructed, the closest approximation may be provided by the wholesale price index since this index excludes services and such other non-tradeables.

Internal Real Exchange Rates

A two-good version of an internal RER divides the economy into two sectors viz. tradeables and non-tradeables. Tradeables as distinct from traded goods consist of all the goods that do or can enter international trade as exports and imports, i.e. they do not have to be actually traded, but only be capable of being exported or imported. It is a quality that is possessed by different goods in varying degree and often a matter of judgement. The internal RER is then defined as

$$\text{IRER}_H = P_{\text{TH}} / P_{\text{NTH}} \tag{A.11.13}$$

Here P_{TH} and P_{NTH} denote price (or cost of production) indices of tradeables and non-tradeables in the home country. An increase in IRER denotes real depreciation – makes tradable goods production more attractive relative to non-tradeables. If law of one price is assumed to hold for tradeables, i.e. if we assume that home prices of tradeables are determined by their border prices, the nominal exchange rate and border taxes, then we can say that

$$P_{\text{TH}} = S_k(\text{FC/HC})\ P_{TFk}\ (1 + t) \tag{A.11.14}$$

Where S_k denotes nominal exchange rate in units of home currency per unit of some reference currency k, P_{FTk} is the price index of tradeables expressed in k-currency and t is the rate of border tax on tradeables. The latter two must be constructed as some sort of indices or averages. The two-good IRER is then

$$\text{IRER}_H = S_k(\text{HC/FC})\ P_{TFk}\ (1 + t) / P_{\text{NTH}} \tag{A.11.15}$$

Aggregating all tradeables into a single good assumes that relative price of exportables and importables – the so-called terms of trade – is fixed. This is usually far from the case particularly in developing countries. A three-good version of IRER has been proposed which actually computes two IRERs, viz. relative price of exportables and non-tradeables and relative price of importables and non-tradeables.

Empirical measurement of all these RER concepts, internal and external, poses formidable problems of choosing appropriate price indices, country weights, classification of goods into tradeables and non-tradeables and lastly data availability.

For further discussion of these concepts and their use in designing exchange rate policies, see Hinkle and Montiel (1999).

In the Indian context, the RBI defines EERs with total trade based weights as well as export based weights. It uses exchange rates of the rupee and partner country currencies against the SDR. Specifically,

$$\text{NEER} = \prod_{i=1}^{n} (e/e_i)^{w_i}$$

The REER is the weighted average of NEER adjusted by the ratio of domestic price to foreign prices. Specifically,

$$\text{REER} = \prod_{i=1}^{n} [(e/e_i)(P/P_i)]^{w_i}$$

e : Exchange rate of Indian rupee against a numeraire, *i.e.,* the IMF's Special Drawing Rights (SDRs) in indexed form

e_i : Exchange rate of foreign currency 'i' against the numeraire (SDR), i.e. SDR per currency I in indexed form

w_i : Weights attached to foreign currency/country 'i' in the index

$$\sum_{i=1}^{n} w_i = 1$$

P : India's wholesale price index

P_i : Consumer Price Index of country I (CPI)

n : Number of countries/currencies in the index other than India

The new six-currency indices represent the US, the Eurozone (comprising of 12 countries), UK, Japan, China and Hong Kong SAR.

For the **36-country** REER/NEER indices, with an objective to broad base the REER/NEER and also to highlight India's changing trade pattern, countries have been chosen based on three broad criteria: (i) the share in India's exports and trade, (ii) regional representation and (iii) the regular availability of data on exchange rates and prices on a monthly basis. With the inclusion of the Euro zone, the 36-currency indices include all the twelve countries that have Euro as common currency. Thus, the 36-currency REER indices effectively represent 47 countries. The thirty-six countries/regions, represented by the thirty-six currencies, together accounted for, on an average, 77 per cent and 89 per cent of India's total foreign trade and exports, respectively during 2002-03 to 2004-05.

In line with the existing practice, the revised indices (both 6-currency and 36-currency) use the wholesale price index (WPI) as a proxy for Indian prices and the consumer price index (CPI) as a proxy for foreign partner countries. While CPI is more representative of the cost/inflationary conditions in the markets to which most of India's exports are directed, WPI reflects the producer costs. The weekly wholesale price index (WPI) for all commodities is used as an index of inflation for India in calculating six-currency REER/NEER indices. While the 6-currency index updates the WPI data every week, it is updated monthly for the 36-currency index.

A.11.2 THE MUNDELL-FLEMING MODEL[42]

We will describe a version of the Mundell-Fleming model which assumes perfect capital mobility and constant domestic price level. The UIP holds so that

$$r_h - r_f = S^e$$

[42]Our treatment here follows DeGrauwe (1989).

where r_h, r_f are nominal interest rates at home and abroad and S^e is the expected depreciation of the home currency. Exchange rate expectations are exogenous. Goods market equilibrium requires that the demand for the home good equal the supply. Figure A.11.1 shows equilibrium combinations of the spot rate S and real income Y designated I-S. The I-S line slopes upward because as S increases (home currency depreciates), home good becomes cheaper (recall that home goods price is sticky) and demand for it increases. Output Y must increase to maintain goods market equilibrium. The line designated L-M exhibits money market equilibrium. It is downward sloping because as S decreases, foreign goods become cheaper at home and the home consumer price index decreases which, in turn, increases the real money stock. [The nominal money stock is fixed by authorities]. This requires that real income should increase to absorb the increase in real balances. [Recall that the home interest rate cannot change unless the foreign interest rate or exchange rate expectations change]. The intersection of I-S and L-M curves gives equilibrium exchange rate and real output[43].

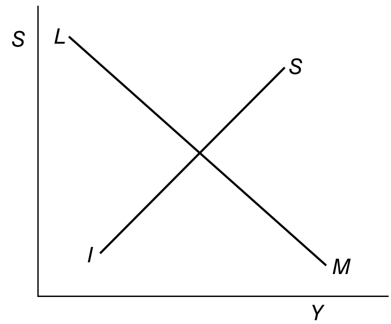

Fig. A11.1 The Mundell-Fleming Model

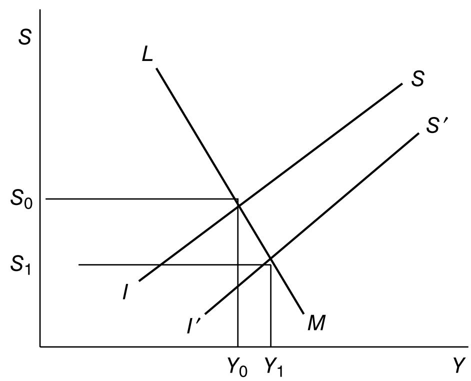

Fig. A11.2 Fiscal Expansion in the Mundell-Fleming Model

Now suppose the government engages in a fiscal expansion financed by domestic borrowing from the public [e.g. a bond issue, not budget deficits financed by the central bank]. This shifts the I-S curve down to the right as shown in Figure A.11.2. [At every exchange rate, output has to be higher because demand for home good has increased]. In the new equilibrium, output Y is higher and the exchange rate is lower, i.e. home currency has appreciated. Note that **we do not know** what path the exchange rate follows from its old to its new lower value. Thus, a fiscal expansion **financed by government borrowing from the public** leads to an appreciation of home currency in this model.

Why the emphasis on government borrowing? To understand this, consider the effect of monetary expansion. In Figure A.11.3 it is shown as a right-and-upward shift of the LM curve. This is so because a larger stock of money can be absorbed only if real income increases which in turn requires that demand for home good must increase for which an exchange rate depreciation is necessary. Thus, in the new equilibrium, output Y and exchange rate S are both higher. A monetary expansion depreciates the home

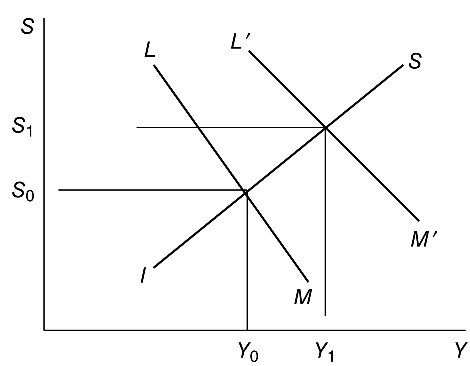

Fig. A11.3 Monetary Expansion in the Mundell-Fleming Model

[43]This is just an extension of the familiar closed economy IS-LM framework to an open economy.

currency. If the fiscal expansion is financed by printing money [borrowing from the central bank], both the *I-S* and *L-M* curves would shift and the effect on exchange rate would be ambiguous.

The combination of tight monetary policy and expansionary fiscal policy is advanced as an explanation of the steady appreciation of the US dollar during 1981 to mid-1985. However, the same explanation does not always fit facts during other historical episodes or other currencies. [See DeGrauwe ***op.cit.***]

It is possible to extend the simple Mundell-Fleming model in several ways. One can dispense with the assumption of fixed prices and wages in the home country and allow aggregate supply to depend upon the real wage. Monetary policy can be characterised as partly exogenous and partly attempting to manage the exchange rate. Lags can be allowed in the response of the current account to exchange rate changes so that the model exhibits the *J*-curve phenomenon[44]. The Mundell-Fleming model, extended in various ways, has proved to be the workhorse of international macroeconomics for analysing the effects of monetary and fiscal policies under various combinations of assumptions about the exchange rate regime – fixed or floating – degree of capital mobility and monetary policy regimes. For a comprehensive but accessible treatment, the reader should consult Argy (1994).

A.11.3 THE CURRENT ACCOUNT MONETARY MODEL

Let us set out the notation:

M_A, M_B : Nominal money supply in *A* and *B*, respectively
P_A, P_B : Price levels in *A* and *B*
Y_A, Y_B : Real incomes in *A* and *B*
i_A, i_B : Nominal interest rates in *A* and *B*
$S(B/A)$: Nominal exchange rate, units of *A* per unit of *B*

In the equations below, lower case letters denote natural logs of the corresponding upper case letters.

$$s = k + p_A - p_B \qquad \text{(A.11.16) PPP}$$
$$m_A = p_A + \phi_A y_A - \lambda_A i_A \qquad \text{(A.11.17) Home Money Market Equilibrium}$$
$$m_B = p_B + \phi_b y_B - \lambda_B i_B \qquad \text{(A.11.18) Foreign Money Market Equilibrium}$$

In these equations, ϕ's and λ's denote, respectively, income and interest elasticities of demand for real balances[45].

Using (A.11.17) and (A.11.18) to substitute for p_A and p_B in (A.11.16), we get

$$s = k + (m_A - m_B) - \phi_A y_A + \phi_B y_B + \lambda_A i_A - \lambda_B i_B \qquad \text{(A.11.19)}$$

Assuming identical parameters viz. $\phi_A = \phi_B$ and $\lambda_A = \lambda_B$, this reduces to:

$$s = k + (m_A - m_B) - \phi(y_A - y_B) + \lambda(i_A - i_B) \qquad \text{(A.11.20)}$$

This is the final reduced form equation of the current account monetary model.

[44] It is often observed in practice that following a depreciation of the exchange rate, the current account initially worsens–i.e. the deficit increases–before improving. This has been termed the "*J*-curve" effect. If one plots the current account on the *y*-axis and time on the *x*-axis, the relation looks like "*J*" after devaluation.

[45] The demand for real balances is given by

$$(M/P)^d = Y^{\phi}/i^{\lambda}$$

Take logs and equate to supply of money.

A.11.4 THE DORNBUSCH "OVERSHOOTING" MODEL

In a seminal paper published in 1976, Dornbusch presented a simple and elegant model which not only had some intuitively appealing features but also accounted for an empirically observed fact, viz. exchange rates often appear to respond excessively to changes in fundamentals or in other words, they "overshoot" their eventual equilibrium levels. We briefly discuss this widely cited model.

The key features of the Dornbusch model are:

1. Purchasing Power Parity holds only in the long run. In the short run, goods prices are "sticky".
2. There is a stable demand for money function which relates real balances to real income and interest rate.
3. Uncovered interest parity holds and the foreign interest rate is fixed.
4. Real output is fixed at its full employment level.
5. Exchange rate expectations are rationally formed. This means that given a change in money supply, people know what the final equilibrium value of the exchange rate is going to be; short run changes in exchange rate are in the nature of adjustment to the gap between the final equilibrium value and the current value.
6. Prices adjust gradually to the gap between the current level of demand for output and the full employment output.

Before setting out the algebraic formulation of the model, let us examine the implications of these assumptions. In equilibrium, real output is fixed and so is the interest rate since UIP holds and foreign interest rate is constant. Hence, in the long run, price level must change in proportion to changes in money supply. Also, since PPP holds in the long run and foreign price level is fixed, exchange rate must depreciate (appreciate) in proportion to the increase (decrease) in price level in the long run. In this context, rational expectations really means perfect foresight – people know what the long-run value of the exchange rate is going to be.

We will now describe the formal model. The version we have used is taken from Argy (1994).

The notation is as follows (All variables are in logarithms except the interest rate):

y_d : demand for output
y^* : full employment output
p_d : price level
r_d: domestic interest rate
s : exchange rate (units of home currency per unit of foreign currency)
s^* : long-run "equilibrium" exchange rate
m : nominal money stock
r_f : foreign interest rate

The superscript "e" denotes expected values. The model below is a discrete-time model.

$$y_d = \beta_1(s - p_d) - \beta_2 r_d \tag{A.11.21}$$

$$m = p_d + \beta_3 y^* - \beta_4 r_d \tag{A.11.22}$$

$$r_d - r_f = s^e_{t+1} - s_t \tag{A.11.23}$$

$$s^e_{t+1} - s_t = \beta_5(s^* - s_t) \tag{A.11.24}$$

$$p_{t+1} - p_t = \beta_6(y_d - y^*) \tag{A.11.25}$$

Equation (A.11.21) says that demand for real output varies inversely with the interest rate and positively with the real exchange rate[46]. Equation (A.11.22) is the standard demand function for real

[46]With foreign price level fixed, we can scale it so that its logarithm is unity. Then log of real exchange rate is $(s - p_d)$. Note that an increase in real exchange rate denotes real depreciation of the home currency leading to higher demand for the country's exports.

balances. Equation (A.11.23) is the UIP condition discussed above. Equation (A.11.24) describes exchange rate dynamics. The expected change in the exchange rate from the current period to the next is proportional to the gap between the long-run equilibrium rate (which is known) and the current rate. The parameter β_5 is the speed of adjustment. Finally, equation (A.11.25) describes price level dynamics; the change in price level is proportional to the gap between demand for output and the actual output, the latter always being at the full employment level. The parameters $\beta_1 \ldots \beta_6$ are all positive.

Consider now the "short run" effects of a monetary contraction. Economic agents know that a permanent decrease in money stock will eventually reduce the domestic price level in proportion to the reduction in money stock and appreciate the exchange rate via PPP in the same proportion. UIP requires then that the home interest rate should decrease since an appreciation of the home currency is expected. However, with real output and the price level being fixed in the short run, a decrease in money stock must increase the interest rate via the demand for money mechanism. How are these contradictions to be reconciled? The answer is that in the short run, the exchange rate must appreciate **more than its expected appreciation in the long run.** In other words, the spot rate must instantaneously "overshoot" its equilibrium value [in this case, it must appreciate **below** its long-run equilibrium value, since the spot rate is stated as units of home currency per unit of foreign currency] giving rise to expectations of subsequent depreciation thus satisfying UIP at all times. Figure A.11.4 illustrates. When long-run equilibrium exchange rate stated as units of home currency per unit of foreign currency appreciates from $(s_1)^*$ to $(s_2)^*$, the spot rate appreciates from s_1 to s_2. A little algebraic manipulation of equations (A.11.21) to (A.11.23) yields the following result:

$$(\Delta s)/(\Delta m) = (1 + \beta_4\beta_5)/(\beta_4\beta_5) > 1 \tag{A.11.26}$$

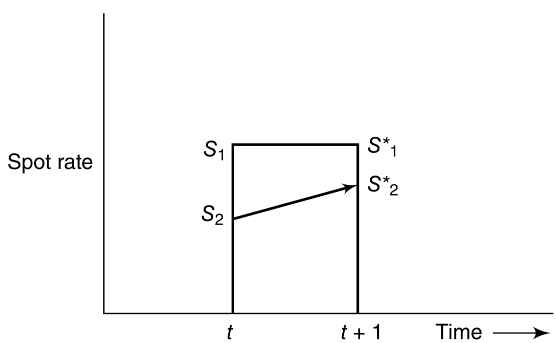

Fig. A.11.4 The Dornbusch Overshooting Model

In the long run, $(\Delta s^*/\Delta m) = 1$. There is overshooting in the short run.

Frenkel and Rodriguez (1982) extended the Dornbusch model by replacing the assumption of UIP (i.e. perfect substitution between domestic and foreign assets) by imperfect asset substitution. They show that in this case, the instantaneous response of the exchange rate may be "undershooting".

The Dornbusch model is the precursor of Frankel's so called "capital account monetary model" introduced in the text. We now turn to a brief formal treatment of that approach.

A.11.5 THE FRANKEL CAPITAL ACCOUNT MONETARY MODEL

We briefly discuss how equation (11.15) in the text is arrived at. Its key ingredients are UIP, long-run PPP, a stable long-run money demand function and an exchange rate expectation equation. In what follows, small-case letters denote natural logs of the corresponding upper-case letters and symbols with a bar over them denote "long run" values.

The expected change in exchange rate is given by

$$s^e - s = \theta(\bar{s} - s) + (\pi_A^e - \pi_B^e) \tag{A.11.27}$$

Here $\bar{s}$ denotes the "long run" equilibrium value of the exchange rate. This is determined by long-run PPP which in turn is affected by long-run productivity trends, technological changes, resource discoveries, trends in monetary policy, etc. Equation (A.11.27) says that the short-run expected change in the exchange rate depends upon the gap between the long-run equilibrium rate and the current rate, as well as the expected inflation differential. Thus, when the exchange rate is at its long-run equilibrium value, expected depreciation equals expected inflation differential. On the other hand, even if expected inflation rates in the two countries are identical, exchange rate is expected to change if it is not at the long-run equilibrium level. Next we have the UIP condition:

$$s^e - s = i_A - i_B \tag{A.11.28}$$

Combining (A.11.27) and (A.11.28) leads to

$$\bar{s} - s = (1/\theta)[(i_A - \pi_A^e) - (i_B - \pi_B^e)] \tag{A.11.29}$$

This says that deviations of the exchange rate from its long-run equilibrium value are proportional to the **real interest rate differentials.** Equation (A.11.29) can be rewritten as

$$\bar{s} - s = (1/\theta)[(i_A - i_B) - (\pi_A^e - \pi_B^e) \tag{A.11.30}$$

When tight monetary policy raises the nominal interest rate differential above its long-run level– which in turn equals the expected inflation differential – the exchange rate appreciates above its long-run level.

Now invoke the assumption that (absolute) PPP holds in the long run:

$$\bar{s} = \bar{p}_A - \bar{p}_B \tag{A.11.31}$$

Finally, a stable money demand function relates the long-run price levels to long-run money supplies, real incomes and nominal interest rates[47]. Using this, the long-run exchange rate is given by:

$$\bar{s} = (\bar{m}_A - \bar{m}_B) - \psi(\bar{y}_A - \bar{y}_B) + \lambda(\bar{i}_A - \bar{i}_B) \tag{A.11.32}$$

Substitute this in equation (A.11.30), and use the fact that long-run nominal interest rate differential equals expected inflation differential to obtain

$$\bar{s} = \bar{m}_A - \bar{m}_B - \psi(\bar{y}_A - \bar{y}_B) + \alpha(i_A - i_B) + \beta(\pi_A^e - \pi_B^e) \tag{A.11.33}$$

which is the reduced form of the capital account monetary model.

[47]The demand for real balances function in both countries is

$$\bar{m} - \bar{p} = \psi\bar{y} - \lambda\bar{i}$$

where m and y denote (logs of) nominal money stock and real income respectively.

A.11.6 A PORTFOLIO BALANCE MODEL

In this section, we will take a brief look at an early portfolio balance model proposed by Branson (1977). This is a particularly simple version of portfolio balance model designed to bring out the role of investors' portfolio adjustments in exchange rate behaviour. It abstracts from exchange rate expectations, changes in output and assumes a fixed foreign interest rate. Thus, asset returns depend only upon the domestic interest rate. Total investor wealth is allocated between three assets, viz. domestic money, domestic bonds and foreign bonds. Our exposition here follows Argy (1994). The notation is as follows:

W : Total wealth measured in home currency
M : Stock of domestic money
B : Value of domestic bond holdings, measured in domestic currency
F : Value of foreign bond holdings, measured in foreign currency
S : Exchange rate, units of home currency per unit of foreign currency

By definition, total wealth $W = M + B + SF$.

Proportion of wealth allocated to any asset is positively related to its own return and negatively to returns on other assets. Domestic money pays no interest. The return on domestic bonds is the domestic interest rate r_d. The asset allocation equations are:

$$(M/W) = -\beta_1 r_d \tag{A.11.34}$$

$$(B/W) = \beta_2 r_d \tag{A.11.35}$$

$$(SF/W) = 1 - (M/W) - (B/W) = 1 + (\beta_1 - \beta_2)r_d = 1 - \beta_3 r_d \tag{A.11.36}$$

(A.11.34) says that share of domestic money in investors' portfolios is inversely proportional to the domestic interest rate, while (A.11.35) says that the share of domestic bonds is directly proportional to the same interest rate. As home interest rate increases, investors allocate a larger proportion of their wealth to the home currency interest bearing asset. Given the foreign interest rate and static exchange rate expectations, proportion of foreign assets varies inversely with domestic interest rate as in (A.11.36).

Now totally differentiate (A.11.34)–(A.11.36) and use the identity

$$dW = dB + dM + d(FS) = dB + dM + SdF + FdS$$

to arrive at the following:

$$\frac{(W - M)}{W^2} dM - \frac{M}{W^2}(dB + SdF + FdS) = -\beta_1 d_{rd} \tag{A.11.37}$$

$$\left(\frac{W - 2}{W^2}\right) dB - \frac{B}{W^2}(dM + SdF + FdS) = \beta_2 d_{rd} \tag{A.11.38}$$

$$\left(\frac{SW - S^2F}{W^2}\right) dF + \frac{F}{W}\left(1 - \frac{SF}{W}\right) dS - \frac{SF}{W^2}(dB + dM) = -\beta_3 d_{rd} \tag{A.11.39}$$

Note that of these three equations, only two are needed to analyse the effects of monetary policy on the interest rate and the exchange rate.

Consider, for instance, an open market sale of bonds by the monetary authority. It exchanges bonds for money, in the process driving down the price of bonds or driving up the domestic interest rate. The instantaneous effect of this is a rise in interest rate. The incipient capital inflow leads to an appreciation of the domestic currency. It is easy to show using (A.11.37)-(A.11.39) and the fact that this action by monetary authority implies $dB = -dM$ and $dF = 0$ that

$$dr_d/dB > 0 \quad \text{and} \quad dS/dB < 0$$

Note the portfolio adjustments. A higher interest rate implies that the proportion of wealth allocated to bonds must increase; this is achieved in two ways. Investors buy bonds in exchange for money and the value of total wealth declines because of the appreciation of home currency which reduces the home currency value of the existing stock of foreign assets. Thus, B increases and W declines. Similarly, the ratio M/W must decline which means M must decline more than in proportion to the decline in W.

Thus, the impact effect of an open market sale of securities is appreciation of the home currency and a rise in domestic interest rate. However, this is not the end of the story. With price levels at home and abroad unchanged, a nominal appreciation also means a real appreciation; this causes a deficit to appear in the current account. This implies that investors are forced to liquidate some foreign assets. They will attempt to get rid of some domestic money and bonds to acquire more foreign assets to rebalance their portfolios. This incipient capital outflow depreciates the currency till value of foreign assets (measured in home currency) is restored.

Further adjustments have to take place till current account balance is restored. This happens by way of improvements in the trade account as currency depreciates (and price level starts falling due to fall in money stock) and a worsening of the invisibles account as interest receipts from foreign assets decline. The former effect must dominate if full equilibrium is to be restored. The interested reader can consult Argy (1994) to pursue the details.

A fully general portfolio balance model would allow for changes in real output as well as rational exchange rate expectations. Unfortunately such a model gets too complicated and few if any testable implications can be derived. As mentioned in the text, empirical testing of portfolio balance models runs into severe data problems.

A.11.7 RANDOM WALKS AND TIME SERIES ANALYSIS OF SPOT RATES

Are foreign exchange markets efficient in the sense that current exchange rates fully and instantaneously reflect all available information? Does market efficiency necessarily imply that exchange rate must follow a random walk process? We will briefly address these questions.

To begin with, a **random walk** (without drift) is a stochastic process in which the successive changes in the variable have zero mean and are statistically independent. Thus, the (log of)

$$s_{t-1} + u_t \tag{A.11.40}$$

with $E(u_t) = 0$ and $E(u_t u_{t+s}) = 0$ and u_t have constant variance[48]. The change in the spot rate from one period to next, is a serially uncorrelated random variable with zero mean and constant variance. In this case, the best forecast of tomorrow's spot rate is today's spot rate. All the information pertinent to exchange rate behaviour available up to today is already impounded in today's rate. Having access to such information does not improve your forecasts.

[48] If $E(u_t)$ does not equal zero, the random walk process can be written as

$$s_t = \mu + s_{t-1} + \varepsilon_t$$

where $\mu = E(u_t)$ and $\varepsilon_t = u_t - \mu$. This is known as random walk with a drift.

The efficient market hypothesis says that it is not possible to consistently "beat the market". The return from buying and holding a unit of foreign currency for one period is

$$x_t = (s_t - s_{t-1})/s_{t-1} \tag{A.11.41}$$

Based on the information available up to $(t - 1)$ and using an equilibrium model of exchange rate determination, the market forms certain expectations about s_t. The "equilibrium expected return" is given by

$$x_t^e = \frac{s_t^e - s_{t-1}}{s_{t-1}} \tag{A.11.42}$$

The "excess market return" over and above the equilibrium return is given by

$$(z_{t_{\backslash I_{t-1}}}) = x_t - x^e_{t_{\backslash I_{t-1}}} \tag{A.11.43}$$

Market efficiency requires that (i) the expected value of z_t conditional on I_{t-1} be zero and (ii) z_t be serially uncorrelated. In plain English, this means **assuming the market is using the "correct" model *and* forming its expectations rationally**, in the long run, the average excess returns must be zero and there must be no discernible pattern in the temporal behaviour of excess returns. In particular, no one can consistently outperform the market.

However, this does not require that the spot rate follow a random walk. All that is needed is that expectation errors $[s_t - (s_t)^e]$ must have mean zero and must be serially uncorrelated. However, if $(s_t)^e$ does not follow a random walk, s_t too need not[49]. The expected exchange rate in turn depends upon the expectations of variables which are thought to be determinants of exchange rates – money supplies, real incomes, interest rates, etc. – and there is no reason why these should follow a random walk.

There are considerable difficulties in devising an operational measure or benchmark of market efficiency. First, as discussed in the text, it is not clear as to what is the relevant information set. We have, therefore, different notions of efficiency (weak, semi-strong, strong). Second, one must have some operational measure of expected exchange rate. One alternative is to assume that the one period forward rate at time $(t - 1)$ equals the spot rate expected at t. But this involves the added assumption that speculators are risk neutral. Alternatively, survey data on professional currency traders' expectations can be employed. But this requires us to assume that traders know the "correct" underlying model and they form expectations according to that model.

Despite the lack of any compelling theoretical basis, researchers have subjected the random walk hypothesis to extensive empirical testing. Some [e.g. Mussa (1979)] have argued that the random walk model gives an adequate representation of the behaviour of natural log of spot rate. Hakkio (1986) has investigated reasons behind this apparent contradiction.

More generally, ARIMA models proposed by Box-Jenkins have been estimated for spot rates of a large number of currency pairs. The findings are on the whole conflicting and confusing. For some evidence on the exchange rates of the rupee, see Apte (1990) and Kamaiah et al. (1988).

[49]This is because $x_t - (x_t)^e$ equals $[s_t - (s_t)^e]/s_{t-1}$ and given the information set at $(t - 1)$, which includes s_{t-1} excess returns will have zero mean and no serial correlation if $s_t - (s_t)^e$ has the same properties.

Chapter 12

Corporate Exposure Management Policy

12.1 INTRODUCTION

In Chapter 2, we addressed the issue of why companies should and do devote considerable amount of resources and effort to managing their exposure to financial variables like exchange rates and interest rates. We also discussed methods of assessing and quantifying the three types of currency exposures, viz. transactions, translation and operating exposure.

The Indian economy is rapidly getting integrated with the global economy both by way of growing volumes of trade in goods and services as well as cross-border capital flows into and out of the country. The number of firms which have a significant amount of business denominated in foreign currencies is rising. Some firms in the IT and biotech industry are reported to have more than 75% of total sales net exports largely to the US but also to other countries. These companies are, therefore, facing growing exposure to currency risk.

This chapter focuses on the risk management process and addresses the issues involved in setting up and implementing an exposure management system. Management of risk and exposure is an extremely important task and the effectiveness with which it is performed can have serious implications for a company's survival. It is not just a question of using particular instruments like forwards, futures or options to hedge individual exposures; deeper issues have to be addressed. Among them are:

(a) The company's strategic business posture, attitude towards risk and its risk tolerance.
(b) Organisational design to implement a coherent policy.
(c) Monitoring and control mechanisms.
(d) Implications for managerial performance evaluation.
(e) Possible conflict of interest between a parent company and its global subsidiaries.

Consequently, top management must get intimately involved in the process of designing the policy and ensure the participation of all those who have contributions to make as also those who might be affected by it.

It is obvious that exposure management policy and its implementation cannot be divorced from the particular set of circumstances which may impose firm-specific constraints on a firm's decision making and operations. Hence, it would be foolhardy to attempt to provide a framework with universal applicability. Our aim in this chapter is only to bring out the critical dimensions – the questions that must be addressed in the process of evolving a risk management policy and related systems. The answers to these questions must be situation-specific.

Some recent studies have argued that exposure management may not succeed in reducing the overall risk faced by the firm, while at the same time, it consumes valuable resources. Copeland and Joshi (1996) have argued that anticipating the consequences of hedging is difficult since exchange rates don't change in isolation, i.e. many other factors which impinge on the firm's performance change when exchange rates change. Survey evidence reported in Alkeback and Hagelin (1999) indicates that firms' managements perceive hedging as a complicated activity. Using a sample of Swedish firms, Hagelin and Pramborg (2004) investigate the risk reducing effect of currency exposure hedging.

Surveys carried out in a number of developed economies seem to indicate that a fairly large proportion of firms explicitly assess their currency exposure and use financial products including forwards, options and swaps to hedge the exposure. It is also reported that active currency risk management is more common among larger corporations. However, in many developed open economies, many firms tend to have natural hedges with significant shares of both their revenues and expenses being denominated in currencies other than their home currency. Also, the currency composition of their assets and liabilities tends to be diversified so that net exposure is much smaller than the overall volume of their business. The reader can refer to Borsum and Odegaard (2005) and the references cited therein. Carter, Pantzalis and Simkins (2001) present findings on the currency risk management practices of US multinationals and the impact of variables like firm size, ownership structure, leverage on the hedging practices.

In the next section, we briefly outline the steps involved in the risk management process. Our exposition here draws on Lessard (1995) who discusses these issues in a somewhat different context. In section III we present a discussion of objectives of risk management policy. Following this, we discuss the issues related to organisational structure, allocation of responsibility and performance measurement. In the last section, we briefly outline the arguments for and against centralisation of the exposure management function in the case of a global corporation.

12.2 THE RISK MANAGEMENT PROCESS

The risk management function can be said to consist of the following four major tasks:

1. Selection of a target performance variable: Effectiveness of the risk management process must be assessed by quantifying its impact on a specific measure of corporate performance. Among the candidates are operating cash flows, post-tax earnings, stock price, etc. As emphasised in Chapter 2, for non-financial companies, operating cash flows is the appropriate choice. For financial institutions, a concept like Value at Risk (VAR) which focuses on the company's asset-liability portfolio is relevant.
2. Identification of those environmental factors that might have significant impact on the selected measure of the firm's performance. As discussed in Chapter 2, a firm's "strategic exposures"

can be said to arise from unanticipated changes in exchange rates, interest rates and prices of critical commodities such as oil and metals[1].

3. Assessing and, if possible, quantifying the impact of each of the environmental risk factors on the target performance variable. This is the exposure measurement process discussed in Chapter 2. As we saw there, transactions exposures are fairly easy to quantify; operating exposures on the other hand are very difficult to assess and detailed simulation exercises with reliable estimates of parameters like demand elasticity, competitive response, etc. are required. We will examine such an exercise in Chapter 14. Sometimes, statistical techniques such as regression analysis may permit identification and measurement of the impact of each risk factor. Translation exposures lie somewhere in-between and the question is often not how to manage them, but whether to manage them at all.
4. Choice of an appropriate mechanism or instrument to eliminate, reduce or shift the risk.

It must be noted that risk management need not rely exclusively on financial markets and instruments. In fact, as we will see later, very few, if any, financial hedges are available to manage operating exposure. Defence against such exposures often calls for structural changes such as reshuffling product-market combinations, shifting sourcing of imported inputs to suppliers in another country and even shifting the geographical location of operations. Operating exposure can influence the very strategic business posture of a company. Even for short-term contractual exposures, natural hedges may be available and shifting the timing of exposure by leading or lagging, i.e. advancing or postponing the timings of foreign currency receivables and payables may be possible so that hedging products may not have to be used.

Having broadly defined the tasks, risk management can be viewed as a sequential process consisting of the following steps:

1. Choose an appropriate performance measure. As mentioned above, for non-financial companies, operating cash flows is the most likely candidate[2]. For financial institutions, it might be net worth.
2. Identify the key risk factors and assess the sensitivity of the performance measure to each of them. Typical macroeconomic risk factors are exchange rates, interest rates and commodity prices.
3. Estimate the risk profile of the performance measure. This step essentially carries forward the exposure measurement process in step two. The idea is to pin down those risk factors that appear to give rise to excessive fluctuations in the performance measure. Risk profiles can be expressed in terms of variance of the target variable or the possible range of variation under reasonable assumptions about the risk factors or "best case" and "worst case" scenarios. Recall that in Chapter 2, we defined exposure as the sensitivity of the performance variable to the underlying risk factors while risk as the standard deviation of the performance variable. In this step, we are estimating risk, while in step 2 above, we assess exposure.

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[1]In addition, a firm may also face strategic risks from unanticipated shifts in government policies, e.g. import and export control which changes the competitive structure of the industry, which may render some lines of business unviable and open up new business opportunities.

[2]Some authors suggest value of the firm – its stock price – as the target variable. However, the stock price is subject to so many complex influences including the so-called "market risk" that it would be very difficult to reliably isolate the influence of macroeconomic risk factors on a firm's value. An instrumental target variable such as operating cash flows is, therefore, a more convenient objective of risk management. Value of the firm would be a more sensible target variable for financial institutions such as mutual funds.

4. Determine the desired risk profile. This is a crucial step. On the one hand, it requires an explicit statement of the firm's risk-return tradeoff. Some firms may wish to entirely remove or shift risk. Others may be willing to take some downside risk, i.e. tolerate a limited loss in the hope of benefiting from favourable movements in the risk factors. Still others may be more adventurous and may wish to adopt an aggressive posture to generate profits from "playing the financial markets" rather than just risk avoidance or mitigation. These firms may, in fact, deliberately create exposures over and above those which arise in the course of their normal operating business. Determination of the desired risk profile in such cases must be based on the firm's "market view", i.e. its forecasts of the risk factors and the degree of confidence with which such beliefs are held. Finally, this step must be implemented in conjunction with the next step, viz. choice of risk reduction mechanism or instrument. This is because the combined risk-return profile of the underlying exposed position ***and*** the instrument chosen to manage it depends upon the risk-return profile and transaction costs of the instrument chosen. Forward contracts have no risk and no possibility of benefiting from favourable movements; futures are pretty much similar except for some basis risk; options have downside risk coupled with potential for gains from upside movements and the relative size of both depends upon the precise specifications of the product chosen–strike prices, maturities, etc. As a rule, risk reduction has a cost in terms of transaction costs and the premium extracted by those who take on the risk.
5. In many cases, a firm may have natural hedges and does not need to execute a hedge transaction. For instance, a receivable in say Euro and a payable in Swiss francs, both maturing at the same time may very well offset each other since these two currencies tend to be strongly correlated. Depreciation of the currency of a subsidiary apparently creates translation losses; however, it may also improve the operating performance of the subsidiary by enhancing its competitiveness in its own and third country markets. A firm's market position may allow it to pass on to the customers any cost increases due to exchange rate changes. These and other built-in hedges must be fully explored before deciding to choose a market-oriented risk reduction device.
6. Choice of the risk reduction mechanism. The choice menu is very wide. Basic building blocks like forwards, futures, simple options, swaps, etc. can be combined and packaged in an almost infinite variety of ways to deal with a particular risk situation and the firm's desired risk profile. Risk management can also be bundled with financing by means of debt instruments with embedded options, commodity linked bonds, etc. As we have seen, instruments like forwards, FRAs and swaps[3] permit complete risk shifting, but involve an opportunity loss if the market moves in the hedger's favour; options and their variants allow the hedger to capture some upside benefit while putting a ceiling on downside loss.
7. Execute the selected transaction.
8. Monitor the performance of the selected risk reduction mechanism. As we have seen, the effectiveness and risk characteristics of hedges involving futures and options vary with the underlying cash market prices and with time. The hedge may have to be periodically adjusted to achieve the desired performance.

It is clear that some of these steps, e.g. selecting the appropriate performance measure and specifying the desired risk profile call for top management involvement; some, such as assessing the exposure and estimating the risk profile will require inputs from managers from operating

[3]Forward currency contracts have been discussed in Chapter 8. FRAs will be discussed in Chapter 15 and swaps in Chapter 16.

departments like marketing, purchase and manufacturing. Others such as executing the transactions and monitoring the hedge performance can be left to the treasury department.

In recent years, a concept known as **Value at Risk (VAR)** is being increasingly adopted by financial institutions to quantify the risk of their portfolios. VAR is a single, summary statistical measure of possible loss in the value of the portfolio due to normal market movements in the underlying risk factors over a given time horizon. More specifically, it is a limit on the loss of value which will be exceeded only with a small pre-specified probability. Thus, to say that for a particular portfolio of assets and liabilities the VAR is "*X*" (dollars, rupees or whatever) with 95% confidence level is to assert that the probability of a loss in the value of the portfolio exceeding *X* is 5%.

Quantifying risk in this manner requires fairly sophisticated analytical modeling and simulation exercises.

The concept of VAR is not particularly useful for non-financial corporations since their portfolios consist of a large number of assets such as buildings, machinery, inventories, brand equity, etc. for which no reliable market prices can be obtained. Also, in the case of a non-financial firm, as argued above, cash flow is a better measure of performance. Hence, it has been recommended that industrial firms should utilise a similar measure called Cash Flow at Risk (CFAR) which attempts to link cash flows to the environmental risk factors. Here we attempt to build a "business model" for the entire firm which links key items such as sales quantity, sales revenue, cost of goods sold, interest expenses, etc. to the environmental risk factors like exchange rates, interest rates and commodity prices and also incorporates "decision rules" for discretionary variables under the control of the firm. We then generate a large number of "scenarios" for the environmental risk factors and use the model to compute cash flows under each scenario. A simplified version of such an approach will be illustrated in Chapter 14. For further discussion of VAR and CFAR, see Wilson (1996), Turner (1996) and Linsmeier and Pearson (1997).

12.3 OBJECTIVES OF HEDGING POLICY[4]

The task of managing financial risks must be guided by clearly defined objectives. The treasury staff who have the responsibility of choosing the risk reduction mechanism and monitoring the performance must have a clear understanding of the following issues:

1. Whether the risk management posture is to be conservative or aggressive.
   As we have mentioned time and again, risk management can be totally conservative or can actively seek to profit from financial markets. If total risk removal is the objective – epitomised by the attitude "we manufacture and sell widgets, we wish to be neither hurt by nor benefit from financial market fluctuations" – then risk management can be a purely passive response to financial fluctuations. Each and every exposure should be fully hedged at all times. Alternatively, a firm may believe that it has superior forecasting ability and high-quality financial expertise and may wish to treat risk management as a profit centre, i.e. the treasury people are expected to generate profits purely by outguessing financial markets, such profits having little or no relation to the firm's core business. If such an active posture is to be adopted, the top management must be willing to tolerate some risk, i.e. fluctuations in the performance measure which may occasionally lead to substantial cash losses. Also, an aggressive risk management policy requires that considerable resource be devoted to the risk

[4]This section follows the exposition in Bishop, P. and D. Dixon (1992).

management function in terms of trained manpower with the requisite financial expertise, sophisticated communications and computing equipment, access to online information about markets and prices, etc. An active posture implies that risk management is treated as a profit generating activity, while a passive approach treats it as a cost centre.

2. The appropriate performance measure in terms of which the efficacy of risk management will be evaluated.

   We have discussed this aspect above and suggested that for non-financial companies operating cash flows is the appropriate performance target in most circumstances.

3. The time horizon to be adopted in making risk management decisions.

   If the time horizon is limited to the coming financial year and the focus is on minimising cash losses, hedging transactions exposure is the critical task. If, in addition, the firm is also concerned about the figures that will be reported in the financial statements, translation exposure would also become relevant. On the other hand, if the time horizon is longer and the prime concern is sustained profitability and enhancing the firm's competitive position, operating exposure is crucial. In practice, both short-term cash losses and longer-term viability will be important. But very often since operating exposure is difficult to assess and defences against it require structural adjustments, the treasury staff have a tendency to focus on transactions and translation exposures. It is here that the top management must ensure that the longer term implications of exchange rate fluctuations are constantly analysed and the required adjustments carried out in a timely fashion.

To summarise, risk management policy must clearly enunciate the risk-return tradeoff, the target performance indicator(s), the relevant time frame, and the amount and quality of resources the firm is willing to commit to the risk management function.

12.4 ORGANISATIONAL ISSUES

It is clear from our discussion so far that at least for non-financial firms, a large part of the financial exposures and risks arise out of their core business operations and the manner in which financial risks are managed has implications for their operations. Consequently, evolution and implementation of risk management policy cannot be left solely to treasury. Senior executives in other functional departments must be intimately involved at various stages. Further, the treasury staff must work closely with the accounting and control department since all financial transactions executed by the former have dimensions like settlement, monitoring of positions, credit risks, proper reporting and tax implications which are the domain of the latter. Hence, effective risk management is predicated upon the existence of structures and systems which facilitate information flows, allocation of responsibility and authority and performance evaluation. We briefly address these issues in this section.

The three main considerations to be addressed are:

1. Who should get involved in the establishment and implementation of risk management policy?
2. What are the roles and responsibilities of the various participants?
3. Performance measurement and control systems.

On the first and second of these issues, it is clear that the primary responsibility for executing the policy must rest with the treasury manager(s) and market dealers. They can also contribute to the process of evolving the policy because of their intimate knowledge of markets, instruments and operational constraints. Senior executives from finance and treasury must provide the overall strategic perspective during the evolution of the policy. Executives from other operating groups such as sales, manufacturing, purchase can provide insights into actually how the various exposures arise, what will be their time profile and what will be the impact on their operations, if they are managed in a particular way, e.g. using leads and lags to manage currency exposures may impact on customer and supplier relations. They also should play an important role in management of operating exposure since they have more intimate knowledge of competitive pressures in product markets, demand elasticities, alternative sources of supply of imported materials, feasibility of restructuring production and so forth. Finally, as mentioned above, the financial controller's staff must work hand in hand with the treasury people because it is the controller's office who look after settlements, monitoring credit risks, receivables and payables, accounting, reporting and taxation issues.

For multinational corporations with worldwide operations, a critical issue is whether to centralise exposure management or leave it to the individual units in different countries[5]. Centralisation offers several advantages, some of which are:

1. It minimises duplication and permits economies of scale to be exploited in the use of expensive manpower, equipment and other resources. Staff dedicated full time to managing financial risks develop in-depth expertise in foreign exchange and other financial markets and instruments.
2. Transaction costs can be minimised by netting intra-corporate payments and offsetting some exposures against each other. For instance, the US dollar payable of the Canadian subsidiary to its US parent can be netted against its US dollar receivable from the UK subsidiary; a Euro payable can be offset against a Swiss franc receivable since these two currencies are highly positively correlated. Transaction costs can also be reduced by pooling together several buy/sell transactions instead of executing each separately.
3. The overall picture regarding exposures is easily identifiable instead of being diffused throughout the global organisation.
4. A centralised exposure and cash management centre located in a major, efficient money market centre can access a wide variety of hedging instruments, while subsidiaries, particularly those operating in developing countries may not be able to access them. This will also contribute to reduction of transactions costs. Also, banking systems in these developed financial centres are much more efficient permitting minimum delays in collections, payments, funds transfers, etc.
5. Managing translation exposure when global consolidation is required can be done more effectively from a centralised location. This consideration is not so compelling for transactions exposures.

On the other hand, centralised exposure management has some disadvantages too. The centralised staff may not be able to appreciate the operational constraints and some specific issues related to the business environment of local subsidiaries. The way they handle overall corporate exposure – and cash management function – may hamper local managements in their dealings with their customers and suppliers. Local managers handling their own exposures would be able to develop closer relations with local banks which yields benefits in terms of better advice and access to information. These relationship benefits are lost with centralised management. Finally, performance appraisal becomes more complicated. The decisions taken by the centralised risk management team would be guided by the total corporate perspective rather than performance of an individual subsidiary but these decisions may have an adverse impact on the reported performance indicators of the local management. This factor must be taken into account in evaluating the performance of local management.

[5]Centralised exposure management often goes hand in hand with centralised cash management. Issues pertaining to the relative advantages and disadvantages of centralised versus decentralised cash management are discussed in Chapter 17, but they have a bearing on the issues being discussed here.

Measurement of hedging performance is a complex issue. The objective of hedging is presumably risk reduction. But except in the case when the firm is extremely risk averse and its policy is to eliminate all the risks that can be eliminated, it is always a question of risk-return tradeoff which is rarely, if ever, made explicit. Statistically, the performance of a particular hedging programme can be assessed by comparing the mean and variance of the operating cash flows attained with the chosen strategy with the mean and variance which would have been obtained by an alternative benchmark strategy. The choice of benchmark strategy is never simple. With discretionary exposure management, a very large number of alternatives are available. The strategy of forward hedging all the exposures all the time may be chosen as benchmark for transaction exposures.

There is also the question of assessing the "gains" and "losses" from particular hedging transactions and attributing them to the appropriate departments. Consider a firm which has exported goods to the United States worth \$500,000. The payment will be received 90 days hence. The current spot rate is ₹62.60, 90 day forward is ₹63.10. At what rate should the export sales be valued? Suppose the treasury manager gives a rate of ₹62.75 to the export group, a rate he has seen in the market a few hours earlier. Then he goes and books a forward sale contract at ₹63.10. Apparently, the treasury department has "earned" a profit of ₹0.35 per dollar or a total gain of ₹1,75,000. But this is really an illusion and arises because the sales were valued at or near the current spot rate. Consider another situation. A firm has a 90-day payable of CHF 1,000,000. The current spot rate is ₹47.00, 90-day forward is ₹48.00. The treasurer decides not to book a forward contract immediately. Sometime later he books a forward purchase contract at a price of ₹47.75. The spot rate when the payable matures is ₹47.50. Would it be right to say that the treasury group has "lost" ₹0.25 per CHF or a total loss of ₹250,000? The answer once again is no. In both the cases, the correct procedure would have been to value the items at the appropriate forward rates, irrespective of booking of a forward contract.

Many firms use the concept of "budget rate" in their annual planning and budgeting exercises. This is a kind of target exchange rate which would be used, among other things, for evaluating the performance of foreign subsidiaries and as a benchmark for assessing the effectiveness of treasury hedging activities. There are a number of issues involved in the choice of such budget rates [See Miyamato and Godfrey (1995)]. Among the candidates are (a) current spot rate (b) the relevant forward rate and (c) an off market rate such as for example, a forecast rate provided by a forecasting service. Choosing a budget rate other than the appropriate market forward rate can be problematic from the point of view of hedging activity. It might induce the treasury managers involved in hedging to be more aggressive than intended by the top management.

Consider the following example. An Indian company has a 6-month British pound (GBP) payable of £100,000. The current spot rate is ₹93.50 and the six-month forward is ₹92.85. The firm subscribes to a forecasting service which is even more bullish about the rupee and has given a six-month forecast of ₹91.90. In order to be a little more conservative, the management chooses a budget rate of ₹92.10. What should the treasury manager responsible for currency hedging do? If he or she covers forward, a "loss" of ₹0.75 per GBP relative to the budget rate is locked in; to avoid this, the treasury manager might leave all or a part of the exposure unhedged. If the forecaster is right, the best that he or she can hope is that the pound will fall below the budget rate of ₹92.10; however if they are wrong as to the direction and/or the extent of sterling weakening, unhedged exposures lead to a loss compared to the forward hedge. Once again, the correct budget rate is the market forward rate[6].

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[6]If there are a series of exposures maturing at different times, a budget rate equal to the weighted average of the relevant forward rates, each weighted by the proportion of total exposure maturing at that time might be a convenient choice. Using the relevant forward rate for each maturity will lead to different budget rates for different quarters or months of the financial year. See Miyamato and Godfrey ***op cit.***

Does this mean that currency forecasts have no place in arriving at hedging decisions? The answer is an emphatic no. What it does mean is that while the decision in respect of whether to hedge or not to hedge, or hedge partially can certainly be guided by management's currency views, the responsibility for forecasting errors should not be assigned to the treasury manager responsible for hedging. What about the situation when the treasury manager is also given the task of forecasting currency rates? Even here, the budget rates should reflect market's forward rates; if the treasury manager decides not to hedge based on his/her own views, then the eventual blame for losses (compared to the budget rate) can be squarely put on the risk manager's shoulders. (Conversely, if the risk manager makes a gain, he deserves credit for "outguessing" the market). For the purposes of performance assessment, the forward rate(s) is the appropriate choice.

In recent years, with opening up of capital markets in most countries, currency exposure management related to foreign portfolio investments is becoming important. A portfolio manager with a mutual fund in, say, US may wish to invest in the stock markets of other countries based on her view that the economies and hence the equity markets of those countries are going to boom during the months to come. However, she is not sure about the behaviour of exchange rates of those currencies against the US dollar and would like to hedge that exposure. She may also wish to invest in the debt markets of other countries. She can outsource the task of managing the currency exposure of her portfolio to an institution which provides ***currency overlay*** services. While the portfolio manager of the mutual fund would decide on the composition of her multi-country, multi-currency equity or bond portfolio, the currency overlay manager would manage the currency risk on the entire portfolio or a fraction of it as specified by his client. A good recent reference on the subject of currency overlay is Record (2003).

12.5 INFORMATION SYSTEM FOR EXPOSURE MANAGEMENT

Effective exposure management requires a well-designed management information system (MIS). Exposures above a certain minimum size must be immediately reported to the executive or department responsible for exposure management. The three types of exposures – transactions, translation and operating must be clearly separated. In the case of cash flow exposures, the report must state the timing and amount of foreign currency cash flows, whether either or both are known with certainty or, if uncertain the degree of uncertainty associated with timing or amount. The exposure management team must evolve a procedure for assessing the risk associated with these exposures by adopting a clearly articulated forecasting method or scenario approach. The benchmark for comparing the alternative scenarios must be clearly stated. As argued above, the appropriate benchmark for short-term transactions exposures is the relevant forward rate.

If a discretionary hedging posture is to be adopted, stop-loss guidelines must be clearly articulated. These can take the form of specified levels of forward rates or specified changes in the spot rate which when crossed would automatically trigger appropriate hedging actions.

All exposed positions including their hedges, if any, should be monitored at frequent intervals to estimate the mark-to-market value of the entire portfolio consisting of the underlying exposures and their corresponding hedges.

When a particular exposure is extinguished, a performance assessment must be carried out by comparing the actual all-in rate achieved with the benchmark. This should be done at regular intervals with the frequency of assessment being determined by the size of exposures and their time profiles. Periodic reviews must be carried out to ensure that the risk scenarios being considered are not far removed from the actual developments in exchange rates due to large forecasting errors.

Effective management of operating exposures requires far more information and judgmental inputs from operating managers. Pricing and sourcing decisions must involve the exchange rate dimension and its likely impact on future operating cash flows. A strategic review of the entire business model must incorporate a realistic assessment of the impact of exchange rate fluctuations on the firm's entire operations in the medium to long term.

Summary

This chapter addresses the issues involved in establishing and implementing risk and exposure management policy in a firm with emphasis on management of currency exposure and risk. The risk management process involves several steps starting with identification and assessment of risk and leading up to the choice of specific risk reduction devices and their execution. Exposure management policy must be guided by clearly defined objectives including the firm's risk-return tradeoff and relevant horizon for risk management. While the choice of hedging mechanisms and the execution of execution of risk management transactions are primarily the ambit of treasury, other departments of the corporation including the top management must play a role in establishing objectives, identifying and measuring exposure and risk and monitoring the performance of treasury staff. The choice of benchmarks for assessing the effectiveness of hedging is a complex and important issue. For an MNC, another important issue is whether to centralise the exposure management function or leave it to the individual operating units including foreign subsidiaries. Both have their associated advantages and drawbacks and a careful weighing of pros and cons is warranted.

Questions and Problems

1. Discuss the relative merits of operating cash flows, net profit after tax and stock price as the target performance measure for setting up an exposure management policy.
2. "A non-financial firm should always completely hedge all its exposures to environmental risk factors such as exchange rates and interest rates". Critically discuss this recommendation.
3. What role can operating divisions such as marketing, production play in setting up and implementing a firm's exposure management policy?
4. Discuss the advantages and disadvantages of centralised exposure management in a MNC.
5. Why is the relevant forward rate the correct budget rate in the context of currency exposure management?

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Chapter 13

Hedging, Speculation and Management of Transactions Exposure

13.1 INTRODUCTION

In Chapter 3, we have defined the various types of exchange rate exposure and the associated risk that firms are subject to as a consequence of fluctuating exchange rates. We must now address the question of how to reduce or avoid this exposure. The present chapter deals with management of transactions exposure. Recall that transactions exposure refers to the change in the home currency value of an item whose foreign currency value is **contractually** fixed.

The terms ***hedging*** and ***speculation*** that appear in the title of this chapter need to be clearly defined. The former will be understood to mean a transaction undertaken specifically to offset some exposure arising out of the firm's usual operations, while the latter will refer to deliberate creation of a position for the express purpose of generating a profit from exchange rate fluctuations, accepting the added risk. With this definition, a decision not to hedge an exposure arising out of operations can also be looked upon as speculation.

Management of transactions exposure has two significant dimensions. First, the treasurer must decide whether and to what extent any exposure should be explicitly hedged. The nature of the firm's operations may provide some natural hedges. Its market position may occasionally permit it to entirely avoid transactions exposure. At other times, these internal hedges may be quite imperfect or too costly because of their adverse effects on sales or profit margins. Having decided to hedge whole or part of an exposure, the treasurer must evaluate alternative hedging strategies.

In Chapter 2, we have discussed in detail the pros and cons of firms devoting resources to management of exchange rate risks. We saw there that notwithstanding the efficient markets argument, there are good reasons why firms should hedge exchange rate exposures. In that chapter, and further in Chapter 12, we addressed the issue of passive versus active approach to managing exchange rate exposure. In the present chapter, we examine the various hedging devices available to the firm and discuss how to compare and evaluate alternative hedging strategies.

13.2 USING THE FORWARD MARKETS FOR HEDGING TRANSACTIONS EXPOSURE

In the normal course of business, a firm will have several contractual exposures in various currencies maturing at various dates. The net exposure in a given currency at a given date is simply the difference between the total inflows and total outflows to be settled on that date. Thus, suppose Fantasy Jewellery Co. has the following items outstanding:

Item	*Value*	*Days to maturity*
1 USD receivable	800,000	60
2 EUR payable	2,000,000	90
3 USD interest payable	100,000	180
4 USD payable	200,000	60
5 USD purchased forward	300,000	60
6 USD loan installment due	250,000	60
7 EUR purchased forward	1,000,000	90

Its net exposure in USD at 60 days is:

$$(800{,}000 + 300{,}000) - (200{,}000 + 250{,}000) = +\ \text{USD } 650{,}000$$

whereas it has a net exposure in EUR of –1,000,000 at 90 days.

The use of forward contracts to hedge transactions exposure at a single date is quite straightforward. A contractual net inflow of foreign currency is sold forward and a contractual net outflow is bought forward. This removes all uncertainty regarding the domestic currency value of the receivable or payable[1]. Thus, in the above example, to hedge the 60-day USD exposure, Fantasy Jewellery Co. can sell USD 650,000 sixty days forward while for the EUR exposure; it can buy EUR 1,000,000 ninety days forward.

What about exposures at different dates? One obvious solution is to hedge each exposure separately with a forward sale or purchase contract as the case may be. Thus, in the example, the firm can hedge the 60-day USD exposure with a forward sale and the 180-day USD exposure with a forward purchase. Is it possible to hedge multiple exposures in a given currency with a single forward contract? In the appendix, we show that this can be done provided either interest rates for various maturities are known with certainty or contracts, known as Forward Rate Agreements, are available which permit a firm to lock in borrowing or lending rates for future periods. These are discussed in Chapter 15. We also discuss application of the concept of duration (see Chapter 15) to this problem.

13.2.1 The Cost of a Forward Hedge

An important and often misunderstood concept is that of ***cost of forward hedging***. It is a common fallacy to claim that the cost of forward hedging is the forward discount or premium. (If the foreign currency is sold at a discount, the discount is claimed to be the "cost" of the hedge; if it is bought at a premium, the premium is regarded as the cost. On this view, the premium gained on forward sale or discount obtained on forward purchase would have to be treated as a "negative cost" or a gain).

[1]Note that if all or part of the net flow fails to materialise, e.g. a foreign customer defaults on a payment, the firm still has to deliver on the forward contract. Thus, in this case, the firm has to buy the foreign currency in the spot market to deliver against the forward sale contract. This is called "reverse exchange risk".

The genesis of this fallacy is in the accounting procedure used to record transactions denominated in foreign currency and for which a forward hedge is used. Suppose an Indian firm buys equipment worth Euro 1,000,000 from a German supplier on 90-day credit. The accounts payable is then valued at today's spot rate which is, say ₹72.50. The firm covers the payable with a 90-day forward purchase of Euros at a premium of say ₹0.20, i.e. the 90-day forward offer rate is ₹72.70 per Euro. The firm has to pay ₹72,700,000 to settle the payable valued at ₹72,500,000. In recording this transaction, the following entries are made:

A/C Payable	72,500,000
Forward Loss	200,000
Bank Account	72,700,000

Thus, the premium paid is recorded as the cost of forward cover. By the same logic, if the Euro had been at a forward discount, cost of forward cover would have been negative. However, this is a conceptually erroneous way of interpreting cost of forward cover.

The point is, the forward hedge must be compared not with today's spot rate, but the ex-ante value of the payable, if the firm does not hedge. Since the latter is unknown today, the relevant comparison is between the forward rate and ***the expected spot rate*** on the day the transaction is to be settled. The ***expected cost of forward hedge*** for the above Indian firm is given by

$$F_{90}(\text{EUR/INR})_{\text{ask}} - S^e_{90}(\text{EUR/INR})_{\text{ask}} \tag{13.1}$$

where the notation S^e_{90} denotes "spot rate expected to rule 90 days from today".

If speculators are risk neutral and there are no transaction costs, we saw in Chapter 11 that

$$F_{t,\,T} = S^e_{t,T}$$

i.e. the forward rate at time t for transactions maturing at T equals the expectation at time t, of the spot rate at time T. In this case, the expected cost/gain from forward cover is zero.

What if the speculators in the foreign exchange market are not risk neutral? In this case, we have

$$F_{t,\,T} > S^e_{t,T} \text{ or } F_{t,\,T} < S^e_{t,T}$$

the former when speculators are on balance forward sellers and the latter when they are net forward buyers. The argument here is that speculators will demand a risk premium for assuming the risk of an uncertain future spot rate.

Even in this case the expected cost of hedging is zero. This is because the hedgers are passing on the risk to the speculators and the risk premium paid is the price of risk avoidance. The forward rate is the market's certainty equivalent of the uncertain future spot rate[2]. This can be understood as follows. Suppose the current USD/INR spot rate is 55.00 and the three-month forward is 56.75. If you take an uncovered long position in the forward contract, you would gain – the bank which sells you the forward contract would lose – if the spot three months later turns out to be greater than 56.75 and you would lose – the bank would gain – if it turns out to be below 56.75. If the forward rate quoted by the bank is inordinately high, say ₹59, so that the probability of your gaining is very small, you would demand an up-front payment for taking a long position; similarly, if it is ridiculously low, say ₹45, the probability of the short side gaining is very low and the bank would demand up-front

[2]The notion of certainty equivalent is as follows. Suppose an individual is offered a gamble in which she wins ₹1000 with a probability of 0.8 or loses ₹1000 with a probability of 0.2. If she says that she is indifferent between this gamble and receiving ₹400 with certainty, her certainty equivalent of the risky choice is ₹400. The expected utility from the risky alternative equals the utility of the certain gain.

compensation. The actual forward rate is such that risk adjusted gains equal risk adjusted losses so that the forward contract has zero value – neither the buyer nor the seller demands any payment at the initiation of the contract.

Hence, presence of risk premium does not invalidate the contention that the expected cost of forward hedging is zero. Transaction costs are a different matter. As we have seen, the bid-ask spreads are generally wider in the forward segment[3] than in the spot segment so that even if there is no risk premium

$$F_{t,T}(\text{EUR/INR})_{\mathbf{ask}} > S^e_{t,T}\,(\text{EUR/INR})_{\mathbf{ask}}$$

and
$$F_{t,T}(\text{EUR/INR})_{\mathbf{bid}} < S^e_{t,T}\,(\text{EUR/INR})_{\mathbf{bid}}$$

Thus, the only cost of a forward hedge is the larger spread in the forward market compared to the spot market. The extent of the difference depends on the relative depth of the two markets. For transactions between the major convertible currencies, the short-maturity forward markets are nearly as deep as the spot markets and the difference in spreads tends to be quite small.

The accounting problem mentioned above arises because the invoice amount is converted into domestic currency at today's spot rate. The correct procedure is to use the forward rate for this purpose. To elaborate this argument, consider the following example:

- A firm has exported textiles to a German customer for which it would like to get ₹1,000,000 cash. However, keeping in view the competitive factors, it has to give 90-day credit. The domestic interest rate is 8% p.a. The firm should charge ₹1,020,000 (= 1.02 × 1,000,000) for 90-day credit sale. How should it translate this into a EUR denominated price? The interest rate in Eurozone is 4% p.a.
  The spot EUR/INR exchange rate is 72.50.
  Obviously it is wrong to calculate the EUR price as (1,020,000/72.50) = EUR 14068.96. To see why, suppose the export bill is discounted with a German bank, the proceeds will be EUR (14068.96/1.01) = EUR 13929.67 which converted into rupees will be worth ₹1009901 (= 13929.67 × 72.50) whereas the firm's target is to realise ₹1,000,000. To realise this, the firm should quote EUR [(1,000,000/72.5) × 1.01) = EUR 13931.03. Thus, the appropriate rate for translating the price is (1,020,000/13931.03) = 73.2178. But this is precisely the forward rate arrived at by the interest parity theorem, viz.

  $$(72.50)(1.02/1.01) = 73.2178$$

  Of course, the example overlooks the fact that in some forex markets, the forward premiums/discounts are not necessarily determined by interest rate differentials and hence, the actual forward rate may be quite different from the interest parity rate. This used to be the case in the Indian forex market a few years ago. In recent times, the forward markets for major currencies against rupee obey the interest parity relation quite closely. However, the point we wish to emphasise is that the appropriate rate is the interest parity forward rate and not today's spot rate. As we have seen in Chapter 8, for the major convertible currencies departures from interest parity are well within the bounds imposed by transaction costs.

[3]The wider spreads in the forward market are also related to exchange rate uncertainty. A bank after taking a forward position with a customer will immediately try to cover itself by acquiring an opposite position. The rate might change adversely before it can accomplish this and the risk is greater in the outright forward market than in the spot market. The speculator's risk reflected in the risk premium is for longer time duration equal to the maturity of the contract even though the nature of the risk is same.

It must be emphasised that forward hedging of contractual exposures does not stabilise a firm's cash flows. Suppose an Indian exporter, who has continuing exports to USA, invoices his exports in US dollars and maintains US dollar prices so as to retain its competitive position in the US market. Each USD receivable is sold forward. The firm's rupee cash flows will then fluctuate as the USD/INR forward rate fluctuates; if it does not hedge, the fluctuations in the cash flow will be proportional to the changes in the spot rate. Empirically, the volatility of the forward rate is not significantly less than the spot rate. It could also remove its contractual exposure by invoicing each shipment in rupees on some kind of a cost-plus basis. Now, the dollar prices will fluctuate and so will the firm's export volume and market share. Thus, hedging a contractual exposure just removes the uncertainty regarding the home currency value of that particular item; it cannot stabilise the firm's cash flows or profits.

13.2.2 Choice of Invoice Currency

This is also the appropriate place to dispose off the issue of the choice of invoice currency in so far as it bears on transactions exposure. As we will see in Chapter 14, choice of invoice currency has important implications for operating exposure of the exporter/importer but the foreign exchange risk dimension is relatively unimportant. Consider the Indian exporter of textiles to Germany in the above example***. After the quantity and price of exports have been negotiated***, it does not matter whether the invoice is in rupees or euros, ***provided both parties have access to efficient forward markets*****.** If the invoice is in EUR, the exporter faces exposure which can be covered in the forward market as seen above; if it is in rupees, the importer can buy ₹1,020,000 in the forward market at a total cost of EUR 13931.03 to be incurred three months from today. Problems arise, if a well functioning forward market does not exist or cannot be accessed by one of the parties. Till a few years ago, with controls on capital movements, for instance, the spot-forward differential in the case of rupee exchange rates was not always very closely related to the interest rate differential. Suppose the EUR/INR forward rate was 72.75. The Indian exporter would have liked to quote a price of EUR 140206.18 (= 1,020,000/72.75) for a 90-day credit sale or would prefer to invoice in rupees. To the German buyer, this would mean an annualised interest cost of 6.06%[4]. This might make the deal unattractive to the importer. A price of EUR 13931.03 would make the deal unattractive to the exporter because this would imply a cost of funds of $[\{(13931.03/13793.10) - 1.0\} \times 4.0]$ or 4% when, in fact, it was 8%.

The choice of currency of invoicing is often dictated by marketing considerations and exchange control factors. An exporter may wish to invoice in the buyer's currency to gain competitive advantage. Invoicing in a weak currency – which may be neither the buyer's nor the seller's currency – may be an indirect way of offering discounts which otherwise may be difficult to offer. In some countries, due to exchange control, the only way a company can take a position in a currency is by invoicing a trade transaction in that currency. As mentioned above, if forward markets in a particular currency are thin or non-existent, it is better to avoid invoicing in that currency since the exposure cannot be effectively hedged. Finally, it should be kept in mind that any gains from the choice of currency of invoicing made by one party are always at the expense of the other party. Hence, for invoicing intra-company transactions as between different subsidiaries of a parent company, overall tax considerations and minority interests of the local shareholders will play a significant role.

The issue of currency of invoicing assumes importance in the analysis of operating exposure and we will return to it in Chapter 14.

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[4]For immediate payment, the Indian exporter would have invoiced EUR 19047.62 (= 1,000,000/52.5). An invoice of 19336.49 for 90-day credit implies an annual interest rate [(19336.49/19047.62) – 1.0]*4.0 = 0.0606 or 6.06%.

13.2.3 Exposures with Uncertain Timing

Sometimes the timing of the exposure may be uncertain though the amount is known with certainty. Suppose a Hong Kong firm has ordered machinery from a Swiss supplier worth CHF 5,000,000. Payment is to be made when the shipment arrives and documents are handed over to the importer. There is some uncertainty regarding the exact time of arrival of the shipment. It may arrive at any time during the fourth month after a firm order is placed.

Such an exposure can be covered with the use of ***option forwards*** discussed in Chapter 8. The importer firm enters into a contract which allows it to purchase CHF 5,000,000 forward with delivery at any time between 3 and 4 months from the date of the contract at the option of the buyer. As we saw in Chapter 8, if the Swiss franc is at a premium vis-à-vis the HK$, the bank will charge the maximum premium between 3 and 4 months, and if it is at a discount, it will give the customer the least possible discount.

Option forwards are generally an expensive device to deal with exposures with uncertain timing. Using swaps may turn out to be cheaper. Thus, suppose on May 1, a company expects to settle a foreign currency payment on August 1, but feels that the payment date may get postponed by as much as three months. Instead of buying a 3-6 option forward, it can buy the foreign currency forward for delivery on August 1; suppose by June 15, it knows with certainty that the payment will have to be settled on September 10; it can do a forward-forward swap, i.e. sell the foreign currency for delivery August 1 and buy for delivery September 10. The first leg of the swap – the sale – cancels its outstanding forward commitment to buy, while the other leg takes care of the payment due on September 10.

13.2.4 Cancellation of Forward Contracts

Cancellation of forward contracts at the customer's option is also possible. In Chapter 10, we have seen that this can be considered as a kind of option. The customer may cancel the entire amount – e.g. when the underlying export or import deal could not materialise – or a part as when the actual payment to be made or received is less than the amount booked in the forward contract. Recall that at the time the contract is entered into at the then prevailing spot and forward rates, the contract has zero value. As the rates change, the contract develops a negative or positive value from the point of view of one of the parties. Cancellation of a forward contract essentially involves settlement of value of the forward contract at the time of cancellation. For a forward sale (by the customer to the bank), cancellation on due date is deemed as purchase by the bank at the contracted forward rate and a simultaneous sale at the then ruling spot rate. If the currency has appreciated beyond the forward rate, the difference is recovered from the customer; if it has depreciated, the difference is paid to the customer. For a forward purchase, cancellation is deemed as a sale by the bank at the contract rate and a simultaneous purchase at the spot rate. Any difference in favour of the customer is paid to the customer, any loss is recovered from the customer. In both the cases, the bank will charge a flat fee over and above any gains/losses.

For cancellation before the due date, an opposite forward contract is deemed to have been entered into. Thus, suppose a firm buys $200,000 three-month forward on September 10 at a rate of ₹57.50. The due date is December 12. On November 10, the firm would like to cancel the entire contract. Conceptually, this can be viewed as the firm entering into a fresh one-month forward contract to sell $200,000 to the bank. The bank would deem this as a one-month forward purchase from the customer and do the cancellation at the one-month forward purchase rate on November 10. It would make a one-month forward sale to the market to cover its original three-month forward purchase from the market (which had offset its three-month sale to the firm). A forward sale (by the customer to the bank) is cancelled at the relevant forward sale rate. Once again a flat fee is charged apart from any difference paid to or recovered from the customer.

The customer can also request premature settlement or extension of a forward contract. In Chapter 8, we have seen how these are carried out.

13.3 HEDGING WITH THE MONEY MARKET

In Chapter 8, we have seen that there is a close connection between money markets and forward exchange premiums and discounts on account of covered interest arbitrage. Firms which have access to international money markets for short-term borrowing as well as investment, can use the money market for hedging transactions exposure.

- Suppose a US firm has a 90-day Euro receivable of EUR 10,000,000. It has access to money markets in EUR as well as USD. To cover this exposure, it can execute the following sequence of transactions:
  1. Borrow EUR in the London money market for 90 days.
  2. Convert spot to USD.
  3. Use the proceeds in its operations, e.g. to pay off a short-term bank loan or finance inventory.
  4. When the receivable is settled, use it to pay off the EUR loan.

  Suppose the rates are as follows:

  EUR/USD Spot: 1.1062/70 90-day forward: 1.0990/1.1045
  EUR interest rates: 5¼/5½
  Euro$ interest rates: 4¾/5.00

  You can check that these rates do not imply a covered interest arbitrage opportunity. Let us compare forward cover against the money market cover.
  With forward cover, each EUR sold will give an inflow of USD 1.0990 days later. The present value of this (at 4.75% p.a.) is

  $$1.0990/[1 + (0.0475/4)] = \text{USD } 1.0861$$

  To cover using the money market, for each EUR of receivable, borrow EUR 1/[1 + (0.055/4)] = EUR 0.9864

  Sell this spot to get USD (0.9864 × 1.1062) = USD 1.0911.

  Pay off the EUR loan when the receivable matures.
  Thus, with money market cover, there is a net gain of USD 0.0051 per EUR of receivable or USD 51,000 for the 10 million Euro receivable.

You will have realised that this is just another instance of one-way arbitrage discussed in Chapter 8. Even though the market rates do not violate conditions (8.7) and (8.8) of Chapter 8, they do violate conditions (8.9) and (8.10). As stated there, absence of covered interest arbitrage opportunities does not necessarily imply that forward cover and money market cover would be equivalent. A careful calculation can at times reveal opportunities to make or save money.

Sometimes the money market hedge may turn out to be the more economical alternative because of some constraints imposed by governments. For instance, domestic firms may not be allowed access to the Euromarket in their home currency or non-residents may not be permitted access to

domestic money markets. This will lead to significant differentials between the Euromarket and domestic money market interest rates for the same currency. Since forward premia/discounts are related to Euromarket interest differentials between two currencies, such an imperfection will present opportunities for cost saving.
Consider the following example:

- A Danish firm has imported computers worth \$5 million from a US supplier. The payment is due in 180 days. The market rates are as follows:

  USD/DKK Spot: 5.5010/20

  180 days forward: 5.4095/5.4110

  Euro\$: 9½/9¾

  EuroDKK: 6¼/6½

  Domestic DKK: 5¼/5½

  The Danish government has imposed a temporary ban on non-residents borrowing in the domestic money market. You can check that covered interest arbitrage possibilities are absent at the Euromarket rates.

  For each dollar of payable, forward cover involves an outflow of DKK 5.4110, 180 days from now.

  Instead, for each dollar of payable, the firm can borrow DKK 5.2525 at 5.5%, acquire \$0.9547 in the spot market and invest this at 9.50% in a Euro\$ deposit to accumulate to one dollar to settle the payable. It will have to repay:

  DKK 5.3969 [= 5.2525 × 1.0275], 180 days later.

  This represents a saving of DKK 0.0141 per dollar of payable or DKK 70,500 on the \$5 million payable. [Note that with these rates, there is a profitable covered interest arbitrage opportunity and the relevant question is: if a lot of Danish investors do it, will the low rates in the Danish domestic market persist? Obviously, the Danish government must impose restrictions on Danish institutions engaging in covered interest arbitrage, if it wishes to maintain the domestic interest rates lower than the Euromarket DKK interest rates.]

The lesson from these examples is that from time to time cost saving opportunities may arise either due to some market imperfection or natural market conditions which an alert treasurer can exploit to make sizeable gains. Having decided to hedge an exposure, all available alternatives for executing the hedge should be examined.

Extending the logic of money market hedge, a firm with planned receivables in a currency can hedge by borrowing in that currency so that the outflows on account of interest and repayments can be set off against the receivables. Once again, if interest parity operates, this would be equivalent to a forward cover. This way of covering exposures is useful only if the firm can freely convert the currency borrowed into a currency it needs or is able to use the borrowed currency itself to finance some local operations.

Under the existing exchange control law in India, authorised dealers in foreign exchange (mostly commercial banks) can use this method to offset the exposure arising out of forward deals done with customers. Importers can avail of financing from foreign banks in the Euromarket to settle their import bills. Depending on the ruling interest rates in the Euromarkets and the rupee-dollar forward premia in the Indian market, it can often happen that the effective total cost of such foreign currency financing works out cheaper than a rupee loan from domestic banks. Exporters can invest a part of their foreign currency proceeds in foreign currency deposits.

13.4 HEDGING WITH CURRENCY OPTIONS

Currency options provide a more flexible means to cover transactions exposure. A contracted foreign currency outflow can be hedged by purchasing a call option (or selling a put option) on the currency while an inflow can be hedged by buying a put option. (Or writing a call option. This is a "covered call" strategy). We have discussed a number of examples of the use of options in Chapter 10.

Options are particularly useful for hedging uncertain cash-flows, i.e. cash-flows that are contingent on other events. Typical situations are:

1. Bidding for international projects: Foreign exchange inflows will materialise only if the bid is successful. If implementation of the project also involves purchase of materials, equipment, etc. from third countries, there are contingent foreign currency outflows too.
2. Foreign currency receivables with substantial default risk or political risk, e.g. the host government of a foreign subsidiary might suddenly impose restrictions on dividend repatriation.
3. Risky portfolio investment: A fund manager, say in UK, might hold a portfolio of foreign stocks/bonds currently worth, say CHF 50 million, which he is planning to liquidate in six months time. If he sells CHF 50 million forward and the portfolio declines in value because of a falling Swiss stock market and rising interest rates, he will find himself to be over-insured and short in CHF. As we have mentioned in the last chapter, financial institutions often outsource the management of currency risk of their global equity and debt portfolios to providers of currency overlay services.

We will discuss a few more examples of the use of options. We will particularly focus on the comparison of options with forward hedge both with reference to an open position. We will also illustrate some tailor-made hedges with option combinations and exotic options such as barrier options.

- On June 1, a UK firm has a CHF 500000 payable due on September 1. The market rates are as follows:

  GBP/CHF Spot: 1.5175/85

  90-day Swap points: 60/55

  September calls with a strike of 1.52 (GBP/CHF) are available for a premium of 0.05 GBP per CHF. We will evaluate the forward hedge versus purchase of call options both with reference to an open position. The strike price is equivalent to GBP 0.6579 per CHF.

  1. Open position
     Suppose the firm decides to leave the payable unhedged. If at maturity, the CHF/GBP spot rate is S_T, the sterling value of the payable is (500,000)S_T. In Figure 13.1 this appears as a straight line through the origin.
  2. Forward hedge
     If the firm buys CHF 500000 forward at the offer rate of CHF 1.5115 per GBP or £0.6615 per CHF, the value of the payable is £(500,000 × 0.6615) = £330750. This is shown as a horizontal line in Figure 13.1.
  3. A call option
     Instead, the firm buys call options on CHF 500,000 for a total premium expense of £25,000. At maturity, its cash outflow will be

     £[(500,000)S_T + 25,625] for $S_T \leq 0.6579$

     and £[(500,000)(0.6579) + 25,625] = £354,575 for $S_T \geq 0.6579$

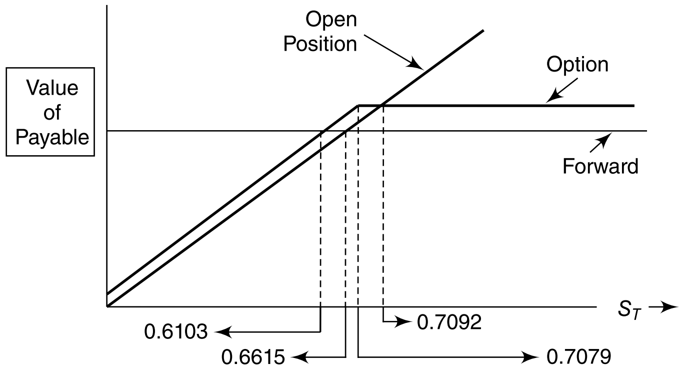

Fig. 13.1 Value of the CHF Payable

We have assumed here that the premium expense is financed by a 90-day borrowing at 10%. Figure 13.1 illustrates.

Open position and forward hedge are equivalent, if the maturity CHF/GBP spot rate equals the forward rate at the beginning, viz. 0.6609. If it is higher, the firm is better off with a forward hedge than with an open position, if lower, open position would have been better.

Call option and open position are equivalent when

$$(500{,}000)S_T = (0.6579)(500{,}000) + 25{,}625$$

i.e. when $S_T = 0.7092$. At higher values, call option is better. Call option and forward are equivalent when

$$(500{,}000)S_T + 25{,}625 = (0.6615)(500{,}000)$$

i.e. when $S_T = 0.6103$. At lower values than this, the option alternative is better because of its one-way privilege – the firm can buy CHF in the spot market letting the option lapse.

Figure 13.2 shows gains/losses of forward and call relative to the open position. For forward, the relative gain is

$$£[(S_T - 0.6615)(500{,}000)],$$

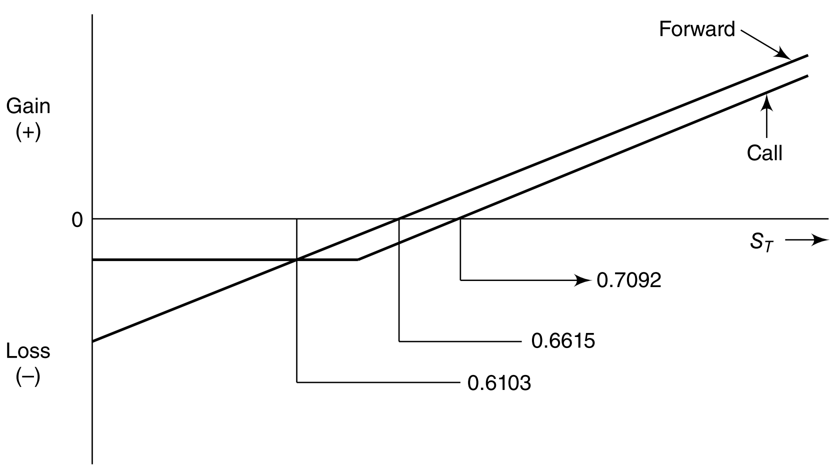

Fig. 13.2 Gains and losses from Alternative Hedging Strategies

while for the call, relative gain is

$$-£25625 \text{ for } S_T \leq 0.6579$$

and

$$£[(500{,}000)(S_T - 0.6579) - 25{,}625] \text{ for } S_T \geq 0.6579.$$

The call option becomes attractive relative to an open position for values of S_T beyond 0.7092. Relative to the forward hedge, the call option is better, if the CHF depreciates below 0.6103. The maximum gain from the forward hedge, relative to the call is

$$(500{,}000)(0.6579) + 25625 - (0.6615)(500{,}000) = £23825$$

whereas, if the CHF depreciates sharply, call option can result in substantial savings. For instance, at $S_T = 0.6000$, saving from the call over the forward is £5125.

Thus, whether the firm should choose the call option strategy, the forward hedge or leave the exposure unhedged depends upon the view it takes of future spot rate. It might do a probabilistic mean-variance analysis to compare the forward hedge with the call, if it can assign subjective probabilities to future values of the spot rate. Thus, suppose its forecast of S_T can be summarised as follows:

S_T	**Probability**
0.6615	0.50
0.5910	0.20
0.7025	0.30

The firm considers the most probable value of maturity spot to be equal to the current forward rate. But it thinks that there is a 30% chance of an appreciation of the CHF (possibly because it thinks that Bank of England is shortly going to cut interest rates to stimulate the economy) and a 20% chance of a very sharp depreciation. The expected cost with an open position would be GBP 0.6598 per CHF with a standard deviation of 0.0368. With a forward cover, the cost would have been higher – GBP 0.6615 per CHF, but with no uncertainty whatever may be the spot rate at settlement. This would result in extra cost of GBP 850 to settle the payable compared to the expected outflow with an open position. For an option, the expected cost including the premium would be even higher viz. GBP 0.6945 per CHF with a standard deviation of 0.0386. Thus, in the mean-variance framework, call option would not be the preferred choice because of its higher expected cost ***and*** larger variance compared to the open position. If, however, the firm thinks that the probability of a sharp appreciation of CHF is much higher and the option premium is somewhat lower, the choice depends upon the firm's risk-return preferences.

In the appendix to this chapter, we briefly present a more rigorous analysis of this choice.

- A US firm has bid for a contract to supply computers and peripherals to a Swiss buyer. The contract is valued at five million Swiss Francs. The outcome of the competitive tender bidding will be known one month from now and the equipment is to be supplied and installed over two months following the award of contract with payment being made on completion of installation.

  The firm would like to cover the potential exposure. Also, the management has decided that any cover obtained must be offset if the firm is not awarded the contract.

The current market rates are:

USD/CHF Spot: 1.5000 90-day Forward: 1.4600

(We are ignoring two-sided quotes. It does not make any substantive difference)

A put option on CHF with a strike price of CHF 1.4500 per USD and maturity of 90 days is available for a premium of 2.8¢ or \$0.028 per CHF.

The firm wishes to evaluate the following two alternatives:

1. Sell CHF 5 million 90-day forward at CHF 1.4600 per USD. If at the end of the month the bid is not successful, the contract will be offset by a 2-month forward purchase at the then ruling rate.
2. Purchase a put option[5]. If the contract is not awarded, close out by selling a put option. (Assume that the options are bought on an options exchange).
   The firm must pay an up-front premium of \$140,000.
   If the contract is awarded, the original hedge is carried to maturity.
   Under each contingency, viz., the firm gets the contract and does not get the contract we will evaluate the two alternatives. In each case we will consider three exchange rate scenarios.

1. The bid is unsuccessful.
   The firm unwinds the hedge by either purchasing CHF 5 million 60-days forward if the initial choice was a forward contract or by selling put options. We consider the gain/loss from each choice under the following three exchange rate scenarios at the end of one month:

(A) CHF has depreciated

USD/CHF Spot: 1.6000
60-day forward: 1.6200
2 month put, strike price 1.4500, premium 8¢

(B) Spot rate unchanged

USD/CHF Spot: 1.5000
60-day forward: 1.4800
2 month put, strike price 1.4500, premium 2.5¢

(C) CHF has appreciated

USD/CHF Spot: 1.3700
60-day forward: 1.3500
2 month put, strike price 1.4500, premium 0.02¢

Scenario (A):
Forward hedge–Firm unwinds by purchasing forward at 1.62. Realises a gain of \$338,238[6] two months hence.

Put options–Firm sells puts on CHF 5 million at \$0.08 per CHF for a total premium income of \$400,000 accruing right away.

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[5]An alternative strategy would be to sell forward and buy a call option. If the bid is not successful, the call covers the long forward position.

[6]This is given by

5,000,000[(1/1.46) – (1/1.62)]

Scenario (B):
Forward hedge–Unwound at 1.48. Gain of $46,279 two months hence.
Put options–Sell puts. Premium income $125,000 right away.

Scenario (C):
Forward hedge–Unwound at a loss of $279,046 two months hence.
Put options–Premium income of $1,000 right away.

We have assumed that the forward hedge is unwound by means of another forward which matures at the same time as the original contract.

Cash flows under various scenarios are summarised below:

Scenario	***Time***	***Forward***	***Puts***
	0	0	–140000
A	1	400000	
	2		
	3	338238	
	0	0	–140000
B	1	125000	
	2		
	3	46280	
	0	0	–140000
C	1	1000	
	2		
	3	–279046	

Thus, in the event of the bid being unsuccessful, the firm risks a large loss, if the CHF sharply appreciates in the interim and it has covered the uncertain inflow with a forward contract. With an option, at worst, its maximum loss is limited to the up-front premium.

2. The bid is successful.
   If the bid is successful, the put option hedge offers an advantage, if over the next three months, the CHF experiences a sharp depreciation. If the CHF remains unchanged or appreciates, the forward contract is more advantageous since it is costless to enter into.

   The firm in tendering a bid will wish to know how to incorporate the element of currency risk. It can attempt to estimate the future spot rate and quote a foreign currency price based on this forecast; if it overestimates the weakness of CHF (underestimates its strength) it runs the risk of submitting an uncompetitive bid. In the reverse case, its profit margins will shrink. It can decide on a hedging device such as a put option and load the expected cost of the hedge into its price.

   The timing, amount and the exercise price of the put option should be chosen to correspond to the forward contract which the firm might have bought had the receivable not been uncertain. This may not always be possible with exchange traded options. Cost of the put option can be reduced by buying an out-of-the money option with lower strike and hence lower premium. Correspondingly, the level of protection against depreciation is reduced[7]. Alternatively, the firm need not hedge the entire amount; if it is a frequent

[7]Effectively, this reduces the expected cost but increases the variance.

bidder for certain types of contracts, it will have built up some experience pertaining to the probability of success at various bid levels. It can reduce the cost of hedge by buying a put to cover only a fraction of the expected receivable reflecting the probability of success.

One important point should be kept in mind. The success or failure of the bid is dependent upon several factors including competition. The exchange rate may not be a factor at all or at best may be one of the many considerations influencing the customer's decision. The risk involved in the option however derives only from the behaviour of the exchange rate and its volatility. Thus, in using the option as a hedge, the firm is trying to offset the risk of a diverse set of risk factors with an instrument the risk of which derives from a single source. The option hedge may be better than a forward contract but may not necessarily be the best hedge.

- The next example illustrates the use of range forward contracts described in Chapter 10. Consider the case of a Singapore firm which has imported textile and leather products from an Indian supplier. The invoice is for INR 25 crore due in 180 days.

  The INR/SGD offer rates in Singapore for are as follows:

  SGD/INR Spot: 25.9740 (INR/SGD: 0.0385)

  180-days Forward: 25.6410 (INR/SGD: 0.0390)

  The firm buys a range forward. This involves buying a call and selling a put. The strike price for the former is INR/SGD 0.0395 with a premium of SGD 0.0006 per INR or SGD 150,000 for INR 25 crore. For the latter, the strike is INR/SGD 0.0380 and premium is SGD 0.0004 per INR or SGD 100000 for the entire payable. The net premium payment is thus SGD 50000[8]. The following table shows the SGD outflows on settlement of the payable with an open position, a forward hedge and the range forward, for various values of the maturity spot[9].

Singapore Dollar Outflow for ₹25 Crore Payable

Maturity Spot (INR/SGD)	*Open Position*	*Forward Hedge*	**Range Forward**
0.0370	9,250,000	9,750,000	9,550,000
0.0375	9,375,000	9,750,000	9,550,000
0.0380	9,500,000	9,750,000	9,550,000
0.0385	9,625,000	9,750,000	9,675,000
0.0390	9,750,000	9,750,000	9,800,000
0.0395	9,875,000	9,750,000	9,925,000
0.0400	10,000,000	9,750,000	9,925,000
0.0405	11,250,000	9,750,000	9,925,000

[8]Thus this deal is not exactly like a range forward since in the latter the strike prices are chosen to yield zero net premium payment or receipts. This deal is also known as "buying a fence".

[9]The calculations are as follows:

For the open position, the SGD outflow is given by: S_T(250,000,000)

For the forward hedge it is: $F_{0,T}$(250,000,000)

For the range forward:

X_p(250,000,000) + Net premium for $S_T \leq X_p$

S_T(250,000,000) + Net premium for $X_p \leq S_T \leq X_c$

X_c(250,000,000) + Net premium for $S_T \geq X_c$

Here S_T is the maturity spot, $F_{0,T}$ is the forward rate at the beginning for a T-day contract and X_p and X_c are, respectively, the strike prices of the put and call. Interest foregone on net premium paid is ignored.

The calculations in the table above do not incorporate the interest foregone on the net premium payment in the case of the range forward.

Thus, if the firm does not expect a sharp depreciation of the rupee a range forward provides a relatively cheap way of protecting itself against rupee appreciation without giving up the opportunity to gain from rupee depreciation at least up to a point. (Rupee depreciation below the strike price of the written put yields no extra benefit).

- The final example illustrates a structure with a barrier option. Barrier options were described in Chapter 10.
  The current market is:

  GBP/INR spot: 82.5665 6-month forward: 83.7500

  A firm with imports invoiced in GBP enters into the following contract with a bank:
  The contract expires 6 months from the transaction date.
  If during the life of the contract, the GBP/INR rate does not touch 75.00 then:
  If at expiry the spot GBP/INR is at below 85.00, the firm buys GBP at the spot rate.
  If the spot rate is above 85.00, the firm buys at 85.00.
  If 75.00 is seen during the life of the contract, the firm buys GBP at 85.00 whatever is the spot rate at expiry.
  Neither the customer firm nor the bank pays any premium to the other party.

It is easy to see that this contract is a combination of:

(a) The firm buys a 6-month European call on GBP at a strike price of ₹85 per GBP and
(b) The firm sells a knock-in put option on GBP to the bank, with strike price ₹85 and knock-in at 75.00.

If the knock-in level is never touched, the pay-off is identical to a long European call with strike 85.00; if the put is knocked in, the long call and short put at 85.00 result in a long position in a forward contract at 85.00. This is a slightly off-market forward contract.

The firm specifies the highest rate it is willing to pay for the GBP it has to acquire. The bank works out the premium for a European call with this rate as the strike price and then chooses a knock-in level such that a knock-in European put with the same strike would have premium equal to the premium of the call.

The firm would use such a contract if the firm's view is that the GBP is going to depreciate somewhat but certainly not going to appreciate as much as implied by the forward rate. At the same time, it is not expecting GBP to go down as much as the knock-in level.

These examples serve to bring out the point that options represent a flexible hedging tool enabling the firm to incorporate its views on exchange rate movements and its risk-return preferences in the hedging decision.

13.5 HEDGING WITH CURRENCY FUTURES

Hedging contractual foreign currency flows with currency futures is in many respects similar to hedging with forward contracts. A receivable is hedged by selling futures while a payable is hedged by buying futures. A number of examples have been discussed in Chapter 9.

A futures hedge differs from a forward hedge because of the intrinsic features of futures contracts. Since amounts and delivery dates for futures are standardised, a perfect futures hedge is generally not possible. An added factor, as discussed in Chapter 9, is basis risk-imperfect correlation between spot and futures prices. Also, futures unlike forwards, give rise to intermediate cash flows due to the marking-to-market feature. Due to a much larger turnover, the bid-ask spreads are tighter in the forward markets. Futures contracts require a deposit to be posted. (Even forward contracts may require a compensating bank balance or a line of credit). There are also brokerage fees to be paid with futures contracts.

The advantage of futures over forwards is easier access and greater liquidity. Banks will enter into forward contracts only with corporations (and in rare cases individuals) with the highest credit rating. Second, a futures hedge is much easier to unwind since there is an organised exchange with a large turnover.

For the sake of completeness, we will present two examples of hedging with futures.

- **A Short Hedge**

  On June 1, a British firm orders some equipment worth \$5 million from a US supplier. Payment is due on September 1. The market rates are:

  £/\$ Spot: 1.7225 90-day forward: 1.7165

  LIFFE September GBP Futures: 1.7170

  The firm decides to hedge by selling 47 sterling[10] contracts with a total value of £2,937,500 = \$5,043,687.5 at \$1.7170/£. It pays a brokerage fee of £50 per contract or £2350 for the total amount.

  On September 1 the following prices rule:

  GBP/USD Spot: 1.6680 September futures: 1.6650

  The firm buys \$5 million at the ruling spot and closes out its futures position by buying 47 sterling futures.
  Sterling outflow on spot purchase of \$5 million

  = (5,000,000)/1.6680 = £2,997,601.9

  Gain on futures = \$(1.7170 – 1.6650)(2,937,500)

  = \$152,750 = £91,576.74 at \$1.6680/£

  Total sterling outlay

  = (2,997,601.90 + 2,350.00 – 91,576.74) = £2,908,375.20

  Effective GBP/USD rate obtained by the firm is

  = (5,000,000/2,908,375.20) = 1.7191.

  The hedge turns out to be better than a forward hedge. The effective rate with the latter would have been 1.7165. This is despite the adverse basis movement. (As usual we have ignored the effect of marking to market).

- **A Long Hedge**

  A Japanese firm has sold a large quantity of memory chips to a US computer maker. The sale is invoiced in US dollars at \$10,000,000, payment due in 180 days. Today is May 25. The market rates are:

  \$/¥ Spot: 125.30 180-day forward: 121.50

[10]This is equivalent to buying dollar futures.

IMM December Yen futures are trading at \$0.8333 per 100 yen, i.e. \$104162.50 per contract, since each contract is for ¥12,500,000.

The firm decides to hedge by buying 98 December contracts valued at ¥12,25,000,000 = \$10,207,900 at \$0.8333 per 100 yen. The brokerage fee is \$75 per contract or \$7,350 for 98 contracts.

On November 25, the rates are:

\$/¥ Spot: 120.50 December futures: 0.8549

The firm sells \$10,000,000 in the spot market to receive ¥1,205,000,000. It closes its futures position by selling 98 contracts. The gain on futures is:

$$\$[(0.8549 - 0.8333) \times 125{,}000 \times 98] = \$264{,}600$$

This translates into ¥31,884,300 at the spot rate of 120.50. The brokerage fee paid is worth ¥885,675. The total yen inflow is, therefore, ¥1236 million, yielding an effective ¥/\$ rate of 123.60 which is better than the forward rate. Of course, if the basis had narrowed much more, futures rate would have been worse than the forward rate[11].

Currency futures are used by commercial banks to hedge positions taken in the forward markets. With their continuous trading in the latter, the problem of timing mismatch is not serious and the liquidity of the market along with the absence of counterparty risk makes it an attractive hedging tool.

13.6 INTERNAL HEDGING STRATEGIES

In addition to the various market-based hedging devices discussed so far, a firm may be able to reduce or eliminate currency exposure by means of internal strategies or invoicing arrangements like risk sharing between the firm and its foreign customers. We take a look at some of the commonly used or recommended methods.

- **Invoicing**

  We have already discussed above the problem of currency of invoicing. A firm may be able to shift the entire exchange risk to the other party by invoicing its exports in its home currency and insisting that its imports too be invoiced in its home currency. As we have seen above, in the presence of well-functioning forward markets, this will not yield any added benefit compared to a forward hedge. At times, it may diminish the firm's competitive advantage, if it refuses to invoice its cross-border sales in the buyer's currency.

Empirically, in a study of the financial structure of foreign trade, Grassman (1973) discovered the following regularities:

1. Trade between developed countries in manufactured products is generally invoiced in the exporter's currency.
2. Trade in primary products and capital assets is generally invoiced in a major vehicle currency such as the US dollar.
3. Trade between a developed and a less developed country tends to be invoiced in the developed country's currency.
4. If a country has a higher and more volatile inflation rate than its trading partners, there is a tendency not to use that country's currency in trade invoicing.

[11]For instance, if the December futures price on November 25 had moved only to 0.8441, the futures and forward hedges would have been equivalent.

Table 13.1 presents some data on the pattern of currency of invoicing of India's exports and imports for the year 1999-2000.

The most notable feature of the change in the pattern of currency composition of invoicing has been the sharp increase in the share of US dollar in both imports and exports. In 1990-91, the share of the dollar as the invoicing currency was 59.7% in imports and 57.2% in exports. By the end of the decade, these figures have crossed 85%.

Table 13.1 Currency Composition of Invoicing of India's Exports and Imports

Share of Each Currency in Invoicing (%)

	Imports				*Exports*			
Currency	***1990-91***	***1994-95***	***1999-00***	***2005-06***	***90-91***	***94-95***	***99-2000***	***05-06***
US Dollar	59.7	73.5	85.8	88.6	57.2	78.8	87.0	85.8
Deutsche Mark	7.0	5.9	1.6	0.0	5.1	6.3	1.6	0.0
Euro	—	—	3.3	6.5	—	—	3.0	7.6
Japanese Yen	4.4	4.4	3.8	2.2	0.1	0.3	0.3	0.5
Pound Sterling	3.1	2.5	1.7	1.0	4.5	4.8	3.9	2.8
Indian Rupee	7.7	0.4	0.0	0.0	27.7	3.3	0.3	1.9
Others	18.3	13.3	3.8	1.7	5.4	6.5	3.9	1.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: RBI

Following the weakening of USD against many currencies including INR, the currency composition of export invoices has changed significantly. Invoicing in dollars has fallen from 85% of total exports in 2006 to a low of 65% by December 2007. It has been reported that in 2008, about 40% of textile exports worth over 7,000 crore rupees were invoiced in currencies other than US dollar. An increasing volume of exports of engineering goods to Europe is also being invoiced in Euro. Invoicing is also being done in currencies of countries such as Japan, Singapore, Australia and Malaysia though the volume of exports to these countries is quite small.

Another hedging tool in this context is the use of "currency cocktails" for invoicing. Thus, for instance, a British importer of chemicals from Switzerland can negotiate with the supplier that the invoice be partly in CHF and partly in GBP. Thus, suppose the parties agree on a price of, say CHF 1000 per litre and the spot rate is CHF 2.25 per GBP, the price may be stated as (CHF 550 + £200) per litre. This way both parties share the exposure. Another possibility is to use one of the standard currency baskets such as the SDR for invoicing trade transactions.

Basket invoicing offers the advantage of diversification and can reduce the variance of home currency value of the payable or receivable as long as there is no perfect correlation between the constituent currencies. The risk is reduced but not eliminated. These days, OTC options on baskets of currencies are readily available so that the residual risk can be hedged.

- **Netting and Offsetting**

  A firm with receivables and payables in diverse currencies can net out its exposure in each currency by matching receivables with payables. Thus, a firm with exports to and imports from say Germany need not cover each transaction separately; it can use a receivable to settle all or part of a payable and take a hedge only for the net EUR payable or receivable. Even if the timings of the two flows do not match, it might be possible to lead or lag (see the next subsection) one of them to achieve a match.

Netting also assumes importance in the context of cash management in a multinational corporation with a number of subsidiaries and extensive intra-company transactions. Let us consider a simple example of an American parent company with subsidiaries in UK and France. Suppose that the UK subsidiary has to make a dividend payment to the parent of GBP 250000 in three months time, the parent has a three-month payable of EUR 500,000 to the French subsidiary and the French subsidiary has a three-month payable of GBP 300,000 to a British supplier (who is not a part of the multinational). A netting system might work as follows. The forecasts of spot rates three months hence are:

GBP/USD: 1.5500 EUR/USD: 1.3000 implying

GBP/EUR: 1.1923

The UK subsidiary is asked to pay GBP 250,000 to the French subsidiary's UK supplier. Thus, the French firm has to hedge only the residual payable of GBP 50,000. GBP 250,000 converted into EUR at the forecast exchange rate amounts to EUR 298,075. The parent may obtain a hedge for the residual amount of EUR 201,925. Any discrepancies between the forecast exchange rates and the actual spot rates three months, hence can be settled by making the necessary intra-company transfers. Thus, suppose the actual spot rates turn out to be \$1.6000 per GBP and \$1.2500 per EUR implying EUR 1.2800 per GBP. At this rate GBP 250,000 equals EUR 320,000. The parent must pay the French subsidiary EUR 180,000. The parent has already obtained cover for EUR201,925. This technique not only reduces the amount of exposures to be covered company-wide but also minimises the number and amount of currency conversions required to settle intra-company payments. This latter aspect can become significant for a multinational with extensive network of subsidiaries and substantial intra-company trade.

To be able to use netting effectively, the company must have continuously updated information on receivables and payables between the parent and all the subsidiaries as well as payables to and receivables from outsiders. One way of ensuring efficient information gathering is to centralise cash management.

Occasionally, a firm might find that it has a receivable in one currency say EUR and a payable not in the same currency but a closely correlated currency such as the CHF. Even though CHF is not a part of the EMU, the movements in the two currencies are very closely correlated so that a loss (gain) on the payable due to an appreciation (depreciation) of the CHF vis-à-vis the firm's home currency will be closely matched by the gain (loss) on the receivable due to the appreciation (depreciation) of the EUR. Such *offsetting* of one exposure against another in a closely related currency provides a natural hedge.

Some countries impose restrictions on netting as part of their exchange control regulations. These may limit the scope for netting or prohibit it altogether. It may still be possible to minimise the number of currency conversions by centralising cash management.

- **Leading and Lagging**

Another internal way of managing transactions exposure is to shift the timing of exposures by leading or lagging payables and receivables. The general rule is lead, i.e. advance payables and lag, i.e. postpone receivables in "strong" currencies and, conversely, lead receivables and lag payables in weak currencies. As we will see below, shifting the exposure in time is not enough; it has to be combined with a borrowing/lending transaction or a forward transaction to complete the hedge.

Essentially, leading and lagging are a response to the existence of market imperfections.

Thus, suppose an American firm has a three month CHF payable and the firm (and everyone else) is almost sure that the CHF is going to sharply appreciate against the dollar. The firm can offer to settle the payment immediately, i.e. forego the usual 90-day credit and demand a discount for cash payment. On the other hand, suppose it has a receivable in a weak currency such as the Mexican peso, it can offer a discount to the Mexican buyer for immediate payment.

The pertinent question is, if the covered interest parity mechanism is working satisfactorily, will this method of covering be equivalent to a forward hedge ? Consider this example. An Indian firm has a 180-day payable of South African Rand (ZAR) 350,000. The rates are:

ZAR/INR Spot: 6.5000. 180-day forward: 6.6585.

The South African supplier will give a discount of 2.5% for cash payment. The Indian firm can borrow at 10% p.a. The net cost of leading the payment would thus be 2.5% which is equal to the 180-day premium on the ZAR. The interest differential is exactly captured in the forward premium and hence leading and forward hedge are equivalent. If some imperfections drive a significant wedge between euromarket interest rates and domestic interest rates, then leading or lagging an exposure may turn out to be cheaper than a forward hedge. Consider the following example:

- An American firm has a 180-day payable of AUD 1,000,000 to an Australian supplier. The market rates are:

USD/AUD Spot: 1.2175 180-day forward: 1.2086

EuroUS$ 180-day interest rate: 4.5% p.a.

EuroAUD 180-day interest rate: 3.0% p.a.

The Australian authorities have imposed a restriction on Australian firms which prevents them from borrowing in the euroAUD market. Similarly, non-residents cannot make money-market investments in Australia. As a consequence, the domestic 180-day interest rate in Australia is 4.25% p.a. The American firm wants to evaluate the following four alternative hedging strategies:

(a) Buy AUD 1,000,000 180-day forward. (Forward hedge)
(b) Borrow USD, convert spot to AUD, invest in a euroAUD deposit, settle the payable with the deposit proceeds. (Money market hedge)
(c) Borrow USD for 180 days, convert spot to AUD, lead the payable, get a discount. (Lead)
(d) Borrow AUD in the euro market, settle the payable, buy AUD 180-day forward to pay off the loan. (Lead with a forward)

Let us determine US $ outflow 180-days hence under each strategy.

1. Forward Cover:

US $ outflow = 1,000,000/1.2086 = 827,403.60

2. Money Market Cover:
   The firm must invest AUD(1,000,000/1.015), i.e. AUD 985,221.67 to get AUD 1,000,000 on maturity. This amount of AUD must be bought in the spot market by selling US$(985,221.67/1.2175), i.e US,$809,216.98. Suppose the American firm uses its credit line to this extent. It must repay US,$[809,216.98(1.0225)] or US,$827,424.36 six months later. Thus, this strategy is as good as the forward cover. (The small difference is on account of rounding errors). This should not be surprising since the borrowing and lending are done at euro rates which in turn determine forward margins.
3. Lead:
   The American firm can possibly extract a discount at 4.25% p.a. from the Australian firm since this is the latter's opportunity cost of short-term funds. Thus, leading would require cash payment of AUD(1,000,000/1.02125) = AUD 979,192.17. To obtain this, US $(979,192.17/1.2175) = US $804,264.61 must be borrowed at 4.5%, requiring repayment of US $[804,264.61(1.0225)], viz. US $822,360.56.
   This represents a saving of US $5,063.80 over the forward hedge.
4. Lead with a Forward:
   The firm must borrow AUD 979,192.17 at 3% p.a. requiring repayment of AUD 993,880.05 which must be bought forward requiring an outflow of US $822,339.94. This is equivalent to the Lead strategy (apart from rounding off errors). You can convince yourself that if the American firm's borrowing cost was higher than the euro US$ rate, the lead with forward strategy would have been better than a simple lead.

In effect, leading-lagging strategies involve trading off interest rate differentials against expected currency appreciation or depreciation. In employing this strategy for intra-corporate payments between units of a multinational, account must be taken of possibly differing tax treatments of different expense items, exchange gains and losses as also of differing tax rates in different countries. Also, if a multinational parent company requires its subsidiaries to employ this method, it may on occasion interfere with optimal cash management at the level of a subsidiary. Suppose, for instance, that an American MNC asks its Mexican subsidiary to lead a CHF payable. This might put the subsidiary in an awkward position, if it is already strapped for cash and has exhausted its credit lines with local banks. The use of leads and lags, therefore, must be evaluated in the overall framework of financing and exposure management and this consideration must be kept in mind when evaluating the performance of the local management. It may also adversely affect the interests of local minority shareholders. Finally, there may also be some legal constraints in free use of leading and lagging as exposure management devices. Since it destabilises currency markets[12], governments may impose restrictions on the extent to which leading and lagging can be done.

Leads and lags in combination with netting form an important cash management strategy for multinationals with extensive intra-company payments.

- Risk Sharing
  Another non-market based hedging possibility is to work out a currency risk sharing agreement between the two parties – e.g. the exporter and the importer. It can be implemented by embedding a bundle of forward and option contracts in the underlying trade transaction. Let us look at an illustrative example.

[12]Suppose the Indian rupee is confidently expected to decline against the CHF. All Indian firms try to lead CHF payables and lag CHF receivables; all Swiss firms try to lead INR receivables and lag payables. Effectively this increases the demand for and reduces the supply of CHF and increases the supply of and reduces the demand for INR in the spot market adding to the already existing speculative pressure on the INR.

◇ An Indian company has exported a shipment of garments to an American buyer on 90-days credit terms. The current USD/INR spot is ₹53.25 and 90-day forward is ₹54.00. The payment terms are designed as follows:
   (a) The notional amount of the invoice is USD 100,000. If at settlement, the spot USD/INR rate, S_T, is greater than or equal to 53.00 but less than or equal to 55.00, the notional invoice amount of USD 100,000 would be translated into rupees at a rate of ₹54.00 per dollar, i.e. ₹5,400,000 and the buyer would pay a dollar amount equivalent to this rupee sum at the actual spot rate. The buyer's cost will vary between USD 98,181.82 (= 5,400,000/55) and USD 101,886.79 (= 5,400,000/53).
   (b) If the spot rate at settlement is less than 53.00, the conversion rate would be [54.00 – 0.5(53.00 – S_T)]. The notional invoice amount of USD 100,000 will be translated into rupees at this conversion rate and the buyer would pay a dollar amount which equals this rupee sum at the actual spot rate. Thus if S_T is ₹52.00, the conversion rate would be ₹ [54.00 – 0.5(53 – 52)] or ₹53.50 per dollar. At this rate, USD 100,000 translates into ₹53,50,000. The buyer's cost would be USD (53,50,000/52) = USD 102884.62
   (c) If the settlement spot rate is greater than 55.00, the conversion rate would be [54.00 + 0.5(S_T – 55.00)]. Thus, suppose the spot rate 90 days later is 57.00, the conversion rate would be 55.00, the rupee amount would be ₹5,500,000 and the US buyer would pay USD(5,500,000/57) or USD 96,491.22.

It is easy to see that such a contract can be synthesised as a combination of a forward contract and a pair of options–a European call and a put. In an exercise at the end of this chapter, you are asked to design such a combination and examine whether it would be a zero cost contract.

A typical hedging situation and the dilemmas facing the decision-maker are brought out by the well known case of Lufthansa.

◆ In January 1985, Lufthansa purchased twenty 737 jets from Boeing for a total cost of USD 500,000,000 to be paid on delivery of the jets in January 1986. The US dollar had been continuously rising since about mid-1981 and had reached approximately DEM (Deutschemark, the German currency before the birth of EURO) 3.2 by January 1985. This represented a substantial exposure with a potential for a huge cash loss if the dollar continued to rise. Herr Heinz Ruhnau, the Chairman of the airline believed (with many others) that the dollar had peaked and would shortly turn down. One-year forward dollar could be purchased at approximately DEM 3.2. Put options on DEM (call options on USD) at a strike price of DEM 3.2 could be bought for a total premium amounting to about 6% of the contract value or DEM 96 million. What should he have done?

Among the choices available to him were:

1. Be very conservative. Cover the whole payable forward.
2. Trust his instincts. Leave it completely unhedged, buy 500 million dollars spot in January 1986.
3. Take a limited risk. Cover partially, e.g. buy half forward leave half open.
4. Buy put options on DEM or call options on USD. Go with your instinct, but protect yourself on the downside, of course at a cost, viz. the up-front option premium.
5. Buy US dollars now and hold them in a deposit for a year to settle the payable, i.e. money market cover.

We will conclude the topic of hedging transactions exposure by analysing Lufthansa's choices for hedging its huge USD exposure.

1. Full forward cover is the most conservative no-risk approach. It would involve a payment of DEM (500 × 3.2) million or DEM 1.6 billion on delivery of the aircraft. This is represented by the thick horizontal line FF in Figure 13.3.

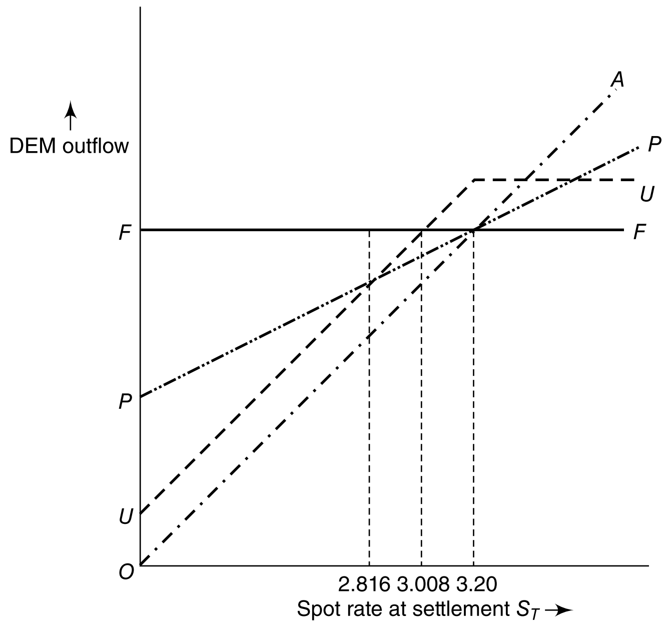

Fig. 13.3 Lufthansa's Currency Hedging Problem

2. Remaining completely unhedged is the maximum risk alternative. The DEM outlay would be $500S_T$ million where S_T is the spot USD/DEM rate at the time of settling the payment. The dashed line OA passing through the origin O depicts this alternative.
3. Cover 50% leave the rest open. The DEM outflow on settlement would be [(250 × 3.2) + $250S_T$] million or (800 + $250S_T$) million. The dotted line PP shows this.
4. The put option is a little complicated. If the dollar remains at or above 3.2 DEM, the DEM cost would be 1696 million – 1600 million to buy the 500 million dollars at DEM 3.2 per dollar plus the premium payment of DEM 96 million. (We are ignoring the financing cost of the premium which would have to be paid up-front in January 1995.) If the dollar falls below 3.2, the cost would be ($500S_T$ + 96) million for $S_T < 3.2$. This is shown by the line UU. It would be better than full forward cover if dollar had fallen to 3.008 or lower and better than 50% forward cover if it had fallen below 2.816.
5. The money market cover would have required that Lufthansa borrow the spot equivalent of USD 500 million in January 1995. Due to some strict covenants in its existing debt, the amount and currency of additional debt it could take on were severely restricted. Also, this option would probably have worked out to be almost equivalent to a forward purchase.

Lufthansa's management ultimately opted for strategy (3), viz. 50% forward cover and rest left open. As it turned out, the dollar had fallen to DEM 2.3 by January 1986. The DEM outflow was thus 1.375 billion. With alternative (2), i.e. no hedge at all, it would have been 1.150 billion and with a put option, 1.246 billion. With hindsight, Mr. Ruhnau's handling of the situation could be criticised as to why he did not go with his instinct that the dollar had peaked. But given the magnitude of the exposure and the high degree of uncertainty, such criticism would not be justified.

Many exposure management situations in practice share these features and definitive answers are rarely forthcoming. The importance of having a clearly articulated risk policy cannot be overemphasised.

13.7 SPECULATION IN FOREIGN EXCHANGE AND MONEY MARKETS

Speculation in contrast to hedging involves deliberately creating positions in order to profit from exchange rate and/or interest rate movements. The speculator believes that market's forecasts as reflected in forward rates and the term structure of interest rates are "wrong". He hopes to profit by taking open positions at these prices.

Consider ***outright speculation*** in foreign exchange markets. Suppose a speculator believes that the EUR is going to appreciate against the dollar by 5% over the next three months. Further, he finds that he can borrow 3-month dollars at 10% and invest 3-month EUR at 8%. He can speculate by borrowing dollars, converting spot to EUR and keeping EUR on deposit. If his forecast materialises, he will net a 2% (annualised) profit on re-conversion of EUR into dollars. Alternatively, these rates imply a 3% (annualised) premium on EUR; the speculator can take an open long position in forward EUR, and sell EUR three months later in the spot market for a net annualised profit of 3%.

Not hedging a receivable or payable is thus equivalent to speculation. If a firm has a payable in a foreign currency and is confident that the currency is going to depreciate more than what is implied in the forward rate (or appreciate less) it speculates by not covering the payable.

Obviously, outright speculation is a high-risk activity. The risk of an open position depends upon the covariance of exchange rate with other assets in the speculator's portfolio. A speculator who is not risk-neutral will demand a premium for undertaking the risk. Thus, he will take an open long (short) forward position, if he expects the currency to appreciate (depreciate) more than what is implied in the forward rate. However, exchange rate risk is diversifiable and hence, unsystematic. As a result, the risk premium–the amount by which the forward rate has to be below or above the speculator's expected future spot rate–is likely to be quite small. Empirical investigations indicate that it is also time-varying.

Speculating with futures is quite similar to speculating with forwards. The main differences are, first, with futures since there are intermediate cash flows, the investor must speculate on interest rate movements too and second, since most futures contracts are liquidated prior to maturity, the relevant comparison is not between expected maturity spot rate and futures price. Chapter 9 contains some examples of speculating with currency futures.

As seen in Chapter 10, options are an ideal speculative device for the small investor. A number of speculative strategies with options have been analysed in that chapter.

Exhibit A.13.1 (Appendix Ch13) displays some information regarding hedging practices in selected large Indian companies.

Summary

This chapter elaborates the various devices available for hedging transactions exposure. We have also addressed the question of whether the firm should engage in hedging itself or leave it to the shareholders to hedge their own exposures in the light of their portfolio compositions, country of residence, risk preferences, etc. There is a continuing debate on this issue. In perfect markets, with shareholders having access to instruments such as futures, options, etc., the only valid reasons for corporate level hedging are exploiting internal information, avoiding financial distress and the possible adverse effect of increased risk on managerial incentives. These matters are discussed in greater depth by Levi and Sercu (1991). However, in practice, several investigators have found that managers do not adopt the CAPM recommendation to focus only on systematic risk.

Questions and Problems

1. Discuss with an example each, the various types of currency exposures faced by a firm. Do you agree with the following statement:

   "The only exposure that really matters is operating exposure which cannot be hedged; with efficient money and foreign exchange markets and rational investors, hedging activities are a waste of time and resources".

   Give reasons whether you agree or disagree.
2. Many finance managers view forward premia/discounts as cost of hedging. Explain why this is an incorrect view.
3. The Clinton Co., has its headquarters in Cleveland, Ohio, USA. It has manufacturing subsidiaries in Ireland and Germany. The company makes process equipment for fertiliser plants and other chemical engineering industries. There is extensive intra-company trading because while each subsidiary is specialised, the sales units are not. Each subsidiary manages its own currency exposure. At 5.00 PM on August 4, the treasurer at the HQ has been given the following cash flow forecast for the parent company (Unsigned numbers are inflows, negative numbers are outflows. Amounts are in millions):

Date	*US$*	*EUR*	*GBP*
August			
5	7	—	—
6	—	—	—
7	–7	5	6
10	—	—	—
11	–4	—	—
12	–2	—	—
13	1	—	–6
14	—	–5	—
17	–2	2	—
18	2	2	—

(Contd.)

19	—	–2	—
20	–2	–3	—
21	–1	1	—
24	3	—	—
25	3	—	—
26	3	—	—
27	–1	2	—
28	—	–2	—
31	1	–1	—
Sept.			
2	1	12	1
3	–2	—	—
4	–2	—	—
7	–4	–5	—
8	7	—	—
9	–1	—	–8
10	– 4	—	—
11	– 4	—	—
14	4	–	2
15	–2	—	–1
16	1	—	–1
17	5	1	—
18	6	–1	—

The company has the policy that very short mismatches (say up to one week) will be covered by short-term deposits and borrowing in the money market. Thus, for instance, the outflow of DEM 5m on August 14 will be met by depositing the inflow of DEM 5m on August 7 in a one-week DEM deposit. The market rates faced by the treasurer are as follows:

EUR/$ Spot: 0.8627/32
EUR/$ 1-month Swap Points: 100/90
US$ prime rate: 13.5%
US$ LIBOR: $13\frac{3}{4}$
Euro LIBOR: $7\frac{1}{4}$
Frankfurt money market one month Euro rates: 7.80/7.90

For short-term borrowings, the company has to pay a spread of 1/2% over the prime in the US market and a spread of 3/4% in the Euromarket. Leading/Lagging is permitted by all concerned governments.

(a) Identify the exposures that need to be covered with some explicit covering strategy.
(b) Evaluate alternative covering strategies for the identified exposures.

4. An American importer has a payable in Yen in six months time. The market prices are as follows:

US$/¥ Spot: 125.00
US$/¥ 6 months Forward: 122.30
6-month Yen call option, strike 122.30: Premium 3.25%

6-month Yen call option, strike 120.00: Premium 2.15%
6-month Yen put option, strike 126.00: Premium 2.15%
6-month Yen put option, strike 127.50: Premium 1.75%

The firm is evaluating the following hedging strategies:

(a) Forward purchase of yen
(b) Buy a 6-month call, strike 122.30
(c) Buy a month call, strike 122.30 and simultaneously write a 6-month put, strike 127.50
(d) Buy a 6-month call, strike 120.00, write a 6-month put, strike 126.00
(e) Do not hedge

Compare these alternatives, with the forward contract as the standard of comparison. The option premia are in terms of % of the principal amount to be hedged.

5. You have a 3-year receivable of say EUR 100. For instance, you have succeeded in getting an order from an Brazilian for some machinery, in EUR invoiced at EUR 400, the agreement being that the buyer will pay 75% of the invoice on delivery and the rest 3-years from delivery. If three-year forward contracts were available you could have hedged this exposure by selling EUR 3-years forward. Such contracts are not available. Alternatively, you could have issued a 3-year zero coupon bond with face value of EUR 100, converted the proceeds to your home currency and used it. This is also not possible. The following strategies are being considered:

(a) Borrow EUR 100 for one year, convert spot to home currency, invest home currency. Repeat this at the end of year 1 and year 2.
(b) Sell EUR 100 one year forward. At the end of the year, buy 100 EUR spot and sell one year forward. Repeat at the end of year 2.

Compare (a) with the strategy (if it were available) of issuing a 3-year zero-coupon bond. What additional risks are involved in the former compared to the latter? Could some of these risks be eliminated? How?

Do the same for (b) and a 3-year forward contract.

6. A US based MNC manufactures and sells paper and wood products. It has subsidiaries in Canada, UK and Ireland. Each subsidiary specialises in a particular product but all products are sold in all markets. This gives rise to a network of intra-corporate payments and receipts. Each subsidiary handles its own exposure and financing needs. Corporate policy is to cover all exposures unless there is a definite trend or cost of cover is too high. The interpretation of "definite trend" and "too high" is left to the subsidiaries. A daily bulletin informs all treasurers of financing needs and exposures of all others.

Today's situation is as follows:

(a) UK needs working capital. It seems the Bank of England has restricted bank borrowing. Business is strong but credit is needed to take advantage of it.
(b) Canada has excess liquidity.
(c) Irish situation is normal.
(d) HQ also needs financing but the Federal Reserve is in a relaxed mood and credit is readily available in the US. HQ has a payable due to Canada in two days and to UK in one month in their respective currencies. There are no capital or exchange controls but HQ's cost of borrowing in the home money market is somewhat lower than in the Euromarket.

The HQ treasurer is trying to figure out whether he can simultaneously solve the financing problems and cover his own exposure. His main concern is that in doing so, he must not incur a higher cost of cover than what it would be if he leaves the subsidiaries to solve their own financing and exposure problems. The accessible market rates are as follows:

£/$ Spot 1.5795

1-month forward: 75 points discount on sterling.
Domestic $ borrowing rate: 14.50% p.a.
Euro–£ deposit rate: 17.75%
Euro–£ borrowing rate: 18.75%
Advise the HQ treasurer and justify your advice.

7. On September 15 the $/Rs rates were 47.15/47.20 spot and 85/95 3-month swap points. A firm booked a 3-month forward purchase contract for $150,000. On November 15 it wished to cancel the contract. At that time, the spot rate was 47.50/47.55 and one month swap rate was 20/30. Explain what the bank would do.

8. A Belgian manufacturer of fine crystal has received an order from a Japanese department store. The buyer wishes to be invoiced in its home currency. The Belgian firm agrees to this because it wishes to gain a foothold in a new market. The order is for ¥250 million with payment due three months from delivery. The Belgian firm is confident about completing delivery 3-months from today. The market rates today are as follows:

EUR/$ spot	: 0.8750/55	$/JPY spot	: 121.50/122.00
3-months	: 45/40		: 2.50/2.00
6-months	: 60/52		: 4.80/4.20

The interest rates are:

EURO LIBOR	: 3 months 6.25%	6 months: 6.50%
EuroJPY	: 3 months 4.25%	6 months: 4.75%

The Belgian firm wishes to know how it should cover its receivable. The Japanese buyer may also be willing to pay on delivery if an appropriate discount is offered. Evaluate the various alternatives.

9. A Swiss firm has bid for a contract to supply construction equipment to a Mexican buyer. The result of the bid will be known 2-months from now and the equipment is to be delivered over a period of 4-months after award of the contract. The bid is worth 500 million pesos. The present rates are:

CHF/MEP Spot: 20.00/20.10 6-months: 21.00/21.20 (0.21/0.2120)

6-months put options on MEP are available:

Strike (MEP/CHF)	Premium (CHF per MEP)
0.04	0.0008
0.05	0.0010
0.06	0.0013
0.07	0.0015

The firm expects the peso to depreciate at roughly the rate implied by the forward price. However, there is some possibility that it might depreciate faster. Evaluate the firm's hedging options.

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APPENDIX

A.13.1 CHOICE OF A HEDGING STRATEGY

In the text, we saw that the ***ex-post*** cost of a hedging strategy depends upon the spot rate at the time of settling the exposure compared to the rate contracted in a forward or option contract. ***Ex-ante***, the choice depends upon the prior subjective probabilities of various exchange rate outcomes and the decision-maker's attitude towards risk. In this appendix, we present a simple formal model of this choice. This model is due to Berg and Moore (1991).

The Berg-Moore Model of Foreign Exchange Strategies

Consider an importer in a country A , who has contractual payment in currency B. The current time is 0, the settlement is at time T. We will analyse the following options open to him:

Leave the payable unhedged. Buy currency B at the spot rate $S_T(B/A)$ at time T.

Enter into a forward contract to buy B, at a price $F(B/A)$, delivery at T.

Purchase a call on B against A with strike F, pay a premium C_0 now.

Write a put on B against A with strike F, receive a premium P_0 now.

Recall from Chapter 10 (the put-call parity) that the above call and put, both having strike price equal to the forward rate for the same expiry date will have identical values, i.e. $C_0 = P_0$.

Define

$$X = S_T - F$$

At time 0, X is unknown. It is a random variable since S_T is a random variable. The importer has a subjective probability distribution for S_T. This is captured in a density function for X, $f(x)$, with expected value $E(X) = \mu$ and standard deviation σ. For example, suppose USD/INR spot rate is 56.25 and 6-month forward is 57.00. An Indian importer thinks that the forward rate is an unbiased estimate of the future spot at time T = 6 months, and any spot rate between 56.80 and 57.20 is equally likely. Then, X has a uniform distribution with density function

$$f(x) = \frac{1}{(0.40)} \text{ for } x \in [-0.20, +0.20]$$

1. with $E(X) = 0$ and $\sigma^2 = (0.04/3)$[13]. A prior belief that the forward rate underestimates (overestimates) the future spot will imply that $\mu > 0$ ($\mu < 0$).
   For future use, we will define a parameter I as follows:

$$I = \int_0^{\infty} x f(x) dx \tag{A.13.1}$$

2. I is the expected value of x given that $x \geq 0$.
   The four strategies (a)-(d) above will be compared in terms of their expected cost per unit of foreign currency purchased.

$$E(\text{Forward}) = F$$
$$E(\text{No Hedge}) = E(S_T) = F + E(S_T - F) = F + E(x) = F + \mu$$
$$E(\text{Call}) = C + F + E[\min(0, X)] = C + F + \mu - I$$
$$E(\text{Put}) = -P + F + E[\max(0, X)] = -P + F + I = -C + F + I$$

Here C and P are call and put premia compounded to the maturity date.
$C = C_0(1 + r)^T$ and $P = P_0(1 + r)^T$, r being the risk free interest rate per annum and T measured in years. Since $C_0 = P_0$, $C = P$.

The first two of these should be obvious. Expected values of the long call and short put need explanation. With the long call, C denotes the premium cost brought forward to the maturity date. The foreign currency will be bought at the minimum of the strike price F and the maturity spot, i.e. $F + \min[0, X]$.

The expected value $E[\min(0, X)] = E(X)_{\_X \leq 0} = \mu - I$[14].

For the put, premium received is brought forward, the price paid for the currency is F if $S_T \leq F$ and S_T otherwise, i.e. $F + \max(0, X)$. Its expected value follows along analogous lines.

Now let us compare the expected costs. First consider the case when the importer believes that the forward rate is an unbiased predictor of the future spot, i.e. $\mu = 0$. Then, it is easily seen that

if $C = P < I$, E(call) is smallest while

if $C = P > I$, E(put) is smallest.

Neither forward hedge nor open position is an optimal strategy, if the criterion is minimising expected cost. Note, however, that with the forward hedge, there is no uncertainty while with

[13]A uniform distribution between $-a$ and $+a$ has $f(x) = 1/(2a)$, expected value zero and variance $a^2/3$.

[14] $E(X)_{|X \leq 0} = \int_{-\infty}^{0} x f(x) dx = \int_{-\infty}^{+\infty} x f(x) dx - \int_{0}^{+\infty} x f(x) dx = \mu - \text{I}$

both long call and short put, the cost of acquiring the foreign currency is uncertain. With the purchased call, the downside risk is limited while with a written put, it is not.

Next consider the case when the importer believes that $\mu \neq 0$.

◇ First consider $\mu > 0$. The forward rate F is believed to be an underestimate of S_T, i.e. the importer expects the home currency to depreciate more than what is reflected in the forward rate. Figure A.13.1 shows the optimal choice. It is determined by the value of C with respect to I and μ.

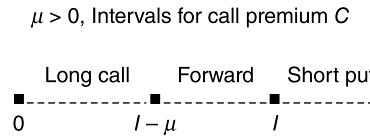

Fig. A.13.1

The decision rules are:

If $C < I - \mu$ Purchase a call

If $I - \mu < C < I$ Buy forward

If $C(= P) > I$ Write a put.

To see this, take the first among these.

When $C < I - \mu$, the expected cost is:

$$F - (I - \mu - C) < F, \text{ for the call}$$

F for the forward

$$F + \mu > F, \text{ for the open position}$$

$$F + I - C > F, \text{ for the put.}$$

The smallest among these is that of the long call.

You can work out the other two cases.

◇ Now take the case $\mu < 0$. The importer thinks that the forward rate overestimates the future spot. Figure A.13.2 shows the optimal choices.

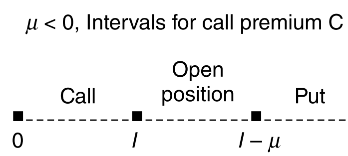

Fig. A.13.2

The decision rules are:

If $C < I$ purchase a call

If $I < C < I - \mu$ remain unhedged

If $C > I - \mu$ write a put.

You can easily work out the proofs of these rules by examining the expected costs of the four strategies under each eventuality.

The importance of volatility of the spot rate as perceived by the importer is brought out by this analysis. As σ increases, the value of I increases, increasing the size of the zone over which the call strategy is optimal. In other words, if the volatility of the spot estimated by the importer is larger than the volatility implied by the market price of the call, the call is underpriced and hence the long call strategy becomes more attractive and the short put strategy less attractive. Figure A.13.3 combines the two earlier figures and shows the regions of preference in the $\mu - C$ plane.

We will look at a numerical example to elucidate the above analysis.

◆ A Singapore firm has imported chemicals from a UK supplier on a 90-day credit basis. The invoice is for GBP 250,000. The market rates are:

GBP/SGD Spot: 2.9130/40

3 months: 100/120

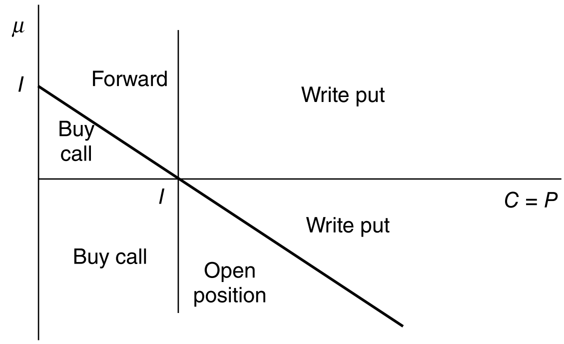

Fig. A.13.3

Thus, the 3-month forward offer rate for GBP is 2.9260
3-month GBP call with strike 2.9260: Premium 0.05 SGD per GBP
3-month GBP put with strike 2.9260: Premium 0.05 SGD per GBP

The importer thinks that 3 months from now, any value of the spot rate between 2.9000 and 2.9400 is equally likely. This implies

$$f(x) = (1/0.04) \quad -0.026 \le X \le 0.014$$
$$= 0 \quad \text{elsewhere.}$$
$$\mu = -0.006. \quad I = 0.0018^{15}$$

From the decision rules given above, since $C > I - \mu$ the importer should write a put option on GBP 250,000.

It must be emphasised that the above analysis assumes that expected cost is the only criterion for choice. Except for the forward, all the other strategies are risky. In practice, managers should take account of this. The level of confidence in one's forecast and the degree of risk tolerance are important determinants of the choice of hedging strategy.

A.13.2 HEDGING MULTIPLE EXPOSURES

Consider a British company which has the following commitments in CHF arising out of its operations:

Item	*Maturity*	*Amount*
1 A CHF payable	1 month	2,000,000
2 A CHF deposit	3 months	1,500,000
3 A CHF receivable	1 month	500,000
4 A CHF forward sale	6 months	450,000
5 A CHF loan	6 months	1,000,000

(Contd.)

[15]This is given by $I = \int_0^{0.014} (x/0.04)dx$

6 A CHF payable	9 months	850,000
7 A CHF forward purchase	9 months	500,000
8 A CHF loan	12 months	2,500,000

In the case of a deposit or a loan, the amount is the maturity value which includes interest and the principal.

The net exposures at various horizons are:

Time	Net Exposure
1 month	(–) 1,500,000
3 months	(+) 1,500,000
6 months	(–) 1,450,000
9 months	(–) 350,000
12 months	(–) 2,500,000

where (–) indicates outflow and (+) indicates inflow.

Suppose CHF interest rate is 6% for all maturities and is known to remain at this level with certainty. We will determine the value of each of these exposures as at 12 months using the known interest rate for compounding.

Exposure maturing at	Value at 12 months[16]
1 month (31 days)	(–) 1,583,500
3 months (91 days)	(+) 1,568,500
6 months (182 days)	(–) 1,494,225
9 months (273 days)	(–) 355,367
12 months (365 days)	(–) 2,500,000
	Total: (–) 4,364,592

The implication of the assumption that interest rates for all maturities is 6% is that forward contracts to lend or borrow funds for any maturity can be entered into at an interest rate of 6% per annum[17]. Thus, the firm can enter into the following contracts:

1. Borrow CHF 1,583,500 for 11 months starting one month from now. With this it settles the first outflow.
2. Lend CHF 1,568,500 for 9 months starting 3 months from now.
3. Borrow CHF 1,494,225 for 6 months starting six months from now. With this, it settles the outflow at 6 months.
4. Borrow CHF 355,367 for 3 months starting 9 months from now. This takes care of the outflow at 9 months.

Finally, the firm buys 12 months forward CHF 4,364,692. This will enable it not only to settle the outflow at 12 months but also repay all its net borrowing along with interest.

Note that the firm could have achieved the same result in a number of different ways. For instance, the forward contract could have been for a maturity of six months with an appropriate profile of

[16]Compounding is done using the Actual/360 day count basis.

[17]Such contracts are known as Forward Rate Agreements or FRAs. The seller of an FRA in effect agrees to lend the buyer a specified amount of money for a specified period starting at a specified date in the future. FRAs will be discussed in detail in Chapter 15.

deposit and lending transactions. Also, it could have used only the money market and the spot market. Thus, it can buy spot the *PV* of the above CHF cash flows and deposit it in such a manner as to have the necessary CHF amounts on hand to settle the net cash flows at various dates.

Note also that it is not really necessary to assume that interest rates for all maturities are identical; what is required is that the interest rates for various maturities are known with certainty and remain unchanged.

Another approach is to use the concept of duration which is discussed in Appendix *A*. As explained there, duration measures in a sense the "average life" of a cash flow stream. Suppose a Dutch firm has the following net cash flows in US dollars:

3 months : +2.5 miilon
6 months : –1.5 million
12 months : +2.0 million

The dollar interest rates are 8% p.a. 3-month maturity, 8.5% p.a. for 6-month maturity and 9% for 1-year maturity. Recall that duration is defined as

$$D = \Sigma t \times PV(t)/\Sigma PV(t)$$

where $PV(t)$ is the *PV* of the cash flow occurring at time *t*. For the above cash flows, we have

t	$CF(t)$	$PV(t)$	$t \times PV(t)$
0.25	+2.5	2.45236	0.61309
0.50	–1.5	–1.44005	–0.72002
1.00	+2.0	1.83486	1.83486
		2.84807	1.72793

and the duration is 0.6067 years or 7.28 months. A single forward sale contract with a maturity of 7.28 months will have the same duration. The contract amount will have to be $\Sigma PV(t)$ compounded for 7.28 months at the appropriate interest rate. Assuming that the relevant rate is same as the 6-month rate this will be $(2.84807)(1.085)^{(7.28/12)} = 2.99258$ million. Note, however, that this procedure must be used with care when the cash flow stream has both negative and positive components and the PV of outflows is very close to *PV* of inflows. This can produce absurdly long duration of the entire stream for which no interest rates or forward contracts can possibly be had. Thus, consider a set of cash flows with *PV* – 49 and duration of 5 years and another set with PV of 50 and duration of 6 years. The duration of the combined stream would be $[-49 \times 5 + 50 \times 6]/(50 - 49) = 55$ years. It is better to have separate hedges, one for all positive cash flows taken together (a sale contract whose duration matches that of the cash flows) and another for all negative cash flows taken together (a purchase contract with matched duration). Also note that as mentioned in Appendix *A*, the concept of duration assumes parallel shifts in the yield curve and is necessarily an approximate tool for hedging interest rate risk.

Exhibit A.13.1 provides some information on the hedging practices of a few large Indian corporates. As seen, most of them focus on short-term transactions exposures arising out of their export-import transactions. Also, most of them use both forward contracts as well as currency options as hedging instruments.

Exhibit A13.1 Currency Exposure Hedging in Some Indian Firms (2006–07)

Instruments	*Currency (mn)*	*₹ (cr)*	*Nature of Exposure*
Reliance Industries			
Currency Swaps		1064.49	Earnings in all businesses are linked to USD. The key input, crude oil is purchased in USD. All export revenues are in foreign currency and local prices are based on import parity prices as well
Options Contracts		2939.76	
Forward Contracts		5764.10	
Maruti Udyog			
Forward Contracts	6411 (INR-JPY) 70 ($-INR)		Import/Royalty payable in Yen and Exports Receivables in dollars.
Currency Swaps	124.70 (USD-INR)		Interest rate and forex risk.
Mahindra and Mahindra			
Forward Contracts	350 (INR-JPY) 2 (INR-EUR) 27.3 ($-INR)		Trade payables in Yen and Euro and export receivables in dollars.
Currency Swaps	5390 (JPY-INR)		Interest rate and foreign exchange risk
Arvind Mills			
Forward Contracts	152.98 ($-INR) 2.25 (GBP-INR) 5 (INR-$)	703.67 21.88	Most of the revenue is either in dollars or linked to dollars due to export.
Option Contracts	122.5 ($-INR)	547.16	
Infosys			
Forward Contracts	119 ($-INR)	529	Revenues denominated in these currencies.
Options Contracts Range barrier options	4 ($-INR) 8 (INR-$) 2 ($-INR) 3 (Eur-INR)	18 36 971	
Tata Consultancy Services			
Forward Contracts	15 (Eur-INR) 21 (GBP-INR)	265.75	Revenues largely denominated in foreign currency, predominantly US$, GBP, and Euro. Other currencies include Australian $, Canadian $, South African Rand, and Swiss Franc
Option Contracts	830 ($-INR) 47.5 (Eur-INR) 76.5 (GBP-INR)	4057	
Ranbaxy			
Forward Contracts		2894.589	Exposed on accounts receivable and loans payable. Exposure in USD and Jap Yen
Dr. Reddy's Labs			
Forward Contracts	398 ($-INR) 11 (EUR-$)		Foreign currency earnings through export, currency requirements for settlement of liability for import of goods.
Options Contracts	30 (EUR-$)		

Note:
1. $-INR Forward contracts denote selling of USD forwards to convert revenues to INR. INR-$ Forward contracts denote buying of USD forwards to meet USD payment obligations.
2. $-INR Option contracts are Put options to sell USD. INR-$ are Call options to buy USD

Source: Anuradha Sivakumar and Runa Sarkar (2007) : "Corporate Hedging for Foreign Exchange Risk in India", IIT Kanpur

Case Study

I

Here are the 'excerpts' from a closed room discussion between heads of purchase, marketing, production and the treasurer of Advanced Tectonic Devices. [*The dialogues given below might appear to be unduly contrived to an expert. This was necessary for attaining clarity for our purpose and maintaining the printability of the statements; impolite usages are deliberately expunged.*]

Head Marketing: See, after a long drawn effort, spread over six months, my boys and girls have managed to get this big #$%^*@ order totalling equivalent of USD 1.5 million. I had to @#$%^*& the happiness of all my staff to get this deal going. Despite an international competitive bidding, we have got this order for the supply of high precision devices to the European Space Agency for the launch of a Japanese communication satellite. This supply agreement is likely to be signed in anytime over next two weeks. The exact rupee equivalent of this order will be known when the price is frozen, on the date of signing of contract.

Head Production: Thanks to all your efforts and advance planning, we are in a position to meet all deadlines, without an iota of problem. My only concern is about the raw material supply linkage. Give me material today and I will deliver the component without any problem in a matter of ten days. Add a cushion of two more days, if some rework is required due to material flaw. [*Ends this sentence with a deprecating chuckle, obviously directed towards the head of purchase*.]

Head Purchase: (He turns to Head Treasury) You #$%^&* production persons, when will you learn to behave. See, just before coming to this meeting I called the raw material supplier with our dates and quantity. He told me that material for entire order can't be purchased in one lot due to international trade restrictions. This grade of alloy steel is on the international watch list due to possible use in nuclear weapons. Therefore, only a part of total material requirement can be bought at a time. As soon as one lot is consumed in production, we will need to issue a certificate to this effect, and then only the next lot of high alloy steel can be purchased. He *turns to head treasury*, See, the payment is to be made every fortnight for raw material (high alloy steel billets) over next six months, in equal instalments of USD 100,000 each. Without fail! Any trouble on that front will jeopardise the entire supply sequence.

Head Marketing: As per the terms of contract, the buyer will be able to pay 50% of the contracted amount once the payload in fitted on the launch rocket in EUR (that is equivalent of USD 750,000) and the remaining 50% (that is equivalent of USD 750,000) immediately after launch of the satellite in JPY.

Head Treasury: [*Definitely not amused*] What is this @#$%& contract you have drawn. At least you *&%^$# should consult me before getting into any such commitments. Our chief economist is not comfortable with the world economy outlook. In her opinion, Japan appears to be heading towards yet another cycle of recession. EUR is likely to strengthen against JPY and USD over next six months. As far as INR is concerned, not much variation is expected over next six months. And you expect me to do a profitable deal under the circumstances!! [*Leaves the meeting room abruptly, door slams behind him, and some muffled shouts are heard*]

Well, as you would have guessed it by now, you are the treasurer who feels slighted due to the process adopted by marketing, purchase, and production heads.

Question: What are the choices available with you to meet these cash flow requirements? Analyze each possibility in detail and argue for and against each of them.

II

The first part of payment was received as planned. All are happy. The second part is due. The rocket is successfully launched but there is a problem. Since the time the communication satellite has been deployed, there has been a continuous decline in the bandwidth and transponder hire charges. Your counter party wants to renegotiate the terms of payment.

Question: What will you do? How you will protect your interest in this situation?

Chapter 14

Management of Operating Exposure

14.1 INTRODUCTION

The last chapter dealt with the ways of coping with transactions exposure. We saw in Chapter 3 that this type of exposure pertains to assets, liabilities and cash flows whose values are contractually fixed in terms of the foreign currency. In this chapter, we address a more difficult problem, viz. how to assess and manage the impact of exchange rate changes on the firm's future cash flows from operations which are not fixed in either the home currency or the foreign currency. Neither the prices nor the quantities of outputs and inputs are fixed and all are subject to change when exchange rates change. Consequently, the firm's profit margin, measured in either currency, is influenced by exchange rates. This is what operating exposure is all about.

The impact of operating exposure can be felt well beyond just pricing and invoicing decisions. Some output markets can become relatively more or less attractive compared to others, input sourcing decisions may have to be reviewed and, in some cases, the firm may even decide to relocate its production facilities. Several examples can be cited.

- Following the reunification of Germany, the DEM depreciated against most major currencies (as also against the Indian rupee). Indian exporters, particularly of nontraditional items like machinery parts, tools and castings found that exports to Germany were becoming unattractive because of local competition.
- When the European currency markets were plunged into chaos following the withdrawal of sterling and lira from the ERM in September 1992, Dow Chemical Corporation decided to invoice all its sales in Europe in DEM.
- Due to the rising dollar during the first half of eighties, a number of US companies shifted their sourcing of components and materials abroad rather than buy from US suppliers in an attempt to reduce costs.
- During the same period, some US corporations shifted manufacturing facilities abroad in order to retain their cost competitiveness.

- Laker Airways, a British airline offered cut-price, no-frills trans-Atlantic flights to British tourists visiting the US in the late seventies. Its business grew rapidly so that it expanded its fleet and financed the purchase with US dollar borrowing. During the first half of eighties as the dollar rose steeply against the pound sterling, tourist traffic from UK to the US shrank. This coupled with the transactions exposure on its debt service created enormous difficulties for the firm eventually leading to bankruptcy.
- After the East Asian currency crisis in which some of those currencies dropped by as much as 50% against the US dollar, Indian exports of gems and jewellery to Western markets suffered a competitive disadvantage vis-à-vis exporters from East Asia.
- For a long time pressure was being brought on China to revalue its currency upward against the US dollar in view of its huge current account surplus. It was felt that Chinese companies were enjoying an unfair competitive advantage against their US counterparts because of the fixed exchange rate. Finally China relented in latter half of 2005 and revalued the yuan to a small extent.
- Japan is often accused of deliberately keeping the yen undervalued to retain or enhance its competitive position in export markets even though it has been consistently enjoying large BOP surplus and accumulating massive foreign assets.
- During 2007-08, the rupee rose against the dollar leading to an adverse impact on the competitive position of Indian IT and biotechnology firms in their export markets in US.

To reiterate, unanticipated changes in exchange rates can have a serious and sustained impact on a firm's revenues and costs so as to threaten its very survival in its existing markets and viability of its existing lines of business forcing a thorough restructuring of its operations and reformulation of business strategy.

An important point to note is that a firm is subject to operating exposure even when it has little or no direct involvement in international markets. For instance, consider a firm which produces exclusively for the domestic market and sources all its inputs from domestic suppliers. Changes in exchange rates can affect such a firm in various ways:

- The firm's competitors may be importing a competing product. Changes in the home currency exchange rate affect their costs and hence, their competitive posture. For instance, an appreciation of the home currency may permit them to undercut the purely domestic firm.
- Even though the firm sources all its inputs from domestic suppliers. They, in turn, (and their suppliers so on down the line) may have imported inputs or competition from imports. Changes in exchange rate affect their costs and hence the prices they offer to our domestic firm. Thus, the firm has "indirect" operating exposure.
- Consumers of the firm's output (and consumers of their output, etc.) may have direct exposure to exchange rates. A change in their fortunes has an impact on our domestic firm. For instance, an Indian manufacturer of chemicals used in domestic leather industry faces indirect exposure because many of its customers are exporters of finished leather goods and their business is adversely affected, if the rupee appreciates against the dollar.
- Changes in exchange rate may lead to changes in wages (due to their impact on the cost of living index) which affect all the firms in the economy. They may also lead to macroeconomic policy shifts – e.g. monetary tightening in the face of depreciating home currency – or changes in trade policies which again impact on all the firms in the economy.

The analysis and management of operating exposure are at the same time more important and considerably more difficult than contractual transactions exposure. More important because operating exposure can have significant long-term impact on future business of the firm and its strategic posture; more difficult because it involves too many imponderables and no simple hedges like forward contracts are available. Hedging such exposures is often highly impractical, if not impossible. As we will see below, most of the time operating exposure has to be managed only by restructuring the firm's operations and altering its strategic posture.

14.2 OPERATING EXPOSURE AND REAL EXCHANGE RATE

In Chapter 3 as well as in Chapter 11, we have emphasised the idea that operating exposure arises mainly on account of changes in real exchange rates. Consider an example to reinforce this point.

- An Indian firm exports carpets to the UK. At the beginning of the year, the exchange rate is ₹80.00 per pound. Competitive considerations suggest that the exporter should invoice in sterling and price the carpets at £200. At this price, it is able to sell 100 carpets per month. The firm's costs are all domestic at ₹9,000 per carpet. Thus, its operating margin is ₹7,000 per unit. Over the year, the inflation in UK is 5%, while in India, it is 8%. Assume that it can raise the UK price to £210 in line with UK inflation without affecting sales and its operating costs increase by 8% to ₹9,720 in line with inflation in India. To maintain operating margin in real terms, i.e. ₹7,560 per unit in end-of-the year prices, it must get a revenue of ₹17,280 from each unit sold. If the exchange rate appreciates to ₹82.2857, the firm is unaffected. But this means that real exchange rate must remain unchanged since 82.2857 = 80.00(1.08/1.05).

This example makes it clear that operating exposure depends upon:

- Change in nominal exchange rate
- Change in the selling price (output price)
- Change in the quantity of output sold
- Change in operating costs, i.e. quantities and prices of inputs

Changes in real exchange rates are among the consequences of real macroeconomic shocks like changes in oil prices. Consumers, firms, labour and governments react to such shocks by altering their buying patterns, wage demands, input choices, technologies, taxes, subsidies, and so forth. The extent and speed of response depends on factors like magnitude of the shock, whether it is perceived to be permanent or transitory, possibilities of substitution in consumption and production, bargaining power of unions, market structures and political compulsions. Real exchange rate changes alter both the relative prices faced by consumers and their incomes.

For instance, a real appreciation of the US dollar versus the Indian rupee makes American imports into India more expensive relative to their Indian-made substitutes and Indian exports to US cheaper than their substitutes made in the US. However, such an appreciation also reduces real incomes of Indian consumers and increases real incomes of American consumers. What will be the net impact on the sales of a firm which sells in both the markets? Obviously, it depends upon the price and income elasticities of demand for its products in the two markets and the relative share of the two markets in its total sales.

Real exchange rate changes may also give a relative cost advantage to some firms over their competitors. As we will see below, the extent of this advantage is largely determined by the degree of mismatch in the currency composition of recurring costs of a firm and its competitors. Such a cost advantage may or may not be translated into competitive price cutting.

Real exchange rate changes will generally have an impact on the costs of a firm's suppliers. Their reactions will be determined by the degree of market power they enjoy and availability of substitutes.

Long lasting changes in real exchange rates produce persistent trade imbalances forcing governments to take corrective actions such as import restraints, export subsidies, controls on capital flows and shifts in monetary policies. Some or all of these can affect a firm's cash flows.

Finally, it must be borne in mind that changes in real exchange rates do not occur in isolation. Usually, they are accompanied by changes in real interest rates. This factor may influence not only expected future cash flows but also the discount rate used to find the PV of these cash flows.

Operating exposure can be looked upon as a combination of two effects – the conversion effect and the competitive effect. The conversion effect refers to the changes in home currency value of a given foreign currency cash flow, while the competitive effect refers to the impact of exchange rate changes arising out of changes in prices and quantities[1]. The former is similar to transactions exposure[2] while a meaningful analysis of the latter must inquire into the factors which determine the price impact and the quantity impact of exchange rate changes. The most important consideration here is the structure of the markets in which the firm sells its output and buys its inputs.

In the example above, output price increased in proportion to foreign inflation, output quantity remained unchanged, input costs went up in proportion to domestic inflation and the nominal exchange rate depreciated in line with relative PPP. In practice, one or more of these happy circumstances do not obtain giving rise to operating exposure. It should also be remembered that the concept of real exchange rate uses some aggregate price index to measure inflation. It is possible that even if exchange rate movements reflect inflation differentials measured by aggregate price indices, the prices of a firm's inputs and outputs may not move in line with inflation rates. Relative price changes in response to exchange rate fluctuations can create exposure even if real exchange rate remains constant.

Table 14.1 provides some data on the nominal and real effective exchange rate of the rupee with various base periods.

These data indicate that in nominal terms, the rupee has depreciated since 1997-98 against a wide basket of 36 trading partner countries, but in real terms, the trend is not obvious with the rupee appreciating during some years such as the period from 2002-03 to 2005-06. This behaviour is probably dictated by the trend in the USD/INR exchange rate since US as India's largest trading partner has a significant weight in the basket.

In practice, unanticipated exchange rate changes are a part of macroeconomic risks faced by a firm. A relevant question is the degree to which exchange rate changes get reflected in the changes in prices of goods and services. This is known as "pass through". Suppose an Indian firm imports tennis racquets from US. The US price is $50 and the exchange rate is ₹44.00. The importer sells the racquets at a price of ₹2750 and earns a margin of 25%. Now suppose the exchange rate depreciates to ₹45. With full "pass through", the rupee price would increase to [(45/44)2750] or ₹2,812.50 and the importer's margin would be unchanged at 25%. However, competitive factors may prevent full pass through subjecting the importer to operating exposure. Also, even in the absence of competitive pressures, decision and implementation lags would generally mean that the full impact of exchange rate changes does not get absorbed in price changes immediately, but only after a lag, the length of

[1]Thus, a purely domestic firm referred to above is not exposed to the conversion effect but is exposed to the competitive effects of exchange rate changes. Also, invoicing exports in home currency would remove transactions exposure for an exporter firm but not operating exposure. Keeping fixed prices in home currency necessarily means fluctuating prices in foreign currency and hence fluctuating export volumes.

[2]It must be stressed that contractually fixed items may not always appear on the firm's financial statements. For instance, an order booked, but not yet shipped, gives rise to a transactions exposure as much as a receivable though it does not show up on the balance sheet.

which depends on many factors. The time profile of "pass through" is also relevant in determining the degree of operating exposure.

In the rest of this chapter, we will examine in detail the factors which influence a firm's operating exposure, the ways to assess its magnitude and any defence mechanisms available to cope with the exposure.

14.3 THE PRICE AND QUANTITY EFFECTS OF EXCHANGE RATE CHANGES: A GENERAL OVERVIEW

The aspects of market structure which influence the behaviour of prices and the resultant quantity response of various goods and services are:

1. The geographical extent of the market.
   Markets for some goods are global in nature. Barriers to cross-border movements imposed by transport costs, tariffs, etc., are moderate and the extent of product differentiation is also moderate. Examples are primary commodities like metals, crude oil, and agricultural produce. Here the probability of goods arbitrage equalising prices across countries (expressed in a common currency) is much higher. In contrast, when cross-border mobility is impeded by high transport costs, tariffs and quotas, the markets tend to be segmented or localised. Prices can differ significantly across countries. A firm selling in such segmented markets would enjoy greater freedom in manipulating prices.

Table 14.1 Indices of Real Effective Exchange Rate (REER) and Nominal Effective Exchange Rate (NEER) of Indian Rupee (36–Currency Bilateral Weights) (Calendar Year–Annual Average)

(Base: 1993-94 = 100)

Year	*Export-based Weights*		*Trade-based Weights*	
	REER	*NEER*	*REER*	*NEER*
1993	100.10	99.62	100.10	99.61
1994	103.60	99.30	103.30	99.86
1995	102.60	93.41	101.00	94.07
1996	97.55	88.16	95.41	88.42
1997	102.60	91.72	100.40	91.85
1998	96.36	90.23	94.52	89.11
1999	94.85	90.58	95.29	90.89
2000	98.07	90.57	99.30	92.19
2001	98.90	89.25	100.90	91.52
2002	96.40	87.57	98.90	90.08
2003	98.17	87.68	99.04	87.60
2004	98.28	87.87	99.68	86.83
2005	100.40	90.76	102.20	89.41
2006	97.51	88.00	98.71	86.51
2007	103.23	93.95	104.10	92.58
2008	97.65	87.75	97.80	87.21
2009	89.86	81.24	90.36	83.47

(Contd.)

(Base: 2004-05 = 100)				
2005	102.45	101.97	102.64	101.90
2006	100.97	98.61	101.23	98.36
2007	107.51	104.39	107.60	103.73
2008	101.34	97.42	101.18	96.48
2009	93.22	90.56	93.04	90.23
2010	102.44	94.80	101.44	93.85
2011	102.34	91.04	100.81	89.62

Note:

1. Data for 2010 and 2011 are provisional.
2. REER indices are recalculated from April 1993 onwards using the new Wholesale Price Index (WPI) series (Base: 1993-94 = 100).
3. The base year is changed from 1993-94 to 2004-05.
4. A new 36-currency REER/NEER series has been introduced with effect from December 2005. The details regarding the new series are available in the December 2005 issue of RBI Monthly Bulletin.
5. Annual average for 1993 is calculated taking data from April 1993 to December 1993. Also see Notes on Tables.

Source: RBI Handbook of Statistics on the Indian Economy, September 2012.

2. Who are the dominant producers and consumers of the good in question?
   This is relevant for determining the currency in which prices will tend to be most stable. For instance, if the US is the dominant producer of wheat and the price elasticity of demand is low, dollar prices of wheat will be relatively more stable[3]. On the other hand, if the UK is the dominant consumer of tea and the price sensitivity is high, tea prices will be relatively more stable when expressed in sterling. This consideration is much more relevant when markets are global in scope rather than localised. In the former case, an American wheat exporter has little operating exposure when the dollar appreciates while in the latter case, a British tea importer has minimal operating exposure.

   The relevant consideration is the difference between currency of denomination and currency of determination. Consider an oil firm which has oil wells in the Middle East and a refinery in Europe. The refinery sells petroleum products to European customers and invoices them in euro. However, world prices of oil and oil products are determined in dollars. The fact that the refinery's revenues are denominated in euros is irrelevant; if euro goes down against the dollar, euro prices will have to be raised and euro revenues will increase; the converse will hold, if the euro rises against the dollar. Thus, the refinery's revenues behave as if they are denominated in dollars. The currency of determination is dollars though the currency of denomination is euro. For the parent firm, the relevant exchange rate is that between its home currency and the dollar.
3. Market power and demand elasticities.
   This factor focuses on the intensity of competition and sensitivity of demand to price changes. Suppose an American firm is a monopolistic supplier of memory chips to Indian computer manufacturers. Following a depreciation of the rupee, the firm can raise the rupee prices by the full extent of devaluation (assuming inelastic demand) or, alternatively, if it invoices in dollars, can maintain dollar prices. If it is supplying to Japan in competition with Japanese chip

[3]More accurately, the predominant influence on wheat price would be behaviour of costs in the US.

producers, a real dollar appreciation will hurt because it may not be able to raise yen prices to compensate for yen depreciation.

The quantity impact of a given price change is determined by price elasticities of demand. These, in turn, are determined by the nature of the product, availability of substitutes, the extent of effective product differentiation and market concentration. An exporter firm selling in a highly competitive market must maintain its price in line with the ruling market price or lose all sales; a firm with some market power selling a differentiated product can raise its price above competition without a significant loss of sales. This is all the more true, if the product has few substitutes.

4. Impact on input prices.

   So far, we have focussed on a firm's output markets. Exchange rate changes affect prices of a firm's inputs too. The relevant considerations here are whether the input market is global or localised, the firm's share as a buyer in the input markets, elasticities of supply, availability of substitutes, the nature of wage bargaining and so forth. An exporter firm's benefit from a real depreciation of its home currency might be considerably reduced, if labour costs go up as a result of depreciation, if the firm uses imported inputs and it has little market power as a buyer.

5. Currency composition of operating costs.

   This factor relates to the extent to which the currency composition of a firm's variable costs differs from that of its major competitors. Suppose a firm is selling in its home market in competition with foreign firms whose costs are denominated in their currencies. When its home currency appreciates, competitors' costs in terms of its home currency decrease and they can cut prices whereas the firm cannot.

Figure 14.1 taken from Lessard and Lightstone (1989) summarises the effects of the above factors on the severity of operating exposure faced by a firm. In this figure, a corporation like the Airbus Industries, is shown to have a very high degree of operating exposure. The share of recurring costs in aircraft manufacture is high and its costs are denominated in European currencies; it competes in a global, integrated market with American firms such as Boeing and McDonnel-Douglas whose costs

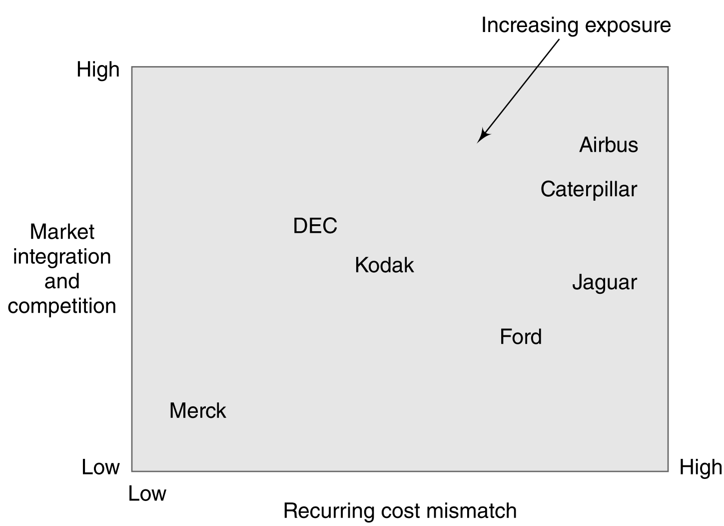

Fig. 14.1 Determinants of Operating Exposure

are denominated in dollars. An appreciation of European currencies against the US dollar will have significant adverse effects on the Airbus. On the other hand, a pharmaceutical firm such as Merck has less severe operating exposure. Because of differing standards and drug control regulations, pharmaceutical markets are segmented and Merck's competition in its output markets is from local firms; also the proportion of recurring costs in total costs is relatively low and these costs are mostly denominated in the local currency. An appreciation or depreciation of the local currency has no drastic effect on its operating margins.

Thus, it is apparent that the operating exposure of a firm is influenced by a variety of factors having to do with the degree of global market integration, intensity of competition and the cost structure. Many of these factors are hard to quantify let alone accurately measure. One possible approach to assessing operating exposure is the scenario analysis. The firm estimates its sales, costs, etc., under alternative assumptions about the exchange rate and thus obtains some quantitative measure of the sensitivity of its operating cash flows to changes in exchange rate. In the next section, we will discuss a hypothetical example of such an approach.

Carter, Pantzalis and Simkins (2006) have studied the currency exposure of US multinationals. They consider both transactions exposure and operating exposure. As expected, they find that large multinational corporations operating in many regions and countries have much greater operational flexibility in terms of sourcing inputs, pricing power, location of production facilities as also a diversified currency composition of operating cash flows so that they have a wider spectrum of operational hedges to manage operating exposure. Also, they find that depending on the nature of their business – e.g. whether they are net importers or net exporters – they face asymmetric exposure and different degree of exposure during strong dollar and weak dollar periods.

14.4 ASSESSING OPERATING EXPOSURE: SCENARIO APPROACH

We will illustrate the simulation or scenario approach with a hypothetical example. AQUARIUS GARMENTS manufactures men's shirts both for the Indian market and exports to USA. Its balance sheet at the end of the financial year 2010-2011 is given in Table 14.2.

Table 14.2 Balance Sheet of AQUARIUS GARMENTS

(All amounts in Rupees)

Cash	1,000,000	A/C Payable	12,000,000
A/C receivable	35,000,000		
Inventory	20,000,000	L.T. Debt	90,000,000
Net Fixed			
Assets	175,000,000	Equity	129,000,000
	231,000,000		231,000,000

The P/L statement for the same year is presented in Table 14.3. In this table, we have also shown the calculation of cash flow from operations. The exchange rate at that time was ₹42 per US dollar. The export price was USD 25.00 per unit. The firm faced significant competition both at home and in the US market from Indian firms as well as foreign brands. Over the next year, inflation in India was expected to be around 10% and that in the US around 3%. About one-third of material inputs were imported. We will treat this as the "base case".

Table 14.3 Aquarius Garments P/L Statement Base Case

	Units	₹ per Unit	*Total*
Home Sales	100,000	1050	105,000,000
Export Sales	50,000	1050	52,500,000
Cost of Sales			
Labour		150	
Domestic Raw Materials		200	
Imported Materials		75	
Total Operating Cost		425	63,750,000
Operating Income			93,750,000
Fixed Cash Operating Cost			8,000,000
Depreciation			10,000,000
Interest			12,000,000
Pre-tax Profit			63,750,000
Tax (@ 40%)			25,500,000
Profit after Tax			38,250,000
Add: Depreciation			10,000,000
Operating Cash Flow			48,250,000

We will consider three alternative exchange rate scenarios. Under each scenario, we specify how prices, quantities and costs would behave. This is based on considerations of competitive behaviour and the response of the various cost components to domestic and foreign inflation and changes in the exchange rate.

Scenario I: The rupee will depreciate to ₹43.75. Price for home sales will be raised by 6.5%, while the foreign currency price for American buyers will be raised by 3%. There will be a loss of sales to the tune of 3% at home, while sales in the US will remain unchanged. Labour costs will increase by 7%, domestic material costs by 10% and foreign currency cost of imported materials by 3%.

Table 14.4 presents the projected P/L statement under this scenario. It can be seen that despite the real appreciation of the rupee there is a marginal improvement in the projected cash flow.

Table 14.4 Aquarius Garments P/L Statement Scenario I

	Units	₹ per Unit	*Total*
Home Sales	97,000	1128.75	109,488,750
Export Sales	50,000	1126.56	56,328,125
Cost of Sales			
Labour		160.50	
Domestic Raw Materials		220.00	
Imported Materials		80.47	

(Contd.)

Total Operating Cost		460.97	67,762,590
Operating Income			98,054,285
Fixed Cash Operating Cost			8,800,000
Depreciation			9,000,000
Interest			12,000,000
Pre-Tax Profit			68,254,285
Tax			27,301,714
Profit after Tax			40,952,571
Add: Depreciation			9,000,000
Operating Cash Flow			49,952,571

Scenario II: We now assume that the rupee would depreciate drastically to 48.00. The firm lowers the dollar price of its shirts in the American markets by 5% and charges its rupee equivalent at home which implies a little over 8.5% increase in the home price over the base case. Export sales increase by 4% and home sales by 5%. Assumptions regarding changes in costs are identical to those in Scenario I. The projections are in Table 14.5.

Table 14.5 Aquarius Garments P/L Statement Scenario II

	Units	₹ per Unit	*Total*
Home Sales	105,000	1140	119,700,000
Export Sales	52,000	1140	59,280,000
Cost of Sales			
Labour		160.50	
Domestic Raw Materials		220.00	
Imported Materials		88.29	
Total Operating Cost		468.79	73,600,030
Operating Income			105,379,970
Fixed Cash Operating Cost			8,800,000
Depreciation			9,000,000
Interest			13,500,000
Pre-Tax Profit			74,079,970
Tax			29,631,988
Profit after Tax			44,447,982
Add: Depreciation			9,000,000
Operating Cash Flow			53,447,982

Now there is a real depreciation of the rupee which leads to a substantial increase in the firm's after-tax cash flow.

Scenario III: Finally, we look at a projection under the assumption that the rupee would appreciate in nominal terms to ₹40 per USD. This could happen, if there was a surge in capital inflow and the RBI did not intervene to prevent strengthening of the rupee. We assume that the firm raises the dollar price in the US by 8%, while the rupee price at home is left unchanged from the base case. Export volume declines by 10% and sales at home by 2%. USD cost of imported materials remains unchanged, domestic materials go up by 10% and labour by 7%. As Table 14.6 shows, the firm suffers a shrinkage of its after-tax cash flow as a result of the real appreciation of its home currency.

Table 14.6 Aquarius Garments P/L Statement Scenario III

	Units	*₹ per Unit*	*Total*
Home Sales	98,000	1050	102,900,000
Export Sales	45,000	1080	48,600,000
Cost of Sales			
Labour		160.50	
Domestic Raw Materials		220.00	
Imported Materials		73.57	
Total Operating Cost		454.07	64,932,010
Operating Income			86,567,990
Fixed Cash Operating Cost			8,800,000
Depreciation			9,000,000
Interest			11,500,000
Pre-Tax Profit			57,267,990
Tax			22,907,196
Profit after Tax			34,360,794
Add: Depreciation			9,000,000
Operating Cash Flow			43,360,794

This example, simple as it is, serves to bring out the complexities of assessing operating exposure. The firm needs to know the structure of its output markets, demand elasticities and competitive reactions as well as detailed information about its cost structure and the response of the various cost components to changes in exchange rate and other macroeconomic shocks. Simultaneous changes in several variables complicates the task further since precise identification of the impact of each becomes difficult.

Adler and Dumas (1984) have suggested that scenario analysis should be combined with the statistical regression approach to get around this difficulty. We now turn to a brief exposition of the regression approach.

14.5 OPERATING EXPOSURE: REGRESSION APPROACH

The simulation or scenario approach leads to estimates of the impact of changes in the exchange rate on a firm's cash flows. We can use these estimates to formally estimate the sensitivity of the firm's cash flows to exchange rate using the regression framework.

Suppose we have estimated at time t_0 (today) the firm's cash flows in its home currency denoted CF_{t1-t2} for the period t_1 to t_2 for various values of the spot rate S_{t1} at time t_1. These values are indexed by i with $i = 1...N$. Consider the following regression equation:

$$CF_{t1-t2}(\mathrm{i}) = \alpha_{t0,\,\mathrm{t}1} + \beta_{t0,\,t1}S_{t1}(\mathrm{i}) + u_{t1}(\mathrm{i}) \tag{14.1}$$

The residual $u_{t1}(i)$ is by definition uncorrelated with $S_{t1}(i)$.

The co-efficient $\beta_{t0,\,t1}$ measures the impact of a unit change in exchange rate on the cash flows. This co-efficient must have the dimension of foreign currency since CF is measured in home currency and S is in units of home currency per unit of foreign currency. The part of cash flow measured by $(\alpha_{t0,t1} + u_{t1})$ is unexposed to exchange rate while $\beta_{t0,\,t1}$ measures the exposed cash flow or exposure. In principle, the firm can hedge itself by selling an amount $\beta_{t0,\,t1}$ of the foreign currency forward. If today's forward rate for contracts maturing at t_1[4] is $F_{t0,\,t1}$, the gain from the forward sale is $b_{t0,\,t1}$ $[F_{t0,\,t1} - S_{t1}(\mathrm{i})]$. The value of the hedged cash flows is given by

$$\begin{aligned} CF_{t1-t2},\ \mathrm{hedged(i)} &= \alpha_{t0,\,t1} + \beta_{t0,\,t1}S_{t1}(\mathrm{i}) + u_{t1}(\mathrm{i}) + \beta_{t0,\,t1}[F_{t0,\,t1} - S_{t1}(\mathrm{i})] \\ &= \alpha_{t0,\,t1} + \beta_{t0,\,t1}F_{t0,\,t1} + u_{t1}(\mathrm{i}) \end{aligned}$$

which is independent of the spot rate at time t_1. There is still some uncertainty represented by the residual u but it is uncorrelated with exchange rate and cannot be hedged by any instrument whose payoff is contingent upon exchange rate.

Let us take a simplified example to illustrate this. JIVE Jeans, an Indian garment manufacturer exports denim jeans to the United States. The export volume is 10,000 and the dollar price per unit is \$20.00. Manufacture of the jeans requires some imported inputs apart from domestic materials and labour. The USD/INR exchange rate can take any of the four values 43.00, 45.00, 47.00 and 50.00 with equal probability. Table 14.7 shows the calculations of after-tax export earnings for JIVE Jeans under the four scenarios. A simple regression of the after-tax earnings on the exchange rate gives the following estimates:

$$\begin{aligned} CF_{t1-t2}(\mathrm{i}) &= 0.928 + 0.0287\ S_{t1}(\mathrm{i}) \\ &\quad\ (0.168)\ (0.0036) \\ R^2 &= 0.97 \end{aligned}$$

The exposure coefficient is significantly different from zero and implies that the firm can hedge against the exposure by selling forward 28,700 US dollars.

In practice, the company would not remain passive in the face of changes in exchange rate. For instance, as the rupee depreciates, it can reduce the dollar price to increase its export sales and depending upon the elasticity of demand, the dollar value of sales could increase reinforcing the effect of depreciation. It could also alter its input structure or sourcing so as to economise on imported inputs. In such cases, a rupee depreciation may increase its cash flows much more than what the example indicates.

Essentially, in the regression approach, we have assumed that the relationship between cash flows and exchange rate is linear; in practice it could be non-linear. In such cases, a forward contract would not be an appropriate hedge since its payoffs are linearly related to the future spot rate. Hedging instruments like options would provide better hedges.

The regression approach can in principle be extended to identifying several exposures simultaneously. Thus, we can include several exchange rates, home and foreign interest rates, prices of key commodities, e.g. oil as "risk factors" to which a firm's cash flow is exposed. The impact of each of these risk factors can be estimated using historical data on budgeted and actual cash flows.

[4]For simplicity, we are assuming that the entire cash flow will be realised at time t_1.

Table 14.7 JIVE Jeans Operating Performance

	USD/INR Exchange Rate			
	43	45	47	50
Export Volume ('000)	10	10	10	10
Dollar Price	20	20	20	20
Sales (₹mill)	8.6	9.0	9.4	10.0
Unit Material Cost	452	478	508	558
Other Costs/Unit	50	50	50	50
Total Unit Cost	502	528	558	608
Total Cost (₹ mill)	5.02	5.28	5.58	6.08
Export Earnings before Tax (₹ mill)	3.58	3.72	3.82	3.92
Export Earnings after Tax (₹ mill)	2.148	2.232	2.292	2.352

In the following sections, we will present simple analytical frameworks to sharpen some of the insights which are implicit in the above general discussion. It must be emphasised that what follows is intended to help a manager in raising the relevant questions rather than providing any answers to the problem of measuring and managing operating exposure.

14.6 AN EXPORTER FIRM

Consider an Indian firm that exports leather jackets to the United States. It is a very large market in which our firm is a small player. Like a perfectly competitive firm of economic theory, it takes the dollar price of its product as given and can sell as much as it wishes at the going market price. The current dollar price is $P_{0\$}$, the USD/INR exchange rate is S_0 and the firm produces and exports X_0 units. The rupee price P_{0R} equals $P_{0\$}S_0$. At this level of output, the marginal cost of production equals the market price, both measured in rupees. Figure 14.2 shows the initial situation.

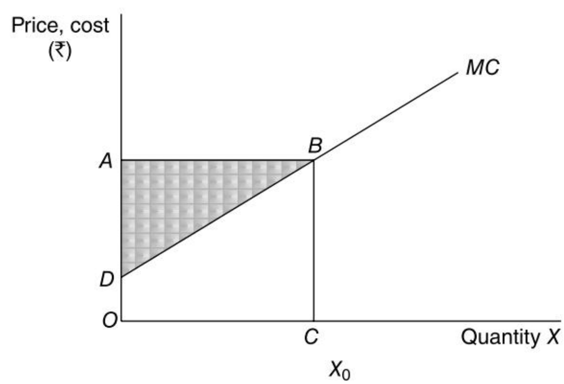

Fig. 14.2 An Exporter in a Competitive Market

The area *OABC* is the firm's total export revenue while the area *ODBC* is the total cost of export production. The hatched area *ABD* is profit. All are in rupees.

Now suppose the dollar depreciates in real terms against the rupee. For concreteness, assume that US inflation is 5% p.a., Indian inflation is 15% p.a. and the USD/INR exchange rate increases only by 8%. These figures imply a 2% p.a. real appreciation of the rupee. From the point of view of our exporter firm, the following questions are relevant:

- How much will the dollar price of jackets in US go up? Will it go up in proportion to the increase in the US price level, viz. 5% or will there be a relative price change?
- What will be the effect of the nominal rupee depreciation and inflation at home on its costs?

The answer to the first question depends, among other things, on the current demand-supply conditions in the market for leather jackets. For instance, if there is excess capacity in the industry, jacket prices may not keep pace with the general inflation. On the other hand, if domestic producers' costs increase by 5%, the new equilibrium price in a competitive industry will be 5% higher. The answer to the second question depends partly on import content of jacket production, cost-of-living adjustments in wages (which may depend partly on the exchange rate, if the workers' consumption basket contains some imported goods), and prices of other inputs.

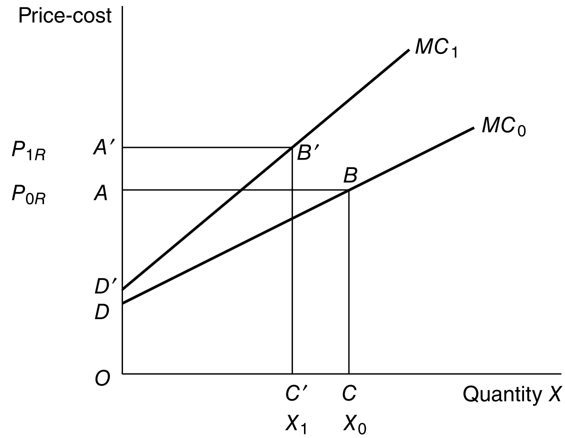

Fig. 14.3 An Exporter in a Competitive Market Effect of a Real Appreciation

In Figure 14.3, we have assumed that the dollar price in the US market increases in proportion to US inflation while the Indian firm's costs increase in proportion to Indian inflation. The new dollar price, $P_{1\$}$, equals $(1.05)P_{0\$}$, the new USD/INR exchange rate, S_1, equals $1.08S_0$ and thus the new price translated into rupees, P_{1R}, equals $1.134P_{0R}$. The marginal cost curve shifts up by 15%.

As shown in Figure 14.3, the quantity of exports reduces to X_1 from X_0 while the price increases. Since the rupee price has increased less than the marginal costs, exporter's profits have shrunk from the area ABD to $A'B'D'$. A real appreciation has hurt the exporter.

It must be kept in mind that we have made some simplifying assumptions in arriving at this conclusion. In particular, we have assumed away the relative price risk by assuming that output prices increase in proportion to foreign inflation, while costs increase in proportion to domestic inflation. In practice, forecasting general inflation rates is comparatively easier; forecasting relative price shifts is a difficult task.

In the long run, it is possible that the fall in profitability might induce some Indian firms – our exporting firm's domestic competitors – to get out of export markets. Unless Indian exports of leather jackets constitute a significant fraction of the total US market, this is unlikely to have any effect on the US price.

So far, we have looked at the exporter's profits denominated in its home currency. What's about its revenue, costs and profits measured in foreign currency? It is demonstrated in the appendix to this chapter that foreign currency profits also decline.

Arguing along similar lines, it is easy to see that a real depreciation will increase the profitability – measured in home as well as foreign currency – of an exporter, provided again that relative price shifts are not significantly adverse.

Next, we will analyse the case of an exporter who enjoys some market power, i.e. faces a demand curve that is not perfectly elastic. We will now consider the case of a real depreciation of the exporter's home currency and examine the effect on profits measured in foreign currency. For concreteness, let our exporter be a British firm exporting luxury cars (say Rolls Royce) to the United States. Figure 14.4 depicts the initial situation.

In Figure 14.4, the line DD is the demand curve for Rolls Royce cars (from American buyers) and the line MR is the corresponding marginal revenue curve. The exporter maximises profits by

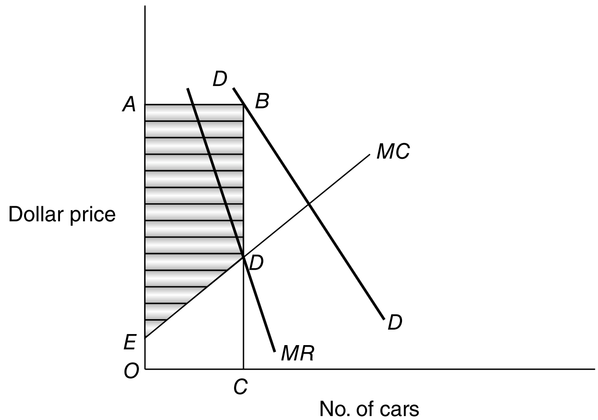

Fig. 14.4 An Exporter in an Oligopolistic Market

setting marginal cost (measured in dollars) equal to marginal revenue. The quantity exported is *OC*, at a dollar price *OA*. The exporter's (dollar) profits are the hatched area *ABDE*.

Now suppose, the inflation rate in the US is 5%, in the UK it is 8% and the sterling depreciates against the dollar by 5%, i.e. a real depreciation of sterling by 2%. Once again, the exporter must determine:

- How does this affect the demand for Rolls Royce cars in the US? A simple answer would be to assume that the entire demand curve shifts up by 5%, i.e. for every quantity, the American consumers are willing to pay a dollar price which is 5% higher than before. This would happen, if the domestic car manufacturers of competing cars face a cost increase of 5% and increase their prices by 5%, the rest of the firms follow suit and other competitive parameters remain unchanged.
- How do the exporter's costs change as a result of exchange depreciation and domestic inflation? Once again the answer depends upon the composition of costs and the behaviour of each component. In a situation where sourcing is from multiple sources, domestic and foreign, there is no alternative to a detailed analysis of the cost structure. Let us assume that 50% of the costs are dollar denominated and the rest are sterling denominated. Further, assume that the former go up in proportion to the US inflation, while the latter go up in proportion to the UK inflation. Under these conditions, marginal costs measured in dollars will be approximately 3.5% higher. Dollar denominated costs will increase, while the other component will increase in sterling terms by 8%, but in dollar terms by only about 3%. In Figure 14.5, we have assumed that marginal cost at each level of output is approximately 3.5% higher after depreciation.

In Figure 14.5, the situation before sterling depreciation is shown by dotted lines, while solid lines depict the post-depreciation equilibrium. *D*, *D*' denote the two demand curves while *MR* and *MR*' are the corresponding marginal revenue curves. *E* and *E*' are the two equilibrium points where marginal revenue equals marginal cost. The (dollar) profits of the British exporter before and after sterling depreciation are shown by areas $OEAP_0$ and $OE'BP_1$, respectively.

The exporter firm has benefitted from the real depreciation of its home currency. This would be generally true unless the costs rise faster than inflation, e.g. workers might be able to extract a substantial real wage increase which exceeds increase in labour productivity or the price of an input which accounts for a large chunk of the total cost might rise faster than inflation.

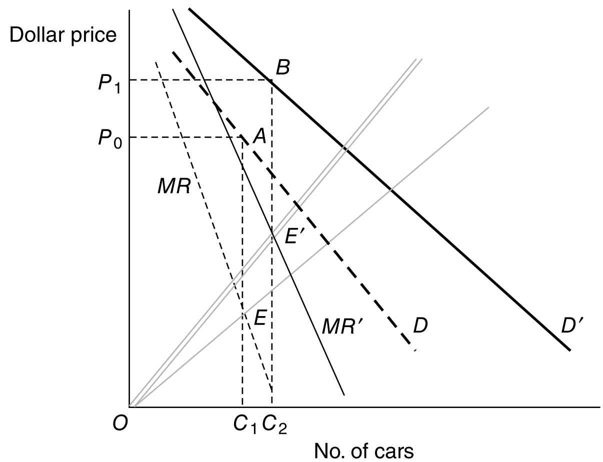

Fig. 14.5 An Exporter in an Oligopolistic Market Effect of a Real Depreciation

Thus, imagine a British airline which flies American tourists for European vacations. With the same inflation rates and exchange rates as in this example, it might be worse off, if prices of jet fuel which are denominated in dollars rise by say 20%.

14.7 AN IMPORTER FIRM

Consider now the case of a firm which is engaged in the business of importing a product from abroad and selling it in the domestic market. It faces competition from domestic producers of import substitutes. Further, assume that as a buyer in the international market it is a price taker, i.e. it can import any quantity at a given price in foreign currency. As a concrete example, imagine an Indian firm which imports floppy diskettes from Japan and sells them in the domestic market. The current landed cost of the diskettes is ¥500 per box of ten. The exchange rate is INR/JPY= 2.50. Over the following year, Japanese prices increase by 3%, Indian price level goes up by 10% and the yen appreciates by 5% to 2.375. Figure 14.6 shows the importer's situation before and after the changes.

The importer's costs will increase by 8% since Japanese prices have increased by 3% and the rupee has depreciated by 5%. In Figure 14.6, we have assumed that the demand curve for the imported diskettes shifts up by 10%, the inflation rate in India. The importer's profits measured in rupees are given by the area *ABEF* before the changes and area *A'B'E'F'* after the real appreciation of the rupee. In the appendix, we provide a formal proof that an importer's profits increase after a real appreciation of the home currency.

Analysis in terms of the foreign currency is straightforward. The demand curve in terms of yen will shift up by 5% (10% Indian inflation minus 5% rupee depreciation) while costs in terms of yen will increase by 3%. Once again importer's profits will increase.

Conversely, a real depreciation of the home currency will reduce importer's profits measured in either currency.

The case of a firm which imports raw materials and components for further processing at home and sells the output in the home market is more difficult. The effect of a real depreciation on profit depends upon the share of imported inputs in total costs, the elasticity of demand and the behaviour of other costs. The simplest case is shown in Figure 14.7 where we have assumed away inflation at

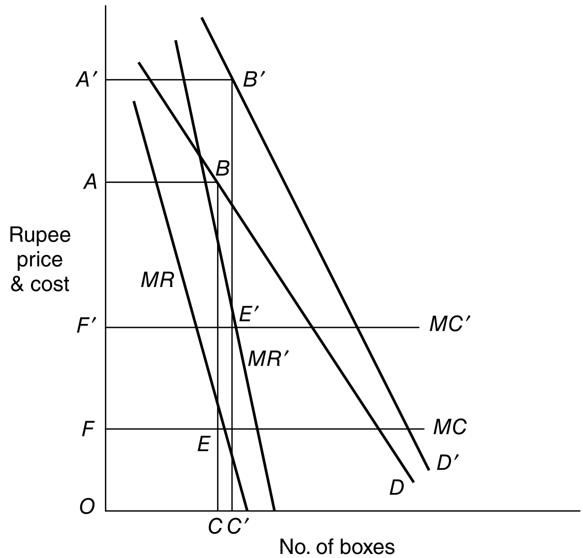

Fig. 14.6 Effect of a Real Appreciation on an Importer

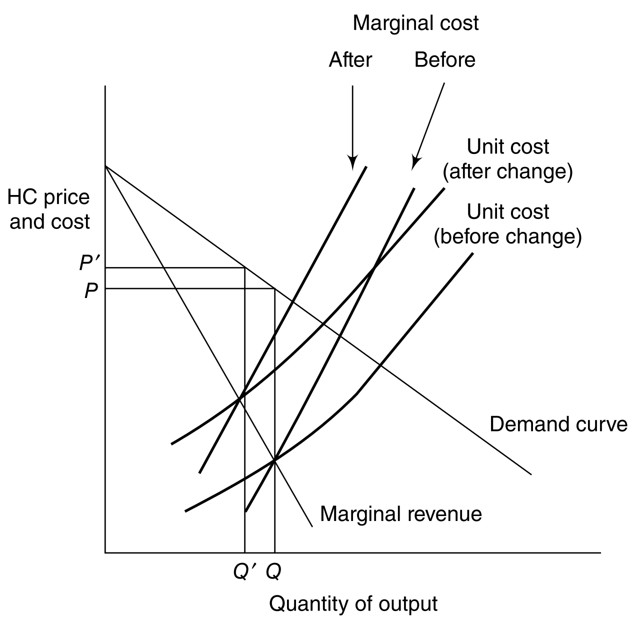

Fig. 14.7 A Producer with Imported Raw Materials

home and abroad and considered only the effect of a home currency depreciation on costs. As the producer's costs increase, the price has to be increased which leads to a reduction in the revenue measured in the home currency as the output declines proportionately more than price increase. Whether profits decline or not cannot be determined a *priori*.

14.8 CURRENCY OF INVOICING, QUANTITY INERTIA AND OPERATING EXPOSURE

In our analysis so far, we have assumed that prices and quantities respond instantaneously to changes in exchange rates. In practice, a substantial amount of trade involves contractual arrangements between the exporter and the importer wherein both the quantities supplied and prices – in either party's currency – are fixed for sometime. In addition, even in the absence of contracts, while prices respond to exchange rate changes rather quickly, quantity response to price changes is likely to be considerably slower.

Consider the case of an Indian exporter who has entered into a one-year contract to supply a fixed quantity of leather jackets per month to a French importer, at a fixed rupee price per unit. This means that on the revenue side, operating exposure has been totally eliminated. On the cost side, however, exposure continues. When rupee depreciates in real terms, rupee revenues remain fixed while rupee costs may rise because of imported inputs, wage increases as well as general inflation. Such an exporter is adversely affected by a real depreciation of the rupee[5]. By the same logic, an importer may temporarily gain from a depreciation of the home currency. What if the price had been negotiated in euros instead of the rupee? Now there is transactions exposure on the revenue side. A depreciation of the rupee will increase rupee revenues by the full extent of depreciation[6] while costs may not go up to the same extent. In terms of euro, revenue is now fixed whereas costs are not. Despite rupee depreciation, costs in terms of euro can increase, e.g. suppose the European inflation is at 5%, Indian inflation at 15% and the rupee depreciates 12% p.a. If all costs are rupee costs and they keep pace with home inflation, they will increase by 3% in terms of euro[7].

Look at the situation from the French importer's point of view. Invoicing in rupees means there is uncertainty both on cost and revenue side. If rupee appreciates, the importer must pay a larger amount of euros. However, unless the French firm faces stiff competition from domestic producers, it will be able to increase its selling price in proportion to the rupee appreciation without any significant loss of sales[8]. The firm faces transactions exposure on the cost side (which can be covered) and operating exposure on the revenue side. If it agrees to be invoiced in euro and the rupee appreciates, it will be better off, but if rupee depreciates, it will suffer particularly when other competitors also import from India and have agreed to be invoiced in rupees. On balance, it should prefer to be invoiced in rupees. Our analysis of the Indian exporter indicates that if India is prone to very high rates of domestic inflation, the exporter would prefer to invoice in euro.

Choice of invoicing currency has other dimensions. If the importer does not have easy access to forward markets or if bid-ask spreads in forward markets are very large, an exporter insisting on invoicing in his own currency will face a competitive disadvantage when other exporters (from the same or another country) are willing to accommodate the importer by invoicing in the latter's currency. In Chapter 12, we mentioned certain empirical regularities in invoicing patterns in international trade found by Grassman. Bilson (1983) provides a theoretical explanation of these patterns and their implications for the relation between the current account and the exchange rate.

We will conclude this section with a simple numerical example of effects of contracting and invoicing on an exporter's profits.

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[5] This effect is similar to the J-curve effect on the current account of balance of payments.

[6] Of course the exporter can remove this uncertainty by selling the anticipated French franc inflows in the forward market.

[7] If there are some inputs imported from France and whose franc prices are not contractually fixed, the exporter's net foreign exchange earnings may suffer if their prices increase with French inflation.

[8] This of course depends upon the price elasticity of demand for jackets by French consumers.

- An Indian jewellery exporter has entered into an agreement with an Australian buyer to supply 50 necklaces per month over the next year. The Australian party has agreed to be invoiced in rupees at ₹50,000 per necklace. At the time of initiating the agreement the AUD/INR exchange rate was 50.00. The Indian firm estimates that it will need to import raw gemstones worth AUD 500 per necklace from Australia and other operating costs would be ₹5,000 per unit. Soon after the contract is signed, the rupee depreciates to ₹54.00 per AUD.

  By invoicing in rupees, the exporter has removed exposure from the revenue side. On the cost side, there is transactions exposure of AUD 25,000 per month. At the time of contracting, the expected annual profit is:

  $$₹\{(50,000 \times 50 \times 12) - [5,000 + (500 \times 50)](50 \times 12)\}$$
  $$= ₹12,000,000$$

  As a result of devaluation the actual profit will be

  $$₹[30,000,000 - 19,200,000] = ₹10,800,000$$

  When the first contract ends, the exporter is subject to operating exposure. He renegotiates the price at ₹53,250. In AUD, this translates to AUD 986. At this price, the Australian buyer is willing to take 55 pieces per month[9]. In the meanwhile, the AUD cost of the gem stones has gone up by 5% to AUD 525, and other operating costs have gone up by 10% to ₹5,500 per unit. The exporter's profits are now expected to be

  $$₹\{(53,250 \times 55 \times 12) - [(525 \times 54) + 5,500](55 \times 12)\}$$
  $$= ₹12,800,000$$

  In inflation adjusted terms, profits have declined despite a real depreciation of the rupee. You can convince yourself that if the exporter had raised the price such that in AUD terms, it had kept pace with Australian inflation, the firm's rupee turnover would have declined[10] but its operating profit measured in rupees would have increased in real terms compared to the pre-devaluation situation.

14.9 COPING WITH OPERATING EXPOSURE

We saw in the last chapter that a variety of external and internal devices are available to a firm to hedge its transactions exposure. When it comes to operating exposure, none of these instruments are of much use in reducing it[11]. Forward and futures contracts, options and money market cover can protect a firm from nominal exchange rate effects on contractually fixed foreign currency assets, liabilities and cash flows. As we have seen above, to the extent the firm can correctly identify and estimate its operating exposure to exchange rates, it can in principle use forward contracts to hedge. The difficulty as we have seen above is in identifying and estimating the relevant exposure parameters. Also, operating exposure covers a much longer horizon that contractual transactions exposures; long-maturity forward contracts are not easily available even in major currencies.

[9]This implies a price elasticity of demand of –7.14.

[10]So would its gross and net foreign exchange earning.

[11]In fact in trying to hedge an apparent operating exposure, the firm might create an exposure where none existed. Consider a firm which sells colour TV picture tubes imported from Japan in India. Its competitors also import from Japan and sell in the Indian market. When rupee depreciates, the firm's rupee costs will increase, but so will its price given the nature of competition. If it tries to hedge for instance by local rupee borrowing, it will create a new exposure.

Given these difficulties in using financial hedges, operating exposure must be managed by altering the firm's operations – pricing, choice of markets, sourcing, location of production, etc.[12]. This requires considerable flexibility in these areas. Not all businesses may permit such flexibility in the sense that costs associated with shifting location of production facilities, changing sourcing, etc., may be quite high. We briefly discuss below how each of the above functional groups might contribute to reduction of operating exposure[13].

- As we have seen above, operating exposure depends upon price elasticity of demand. In the area of marketing, improved knowledge of customers' price sensitivity, competitive reaction to price change, effect of non-price variables on sales, etc. are of great importance. The firm can reduce the adverse effects of exchange rate changes on its revenue by moving into product lines for which the price elasticity of demand is lower and by countering the effect of increased prices by means of other competitive weapons such as local advertising and promotion. Note that shifting product-market combinations is a long-term strategic decision. It may involve adoption of new technologies as well as changes in input sourcing.
- If inputs are purchased in markets where the local content in their costs is high, exchange rate changes will significantly alter the relative costs of sourcing from alternative sources. When the input markets are global in scope, e.g. crude petroleum and petroleum products, sourcing decisions are relatively less important. In some cases, use of commodity options and futures may enable the firm to hedge commodity price risk[14].
- Shifting the location of production to countries whose currencies have depreciated in real terms can reduce the adverse impact of exchange rate changes, provided production costs in different locations have a large local content (e.g. labour) and economies of scale are relatively less important.

Frequent shifts in product-market combination, sourcing and location of production facilities imply changing currency composition of costs and revenues. This will call for a more quick-footed response from the treasury in terms of short-term management of funds and borrowings.

A number of authors have suggested that currency matching of inputs and outputs will enable the firm to reduce its operating exposure, i.e. reduce the variance of its profits. For instance, Pringle and Connolly (1993) argue that

> "Economic exposure results most directly in cases of direct exposure in which there is an imbalance in revenue and cost streams with respect to currency – that is when the revenue and cost 'currency footprints' do not match...There are basically two possible ways to hedge economic exposure: operational hedges and financial hedges. An example of an operational hedge is a change in sourcing to better match revenue and cost currency footprints".

An article which appeared in the Wall Street Journal[15] some years ago reports that a number of multinational giants such as Toyota, Honda, BMW, GM and IBM manage their currency exposure by attempting to match currency footprints which involves locating production abroad or sourcing

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[12]It has been argued that the drive for globalisation can at least in part be attributed to the desire of businesses to cope with exchange rate risk – specifically operating exposure – by diversifying the currency composition of their revenues and costs. See Logue (1995).

[13]See Flood (1986).

[14]For commodities such as crude oil, oil products, minerals and metals where the markets are global and prices are denominated in one of the major convertible currencies, both suppliers and users can reduce price risk with the use of these instruments.

[15]"Business Risk: As US Firms Gain on Rivals the Dollar Raises Pesky Questions", ***Wall Street Journal,*** August 16, 1996, page 1.

in countries where they sell their products. Logue (1995) has argued that one of the reasons for the globalisation of production and sourcing may in fact be the desire on the part of MNCs to match the currencies of revenues and costs.

This recommendation needs to be analysed carefully. While reducing the variability of profits is certainly one of the goals, it must be remembered that often it can conflict with the competing goal of increasing expected profits – the ubiquitous risk-return tradeoff. Harris, Melumad and Shibano (1996) demonstrate that when output markets are not perfectly competitive, the strategy of currency matching of costs and revenues might result in smaller expected profits though it will reduce the variance of profits. By sourcing inputs in the market where output is sold, the firm loses strategic flexibility – the possibility of gaining market share at the expense of a rival by altering prices as exchange rates change. Sourcing and location decisions have to be made well before the firm knows what exchange rate is eventually going to materialise; further these decisions cannot be easily and quickly reversed. Under these circumstances, currency matching may not always be the best response to exchange rate fluctuations.

14.10 THE PRACTICE OF EXPOSURE MANAGEMENT

There have been a number of investigations of corporate currency exposure management practices. Important among these are Bodnar and Gentry (1993), Bodnar, Marston and Hayt (1998), Bodnar and Gebhardt (1999) and Loderer and Pichler (2000). Using and survey and secondary data, these studies investigate the reasons why corporations do or do not manage currency risk, the methods and instruments they use, whether they make any conscious effort to assess and quantify their currency risk profiles and whether there are any systematic relationships between firm characteristics such as size and risk management practices. While detailed findings vary, some broad patterns seem to be common across industries and countries. The key findings can be summarised as follows:

1. Very few corporations undertake an accurate, quantitative assessment of how unanticipated exchange rate changes impact on the value of their firm. Even firms which are aware of the serious impact currency risk can have on the valuation of their stock have at best a qualitative understanding of currency exposure – whether a depreciation of their home currency will improve or adversely affect their value.
2. Most firms find it very difficult to gauge the long-term exposure of their businesses to currency fluctuations.
3. Relatively more but still a minority of the firms have some reliable quantitative understanding of the exposure of their operating cash flows to currency fluctuations.
4. A surprisingly large number of firms appear to think that they are not exposed to currency risk or that the risk is trivial. Most firms do not seem to be aware of the fact that indirect exposure can sometimes be quite significant.
5. Even among firms which engage in systematic assessment of their currency risk profile and conscious currency risk management, the focus is almost exclusively on short-term transactions exposures extending up to a year. Here too, firms do not appear to take an aggregate view of exposures preferring to deal with them individually.
6. Long-term operating exposures are dealt with by "on-balance sheet" operating mechanisms. Among such structural defence mechanisms are:
   (i) Setting up plants and sourcing of inputs in different currency areas
   (ii) Have foreign subsidiaries borrow in local currencies

(iii) Employee wages indexed to the exchange rate
(iv) Redesign or upgrade products to cater to more price-inelastic market segments

Firms also react to exchange rate changes after-the-fact by revising pricing policies.

There have been some recent studies regarding currency exposure management practices of Indian companies. The findings are similar to those reported above. A little over half of the firms included in surveys have active currency management policy. Most of them tend to focus on short-term transactions exposure. Also, most of the firms confine their risk management activity to forward contracts.

Thus, the practice of currency risk management, particularly long-term exposure, is much less precise and sophisticated than what the development of the theory would suggest even among the large firms in advanced countries.

Summary

This chapter deals with measurement and management of operating exposure. Unlike transactions and translation exposure, operating exposure is more difficult to measure and manage but has much deeper and long-term impact on the fortunes of a firm. To assess operating exposure accurately, a firm needs to know a great deal about its product and input markets, competitive response, its customers and its cost structure. A cash flow at risk kind of framework needs to be constructed which incorporates the firm's business model which can help simulate alternative scenarios of the key risk factors.

Virtually no financial hedges are available to mitigate operating exposure. It has to be managed by changing the structure of operations including product-market combinations, sources of inputs and even location of production facilities. While matching the currency composition of revenues and operating costs does offer some protection, it may not be the best defensive strategy.

Questions and Problems

1. Which of the following can expect to increase sales volume by lowering foreign currency prices after a rupee depreciation?
   (a) An exporter of tea to US and UK
   (b) An exporter of leather goods to Europe
   (c) An exporter of jewellery to Europe
   (d) An exporter of auto parts to US

2. Real exchange rate changes are measured by adjusting nomial exchange rate changes by inflation differentials, the latter in turn being measured by some price index such as WPI or CPI. It is said that a firm faces operating expsoure only if real exchange rates change. Is this strictly true? Why or why not?

3. Consider two Indian firms. One manufactures petrochemicals in India and sells them in global markets in competition with German, American and Japanese firms. The other manufactures and exports pickles and Indian spices to Europe and Middle East competing with other firms which either import these products from India or manufacture them in India and sell in the same markets. Which of these two firms faces the more severe operating exposure to exchange rates? Explain your answer.

4. Consider an exporter who sells in a foreign market. His annual demand curve in that market is given by

$$Q^d = 10{,}000 - 1.2P_f$$

where Q^d is the quantity demanded and P_f is the price in foreign currency. His marginal cost curve measured in home currency is given by

$$MC = 200 + 0.75Q$$

During the year, the foreign country faces an inflation rate of 5% and the home country 12%. The home currency depreciates by 5%. Compute the effect on the exporter's inflation adjusted profits.

5. Suppose the exporter in Problem 4 is in a market in which the producers have substantial excess capacity. Will your answer remain unchanged? Why or why not?

6. An importer buys Japanese TVs and sells them in India in competition with domestic TV makers. His annual demand curve is given by

$$Q^d = 1{,}612{,}000 - 50P_R$$

where Q^d is the quantity demanded and P_R is the rupee price. At present, he can import any number of TVs at a price of ¥36,000 and the exchange rate is ¥3.00 per rupee. Over the next year, Japanese prices increase by 3%, Indian price level by 10% and the rupee depreciates against the yen by 10%. What will be the effect on the importer's profit?

7. A devaluation increases prices of exports in home currency but decreases them in foreign currency. Why? Under what market conditions does this happen?

8. One importer imports copyrighted applications software and another imports watches. Which of these faces a greater degree of operating exposure? Why?

9. Can an exporter avoid operating expsoure by invoicing all his export sales in his home currency? Similarly can an importer avoid operating exposure by insisting on invoicing his purchases in his home currency?

10. A manufacturer of refrigerators imports certain key components from West Germany. The EUR value of these imports is EUR 200 per unit and his domestic costs are ₹8,000 per unit. The current EUR/INR rate is ₹42.00. He sells the finished fridge at ₹22,000. His main competitor imports components from US worth $180 and has identical domestic costs. The $/₹ rate is ₹48.50. The competitor sells his product at the same price. During the year, Indian price level rises by 10%, German price level by 3% and US price level by 5%. The EUR/INR rate depreciates to ₹44 and the $/₹ rate remains unchanged. The cross price elasticity between the two brands of refrigerators is 0.7. Assuming the competitor will maintain his price, what should our manufacturer do?

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Aside from these, also see the references for Chapter 3.

APPENDIX

A.14.1 AN ALGEBRAIC TREATMENT OF OPERATING EXPOSURE

In the text, we have discussed operating exposure of exporters and importers by examining the effect of exchange rate changes on their profits measured in domestic and foreign currencies. There we used numerical examples to illustrate the argument. Here we provide a more formal algebraic treatment of the same.

Exporter's Operating Exposure

Consider an exporter firm in the home country. We will assume that the demand for its product in the foreign country has a constant price elasticity $\eta^d > 1$. Further, its unit cost of production measured in the home currency, depends only on the exchange rate S, defined as units of the home currency per unit of the foreign currency. Specifically, unit cost increases as the home currency depreciates (S increases). This could be both due to the presence of imported inputs and any effect of depreciation on wages. Thus,

$$\text{Unit cost} = c(S) \qquad dc(S)/dS = c'(S) > 0$$

Define the elasticity of unit cost $c(S)$ with respect to S:

$$\eta_{cs} = [dc(S)/dS][S/c(S)] = c'(S)[S/c(S)]$$

We will examine the effect of changes in S on the exporter's revenue, costs and profit, all measured in the home currency, and price, measured in the foreign currency. Similar analysis with revenue, cost and profit measured in the foreign currency is left to the reader as an exercise.

The total revenue in home currency is given by

$$TR = SP_f Q \tag{A.14.1}$$

where, P_f denotes the price, in foreign currency, charged to the foreign buyers and Q is the physical volume of exports per period. The total cost, again measured in home currency is

$$TC = c(S)Q \tag{A.14.2}$$

A profit maximising exporter should set the price such that marginal revenue (MR) equals marginal cost (MC):

$$MR = d(TR)/dQ = SP_f + SQ(dP_f/dQ) = SP_f[1 + (Q/P_f)(dP_f/dQ)]$$

However, since the price elasticity of demand η^d is

$$\eta^d = -(dP_f/dQ)(Q/P_f)$$

$$MR = SP_f[1 - (1/\eta^d)] \tag{A.14.3}$$

Marginal cost is given by

$$MC = d(TC)/dQ = c(S) \tag{A.14.4}$$

Equating MR to MC, we have

$$P_f = \frac{c(S)}{S\left(1 - \dfrac{1}{\eta^d}\right)} \tag{A.14.5}$$

Now consider a change in S, or more specifically a depreciation of the home currency. How should the exporter adjust his profit-maximising price? The answer is found by differentiating P_f with respect to S:

$$\frac{dP_f}{dS} = \frac{1}{1 - \dfrac{1}{\eta^d}} \frac{d}{dS}\left(\frac{c(S)}{S}\right) \tag{A.14.6}$$

Using the quotient rule for differentiation and the definition of η_{cs}, the elasticity of unit cost with respect to the exchange rate, we have:

$$\frac{dP_f}{dS} = \frac{c(S)}{S^2\left(1 - \dfrac{1}{\eta^d}\right)}(h_{cs} - 1) = \frac{P_f}{S}(h_{cs} - 1) \tag{A.14.7}$$

This implies that whether the exporter should reduce or increase his foreign currency price in response to a depreciation of his home currency depends upon how sensitive his unit costs are to exchange rate changes:

If $\eta_{cs} < 1$ then $(dP_f/dS) < 0 \rightarrow$ price should be reduced

If $\eta_{cs} > 1$ then $(dP_f/dS) > 0 \rightarrow$ price should be increased

If $\eta_{cs} = 1$ then $(dP_f/dS) = 0 \rightarrow$ price should be left unchanged[16]

[16]Note that if the unit cost is constant, i.e. $\eta_{cs} = 0$, then we get

$$(dP_f/dS) = -(P_f/S)$$

This implies that price should be reduced in proportion to the depreciation of the home currency.

Thus, suppose dollar appreciates from ₹50 to ₹55, i.e. S increases by 10. If an Indian exporter's unit cost rises by less than 10%, dollar price of the exported product should be reduced. If the unit cost rises by more than 10%, the price should be raised and if it rises by 10%, the dollar price of the exported product should be left unchanged.

Obviously, the response of the unit cost to exchange rate changes depends upon the input structure and how labour and capital costs respond to exchange rate changes. For instance, the unit cost of a textile exporter may not respond significantly to rupee-dollar exchange rate, while the unit cost of a jewellery exporter may be very sensitive to exchange rate.

Let us now examine the effects on revenue, costs and profits all denominated in home currency.

$$\frac{d(TR)}{dS} = SQ\frac{dP_f}{dS} + SP_f\frac{dQ}{dP_f}\frac{dP_f}{dS} + P_fQ \tag{A.14.8}$$

Substitute for (dP_f/dS) from (A.14.7) and use the definitions of η_{cs} and η^d to get:

$$\frac{d(TR)}{dS} = P_fQ[1 + (\eta_{cs} - 1)(1 - \eta^d)] \tag{A.14.9}$$

which simplifies to:

$$\frac{d(TR)}{dS} = P_fQ[\eta_{cs} + \eta^d - \eta_{cs}h^d] \tag{A.14.10}$$

Thus, whether the exporter's revenue will increase or decrease depends upon whether

$$\eta_{cs} + \eta^d > \eta_{cs}\eta^d \text{ or } \eta_{cs} + \eta^d < \eta_{cs}\eta^d$$

What is the economic significance of this condition? First consider the case when $\eta_{cs} < 1$. In this case it is easy to see that the first of these inequalities will hold and exporter's revenue will increase in response to a depreciation[17]. We have seen from above that when elasticity of the unit cost with respect to the exchange rate is smaller than unity, the exporter should reduce foreign currency price, which, with price-elastic demand, will increase revenue in foreign currency and, since S has increased, also in the home currency. The other case is when $\eta_{cs} > 1$. Here, there are two conflicting influences at work. On the one hand, as seen above, the exporter should increase foreign currency price P_f. With elastic demand, this will reduce revenue measured in foreign currency; but since S has increased, the revenue measured in home currency may still increase. Whether it will or not depends upon the relative magnitudes of price elasticity of foreigners' demand η^d, and exchange rate elasticity of the exporter's unit cost η_{cs}. For a given value of η_{cs}, smaller the value of η^d (within the restriction that it be greater than unity), greater is the possibility that revenue will increase[18]. This again makes sense. Smaller the price elasticity, smaller is the loss of foreign currency revenue when foreign currency price is raised. The exchange rate effect will dominate. An exporter whose unit costs are very sensitive to exchange rate, will suffer a loss of revenue, if the foreign demand for his product is highly price elastic; such an exporter would be well advised to try and acquire a market position where his demand is not so price sensitive.

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[17]Recall that by assumption, $\eta^d > 1$ and $\eta_{cs} > 0$.

[18]The required condition is

$$[\eta^d/(\eta^d - 1)] > \eta_{cs}$$

For a given value of η_{cs}, there is critical value of η^d below which the condition will be satisfied.

Proceeding now to total cost,

$$\frac{d(TC)}{dS} = Q\frac{dc(S)}{dS} + c(S)\frac{dQ}{dP_f}\frac{dP_f}{dS} \tag{A.14.11}$$

Once again, substituting for (dP_f/dS) and using the definitions of the two elasticities,

$$\frac{d(TC)}{dS} = \frac{Qc(S)}{S}[\eta_{cs} + \eta^d - \eta_{cs}\eta^d] \tag{A.14.12}$$

Exporter's total costs measured in the home currency will increase or decrease again according to whether

$$\eta_{cs} + \eta^d > \eta_{cs}\eta^d \qquad \text{or} \qquad \eta_{cs} + \eta^d < \eta_{cs}\eta^d$$

The explanation again is straightforward. When the exchange rate depreciates, the unit cost increases; what happens to the total cost depends upon changes in export quantity. We know that when $\eta_{cs} < 1$, price is reduced and physical volume of exports increases. Total cost will increase. The first of the above inequalities holds. When $\eta_{cs} > 1$, the price is increased and volume is reduced. Whether the unit cost effect will dominate the volume effect cannot be determined a priori. As seen above, in the case of revenue, smaller the price elasticity of demand, smaller will be the quantity effect and total costs will increase; if the demand elasticity is large, the volume effect will dominate and total costs will decrease.

Finally, let us examine what happens to exporter's profit measured in home currency. Denote the difference $(TR - TC)$ by π.

$$(d\pi/dS) = [d(TR)/dS] - [d(TC)/dS]$$

$$\frac{d\pi}{dS} = \left[PfQ - \frac{Qc(S)}{S}\right][\eta^d + \eta_{cs} - \eta_{cs}\eta^d] \tag{A.14.13}$$

The last equation is obtained using (A.14.10) and (A.14.12).

Thus, starting from a situation in which the exporter was making profit, a depreciation will improve operating profits if $\eta_{cs} + \eta^d > \eta_{cs}\eta^d$. Otherwise profits will decrease. The interpretation is analogous to the one for the behaviour of revenue and costs.

A similar analysis can be carried out for revenue, cost and profit measured in foreign currency. We leave it to the reader.

Importer's Exposure

We will now analyse the effects of an exchange rate appreciation on an importer's revenue, costs and profits, all denominated in foreign currency. We again assume that the importer sells the imported product in the domestic market and faces a constant elasticity demand curve with price elasticity of demand η^d larger than unity. Further we will assume that his unit cost of imports, measured in foreign currency, is constant. His total revenue and costs measured in foreign currency are given by:

$$TR = (P_d/S)Q \qquad \text{and} \qquad TC = c_fQ$$

where P_d is the domestic currency price, he charges to his customers and c_f is his fixed foreign currency unit cost.

The usual profit maximising condition MR = MC yields:

$$Pd = \frac{S_{cf}}{1 - \dfrac{1}{\eta^d}} \tag{A.14.14}$$

Consider now the effect of a change in the exchange rate. It is easy to see that

$$\frac{dPd}{dS} = \frac{cf}{1 - \dfrac{1}{\eta^d}} = \frac{Pd}{S} \tag{A.14.15}$$

This says that with constant unit import cost, the importer should change the price in proportion to the exchange rate change. If home currency appreciates (S decreases), say by 5%, the domestic price of imported good should be reduced by 5%.

The change in the revenue denominated in foreign currency is given by:

$$\frac{d(TR)}{dS} = -\frac{P_d Q}{S^2} + \frac{Q}{S}\frac{dP_d}{dS} + \frac{P_d}{S}\frac{dQ}{dP_d}\frac{dP_d}{dS} \tag{A.14.16}$$

Substituting for (dP_d/dS) from (A.14.15),

$$\frac{d(TR)}{dS} = -\frac{\eta^d P_d Q}{S^2} \tag{A.14.17}$$

This shows that an appreciation of the home currency will unambiguously raise the importer's revenue measured in foreign currency.

Coming to the costs, it is easily seen that

$$\frac{d(TC)}{dS} = -\frac{\eta^d C_f Q}{S} \tag{A.14.18}$$

This means that with an appreciation, the importer's foreign currency total costs will increase. This must be so since we know that he will reduce the home currency price which will increase the volume of imports and the unit cost is fixed.

Finally, coming to importer's profits,

$$\frac{d\pi}{dS} = \frac{d(TR)}{dS} - \frac{d(TC)}{dS} = -\frac{Q\eta^d}{S}\left(\frac{Pd}{S} - C_f\right) \tag{A.14.19}$$

This tells us that starting from a situation wherein the importer was making a profit, an appreciation increases his profit measured in foreign currency.

Analysis in the home currency terms is left to the reader. Also, the reader can work out the effects of an appreciation on an exporter and a depreciation on an importer. The latter results are implicit in our derivations above.

Note that we have not explicitly taken into account inflation either at home or abroad. The interdependence between inflation and exchange rate changes warrants a full general equilibrium approach.

Case Study

You are the chief financial officer of a leading dental hospital located in India. Your hospital has been having a roaring practice. You have a large group of dedicated doctors and a wide range of patients traveling from all over the region. Your hospital is known for its professional perfection and value-for-money services.

Of late the hospital has started offering services to relatively well off customers under 'cosmetic dentistry'. The opening of this market segment has helped the hospital to reduce per patient charges for patients of 'essential dentistry'. The hospital is also planning to start 'mobile dental clinics' to cover rural areas, in line with its motto 'Oral Hygiene for All'.

While the Ministry of Public Health and Social Welfare is supporting the second initiative, the Ministry of Tourism and Hospitality is supporting the previous initiative along the lines of 'Smile India' campaign. This has helped India in becoming a preferred destination for the emerging market for 'health tourism'. A majority of customers of cosmetic treatment are from Europe and the US of A. Recent interest of some of the corporate clients from Australia and some pop-divas has given your hospital practically free media coverage.

Expectedly, this success is not an unmitigated blessing. Competition in the region is coming from a Chinese dental hospital. They are offering 'tooth' transplant with the help of a Korean firm. This firm has staked a claim that they have the technology to organically grow a tooth with the help of root-canal cells taken from a patient. This is a time-consuming and costly process and requires a longer stay in China and frequent visits to Korea, but patients do not seem to mind—since they are assured of an 'organically' grown tooth.

There is another competitor coming up in Belgium. They have a different technology. It is neither 'organic' nor as good as Indian, but highly cost effective since they fix an artificial tooth in a metallic socket, which can be removed and refitted without much effort.

However, in last few months, the dedicated lot of dentists with your hospital are also reading the media reports and there is growing feeling among them that the hospital is increasingly straying away from its path of 'oral hygiene for all'. Some of the younger dentists have, on more than one occasion voiced their demand for higher compensation. Recently, a group of experienced dentists have taken up visiting positions with the Belgian hospital for a few weeks in a year. Now, the dentists want a pay hike and that wages to be paid in USD, not in INR as was the practice so far.

Your CEO has asked you to see her with the possible scenario analysis in a month from now.

You have gone through all your cost sheets. You know that the costliest element is the special grade dental cement, which is to be imported in packs of 1000 gm each costing over INR 1,000,000. Each tooth requires about 2 gm of this secial grade cement. Adding other facilities and services, it costs INR 3000 per tooth for each 'cosmetic' treatment. Your charges are in the range of USD 200 which is very competitive in the international market. However, the Chinese-Korean combine is offering 'organic' tooth at USD 600 per tooth, all inclusive. The Belgian experiment is at about USD 30 per tooth, but has a shorter useful life.

When you look at your cash inflow you find that your earnings are in all possible currencies of the world but your costs are tied with USD and INR. The cover story of *The Economist* indicates possibility of USD appreciating against INR and other major currencies on account of successful resolution of the Iraq situation and peaceful resolution of the Iran crisis, leading to the softening of world oil market prices. Though you are not a dentist by profession, you have a tooth in every possible profession! You have suggested to the chief dentist to explore the possibility of using heavy metal/precious metal with ceramic composite. You heard about this kind of material in your previous job while dealing with the Japanese Satellite Agency. The chief dentist was not very happy but promised to explore the possibility. You want to get into this material because there are commodity futures available on heavy/precious metals, while there is no way to cover 'special grade cement'.

With this information on hand, you want to approach the Ministry of Public Health and Social Welfare and the Ministry of Tourism and Hospitality with a request to absorb price variation due to strengthening dollar. You have also approached RBI to grant permission to trade in futures in all the currencies in the world, but there are problems.

Question: How will you guide your CEO in this situation?

Chapter 15

Management of Interest Rate Exposure—FRAs, Interest Rate Caps and Floors

15.1 INTRODUCTION

So far we have been dealing with exposures arising out of exchange rate volatility. For many companies which borrow and invest in the international money and capital markets, interest rate uncertainty poses an equally worrisome problem. During the eighties, investor preferences have increasingly shifted towards floating rate assets as interest rate volatility increased in all markets. Also, fixed rate lenders place a greater premium on credit rating than floating rate lenders so that a firm which does not enjoy top rating finds it more expensive to raise funds in the fixed rate markets than on a floating rate basis. Thus, borrowing costs become uncertain. For firms undertaking long gestation projects, this means they cannot be certain about their cost of capital and hence, financial viability of the projects being appraised. From an investor's point of view, interest rate uncertainty means that the rates might move down before the investor has the cash ready to invest. For fund managers, interest rate uncertainty implies uncertainty regarding the terminal value of their portfolios.

Figures 15.1 to 15.4 present the trends in short-term interest rates in the three major currencies, viz. USD, EUR and JPY. There has been significant increase in interest rate volatility. As the Indian financial markets get liberalised, interest rate risk will become a matter of concern even for domestic firms and financial institutions.

We will begin this chapter with a brief discussion of the nature and measurement of interest rate exposure. We will then go on to an examination of some of the products available to hedge interest rate risk.

In Chapter 9, we took a brief look at the use of interest rate futures as a device to hedge interest rate exposure. In this chapter, we will examine the nature and applications of forward rate agreements (FRAs), interest rate caps, floors and collars for the same purpose. Another product, viz. interest rate swaps will be dealt with in the next chapter.

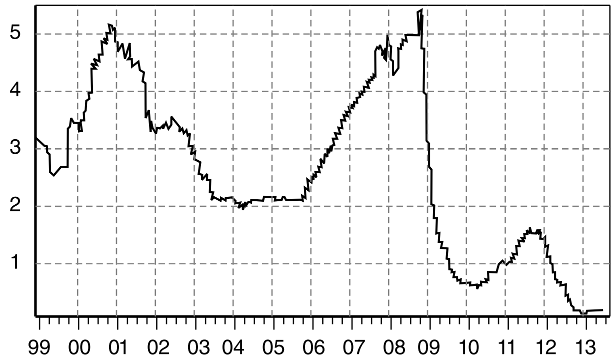

Fig. 15.1 LIBOR 3-Month EUR 2 January 1999–25 June 2013

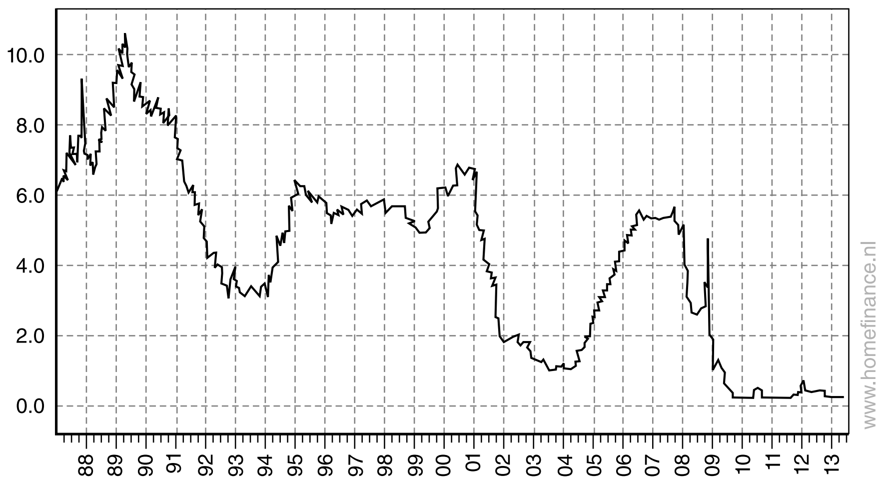

Fig. 15.2 LIBOR 3-Month USD from 01-02-1087 up to 06-25-2013

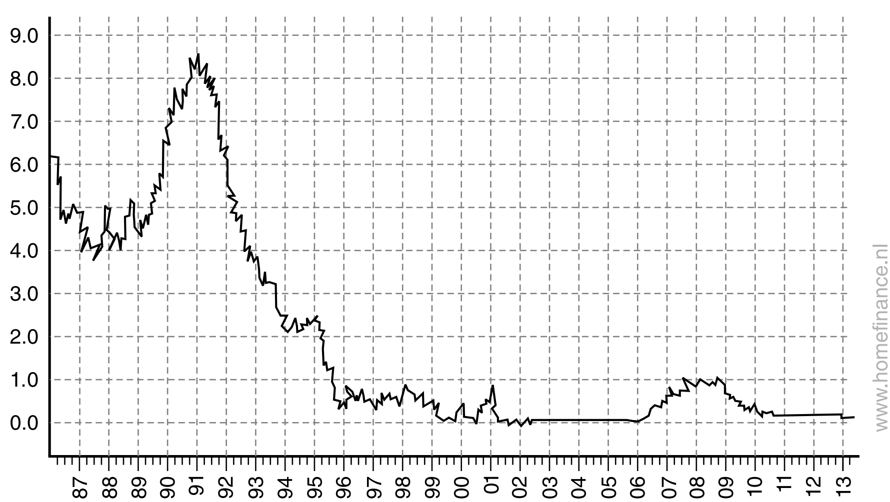

Fig. 15.3 LIBOR 3-Month JPY from 01-02-1086 up to 06-25-2013

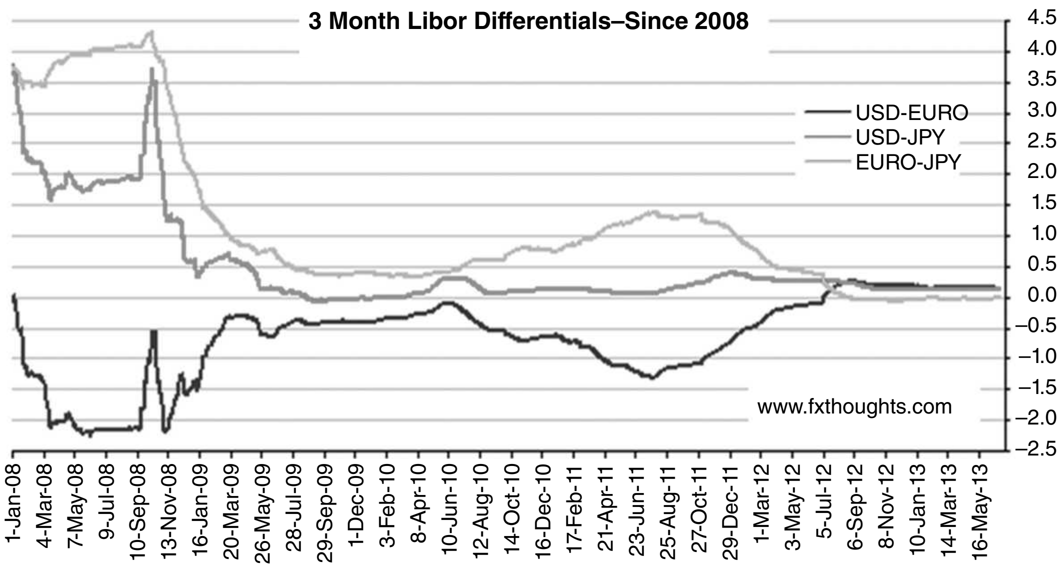

Fig. 15.4 USD-EURO, USD-JPY, EURO-JPY 3-Month Libor Differential

15.2 THE NATURE AND MEASUREMENT OF INTEREST RATE EXPOSURE

Fluctuations in interest rate affect a firm's cash flows by affecting interest income on financial assets and interest expenses on liabilities and consequently their market value. For a non-financial firm, fluctuations in interest rates cause corresponding fluctuations in operating earnings and rates of return on projects.

Effective assessment and management of interest rate exposure requires first of all a clear statement of the firm's risk objectives. The finance manager must then translate these into operational guidelines for monitoring key parameters which will reveal the firm's total exposure. Leach (1988) has suggested a classification into primary and secondary objectives as follows:

- Primary Objectives:
  1. Net interest income, i.e. interest income on assets minus interest expense on liabilities. Monitoring of this account will reveal the sensitivity of the firm's profitability to changes in interest rates.
  2. Net equity exposure, i.e. sensitivity of the firm's net worth to interest rates.

The first of these is more suitable for a non-financial corporation with relatively few financial assets as the latter measure requires estimating the changes in values of non-financial assets as interest rates change. The second measure is more suitable for a financial institution with predominantly financial assets and liabilities.

- Secondary Objectives:
  1. Credit exposure which is really a measure of default risk. Most firms would wish to limit their exposure to any one individual or firm.

2. Basis risk arises when interest rate exposure on one instrument, e.g. commercial paper is offset with another instrument, e.g. eurodollar futures or when floating rate assets tied to one index, e.g. T-bill rate are funded by floating rate liabilities tied to another index, e.g. LIBOR or MIBOR.
3. Liquidity risk pertains to timing mismatches between cash inflows and outflows, e.g. when a longer duration asset is funded by a shorter duration liability which will have to be refunded at maturity possibly at a higher cost[1]. This is known as "gap risk".

The measure of exposure selected must incorporate these objectives.

The most often used device to assess interest rate exposure is Gap Analysis. It focuses mainly on the liquidity risk. The entire planning horizon is divided into sub-periods. For each sub-period, the difference between the assets and liabilities which mature or are re-priced during that interval is designated as the "gap". If the gap is positive, there will be a net cash surplus, while if it is negative, there will be a deficit. For instance, suppose a bank has financed a one-year money market investment with a nine-month loan, during the interval 9-12 months there is a negative gap – the asset will have to be refunded by a three-month borrowing. The main drawback of this approach is that it ignores the effects of changing interest rates on values of assets and liabilities[2] and focuses exclusively on timing mismatches.

A more sophisticated approach uses the concept of duration discussed in detail in Appendix A. Roughly speaking, it measures the "average life" of the cash flows associated with an interest-bearing asset. Duration of an interest bearing security measures the sensitivity of its market value to changes in the interest rate. Another interpretation brings out the tradeoff between reinvestment and the market value. Consider a coupon bond. An increase in interest rate reduces the market price of the bond, but allows the coupon payments to be reinvested at a higher rate of return. Duration can be interpreted as the period over which these two effects balance each other.

Since durations are additive, the duration of a portfolio is simply the weighted sum of the duration of components of the portfolio. A firm with a portfolio of financial assets and liabilities can minimise interest rate exposure by equating as nearly as possible the duration of its assets and liabilities.

The important point to note is that the duration of a security is not constant but changes as yields change[3]. The portfolios of assets and liabilities need to be periodically reshuffled to maintain value neutrality.

The decision as to whether or not a firm should hedge interest rate exposure involves pretty much the same considerations as in the case of currency exposure. It is important to remember that hedging is a conscious policy decision which can, ex-post, turn out to be "wrong".

In the sections to follow, we will discuss a number of products which can be used to reduce or eliminate interest rate risk and to take views on interest rates to profit from perceived mispricing by the market.

[1]For a non-financial firm, an analogous situation would be when a fixed asset is financed by borrowing on a floating rate basis.

[2]For instance, suppose a firm holds a zero-coupon bond and a coupon bond both with seven years to maturity. There is no "gap" but a change in interest rate has significantly different effects on the values of the two assets.

[3]This is the convexity dimension mentioned in the appendix to Chapter 9. The price sensitivity of a security to changes in yield depends upon the level of yield itself and decreases as yield increases.

15.3 FORWARD RATE AGREEMENTS (FRAs)

A Forward Rate Agreement (FRA) is notionally an agreement between two parties in which one of them (the seller of the FRA), makes a commitment to lend to the other (the FRA buyer), a certain amount of funds, in a particular currency, for a specified period starting at a specified future date, at an interest rate fixed at the time of agreement. We say "notionally" because in practice, actual lending or borrowing of the underlying principal may not take place, but only the interest rate is locked in. The buyer of the FRA in turn agrees to borrow (again notionally), funds for a specified duration, starting at a specified future date, at a rate fixed at the time the FRA is bought. A typical FRA quote from a bank might look like this:

USD 6/9 months: 7.20-7.30% p.a.

This is to be interpreted as follows:

- The bank is willing to accept a 3-month US dollar deposit starting six months from now, maturing nine months from now, at an interest rate of 7.20% p.a. (the bid rate).
- The bank is willing to give a 3-month dollar loan starting six months from now, to be repaid nine months from now, at an interest rate of 7.30% p.a. (the ask rate).

Figure 15.5 is a schematic diagram of an FRA contracted at $t = 0$, applicable for the period between $t = S$ and $t = L$. DS and DL are actual number of days from $t = 0$ to $t = S$ and $t = 0$ to $t = L$, respectively. The period from $t = S$ to $t = L$ is the contract period, $t = S$ is the settlement date and DF is the number of days in the contract period.

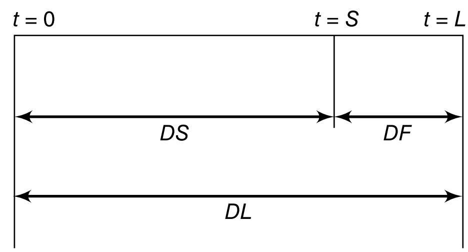

Fig. 15.5 Forward Rate Agreement

The important thing to note is that most often, there is no exchange of principal amount[4].

If the settlement rate on the settlement date[5] is above the contract rate, the seller compensates the buyer for the difference in interest on the agreed upon principal amount for the duration of the period in the contract. Conversely, if the settlement rate is below the contract rate, the buyer compensates the seller.

The compensation is paid up-front on the settlement day and, therefore, has to be suitably discounted since interest payment on short-term loans is at maturity of the loan. One of the following two formulas is used for calculating settlement payment from the seller to the buyer:

$$P = \frac{(L - R) \times DF \times A}{[(B \times 100) + (DF \times L)]}$$

$$P = \frac{(R - L) \times DF \times A}{[(B \times 100) + (DF \times L)]}$$

[4]This means that the FRA is only a hedge; the actual underlying deposit or loan is a separate transaction which may not be–and most often is not – with the same bank that traded the FRA.

[5]The settlement rate is the rate with which the contract rate is to be compared to compute the settlement payment. In each market, there is a clearly specified procedure to determine the settlement rate. The fixing date is the day on which the settlement rate is determined. For US dollar FRAs, fixing date is the settlement date itself, i.e. $t = S$, while for other currencies, it is two business days before the settlement date. In the Indian rupee market, it is one day before the settlement date. See calculation of settlement payment discussed below.

Here the notation is

L : The settlement rate (%)
R : The contract rate (%)
DF : The number of days in the contract period
A : The notional principal
B : Day count basis (360 or 365)

The first formula is used when $L > R$ and the payment P is from the FRA seller to the FRA buyer; the second formula is used when $L < R$ and the payment is from the buyer to the seller. In effect, if the settlement rate is higher, the FRA seller compensates the buyer for the extra interest payment the buyer has to incur; if the settlement rate is lower, the buyer surrenders the interest saving to the seller[6]. Let us illustrate this with an example.

Consider the 6-9 FRA quotation given above:

USD 6/9 months: 7.20-7.30% p.a.

Suppose a company which intends to take a 3-month loan starting 6 months from now wishes to lock in its borrowing rate. It buys the FRA from the bank which is giving the above FRA quotes, at the bank's ask rate of 7.30% for an underlying notional principal of USD 5 million. Suppose on the settlement date, the reference rate, e.g. 3-month USD LIBOR is 8.5%. The number of days in the contract period is 91 and the basis is 360 days. The bank will have to pay the company the following amount:

$$\text{USD } [(8.50 - 7.30)(91)(5{,}000{,}000)]/[(36{,}000) + (91 \times 8.50)]$$
$$= \text{USD } 14847.65$$

The numerator is the extra interest the company will have to pay because the actual borrowing rate is higher than the contract rate. This will be paid at the expiry of the loan. The FRA seller pays the company the PV of this by discounting the extra payment at the actual rate, viz. 8.5% for 91 days at the start of the loan. If instead the 3-month LIBOR had fallen to, say 6%, the company would have to pay the FRA seller an amount

$$= \text{USD } [(7.30 - 6.00)(91)(5000000)]/[(36000) + (91 \times 6.00)]$$
$$= \text{USD } 16185.09$$

This is the PV of the saving the company would make due to the actual rate being lower than the contract rate. In either case, the effective cost of funds for the 3-month loan would be 7.30%.

In the global financial markets, FRAs are traded in all convertible currencies. The minimum principal amount is around 5 million units of a currency. Like the forward exchange contract, FRAs are an over-the-counter product and, therefore, not standardised.

In a forward foreign currency contract, the parties fix the rate of exchange between two currencies for future delivery. In a FRA, the rate of interest on a future borrowing or lending is locked in. Just as the forward exchange rate reflects the market's expectations regarding the future spot rate, the rate fixed in an FRA reflects the market's expectations of future interest rates.

We have already looked at the concept of forward interest rates in our discussion of the term structure of interest rates in Chapter 9. Recall that the expectations theory of the term structure says that forward interest rates implicit in a given term structure equal the expected future spot interest

[6]When $L > R$, the FRA buyer incurs extra interest cost equal to $[(L - R)/100](A)(DF/B)$. This is discounted by a discount factor equal to $[1 + (L/100)(DF/B)]$. This gives the formula above.

rates. Thus, the 3-month rate expected to rule 6 months from today is implied by the 6 and 9 months actual rates today:

$$\left[1 + i_{0,6}\left(\frac{180}{360}\right)\right]\left[1 + i^e_{6,9}\left(\frac{90}{360}\right)\right] = \left[1 + i_{0,9}\left(\frac{270}{360}\right)\right] \tag{15.1}$$

where, as usual, the superscript "*e*" denotes expected. In general, given the spot interest rates for a short and a long maturity, the rate expected to rule for the period between the end of short maturity and the end of long maturity is given by

$$\left[1 + i_{0,S}\left(\frac{DS}{B}\right)\right]\left[1 + i^e_{S,L}\left(\frac{DF}{B}\right)\right] = \left[1 + i_{0,L}\left(\frac{DL}{B}\right)\right] \tag{15.2}$$

DS, DL and *D*F are as explained above. *B* is the day count basis (360 or 365 days). Interest rates $i_{0,S}$, $i_{0,L}$ stated as fractions, (not per cent) are the spot interest rates at time $t = 0$ for maturities *S* and *L,* respectively. The $(i^e)_{S,L}$ computed from (15.2) forms the basis for quoting the bid and ask rates in an FRA *DS/DL*. We have the following formula:

$$i^e_{S,L} = \frac{i_{0,L}DL - i_{0,S}DS}{DF\left[1 + i_{0,S}\left(\frac{DS}{B}\right)\right]} \tag{15.3}$$

We will illustrate this with a quick example.

- On April 30 2007, the following 3-month and 6-month CHF LIBORS were observed:

  $i_{0,\,S} = 2.35\%$ $DS = 91$ days
  $i_{0,\,L} = 2.42\%$ $DL = 183$ days
  $DF = 92$ days

For these data, using (15.3), we get

$$i^e 3,6 = \frac{(0.0242)(183) - (0.0235)(91)}{(92)\left[1 + (0.0235)\dfrac{91}{360}\right]} = 0.0247 \text{ i.e. } 2.47\%$$

Note that the rate so calculated will only serve as a benchmark for a FRA quotation. The actual quote will be influenced by demand-supply conditions in the market and the market's expectations.

We will now illustrate applications of FRAs for borrowers and investors–the former to lock in the cost of short-term borrowing and the latter to lock in the return on short-term investment.

- FRA for a Borrower.
  A firm plans to borrow £5 million for 3 months, 6 months from now. The current 3-month euro-sterling rates are 5.50-5.75%. The firm has to pay a spread of 25 bp (0.25%) over LIBOR. The treasurer is apprehensive about the possibility of rates rising over the coming six months. He wishes to lock in the cost of loan. Sterling 6/9 FRA is being offered at 5.8750%. The treasurer decides to buy it. We will work out the firm's cost of borrowing under alternative scenarios of 3-month rates 6 months from today. The anticipated borrowing is for 91 days.

Scenario 1: Six months later, sterling settlement LIBOR is 6.50. The bank which sold the FRA compensates the firm by immediately paying an amount *A* calculated as:

$$A = \frac{(0.0650 - 0.05875) \times 5000000 \times (91/365)}{[1 + 0.0650(91/365)]}$$

$$= £\ 7{,}666.89$$

Notice that the up-front payment by the FRA seller equals the difference in interest on £5 million, for 91 days at the actual LIBOR and the contracted rate, discounted at the actual LIBOR. The discounting is necessary because the firm will be paying interest on its loan at maturity (i.e. at the end of 91 days from the settlement date) while the bank pays the difference on the settlement date. The firm borrows £5 million at 6.75% including a spread of 25 bp. The compensation received can be invested at 6.25% (This is the LIBID). The cost of the loan is:

Interest on 5 million at 6.75% for 91 days
$= (0.0675) \times 5{,}000{,}000 \times (91/365)$
$= 84{,}143.83$

From this, we must subtract the compounded value of the compensation received from the FRA selling bank. This is given by:

$(7{,}666.89) \times [1 + 0.0625(91/365)] = 7{,}786.36$

So the net cost is £76,357.47 which works out to an annual rate of 6.125%. This is the rate locked in by the firm, viz.

(FRA offer rate + Margin over LIBOR the firm normally pays)
= (5.875 + 0.25 = 6.125).

Scenario 2: 6 months later the settlement rate LIBOR is 5.25%

The firm pays the bank an amount A given by

$$A = \frac{(0.05875 - 0.0525) \times 5000000 \times (91/365)}{[1 + 0.0525(91/365)]} = 7690.35$$

The firm has to borrow this at 5.50% in addition to the loan of £5 million. Its total cost now consists of interest on 5 million plus the repayment of the loan taken to pay the compensation. Thus its repayment six months later would be £5076357.45 for a loan of £5000000. This again works out to an annualized interest rate of 6.125%.

- **FRA for an Investor**.
  A fund manager is expecting to have \$5 million 3 months from now to invest in a 3-month (92 days) eurodollar deposit. The current 3-month rates are 4.25-4.375%. The \$ 3/6 FRA bid rate is 4.1250. The manager sells a FRA with notional principal \$5 million.
  1. 3 months later, the settlement rate is 3.50%. The bank pays the manager an amount A given by

$$A = \frac{(0.04125 - 0.0350)(5{,}000{,}000)(92/360)}{[1 + 0.035(92/360)]} = \$7{,}915.32$$

  The manager invests this along with \$5 million at 3.50%. His deposit matures to \$5,052,708.34 which is 4.125% annual return on his \$5,000,000 investment as contracted in the FRA.

  You can check out that if the settlement rate had instead been above the contract rate, the investor would have had to pay the bank and his net return would again be 4.125%.

FRAs, like forward foreign exchange contracts are a conservative way of hedging exposure. It removes all uncertainty from cost of borrowing or rate of return on investment. The relationship between a FRA and an interest rate futures contract is exactly analogous to that between a foreign currency forward contract and a currency futures contract. Like in a currency forward, FRAs imply credit risk for both parties though in a FRA the risk is limited only to the amount of settlement payment since there is no actual borrowing or lending transaction involved. Also, being an OTC product, FRAs are not liquid and compared to futures, the bid-offer spreads tend to be wider.

There is another product similar to a FRA for locking in borrowing cost or the return on investment. This is known as a "forward-forward" contract. Here too, the two parties agree to fix an interest rate for a lending or a borrowing transaction covering a specific period, starting at a specified future time; however, unlike a FRA, here the lending or borrowing is not notional. There is actually a loan or deposit transaction at the contract rate.

Banks who make a market in FRAs find interest rate futures such as eurodollar futures a convenient hedging device for hedging their FRA commitments. Technically, a bank which sells say a 3/6 FRA or forward-forward, can borrow funds for 6 months, invest them for the first three months and then "lend" them to the FRA buyer. Alternatively, it can hedge itself against rising interest rates by selling eurodollar or similar futures. FRAs (like futures) can also be used as a form of highly leveraged speculation on interest rate movements. Such speculative use of FRAs is largely confined to market making banks.

FRAs were introduced in the Indian money market in 1999. The Reserve Bank of India circulated the guidelines applicable to FRAs in a circular dated July 7 1999. The benchmark rate may be any domestic money market rate such as t-bill yield or relevant MIBOR (Mumbai Interbank Offer Rate) though the inter-bank term money market has not yet developed sufficient liquidity. FRA is viewed as an exchange of interest payments on a notional principal wherein the FRA buyer agrees to pay interest at a fixed rate (the contract rate) while the seller pays interest at the settlement rate. Settlement is done by payment of the net difference by one party to the other. Here is an example:

Bank *A* & Bank *B* enter into a 6 × 9 FRA. Bank *A* pays fixed rate at 6.50%. Bank *B* pays a rate based on 91-day T-bill yield fixed the day before the maturity date.

Other details:

— Notional principal = ₹10 crore
— FRA start & settlement date 10/12/06, Maturity date 10/6/07
— T-bill yield on fixing date (say 9/6/07) = 5.50%
— Determine cash flow at maturity (assume discount rate as 7%)

The calculations are as follows:

(a) Interest payable by Bank *A* = (10 cr) (0.065) (91/365) = ₹1,620,547.9
(b) Interest payable by Bank *B* = (10 cr) (0.055) (91/365) = ₹1,371,232.8
(c) Net payable by Bank *A* on maturity date {(a) – (b)} = ₹249,315.1
(d) Discounting (c) to settlement date

= (c)/(1 + discount rate × discount period)
= ₹249,315.1/[1 + 0.07(91/365)] = ₹245,038.67

Amount payable on settlement date = ₹245038.67 payable by Bank *A*.

RBI guidelines state that companies are permitted to do FRAs only to hedge underlying exposures while market maker banks can take on uncovered positions within limits specified by their boards and vetted by RBI. Capital adequacy norms are applicable and the minimum required capital ratio would depend upon the underlying notional principal, the tenor of the agreement and the type of counterparty. For details of capital ratio calculations, see appendix to Chapter 16. For guidelines on documentation, accounting and reporting, the reader can consult the RBI circular on FRAs and IRS which is available on its website ***www.rbi.org***.

In the next section, we will discuss interest rate options that allow the investor (or borrower) to limit the loss from an adverse rate movement while permitting him to gain from a favourable rate movement as in currency options. The cost of this privilege is an up-front premium.

15.4 INTEREST RATE OPTIONS

A less conservative hedging device for interest rate exposure is interest rate options. A call option on interest rate gives the holder the right to borrow funds for a specified duration at a specified interest rate[7] without an obligation to do so. A put option on interest rate gives the holder the right to invest funds for a specified duration at a specified return without an obligation to do so. In both cases, the buyer of the option must pay the seller an up-front premium stated as a fraction of the face value of the contract or the underlying notional principal.

An interest rate cap consists of a series of call options on interest rate or a portfolio of calls. A cap protects the borrower from increase in interest rates at each reset date in a medium-to-long term floating rate liability. Similarly, an interest rate floor is a series or portfolio of put options on interest rate which protects a lender against fall in interest rate on rate rest dates of a floating rate asset. An interest rate collar is a combination of a cap and a floor.

In the following subsection, we will analyse simple interest rate options. Following this, we will discuss caps, floors and collars.

15.4.1 A Call Option on Interest Rate

Consider first a European call option on 6-month LIBOR. The contract specifications are as follows:

Time to Expiry: 3 months (say, 92 days)
Underlying Interest Rate: 6-month LIBOR
Strike Rate: 5%
Face Value: \$5 million
Premium or Option Value: 50 bp (0.5% of face value) = \$25,000

The current three and six-month LIBORS are 4.60% and 4.75%, respectively. Let us work out the payoff to a long position in this option. Assume that the option has been purchased by a firm which needs to borrow \$5 million for six months starting three months from now. Figure 15.6 shows the relevant timings in this option.

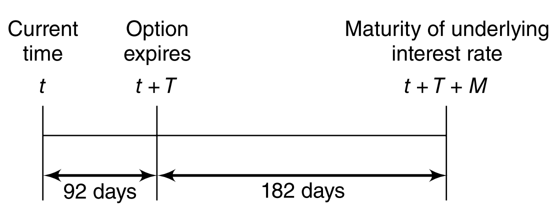

Fig. 15.6 A Call Option on Interest Rate

[7]Actually the option will fix the level of some index such as LIBOR. The borrower will have to pay the usual spread. Also, as in an FRA, the actual borrowing transaction is quite separate from the purchase of the option and the loan need not be from the bank which sold the call option.

The payoff to the holder depends upon the value of the 6-month LIBOR 3 months later:

Scenario 1: 3 months later 6 month LIBOR ≤ 5%.
The option is not exercised. The firm borrows in the market. The payoff is a loss of compounded value of the premium paid three months ago. The present value of the loss (at the time of option expiry) is the premium compounded for three months at the 3-month rate which prevailed at option initiation. In the above example, it is

$$\$25{,}000[1 + 0.0460(92/360)] = \$25{,}293.89$$

If the loss is to be reckoned at the maturity of the loan, this amount must be further compounded for 6 months at the 6-month LIBOR at the time the option expires.

Scenario 2: 3 months later the 6-month LIBOR > 5%.
The option is exercised. The option writer has to pay the option buyer an amount which equals the difference in interest on \$5 million for 6 months at today's 6-month LIBOR and the strike rate 5%:

$$(i_6 - 0.05) \times 5{,}000{,}000 \times (182/360)$$

where i_6 is the 6-month LIBOR at option expiry.
Thus, suppose 6-month LIBOR at option expiry is 6%, the option writer has to pay

$$(0.06 - 0.05)(5{,}000{,}000)(182/360) = \$25{,}277.78$$

This amount would be paid not at the time of exercise of the option but at the maturity of the loan 6 months later. Alternatively, its discounted value using the 6-month LIBOR at option exercise can be paid at the time of exercise.

Figure 15.7 shows the payoff profile from the call option where the payoff has been reckoned at option expiry. Note that the rising portion of the profile is not linear because of the discounting[8]. R is the strike rate and B is the breakeven rate defined later in this section.

The breakeven rate is defined as that value of LIBOR at option expiry at which the borrower would be indifferent between having and not having the call option, i.e. the total cash outflow at loan maturity would be identical with and without the option. Obviously, because of the up-front premium, the breakeven rate must be higher than the strike rate in the option. It is the value of i which satisfies the following equality:

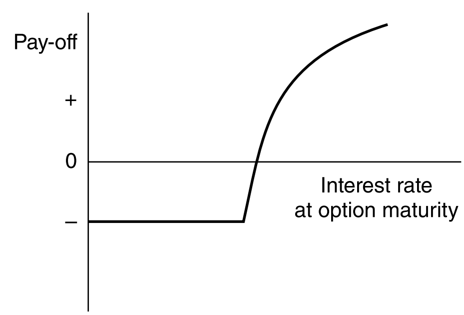

Fig. 15.7 Schematic Diagram of the Payoff from a Call Option on Interest Rate

$$\boldsymbol{A[1 + i(M/360)] = A[1 + R(M/360)] + C[1 + i_{t,T}(T/360)][1 + i(M/360)]}$$

where A is the underlying notional principal, R is the strike rate, $i_{t,T}$ is the T-day LIBOR at time t when the option is bought, C is the premium paid at time t, and T and M are number of days to

[8]The present value at time $t + T$, of the compensation to be received at time $t + T + M$ is

$$V_1 = [(i - R) \times A \times (M/360)]/[1 + i(M/360)]$$

where i is the M-day LIBOR at option expiry, R is the strike rate, M is the number of days to maturity of the underlying interest rate and A is the face value. The compounded value of the premium is

$$V_2 = C[1 + i_{t,T}(T/360)]$$

where $i_{t,T}$ is the T-day LIBOR at option initiation and C is the call premium. The net payoff for $i \geq R$ is $V_1 - V_2$.

option expiry and maturity of the underlying interest rate. For the example at hand, $A = 5{,}000{,}000$, $R = 0.05$, $i_{t,T} = 0.046$, $C = 25000$, $T = 92$ and $M = 182$. The breakeven rate works out to 6.03%[9]. If the 6-month LIBOR at option expiry is above (below) the breakeven rate, the call buyer makes a net gain (loss).

As in the case of currency options, the borrower can reduce the up-front premium by buying a call with a higher strike rate. For instance, suppose a call with strike 6% is available for a premium of 30 bp or $15,000. The breakeven rate is now 6.62%[10]. The level of protection is reduced and so is the up-front premium.

15.4.2 A Put Option on Interest Rate

Consider an investor who expects to have surplus cash 3 months from now to be invested in a 3-month eurodeposit. The amount involved is $10 million. The current 3-month rate is 5.50% which the investor considers to be satisfactory. A put option on LIBOR is available with the following features:

Maturity: 3 months (91 days)
Strike Rate: 5.50%
Face Value: $10 million
Underlying: 3-month LIBOR
Premium: 30 bp (0.30% of face value) = $30000

To hedge the risk, the investor goes long in the put. Three months later, if the 3-month LIBOR is less than 5.50%, he will exercise the option or else let it lapse. Suppose the 3-month LIBOR at option expiry is 4.5%. The option writer must pay the option buyer a sum equal to:

$$(0.055 - 0.045)(10{,}000{,}000)(91/360) = \$25{,}277.78$$

This is paid 3 months after option exercise or its discounted value at option exercise. Figure 15.8 shows the payoff profile.

The breakeven rate is the value of i satisfying the following equality:

$$\boldsymbol{A[1 + i(M/360)] = A[1 + R(M/360)] - P[1 + i_{t,T}(T/360)][1 + i(M/360)]}$$

where P is the put premium and other notation is same as in the case of a call option. In the example, $A = 10$ million, $R = 0.055$, $T = 91$, $M = 91$, $i_{t,T} = 0.055$ and $P = 30{,}000$. The breakeven rate works out to 4.2836%. If the 3-month LIBOR three months later is less than this, the put buyer makes a net gain.

Interest rate options are thus similar to currency options in their payoff profiles and hedging applications. Valuation of these options also has many similarities with valuation of currency options. In the appendix to this chapter, we will briefly discuss this aspect.

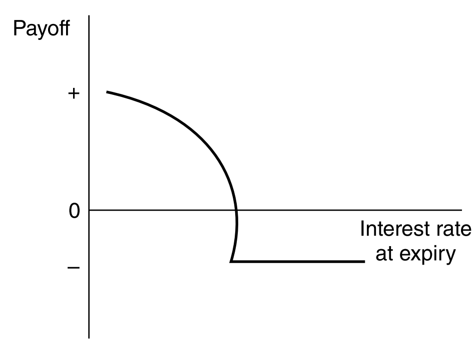

Fig. 15.8 Schematic Diagram of the Payoff from a Put

[9]Thus, the call can be interpreted as insurance with a deductible. Here the strike rate 5% is the "deductible" and 1.03% is the "insurance premium".

[10]This is like buying insurance with a lower premium but higher deductible. The deductible is now 6%, the premium is 0.62%.

15.4.3 A Put-Call Parity Relation

It is easy to see that a long position in a call option with strike rate R and a short position in a put with the same strike and same maturity, both on the same underlying index (such as 6-month LIBOR), are equivalent to a long position in an FRA at R[11]. To prove this, we proceed as follows. Consider the following three securities at time t, say today:

1. A call option on M-day LIBOR, at strike rate R, maturing T days from today, face value A, premium C.
2. A put option on M-day LIBOR, at strike rate R, maturing T days from today, face value A, premium P.
3. An FRA, on M-day LIBOR, maturing T days from today, face value A, contract rate R.

We will show that unless $P = C$, riskless arbitrage profits can be had.

- Suppose $P > C$. Consider the following portfolio:
  Buy the call, sell the put and sell the FRA.
  At time $t + T$, if the M-day LIBOR, $i > R$, the portfolio pays:
  (i) The gain from exercising the call
  (ii) The compensation that has to be paid to the buyer of FRA
  (iii) The compounded value of the put premium received at time t
  (iv) The compounded value of the call premium paid at time t.
  Of these, (i) and (ii) will cancel each other leaving you with the difference between (iii) and (iv). Thus, the value of the portfolio would be:

$$\{[(i - R) \times A \times (M/360)]/[1 + i(M/360)]\}$$
$$-\{[(i - R) \times A \times (M/360)]/[1 + i(M/360)]\}$$
$$+ P[1 + i_{t,T}(T/360)] - C[1 + i_{t,T}(T/360)]$$
$$= (P - C)[1 + i_{t,T}(T/360)] > 0.$$

  If $i \leq R$, the portfolio pays:
  (i) The payment to be made to the holder of the put
  (ii) The compensation received from the buyer of FRA
  (iii) The compounded value of the put premium received at time t
  (iv) The compounded value of the call premium you paid at time t.
  Once again (i) and (ii) will cancel each other leaving you with the difference between (iii) and (iv). Thus, the value of the portfolio would again be:

$$-C[1 + i_{t,T}(T/360)] + \{[(R - i) \times A \times (M/360)]/[1 + i(M/360)]\}$$
$$-\{[(R - i) \times A \times (M/360)]/[1 + i(M/360)]\} + P[1 + i_{t,T}(T/360)]$$
$$= (P - C)[1 + i_{t,T}(T/360)] > 0.$$

  Thus, irrespective of the outcome you gain. The discounted value of the gain at time t (today) is $(P - C)$ as it should be since the FRA is costless.
- Now suppose $C > P$. You can verify that by selling a call, buying a put and buying an FRA profit can be made irrespective of what the interest rate is at option expiry.

Thus, if the strike rates in the put and the call both equal the current rate in a corresponding FRA, the call and put must have identical premia. To put it in another manner, a long position in a call

[11] Recall from Chapter 10 that a portfolio of a long call and a short put on a currency at identical strike price price X and identical maturities is equivalent to a forward contract at rate X.

and a short position in a put both with same maturity, the same strike rate and the same underlying interest rate is equivalent to buying an FRA with the same settlement date and on the same interest rate at a contract rate equal to the strike rate in the put and call.

Thus, if the market is quoting a 6-9 FRA on 3-month LIBOR at 5%, then a 6-month call on 3-month LIBOR with strike rate 5% must have the same premium as a 6-month put on 3-month LIBOR with strike rate 5%.

Recall that a similar relationship holds for European call and put currency options on currency *Y* against currency *X* both with a life equal to say *n*-months and strike rates equal to the (*Y*/*X*) forward rate for the same horizon.

15.5 INTEREST RATE CAPS, FLOORS AND COLLARS

As mentioned above, interest rate caps and floors are portfolios of simple calls and puts on interest rate, respectively. We will begin by looking at examples of applications of caps and floors.

15.5.1 Interest Rate Caps

A corporation borrowing medium-term floating rate funds wishes to protect itself against the risk of rising interest rates. It can do so by buying an interest rate cap for the duration of the loan. The following example illustrates the working of this instrument.

- A corporation has borrowed $50 million on floating rate basis for 3 years. The interest rate reset dates are March 1 and September 1. The spread over LIBOR is 25 bp (0.25%). It is a bullet loan (i.e. repayment of the entire principal is at maturity).

  It buys a 3-year cap on 6 month LIBOR with the following features:

Term:	3 years
Underlying:	6 month LIBOR
Reset Dates:	March 1, September 1
Strike Rate:	9%
Face Value:	$50 million
Up-Front Fee:	2% of face value or $1 million

  The cap is traded on February 27, 2013, the settlement date is March 1, 2013. The current level of 6-month LIBOR is 9%.

  Since the rate applicable to the first 6-month period is known, there are five interest rate call options in this cap maturing at six monthly intervals starting six months from March 1. Each option has a strike rate of 9% and face value of $50 million.

  To determine the effective cost of borrowing with the cap, we must assume an interest rate scenario. Measuring time in half-years suppose the 6-month LIBOR at subsequent reset dates moves as follows:

RESET DATE	**LIBOR (%)**
SEPTEMBER 1, 2013	10.0
MARCH 1, 2014	9.5
SEPTEMBER 1, 2014	9.5
MARCH 1, 2015	9.0
SEPTEMBER 1, 2015	8.5

The premium cost is amortised over a 2½ year period using a discount rate of 9%. This gives annuity of $227,790.43 for 5 periods starting 6 months from September 1, 2013. Table 15.1 sets out the cash flows associated with the capped loan. For simplicity of calculations, we have assumed that each half-year period consists of 182½ days. The first column of the table shows semiannual periods 0...6. The second column shows cash flows from the loan. For instance at $t = 1$, interest to be paid is

$$50{,}000{,}000[0.0925(182.5/360)] = 2{,}344{,}618.1$$

while at $t = 3$ the interest outflow is

$$50{,}000{,}000[0.0975(182.5/360)] = 2{,}471{,}354.2$$

The third column is amortisation of the up-front premium. The next column shows payments received from the cap seller. Thus, at t = 2, the borrower gets

$$50{,}000{,}000(0.10 - 0.09)(182.5/360) = 253{,}472.2$$

This is because LIBOR applicable for the second six-monthly period was 10%, one per cent higher than the strike rate of 9%. The last column shows the net cash flows from the capped loan. The effective cost of borrowing is found by finding the IRR of this stream. It works out to a semiannual rate of 5.02% corresponding to an annual rate of 10.29%.

Table 15.1 A Floating Rate Loan with an Interest Rate Cap

Time t	*Cash Flow from loan*	*Amortisation of premium*	*Cash Flow from cap*	*Total*
0	+50,000,000	—	—	+50,000,000
1	–2,344,618.1	–227,790.43	—	–2,572,408.5
2	–2,598,090.3	–227,790.43	+253,472.2	–2,572,408.5
3	–2,471,354.2	–227,790.43	+126,736.1	–2,572,408.5
4	–2,471,354.2	–227,790.43	+126,736.1	–2,572,408.5
5	–2,344,618.1	–227,790.43	—	–2,572,408.5
6	–52,154,514	—	—	–52,154,514

Figure 15.9 shows schematically the effective cost of a capped floating rate loan for various values of LIBOR under the assumption that LIBOR remains constant throughout the life of the loan.

In the appendix to this chapter, we will present some parity relationships between an interest rate cap and a simple call option on the same interest rate[12].

Caps on other interest rate indexes such as the New York prime, Euro CD rate, the US treasury bill rate, etc. are also traded in the market.

[12]Consider, for instance, a nine-month cap on 3-month LIBOR with 3-month reset period and a 3-month call option on 6-month LIBOR. In the appendix, we will prove that the former is in general worth more than the latter.

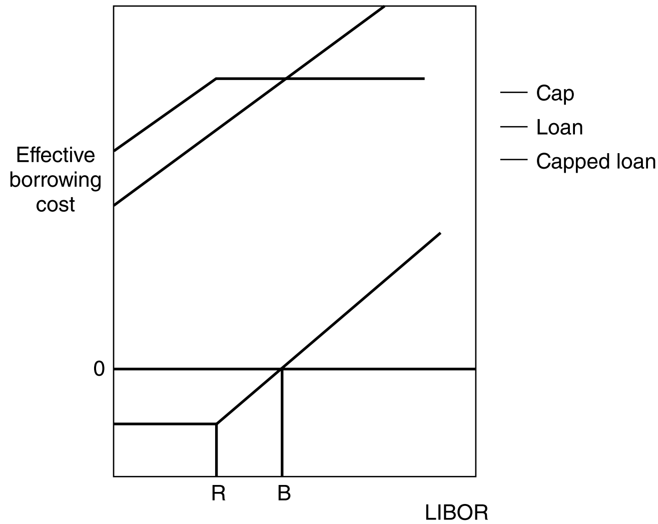

Fig. 15.9 Payoff from a Cap

15.5.2 Interest Rate Floors

A fund manager is planning to invest \$50 million in 5-year FRNs. The notes pay 6-month LIBOR + 0.50%, the rate being reset every 6 months. The current 6-month LIBOR is 8.60%. As protection against falling rates, the manager decides to buy an interest rate floor with the following features:

Term	:	5 years
Underlying Interest Rate	:	6 month LIBOR.
Reset Dates	:	June 1, December 1
Strike Rate	:	8%
Face Value	:	\$25 million
Up-front Fee	:	1.5% of the face value or \$375,000

This is a portfolio of nine simple put options on 6-month LIBOR with maturities 6, 12, 18...54 months. As in the case of the cap above, the up-front premium is amortised in 9 equal 6 monthly instalments discounted at today's 6 month LIBOR, viz. 8.5%. The corresponding annuity is \$51,126.84. Now, the effective return on investment depends upon the value of LIBOR at all future reset dates. The cash flows in Table 15.2 are based on the following scenario:

t	**LIBOR(%)**
0	8.50
1	8.75
2	8.75
3	8.00
4	7.50
5	7.50
6	7.50
7	7.75
8	8.00
9	8.00

Table 15.2 An Investment with an Interest Rate Floor

Time t	*Cash Flow from Investment*	*Amortisation of Premium*	*Cash Flow from Floor*	*Total*
0	–25000000	—	—	–25000000
1	1140625.0	–51126.8	—	1089498.20
2	1172309.0	–51126.8	—	1121182.20
3	1172309.0	–51126.8	—	1121182.20
4	1077256.9	–51126.8	—	1026130.10
5	1013888.9	–51126.8	63368	1026130.10
6	1013888.9	–51126.8	63368	1026130.10
7	1013888.9	–51126.8	63368	1026130.10
8	1045572.9	–51126.8	31684	1026130.10
9	1077256.9	–51126.8	—	1026130.10
10	26077257.0	—	—	26077257.00

The calculations are quite similar to the case of a cap except the buyer of the floor receives payment from the seller when LIBOR falls below the strike rate. The effective return on investment is the IRR of the cash flows shown in the last column. It works out to 4.24% semiannual which is equivalent to 8.66% annual. Figure 15.10 is a schematic diagram of the effective return to an investment with interest rate floor.

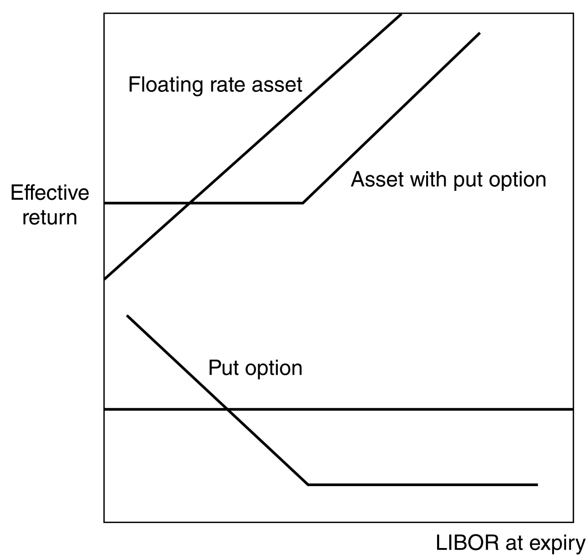

Fig. 15.10 Effective Return with a Floor

Parity relations between simple put options on interest rate and floors are explored in the appendix[13].

An interest rate collar is a combination of a cap and a floor. A corporation wishing to limit its borrowing cost on a floating rate liability might find the premium associated with a cap too expensive. It can reduce this by sacrificing some of the potential gain from low interest rates. It buys a cap and simultaneously sells a floor. The premium received from the sale of the floor would partly or wholly compensate for the premium paid for the cap. In the latter case, we have a zero cost collar.

Thus, suppose the current 6-month LIBOR is 7.50% and the company has a floating rate liability with rate reset every six months indexed to 6-month LIBOR. It might buy a cap with a strike rate of 9% and sell a floor with a strike rate of 7%. Suppose the premia cancel out. Effectively, its borrowing cost will vary between 7% and 9% (plus of course any spread over LIBOR it must pay). By sacrificing the potential gain if LIBOR falls below 7% (in which case buyer of the floor sold by the company would exercise its option), it has eliminated the up-front premium payment. The product is exactly analogous to the range forward contract for a foreign currency discussed in Chapter 10. Figure 15.11 shows the payoff diagram of a collar.

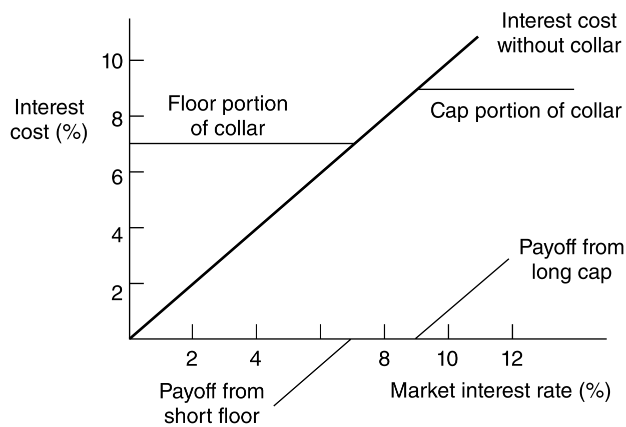

Fig. 15.11 Payoff Diagram of a Zero-Cost Collar

A number of other variations exist which combine the basic cap and floor products with each other and other derivative products like interest rate swaps which cater to specific needs of an end user. An exposition can be found in Dehnad (1994).

15.6 VALUATION OF INTEREST RATE OPTIONS

The approach to valuation of interest rate options is quite similar to that for currency options. The risk-neutral binomial model can be applied to simple interest rate options as discussed in the appendix. Since caps and floors are portfolios of simple options, they can be valued by simply valuing each of the embedded options separately and adding together the values. While conceptually simple, this approach is not theoretically very satisfactory particularly for options with long lives. In the appendix, we will briefly discuss the limitations of the binomial approach to valuation of interest rate options.

[13]Relationships between caps and floors on the one hand and interest rate swaps are examined in the next chapter.

Another approach to valuation uses modifications of the Black-Scholes model. The main modifications required are to view options on interest rate as options on an interest bearing instrument and take account of stochastic interest rates[14]. We will not pursue it here. A brief sketch is provided in the appendix. The interested reader can consult the references cited in the bibliography.

A theoretically rigorous approach to valuing interest rate options has to be based on a model of the complete term structure of interest rates. Many such models have been proposed in the literature. A detailed exposition of these is beyond the scope of this book. In the appendix, we will briefly mention the basic ideas and provide references to the literature.

15.7 OPTIONS ON INTEREST RATE FUTURES

Recall from Chapter 10 that options on interest rate futures contracts are traded on a number of financial exchanges including LIFFE. The underlying asset is a futures contract such as eurodollar futures. The holder of a call has the right to establish a long position in a futures contract while a put holder has the right to establish a short position. Recall from Chapter 9 that short-term interest rate futures prices are quoted as "points of hundred" i.e. (100–the relevant interest rate in per cent). Consequently, holder of a call option on say a eurodollar futures benefits from a fall in interest rate while the put holder benefits from a rise in interest rate. Thus, payoffs from a long call (put) on futures are similar to a long put (call) on the underlying interest rate itself. The options traded on exchanges are American options. However, in the examples below, we will assume away the possibility of early exercise.

We will confine ourselves to illustrating some applications of options on interest rate futures to hedging interest rate risk. The problem of valuation will not be addressed here. The bibliography contains the relevant references.

- Borrower's hedge: Hedging against a rise in interest rate.
  Today is March 1. A corporation is planning to issue 92-day commercial paper with face value \$20 million on June 1. To protect itself against a rise in interest rate, it decides to buy a put option on 20 eurodollar futures contracts. The option has the following features:

Type	:	American put option
Underlying	:	June Eurodollar contracts
Expiry date	:	June 1 (91 days from today)
Strike price	:	95
Face value	:	\$1 million per contract, \$20 million total.
Premium	:	0.75 bp

  The current price of June futures is 96. The current 3-month dollar LIBOR is 4.5%. 3-month CP rate is 5%.
  The dollar value of the premium is calculated as follows:

$$0.75 \times (1/100) \times (90/360) \times \$1,000,000 = \$1875.$$

  For 20 contracts, the premium is \$37,500.

[14]Recall that in the Black-Scholes model, the risk-free interest rate is assumed to be constant. In such a world, interest rate options would be valueless.

On June 1, the payoff from each option is:

June Futures Price F	Payoff
≥ 95	Option lapses, no payoff
< 95	$[(95 - F)(1/100)(90/360)1{,}000{,}000]$

Thus, suppose the futures price has fallen to 94. The total gain from exercising the option and immediately liquidating the position would be

$$(0.01)(90/360)(1{,}000{,}000)(20) = \$50{,}000.$$

On June 1, 3-month LIBOR has risen to 5.9%, while the 3-month CP rate is 6.4%. Without the option, the CP issue would have realised

$$\$(20{,}000{,}000)/[1 + 0.064(92/360)] = \$19{,}678{,}152$$

apart from issue costs. With the gain from the option, it would realise \$19,728,152. Of course, we must deduct the compounded cost of the premium which is

$$37500[1 + 0.045(91/360)] = 37{,}926.56.$$

The net realisation is therefore \$19,640,226. If the issue had been made on March 1, the firm would have realised

$$\$(20{,}000{,}000)/[1 + 0.05(92/360)] = \$19{,}747{,}669.$$

The breakeven futures price on June 1 is that value of F for which the gain from the option equals the compounded value of the premium. It works out to 94.24. Figure 15.12 illustrates the payoff from the put option.

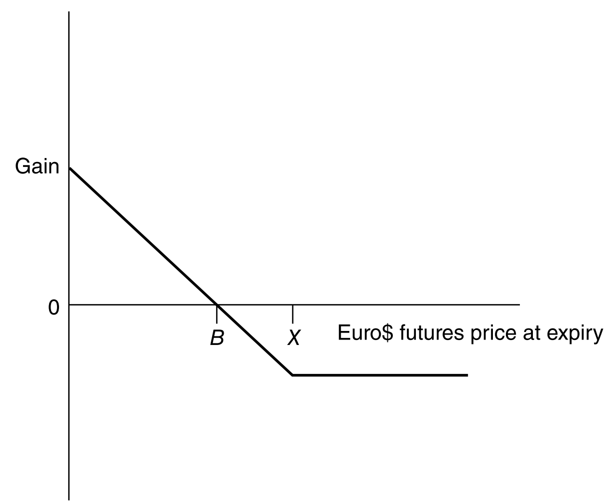

Fig. 15.12 Payoff from a Put on Eurodollar Futures

As usual, the firm could have chosen a deeper out-of-the-money option with a smaller premium but lower level of protection. Alternatively, the firm could have written a call option on futures and collected an up-front premium. If interest rates had gone up as before, the call would have lapsed unexercised and the premium gained would have reduced the firm's effective borrowing cost. If the rates had fallen, the call would be exercised limiting the gain from lower rates. In one of the problems at the end of this chapter, you are asked to compare this strategy with purchase of a put on futures.

We will conclude with an example in which we compare a number of alternative strategies for an investor to cope with interest rate risk.

- Today is March 1. An investor foresees a cash surplus of $50 million in 3 months time to be invested in 3-month Eurodollar CDs. The current 3-month LIBOR is 8%. The following alternatives are being considered:
  1. Do not hedge.
  2. Sell a 3/6 FRA at 8%.
  3. Buy a 3-month put option on 3-month LIBOR.
  4. Write a put on June eurodollar futures.
  5. Write a 3-month call on 3-month LIBOR.
  6. Buy a 3-month call on June eurodollar futures.

  We have already seen how (2) and (3) work. Consider (4). Writing a put on eurodollar futures yields an up-front premium. If rates fall, futures prices will rise and the put will not be exercised. The premium income will lead to a higher return than remaining unhedged or an FRA. If rates rise, beyond a point, the put will be exercised against the investor and gain will be limited. Similarly, strategy (5), writing a call on LIBOR yields an up-front income but limits gains from rising rates. The call will be exercised when rates rise. As to (6), if the rates fall, there will be a gain which will partly compensate for the loss on investment while if the rates rise, investor can gain as in buying a put on LIBOR.

  For simplicity, we will ignore the compounding of option premia paid/received over the maturity period of the underlying rate, i.e. from 6 to 9 months from the start date. Also, ignore the problem of basis in futures. The strike rates in the interest rate options are all 8% and the strike prices in the futures options are 92.

Figure 15.9 shows the effective rates of return on the investment for each of the above six alternatives for various values of 3-month LIBOR on June 1.

As Figure 15.13 shows the un-hedged position is the most risky. The effective return simply equals to the 3-month LIBOR on June 1. The other extreme is locking in the return at 8% by means

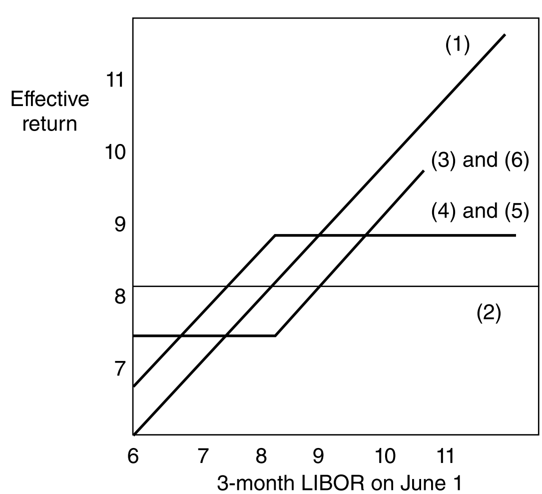

Fig. 15.13 Alternative Hedges for an Investor

of an FRA. Going long a put on LIBOR or a call on eurodollar futures limit the downside risk to the amount of premium and allow the investor to benefit from increase in rates. The investor is better off with these strategies than with an FRA if the interest rate increases beyond a certain value (the point of intersection of the FRA line and the dotted line). The strategies of writing a call on LIBOR or a put on futures are better if interest rate declines below 8% or rises only marginally but have a limited gain potential if it rises well beyond 8%. If it rises beyond the level represented by the intersection of the dotted and dashed lines, the strategies of buying a put on LIBOR or a call on futures are better (but remaining un-hedged is still better).

This example illustrates how the available instruments allow the investor a lot of flexibility in designing a package with the preferred risk-return profile in the light of his views about future movement in rates.

If an investor is very confident that rates will rise considerably, he should not hedge. If he thinks that an upward movement is very likely, but there is some probability of a fall, he should prefer the strategies of buying a put on LIBOR or a call on futures. If his view is that the rates will most probably fall or at best marginally rise, writing puts on futures or calls on LIBOR would be the preferred strategy. If the investor is strongly risk-averse, he would prefer an FRA.

15.8 SOME RECENT INNOVATIONS

As in the case of currency options, a number of exotic products have appeared in recent years that permit more flexible management of interest rate risk. An interest rate cap can be designed that provides protection contingent upon the price of some commodity or asset, e.g. an oil producer may want protection against high interest rates only when oil prices are low. Average rate or Asian interest rate options have payoffs based on the average value of the underlying index (e.g. 6-month LIBOR) during a specified period and look-back options give payoffs determined by the most favourable value. In a cumulative option, the buyer can obtain protection such that cumulative interest expense over a period does not exceed a specific level. A description of some of these products can be found in Euromoney[15].

15.9 INTEREST RATE DERIVATIVES IN INDIA

FRAs were introduced in the Indian market in 1999. The benchmark rate can be any one of the following:

(i) Overnight MIBOR (Mumbai Interbank Offer Rate)
(ii) MITOR: US dollar overnight rate plus (minus) overnight premium (discount) on USD
(iii) MIFOR: US dollar LIBOR for 1/3/6 months plus (minus) forward premium (discount) on USD for same maturity
(iv) MIOIS: This is like the term interbank rate
(v) INR-BMK: Effectively this is one-year yield in the government securities yield curve

Interest rate options have not yet been permitted in the Indian market. However, the recent trend toward liberalization and widening of the financial derivatives market it is expected that these products will soon make their appearance in the Indian market.

A recent reference on interest rate derivatives in the Indian market is Rajwade (2007).

[15] "Derivatives Sprout Bells and Whistles", ***Euromoney,*** August 1992, p. 29-46. Euromoney Publications, London

Summary

Interest rate volatility is a major source of uncertainty particularly for financial institutions. A simple measure of interest rate exposure uses gap analysis which focuses on the maturity profile of assets and liabilities. A more sophisticated approach is to use the concept of duration.

A single-period interest rate exposure can be hedged using Forward Rate Agreements (FRAs), interest rate futures, simple interest rate options and options on interest rate futures. Multi-period risk can be managed with interest rate caps and floors. Several innovative combinations can be structured by combining these basic products.

Valuation of interest rate derivatives must take account of the stochastic evolution of the entire term structure. In certain cases, simpler approaches using binomial lattice or modifications of Black-Scholes model may be adequate. For more advanced, rigorous treatment of fixed income derivatives, the reader can consult Jegadeesh and Tuckman (2000).

Questions and Problems

1. A firm is planning an issue of 180-day CP in 3 months with a face value of $25 million. The current 6-month Eurodollar LIBOR is 5.75% and CPs of AAA firms are trading at a discount of 50 b.p. over LIBOR. To protect itself from rising rates, the firm buys a 3/9 FRA with face amount $25 million, indexed to 6-month LIBOR, with an offer rate of 6.25%. Calculate the net interest cost of the CP issue if on day 91,
   (a) The 6-month LIBOR is 6.50% and the CP rate is 7.00%
   (b) The 6-month LIOBOR is 5.25% and the CP rate is 6%

2. The treasurer of an insurance company expects to have a surplus of £5 million 6-months from now. She has decided to park the funds in a 3-month USD deposit. The current 3-month deposit rate is 9%. A 6/9 £5 million FRA is being quoted at 8.75/9%. The treasurer sells an FRA to protect herself from falling rates. Compute the effective rate of return on her investment if on day 182
   (a) The 3-month deposit rate is 9.5%
   (b) The rate is 8%.

3. Suppose the firm in Problem 1 above decides instead to buy a call on 6-month LIBOR with a strike price of 6.25%, maturity of 3 months at a premium of 30 b.p. Compare this hedge with the FRA under the two alternative scenarios.

4. Suppose the treasurer in Problem 2 decides to buy a put on 3-month USD deposit rate at a strike price of 8.75% and a premium of 25 b.p. Compare the outcomes with the short FRA position under the two scenarios of Problem 2.

5. A bank has received a 1 year 365 days USD deposit for which it has to pay 9.125% ($9\frac{1}{8}$%). It can loan it back at 9.1875% ($9\frac{3}{16}$%). However, it finds the margin of 1/16% to be unattractive. The current 6-month LIBOR is 8.875% ($8\frac{7}{8}$%). It is contemplating the following two strategies:

(a) Loan the funds for 6-months. Reinvest the proceeds of the loan for a further 6-months at the then 6-month LIBOR.
(b) Loan the funds for 6-months and sell 6/12 FRA for a face amount equal to the loan proceeds at a rate of 9.22%. Invest the loan proceeds at the then 6-month LIBOR.

Compare the outcomes of the two strategies for alternative values of 6-month LIBOR, 6-months from now, in the range 7% to 11% in steps of 0.5%.

6. This problem is a simple example of arbitrage between interest rate futures and FRAs. On July 15, IMM September Eurodollar futures contract is quoted at 92.50 while a 2/5 FRA is available at 7.40%. The start date of the FRA coincides with the maturity date of the futures contract. On September 15, 3-month LIBOR is 8.5% and the futures contract settles at 91.50. Calculate the net gain if a trader had bought a futures contract and an FRA on July 15 and held the position till September 15. Ignore marking to market.

7. A company has decided to take a 3-year floating rate loan of $200 million to finance an acquisition. The loan is indexed to 6-month LIBOR with a spread of 0.125% (1/8%). The current level of LIBOR is 7.625%. The company thinks that the projected cash flows from the acquisition would enable it to live with an interest cost not exceeding 10.125%. A 3-year interest rate cap with a face amount of $200 million and a strike rate of 10.125% is available for a premium of 4.5%. Calculate the effective cost of the capped loan for the following scenario of LIBORS on the next five rollover dates: 5%, 7%, 9%, 11%, 13% (Use a rate of 9% to amortise the premium).

8. The company in Problem 7 is offered an interest rate collar with strike rates of 7.625% and 10.125% respectively for a net premium of 2.5%. Under this, the company has to compensate the seller of the collar if the LIBOR falls below 7.625% and the seller compensates if the LIBOR rises above 10.125%. Compute the effective cost of the loan under the same scenario.

9. An investor has invested £5 million in a 5-year FRN which pays 0.25% over 6-month LIBOR. The LIBOR for the first semester is fixed at 10%. A 5-year floor on 6-month LIBOR at a strike rate of 9% is available for a premium of 3%. Compute the effective rate of return on the investment with the floor for the following scenario of LIBORS: 10.5%, 10%, 9.5%, 9%, 8.5%, 9%, 8%, 9%. Use a discount rate of 10% to amortise the premium.

10. To hedge a 3-month borrowing requirement of $1 million 3-months from now, a treasurer decides to use options on Eurodollar futures. The current 3-month LIBOR is 8.5%. The following options are available:

Option type :	American Put	American Call
Expiry Date :	September (91 days from now)	September
Underlying :	Sept. Euro $ Futures	Sept. Euro $ Futures
Strike price :	92	92
Face Value :	$1 million	$1 million
Premium :	0.90	0.90

Explain how the hedge will be executed. Compute the breakeven rate and draw the payoff diagram.

11. A $25 million borrowing requirement 6 months from now for six months is to be hedged. The current 6-month LIBOR is 8%. The following alternatives are being considered:
(a) Remain unhedged.
(b) Buy a 6/12 FRA at 8.5%.
(c) Buy a call on 6-month LIBOR, expiring in 6 months. Calls with strike rate of 8.5% have a premium of $75,000 and with strike rate of 9.5%, the premium is $30,000.

(d) Write puts on 6-month LIBOR. Puts with strike rate of 8.5% carry a premium of $75,000 and puts with strike of 9.5% carry a premium of $40,000.
(e) Buy a put with maturity of 6 months on Eurodollar futures contracts. Puts with strike price of 91.5 carry a premium of 0.75.
(f) Write a 6-month call on Eurodollar futures with a strike price of 91.5 carrying a premium of 0.75.

Compare these alternatives. Determine the ranges of values of 6-month LIBOR 6-month from today over which each alternative dominates the other. Draw the payoff diagram.

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APPENDIX

A.15.1 VALUATION OF SIMPLE INTEREST RATE OPTIONS

We will illustrate the binomial approach to valuation of interest rate options in a risk-neutral world. In such a world, investors look only at expected payoffs from alternative portfolios. One implication of this assumption is that expectations hypothesis about the term structure of interest rates is valid, viz. the forward rate equals the expected spot rate. Secondly, any security can be valued by weighting its payoffs in different "states of nature" by the probabilities of those states. Recall from our discussion of valuation of currency options that risk-neutrality is *not required*. The risk-neutral probabilities will automatically capture any risk aversion.

We will consider 2-period options on 1-period interest rate. For convenience, the length of a "period" is taken to be one year. The start date is $t = 0$, the options expire at $t = 2$ and the underlying rate is the one year rate from $t = 2$ to $t = 3$. The notional principal is \$1. From one period to next, the one-year interest rate is assumed to follow a binomial process:

Either the rate increases by 1%: probability π
Or it decreases by 1%: probability $(1 - \pi)$

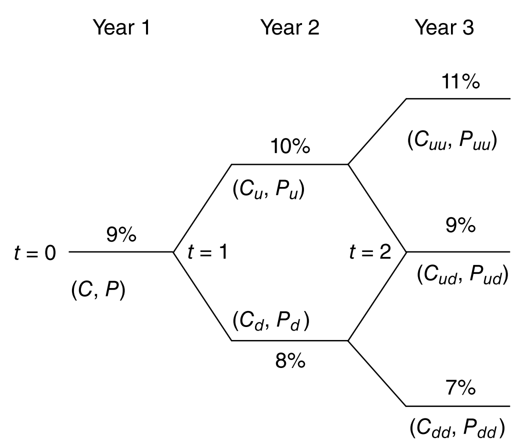

Fig. A.15.1 Two-Year Option on One-Year Rate

Figure A.15.1 shows the evolution of the interest rate and corresponding notation for option values. Thus, C_{uu} is call value after two up-movements, and so on.

The interest rate during the first year is 9%. During the second year, it may be 10% or 8% and during the third year, 11%, 9% or 7%. C_{uu} and P_{uu} are values of the call and put respectively at expiry ($t = 2$), if the rate has increased during both the periods. C_{ud}, P_{ud}, C_{du}, P_{du}, etc. are to be interpreted similarly. In the same manner, C_u and P_u are values of the call and the put at $t = 1$, if the rate increased during the first period and C_d and P_d are values if the rate decreased. C and P denote, respectively, the call and put values at the start, $t = 0$. Denote by $i_{0,1}$ the one year rate between $t = 0$ and $t = 1$, i.e. the first year, etc. It is easy to see that for a call with strike rate R,

$$C_{uu} = \max\{0,(i_{2,3} - R)/(1 + i_{2,3})\} \text{ and } i_{2,3} = i_{0,1} + 0.02$$
$$C_{ud} = C_{du} = \max\{0,(i_{2,3} - R)/(1 + i_{2,3})\} \text{ and } i_{2,3} = i_{0,1}$$
$$C_{dd} = \max\{0,(i_{2,3} - R)/(1 + i_{2,3})\} \text{ and } i_{2,3} = i_{0,1} - 0.02.$$

In a risk-neutral world,

$$C_u = [\pi C_{uu} + (1 - \pi)C_{ud}]/(1 + i_{1,2}) \text{ with } i_{1,2} = i_{0,1} + 0.01$$
$$C_d = [\pi C_{du} + (1 - \pi)C_{dd}]/(1 + i_{1,2}) \text{ with } i_{1,2} = i_{0,1} - 0.01$$

And, finally,

$$C = [\pi C_u + (1 - \pi)C_d]/(1 + i_{0,1})$$

As a numerical example, suppose $\pi = 0.60$, $R = i_{0,1} = 0.09$.
Then,

$$C_{uu} = (0.02)/(1.11);\ C_{ud} = C_{du} = C_{dd} = 0$$

and $$\mathrm{C} = (0.60)^2\ (0.02)/[(1.11)(1.10)(1.09)] = \$0.0054$$

With a lower strike rate, say $R = 0.08$,

$$C_{uu} = (0.03)/1.11 = 0.0270$$
$$C_{ud} = C_{du} = (0.01)/1.09 = 0.0092.\ C_{dd} = 0$$
$$C_u = [(0.6)(0.0270) + (0.4)(0.0092)]/1.10 = 0.0181$$
$$C_d = (0.6)(0.0092)/1.08 = 0.0005$$
$$C = [(0.6)(0.0181) + (0.4)(0.0005)]/1.09 = \$0.0101.$$

The value of the call increases as strike rate decreases as it should.

The value of a put can be found by an exactly analogous argument. For instance, a put with strike 9% will have a value

$$[(0.4)^2(0.02)]/[(1.07)(1.08)(1.09)] = \$0.0025$$

Extension to multi-period options is straightforward though tedious. Note that we cannot give a general binomial formula as in the case of currency options because different payoffs have to be discounted at different rates.

Having valued simple interest rate options, caps and floors can be valued by valuing each embedded option separately and then adding together.

For the same data as above, consider a two-year floor on one year LIBOR with a strike rate of 9%. If the interest rate during year 2 is 10% the payoff is zero; if it is 8%, the payoff is 0.01 at the end of year 2 whose present value is (0.01)/(1.08)(1.09). The expected payoff is, therefore, [(0.4)(0.01)]/[(1.08)(1.09)]. During the third year, if the interest rate is either 11% or 9%, the payoff is zero; if it is 7%, the payoff is 0.02 at the end of third year whose present value is (0.02)/[(1.07)(1.08)(1.09)]. The expected value is $(0.4)^2(0.02)/[(1.07)(1.08)(1.09)]$. Thus, the value of the floor at time zero is

$$P(9\%) = \frac{[(0.4)(0.1)]}{[(1.08)(1.07)} + \frac{[(0.4)^2(0.02)]}{[(1.07)(1.08)(1.09)]}$$
$$= 0.006.$$

There are two major limitations of this model. First, it is an observed empirical fact that interest rates, unlike stock prices exhibit "mean reversion", i.e. there is a tendency to return to some "long-run equilibrium level" though they may wander away from this level for extended periods of time. The binomial model assumed here does not have this property. The other limitation is the assumption that investors are risk-neutral and, therefore, the term structure conforms to the expectations hypothesis. Without this assumption, both the mean and variance of interest rate changes as well as investor preferences would enter option valuation. Alternative theories of the term structure have been proposed. Among these are equilibrium models like that of Cox, Ingersoll and Ross (1985) and "arbitrage-free" models like that of Ho and Lee (1986). Valuation models based on these are also available. The reader may consult the references at the end of this chapter for further reading.

A.15.2 SOME PARITY RELATIONS

We have examined a relation between a call and a put on interest rate in the text. There we saw that a long call and a short put with identical maturities, underlying interest rate and strike rate R is equivalent to buying an FRA at the rate R. An obvious extension of this is that a long position in a T-period cap with a short position in an identical floor is equivalent to an agreement to borrow at the strike rate R on each of the T reset dates, i.e. a portfolio of FRAs. As we will see in the next chapter, this is equivalent to paying fixed interest rate payments in a floating-to-fixed interest rate swap.

Now let us compare a single longer period option with a series of shorter period options with identical strike rates. Consider the two alternatives:

1. A 3-month call on 6-month LIBOR
2. A portfolio consisting of:
   A 3-month call on 3-month LIBOR and
   A 6-month call on 3-month LIBOR.

Figure A.15.2 shows the two alternatives schematically. For each of the options, the solid line shows the interval over which the option is alive and the dotted line shows the maturity of the underlying interest rate.

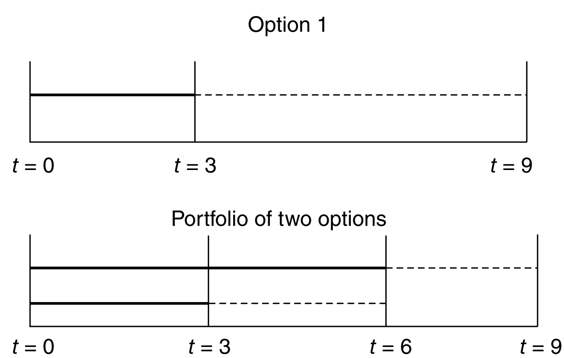

Fig. A.15.2

To unambiguously compare these two alternatives, we have to assume that the yield curve at $t = 0$ is flat and it remains flat. This means that at any time, 3- and 6-month LIBORs are equal. Suppose the 3- and 6-month LIBORs at $t = 0$ are 9%. As before, we assume a binomial process wherein the LIBORs either increase by 1% or decrease by 1% from one period to the next. Suppose the strike rates in the three options described above are 9.25%. Figure A.15.3 shows the tree diagram. The number above each branch indicates the interest rate ruling over the relevant period; the numbers in parentheses below each branch show the gains from, respectively, the portfolio of option (2) and option (1).

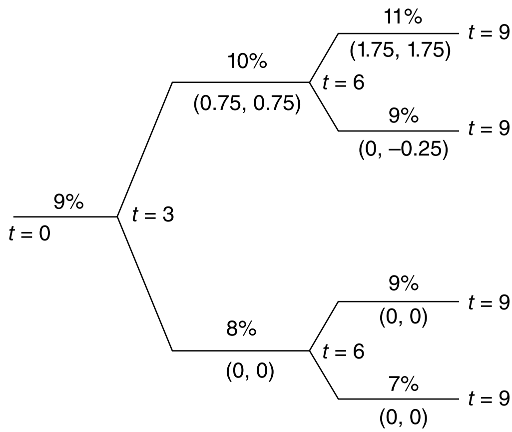

Fig. A.15.3 A Call on 6-Month LIBOR vs. Two Calls on 3-Month LIBOR

Consider this sequence of rates:

9% from t = 0 to t = 3, 10% from t = 3 to t = 6 and 9% from t = 6 to t = 9

At t = 3, option 1 will be exercised and so will the first option of the portfolio 2. The gain will be identical, viz. 0.75%[16]. Now if interest rate falls back to 9%, *option 1 loses because the strike rate under it is valid till t = 9,* while the second option of the portfolio 2 simply lapses. Thus, the gains are 0 from the latter and –0.25% from the former.

As Figure A.15.3 shows, gains from the portfolio of options in 2 are greater than or equal to the gain from the single option 1 in every eventuality. Thus, the present value of the former must exceed that of the latter.

You must have realised the necessity of assuming a flat term structure. If the 6-month LIBOR is higher than 3-month LIBOR at t = 0, say 9.5%, and both follow binomial process as above, then we cannot unambiguously say that the single option will yield smaller payoffs.

An extension of this result is the following proposition:

> Consider a 5-year cap on 3-month LIBOR with 3-month reset period versus a 5-year cap on 6-month LIBOR with 6-month reset period. Both have identical strike rates and face values. Once again, assuming a flat-term structure, the former will be worth at least as much as the latter.

In an exercise at the end of the chapter, you are asked to verify this with a numerical example.

Similar results hold for puts and floors. A portfolio of a 3-month and a 6-month puts on 3-month interest rate is more valuable than a 6-month put with the same strike and face value on the same 3-month rate. A floor on a shorter-period interest rate with shorter reset interval is more valuable than a floor on a longer-period rate with correspondingly longer reset period.

A.15.3 THE BLACK-SCHOLES MODEL FOR INTEREST RATE OPTIONS

We will briefly indicate how the Black-Scholes model can be modified to value interest rate options. The details are beyond our scope[17].

[16]Comparison is with borrowing for 3 months every 3 months.

[17]The interested reader can consult Stapleton and Subrahmanyam (*op.cit.*) for an introductory discussion and for a more advanced treatment.

The Black-Scholes (BS) model was originally developed to price options on common stock. Later it was extended to valuation of currency options. It values options on an asset whose price has an instantaneous lognormal distribution. It can be applied to value interest rate options, if the latter can be restated as options on an asset with stochastic price. It is well known that interest rates and prices of interest bearing instruments are inversely related. Consequently, an option on an interest rate, e.g. the *T*-bill rate can be restated as an option on a *T*-bill. Secondly, the original BS model assumes constant interest rate while the very rationale for interest rate options is interest rate uncertainty. This difficulty too can be circumvented by using Black's (1976) model for valuation of options on futures contracts.

Equivalence of interest rate options and options on suitable debt instruments is easy to see. Consider a 6-month call option on 6-month *T*-bill rate, with a strike rate of R. At maturity, it pays nothing if i, the spot add-on yield on 6-month bills is smaller than R; if it exceeds R, per dollar of face value it pays:

$$\frac{[i \times (182/360)] - [R \times (182/360)]}{[1 + i(182/360)]}$$

Now consider a 6-month put option on a 6-month *T*-bill with strike price of $1/[1 + R(182/360)]$ per dollar of face value. The option pays nothing if $i \leq R$.

If $i > R$, per dollar of face value it pays

$$\left\{\frac{1}{[1 + R(182/360)]} - \frac{1}{[1 + i(182/360)]}\right\}$$

Take K such put options where

$$K = [1 + R(182/360)]$$

then you can verify that the payoff from the K put options on T bills is identical to the payoff from the call option on *T*-bill rate.

Given this equivalence, the BS model can be extended to valuation of interest rate options if we assume that *T*-bill prices are log-normally distributed. The obvious limitation of this approach is the assumption that the variance of the price of a debt instrument remains constant over the life of the option. In reality, we know that as a debt instrument approaches maturity, this variance must decrease since at maturity, the price must equal the face value irrespective of the prevailing interest rate. Thus, the model can at best be used to value very short-life options on debt instruments with long maturities. These developments are not pursued here. The interested reader can consult the relevant references cited in the bibliography. A good starting point would be Hull (2009).

Chapter 16

Financial Swaps

16.1 INTRODUCTION

The geographical and functional integration of global financial markets presents borrowers and investors with a wide variety of financing and investment vehicles in terms of currency, type of coupon – fixed or floating – index to which the coupon is tied – LIBOR, US treasury bill rate, etc. ***Financial Swaps*** are an asset-liability management technique which permit a borrower to access one market and then exchange the liability for another type of liability. Investors can exchange one type of asset for another with a preferred income stream in terms of currency, and interest rate fixed or floating. We will see below that there are several reasons why firms and financial institutions might wish to implement such an exchange. Note that swaps by themselves are ***not*** a funding instrument or an investment vehicle; they are a device to obtain the desired form of financing or asset indirectly which otherwise might be inaccessible or too expensive.

The main purpose of this chapter is to provide an introductory exposition of the major prototypes of financial swaps and their applications. There are a large number of variations and combinations of the basic structures. We will briefly examine some of them mainly to illustrate the tremendous flexibility offered by swaps in combination with other instruments for management of assets and liabilities.

The growth in the volume and variety of swap transactions has outpaced the growth in the analytical literature dealing with theoretical explanations of swaps, their pricing and valuation. Even then, the topic is vast enough for specialist works to have made their appearance during the last few years. Detailed treatment of all these aspects is beyond the scope of this book. The focus in the text, therefore, will be on discussing a number of typical situations in which a firm can achieve its funding or investment objectives more effectively through a swap transaction rather than directly. The appendix will briefly outline an approach towards pricing and valuation of swaps.

Other aspects of swaps such as documentation, accounting, legal and tax issues are not dealt with here. For these topics as well as details of pricing and valuation, the reader can consult specialist works on the subject many of which are cited in the bibliography.

16.2 MAJOR TYPES OF SWAP STRUCTURES

All swaps involve exchange of a series of periodic payments between two parties, usually through an intermediary which is normally a large international financial institution which runs a "swap book". The two payment streams are estimated to have identical present values at the outset when discounted at the respective cost of funds in the relevant primary financial markets. So like a forward contract, the value of a swap at the start is zero.

The two major types of swaps are ***interest rate swaps (also known as coupon swaps)*** and ***currency swaps***. The two are combined to give a ***cross-currency interest rate swap***. A number of variations are possible within each major type. We will examine in some detail the structure of each of these below and indicate some of the variations.

16.2.1 Interest Rate Swaps

A standard fixed-to-floating interest rate swap, known in the market jargon as a ***plain vanilla coupon swap*** (also referred to as "exchange of borrowings") is an agreement between two parties in which each contracts to make payments to the other on particular dates in the future till a specified ***termination date***. One party, known as the ***fixed rate payer,*** makes fixed payments all of which are determined at the outset. The other party known as the ***floating rate payer*** will make payments the size of which depends upon the future evolution of a specified interest rate index (such as the 6-month LIBOR)[1]. The key features of this swap are[2]:

- **The Notional Principal**
  The fixed and floating payments are calculated as if they were interest payments on a specified amount borrowed or lent. It is ***notional*** because the parties do not exchange this amount at any time; it is only used to compute the sequence of payments. In a standard swap, the notional principal remains constant through the life of the swap.
- **The Fixed Rate**
  The rate applied to the notional principal to calculate the size of the fixed payment. Where the transaction is a straightforward 'plain vanilla' fixed/floating interest rate swap with the principal amount remaining constant throughout the transaction, swap dealers openly display the rates at which they are willing to pay or to receive fixed rate payments. A dealer might quote his rates as:

  US Dollar Fixed/Floating

2 Yrs	Treasury (4.50%) + 45/52
3 Yrs	Treasury (4.58%) + 48/56
4 Yrs	Treasury (4.75%) + 52/60
5 Yrs	Treasury (4.95%) + 55/68

  and so on out to perhaps 25 years.

  The dealer is, in fact, saying "I am willing to be the fixed-rate payer in a 2-year swap at a rate 45 basis points above the current yield on Treasury Notes which works out to 4.95%. I am also willing to be the fixed rate receiver at 52 basis points above the Treasury yield which would be 5.02%."

[1]The fixed rate payer is said to have "bought" the swap, while the floating rate payer is said to have "sold" the swap.
[2]We follow Miron and Swannell (1990) here.

As the floating rate will be LIBOR in both the cases, the dealer thus enjoys a profit margin of 7 basis points in the 2-year swap market.

The swap rates are close to long-term interest rates charged to top quality borrowers. Obviously, if the counterparty wishes to receive or make fixed payments at a rate other than the rates quoted by the bank, the bank will adjust the floating leg by adding or subtracting a margin over LIBOR. Thus, suppose 5-year treasury notes are yielding 8.50%. The bank is quoting swap rates of 5-year Treasuries + 30/50, i.e. it is willing to pay fixed at 8.80% in return for LIBOR; a firm wishes to receive fixed payments at 9.25%. The bank will require floating payments at LIBOR + 45 bp. This is an example of what are called ***off-market swaps***.

- **Floating Rate**

  In a standard swap at market rates, the floating rate is one of market indices such as LIBOR, prime rate, *T*-bill rate, etc. The maturity of the underlying index equals the interval between payment dates[3].

- **Trade Date, Effective Date, Reset Dates and Payment Dates**

  Fixed rate payments are generally paid semiannually or annually. For instance, they may be paid every March 1 and September 1 from March 1, 2007 to September 1, 2011, this being the termination date of the swap. The ***trade date*** is the date on which the swap deal is concluded and the ***effective date*** is the date from which the first fixed and floating payments start to accrue. For instance, a 5-year swap is traded on August 30, 2006, the effective date is September 1, 2006, and ten payment dates from March 1, 2007 to September 1, 2011. Floating rate payments in a standard swap are "set in advance paid in arrears", i.e. the floating rate applicable to any period is fixed at the start of the period, but the payment occurs at the end of the period. Each floating rate payment has three dates associated with it as shown in Figure 16.1.

Fig. 6.1 Relevant Dates for the Floating Payment

$D(S)$, the setting date is the date on which the floating rate applicable for the next payment is set. $D(1)$ is the date from which the next floating payment starts to accrue and $D(2)$ is the date on which the payment is due. $D(S)$ is usually two business days before $D(1)$. $D(1)$ is the day when the previous floating rate payment is made (for the first floating payment, $D(1)$ is the effective date above). If both the fixed and floating payments are semiannual, $D(2)$ will be the payment date for both the payments and the interval $D(1)$ to $D(2)$ would be six months. It is possible to have the floating payment set and paid in arrears, i.e. the rate is set and payment made on $D(2)$. This is another instance of an "off-market" feature.

- **Fixed and Floating Payments**

  The fixed and floating payments are calculated as follows:

$$\text{Fixed Payment} = P \times R_{fx} \times F_{fx}$$
$$\text{Floating Payment} = P \times R_{fl} \times F_{fl}$$

[3] In a non-standard swap, this need not be so. Floating payments could be semiannual, but indexed to 3-month LIBOR or vice versa.

Here, P is the notional principal, R_{fx} is the fixed rate, R_{fl} is the floating rate set on the reset date, F_{fx} is known as the "Fixed rate day count fraction" and F_{fl} is the "Floating rate day count fraction".

The last two are time periods over which the interest is to be calculated. For floating payments it is either $[(D_2 - D_1)/360]$ or $[(D_2 - D_1)/365]$[4], i.e. [Actual no. of days/(360 or 365)] depending upon the currency while for the fixed payments, it is either one of these or a third convention known as "30/360" basis[5]. The "Actual/365" basis is known as "bond basis" and the "Actual/360" basis is called "money market basis" in the US.

It is to be noted that in an interest rate swap, there is no exchange of underlying principal; only the interest payments are exchanged between the two parties.

In the appendix to this chapter, we have given the terms applicable to a generic US dollar coupon swap. Table 16.1 illustrates some quotes for USD, EUR and GBP interest rate swaps taken from the ***Financial Times***.

Table 16.1 Interest Rate Swap Quotes (September 19, 2013)

	USD		*EUR*		*GBP*	
	BID	***ASK***	***BID***	***ASK***	***BID***	***ASK***
2 Year	0.53	0.56	0.60	0.64	0.59	0.62
5 Year	1.79	1.82	1.40	1.44	1.95	2.00
7 Year	2.42	2.45	1.81	1.85	2.44	2.49
10 Year	3.00	3.03	2.25	2.29	2.91	2.96
15 Year	3.48	3.51	2.64	2.68	3.25	3.34

Source: Financial Times, September 20, 2013.

Normally the swap spreads over treasury rates are positive. However, in early 2010 and again towards the end of July 2010, the Financial Times reported that the swap spreads in the US dollar market had become negative. This was attributed to massive issues of fixed rate USD bonds by many companies and then their demand to convert these fixed rate liabilities into floating rate liabilities which led to banks bid rates on interest rate swaps falling below the treasury yields for the same maturity.

A number of variants of the standard structure are found in practice. The notional principal may change instead of remaining constant[6]. The maturity of the floating index may not be identical to the interval between two floating payments. The floating rate may be set not equal to the value of the index on the setting date, but as average of values on specified dates prior to the setting date[7]. In an off-market swap, the floating payments would have a margin over or under the index. A ***zero-coupon swap*** has only one fixed payment at maturity. A ***basis swap*** involves an exchange of two floating payments, each tied to a different market index, e.g. LIBOR and prime rate. In a ***callable swap***, the fixed rate payer has the option to terminate the agreement prior to scheduled maturity while in a ***puttable swap***, the floating rate payer has such an option. In an ***extendable swap***, one of the parties has the option to extend the swap beyond the scheduled termination date. In a ***forward start swap***, the

[4]Number of days from D_1 to D_2 are counted including D_1 but excluding D_2.

[5]In the "30/360" basis, the number of days from D_1 to D_2 are calculated assuming that all months have 30 days and divided by 360.

[6]In an ***Amortising Swap***, it decreases; in an ***Accreting Swap*** it increases while in a ***Rollercoaster Swap*** it initially increases and then decreases.

[7]In a delayed reset swap, the floating payments for a period are based on the value of the index at the end of the period rather than the beginning of the period.

effective date is several months even years after the trade date so that a borrower with an anticipated future funding requirement can take advantage of prevailing favourable swap rates to lock in the terms of a swap to be entered into at a later date. An ***indexed principal swap*** is a variant in which the principal is not fixed for the life of the swap but tied to the level of interest rates – as rates decline, the notional principal rises according to some formula.

Of course, all these option-like features have to be paid for by adjusting the size of the payments to be made or received.

We will look at an example to illustrate the above features of a standard interest rate swap.

- **A Three Year Fixed-to-Floating Interest Rate Swap**

  Notional principal P = \$50 million
  Trade Date: May 30, 2007.
  Effective Date: June 1, 2007.
  Fixed Rate: 5.5% p.a. payable semiannually.
  Floating Rate: 6-Month LIBOR.
  Fixed and Floating Payment Dates: Every December 1 and June 1 starting December 1, 2007 till June 1, 2010.
  Floating Rate Reset Dates: 2 business days prior to the previous floating payment date.

The fixed payments are as follows:

Payment Date	*Day Count Fraction*	*Amount*
1/12/2007	183/360	$1397916.67
1/6/2008	183/360	$1397916.67
1/12/2008	182/360	$1390277.78
1/6/2009	183/360	$1397916.67
1/12/2009	182/360	$1390277.78
1/6/2010	183/360	$1397916.67

The floating rates evolved as follows:

Reset Date	*LIBOR (% p.a.)*
30/5/2007	5.80
29/11/2007	5.20
30/5/2008	5.50
29/11/2008	4.90
30/5/2009	5.70
29/11/2009	6.20

This gave rise to the following floating payments:

Payment Date	*Amount ($)*
1/12/2007	1474166.67
1/6/2008	1321666.67
1/12/2008	1390277.78
1/6/2009	1245416.67
1/12/2009	1440833.33
1/6/2010	1575833.33

Normally, the payments would be netted out with only the net payment being transferred from the deficit to the surplus party.

16.2.2 Currency Swaps

In a currency swap, the two payment streams being exchanged are denominated in two different currencies. Usually, an exchange of principal amounts at the beginning and a re-exchange at termination is also a feature of a currency swap.

A typical ***fixed-to-fixed currency swap*** works as follows. One party raises a fixed rate liability in currency *X*, say US dollars, while the other raises fixed rate funding in currency *Y*, say EUR. The principal amounts are equivalent at the current market rate of exchange. At the initiation of the swap contract, the principal amounts are exchanged with the first party handing over USD to the second and getting EUR in return. Subsequently, the first party makes periodic EUR payments to the second, computed as interest at a fixed rate on the EUR principal, while it receives from the second party payments in dollars again computed as interest on the dollar principal. At maturity, the dollar and EUR principals are re-exchanged. A ***fixed-to-floating currency swap*** also known as ***cross-currency coupon swap*** will have one payment, say in currency *X*, calculated at a floating interest rate, while the other in currency *Y* is at a fixed interest rate. It is a combination of a fixed-to-fixed currency swap and a fixed-to-floating interest rate swap. It is also possible to have both payments at floating rate but in different currencies. Contracts without the exchange and re-exchange of principals do exist. In most cases, an intermediary – a swap bank – structures the deal and routes the payments from one party to another.

For both the interest rate and currency swaps, we have given examples of ***liability swaps***, i.e. exchanging one kind of liability for another. The same structures can be employed for ***asset swaps***. For instance, a financial institution may have floating dollar assets (say, corporate Floating Rate Notes or FRNs) funded with fixed rate dollar liabilities. It can contract to exchange the stream of floating payments with a stream of fixed rate payments with another party which has the opposite problem, i.e. it passes on its interest receipts from the FRNs to the other party and receives interest payments at a fixed rate. An investor with say CHF assets funded with USD denominated liabilities can enter into a currency swap to match the currency denomination of assets and liabilities.

16.3 MOTIVATIONS UNDERLYING SWAPS

Why would a firm want to exchange one kind of liability or asset for another? In other words, why take on one kind of liability or asset and then exchange it for another rather than contracting the desired kind of liability or asset in the first place? If a firm wants fixed rate funding, why not access the fixed rate market directly rather than taking on a floating rate loan and then doing a coupon swap? Similarly, if a firm wishes to have fixed rate USD funding, why not borrow in that market directly? Why go the route of borrowing in another currency and then do a currency swap? Several explanations have been advanced for the existence of a large and growing volume of activity in the swap markets. Most of these hypotheses rely on either a capital market imperfection or factors like differences in investor attitudes, informational asymmetries, differing financial norms, peculiarities of national regulatory and tax structures and so forth to explain why investors and borrowers use swaps.

Borrowers and investors differ in their preferences and market access. For instance, a manufacturing firm or a utility might prefer fixed rate funding to finance long gestation physical investment projects but finds that fixed rate investors do not view it very kindly, while it is able to borrow relatively easily in the floating rate market[8]. On the other side is a large international financial institution such

[8]This may not necessarily reflect a market inefficiency or imperfection. The firm may be willing to reveal much more information to its bankers than to the capital market at large or bankers may have an advantage in processing information compared to potential subscribers to the firm's bond issue.

as a money centre bank which can borrow on excellent terms in the fixed rate market but prefers floating rate funding because it has a large portfolio of floating rate loans. Or consider a firm which has borrowed from a Japanese government agency to finance imports of capital equipment from Japan. It exports to the Middle Eastern and African markets and expects to earn a steady income stream in US dollars. It might like to match the currency of its foreign exchange receivables and payables to hedge exchange risk. An American firm might find that while it can raise funds easily in the large US dollar domestic market, it is relatively unknown in Europe and faces rather high costs for a fixed rate CHF funding it would like to raise. An investor with a portfolio of fixed rate assets might have strong views that rates are going to rise and may wish to shift to floating rate assets. To sum up, because of differences in preferences, market access and expectations there are, at any time, borrowers and investors with mismatched assets and liabilities who would like to reshuffle their balance sheets or acquire new assets/liabilities to which direct access may be very difficult or expensive. Finally, swaps are also a low-cost device for achieving certain objectives which can be achieved by other means, but at a higher transaction cost. For instance, a firm may wish to retire its foreign currency loan and refund itself in the home currency market. Apart from any penalties attached to prepayment, transactions costs would be higher, if it retires an old issue and makes a new issue; the same objective can be achieved via a swap at a lower cost.

Obviously, swaps must help borrowers and investors overcome the difficulties posed by market access and/or provide opportunities for arbitraging some market imperfection. We will briefly look at some arguments offered to explain how swaps achieve this.

- **Quality Spread Differential (QSD)**
  This is one of the commonly offered explanations of the fixed-to-floating interest rate swaps. The argument can be illustrated by means of an example. Consider XYZ Corp., a manufacturing firm which wants to raise 5-year fixed rate dollar funding to finance an expansion project. Its credit rating is not very high, say ABB. It finds that it will have to pay 2% over 5-year treasury notes which are currently yielding 9%. In the floating rate market, it can issue 5-year FRNs at a margin of 0.75% over the prime rate. On the other hand, ABC Bank, a large bank looking for floating rate funding finds that it will have to pay prime rate, while in the fixed rate market, it can raise 5-year funds at 50 bp (0.50%) above *T*-notes due to its AAA rating. Thus, the spread demanded by the market between an AAA and a ABB credit is 150 bp in the fixed rate segment while it is only 75 bp in the floating rate segment. This differential is known as ***Quality Spread Differential (QSD)***. The requirements and access of the two parties are summarised below:

	XYZ	***ABC***
Requirement	Fixed Rate $	Floating Rate $
Cost fixed $	7%	5.5%
Cost floating $	Prime + 0.75%	Prime

  The bank ABC has an ***absolute advantage*** over the corporation XYZ in both the markets but the corporation has a ***comparative advantage*** in the floating rate market[9]. Both can achieve cost saving by each borrowing in the market where it has a comparative advantage and then doing a fixed-to-floating interest rate swap. Suppose the notional principal is $100 million. The terms of the swap arranged by a swap bank can be as follows:

[9]This is similar to the well-known Ricardian comparative advantage doctrine in trade theory. Germany may be more efficient than India in the production of both textiles and chemicals but its superiority in chemicals is greater than in textiles. India has a *comparative advantage* in producing textiles.

ABC borrows \$100 million at 5.5% s.a. (semi annual) fixed.
XYZ borrows \$100 million floating at prime + 0.75 payable semiannually.

ABC pays the swap bank (prime – 0.25%) on \$100 million every six months. The swap bank passes this on to XYZ. XYZ pays the swap bank 5.75% s.a. on \$100 million. The swap bank pays ABC 5.5% s.a.
Figure 16.2 shows the swap diagrammatically.

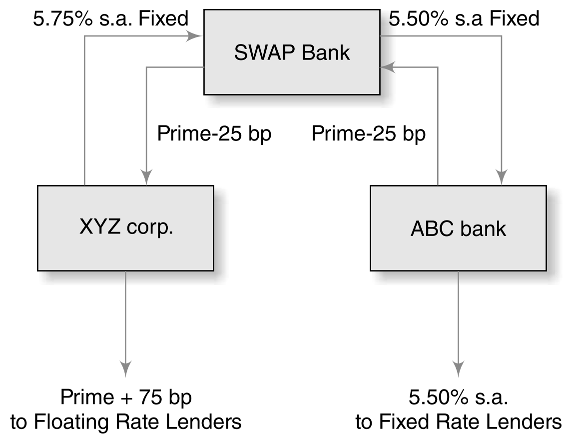

Fig. 16.2 Fixed-to-Floating Interest Rate Swap

The key result is that both the parties have achieved their objectives ***with some cost saving***:

XYZ Corp.: 5.75% + [prime + 0.75 – (prime – 0.25)]%
= 6.75% fixed rate, 25 bp below its own cost of fixed rate funds.
ABC Bank: 9.5% – 9.5% + prime – 0.25%
= prime – 0.25%, 25 bp below its own cost of floating funds.

The swap bank earns a margin of 25 bp.
The cost savings could be achieved by exploiting the comparative advantage. By ABC borrowing in the fixed rate market instead of XYZ, there was a saving of:

7.0 – 5.5 = 1.5%

and by XYZ borrowing in the floating market instead of ABC, there was a loss or extra cost of:

prime + 0.75 – prime = 0.75%

This results in a net gain of 0.75%. Notice that the gains of all three parties together equal this total gain. The division of the total gain between these parties is subject to negotiation depending upon supply and demand factors. The equal division assumed in the example is purely illustrative[10].

[10]This example also brings out another important point. ABC Bank would be willing to receive fixed at 9.5% or higher and pay prime in a fixed-to-floating swap instead of directly borrowing in the floating rate market. If the swap bank is willing to pay fixed less than 9.5%, ABC would be better off directly accessing the floating rate market. Similarly, XYZ would not be willing to pay more than 10.25% fixed in return for prime since it would be better off directly borrowing at fixed rate. In perfect capital markets, these two limits viz. 9.5% and 10.25% provide boundaries on swap rates for equivalent credit risks. If treasury rate is 9.75%, the boundaries on swap spreads would be 25 bp and 50 bp. However, capital market imperfections can cause swap spreads to deviate outside these boundaries.

QSD was one of the earliest explanations offered for interest rate swaps [Bicksler and Chen (1986)]. It continues to be featured in most non-rigorous discussions of swaps. However, the argument has been questioned by many writers. The existence of quality spread differential between fixed rate lending and floating rate lending has not been satisfactorily explained[11].

There is also a debate about whether the cost savings represent arbitrage gains or compensation for bearing additional risk[12]. Some writers have offered agency-theoretic explanations for the existence of interest rate swaps. We will not pursue this debate here. The interested reader can consult Turnbull (1987), Arak et al. (1988) and Wall and Pringle (1989). Litzenberger (1992) has critically examined these issues with a lucid discussion of effects of credit risk and legal provisions in the event of default, on swap pricing. It has also been pointed out that the quality spread differential may not represent an imperfection but a perfectly rational pricing decision [Arditti (1996)]. In any case, if it represents mispricing, it should have been arbitraged away long ago and the volume of swaps should have declined. Similarly, the "comparative advantage" argument is difficult to accept except as a short-term phenomenon and cannot explain the continually growing volume of swap transactions.

- **Market Saturation**

  One of the earliest currency swaps was the one between the World Bank and IBM executed in 1981. At that time the World Bank was looking for fixed rate funding in CHF and DEM (Deutschemark) to on-lend the funds to its clients. World Bank loans are serviced in the currency of borrowing so that exchange risk is entirely borne by the borrowing country. World Bank, therefore, had traditionally tended to borrow extensively in low nominal interest rate currencies such as the CHF and the DEM. Because of its frequent resort to these relatively small markets (compared to the US dollar domestic bond market), they had become "saturated" with World Bank paper. Consequently, despite its top AAA rating, World Bank faced rather stiff terms for borrowing fixed rate CHF and DEM. IBM had existing liabilities in these currencies contracted at a time when the dollar was weak against these currencies. Since then, due to the appreciation of the dollar, it had made a capital gain on its liabilities which it wanted to lock in. Objectives of both parties were achieved by the World Bank making a dollar bond issue in the US market and then swapping this liability for IBM's existing liabilities in CHF and DEM[13]. We will look into the exact mechanics of the deal in Section 16.5. Another explanation for currency swaps derives from the differences that were said to exist between attitudes of European and US investors towards formal credit rating[14]. European investors in countries such as Switzerland, Germany, France, etc., are said to be less sensitive to formal credit rating and attach greater weight to a company's name, reputation, etc., while

[11]The distinction between a medium- or long-term loan at floating rate and short-term borrowing repeatedly rolled over is important in this context. In the latter case, the lenders can reassess the borrower's financial conditions at each rollover date and adjust the risk premium over the market index. However, a medium- or long-term floating rate loan does not give this option. In that respect it is similar to a fixed rate loan and it is not clear why it should enjoy a quality spread differential. It could be attributed to the informational advantage enjoyed by floating rate lenders.

[12]Thus suppose an AAA rated, government backed agency can issue 10-year fixed rate notes at 30 bp over 10-year treasuries and a 10-year FRN at LIBOR minus 10 bp. If the current swap rate is 50 bp, i.e. the counterparty is willing to pay 50 bp over treasuries and receive LIBOR flat it would seem that the AAA agency can issue 10-year notes and do a fixed-to-floating swap to achieve floating funds at LIBOR minus 20 bp, a saving of 10 bp over its own cost. However, suppose the counterparty is an 'A' rated firm which would have to pay 125 bp over treasuries to borrow 10-year fixed. The AAA firm has taken on the credit risk of an inferior rating. In effect, one can argue that it has "lost" 85 bp.

[13]Thus, there was no initial exchange of principals.

[14]See, for instance, Beidelman (1985) who calls the phenomenon "spread compression".

US investors are said to be very particular about formal rating[15]. As a result of this, a company with worldwide reputation such as Coca-Cola or General Electric might find that even when its rating is not top quality, the spread that it has to pay over a top rated borrower is less in the continental markets than in the US market. Consequently, it would be better off borrowing in say CHF or EUR and swapping into US dollars.

A typical currency swap situation is illustrated by this example:

	Alpha Corp.	Beta Bank
Requirement:	Fixed $ funding	Fixed CHF Funding
Cost of $ Funding:	5.5%	4.5%
Cost of CHF Funding:	4.0%	3.5%

Once again, an overall saving of 0.5% can be achieved by the Beta bank borrowing in the dollar market, Alpha corporation in the CHF market and the two swapping the liabilities. Figure 16.3 shows the structure. Alpha corporation has effectively acquired fixed rate USD funding at 5.30%, 20 bp below its own cost, while the Beta bank has acquired CHF funding at 20 bp below its cost. The swap bank makes a gain of 10 bp[16] for a total gain of 50 bp.

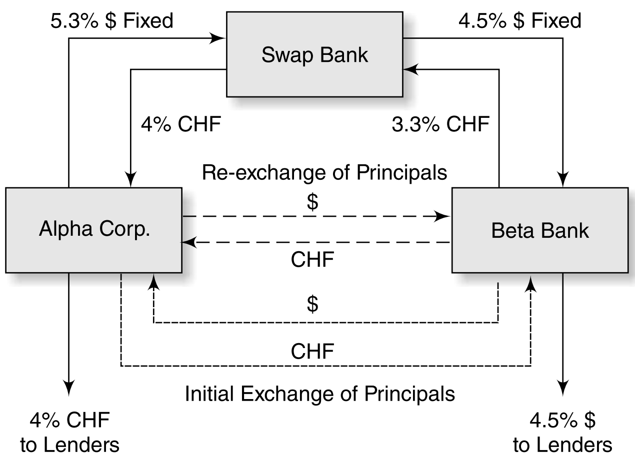

Fig. 16.3 A Currency Swap

- **Differing Financial Norms**

  Investors use a variety of financial ratios such as the debt:equity ratio, interest coverage ratio, etc., to assess financial health of a firm. Norms regarding "acceptable" values of these ratios differ across countries. For instance, Japanese companies tend to have much higher debt:equity ratios than what would be considered acceptable in the US[17]. A Japanese firm wanting to raise dollar funding might find a direct approach to the US market unattractive because its rating

[15]Some categories of institutional investors in the US are not permitted to invest in securities which are rated "below investment grade".

[16]For the swap bank, it is a little complicated. Its gain of 0.80% is in dollars while the loss of 0.70% is in CHF. Since the discount rates for these streams are different, one cannot simply add the two to find the net gain. Also, note that the bank is exposed to the risk of appreciation of CHF.

[17]This is attributed by some writers to the fact that Japanese banks have a much closer involvement with Japanese companies through their large shareholdings.

may be affected by its high debt:equity ratio. It might be cheaper to borrow at home in yen and then execute a swap.

- **Hedging Price Risks**
  The factors considered so far, made swaps an attractive funding tool from the point of view of lowering financing costs. An equally important objective underlying swaps is hedging of interest rate and exchange rate risks. Swapping out of a floating rate debt (or asset) into a fixed rate debt (or asset) could be motivated purely by the desire to eliminate interest rate risk rather than saving on borrowing costs (or improving return on investment). Similarly, swapping out of, say, a EUR denominated liability into a USD denominated liability, is a way of eliminating exchange rate exposure if the firm has certain future inflows in dollars. In a basis swap mentioned above, a bank with LIBOR tied assets funded with prime-tied liabilities may wish to eliminate basis risk (created by the fact that prime rate and LIBOR are not perfectly correlated) by doing a swap. Arditti (1996) has argued that swaps are possibly the only low-cost hedging device for long-dated risks and hence, their continuing popularity.

- **Other Considerations**
  A few other possibilities have been pointed out where swaps provide an efficient way of achieving the firm's objectives. In some capital markets, e.g. Japan, the authorities regulate the timings of foreign issues by means of a queue system. Suppose an American firm is way back in the queue and needs yen funding urgently. It can "jump the queue" by entering into a currency swap with a firm which is at the head of the queue and is willing to accept dollar funding. A firm may be able to access markets via swaps which it otherwise cannot enter profitably. Occasionally, differences in tax laws across countries create profitable swap opportunities. A firm which believes that the market is overestimating its credit risk may borrow floating, say at LIBOR + 2% and swap into fixed. At subsequent rollovers, it hopes to see its credit spread come down to say 1% thus realising a net saving. Thus, informational asymmetries may be another reason driving the interest rate swap market. Finally, as we will see below, swaps can be used to convert callable debt into non-callable debt. If firms believe that investors under-price the call option, they grant to the issuers of callable debt (and thus, demand lower premium over comparable non-callable debt), firms can achieve savings in funding costs by issuing callable bonds and using swaps to convert them into non-callable debt. Some examples in Section 16.5 will illustrate some of these possibilities.

16.4 EVOLUTION OF SWAP MARKETS

Most analysts agree that the origins of the swap markets can be traced back to 1970s when many countries imposed foreign exchange regulations and restrictions on cross-border capital flows. Borrowers and investors wishing to diversify the currency composition of their assets and liabilities had to find ways of circumventing these controls.

Early precursors of swaps are seen in the so-called ***back-to-back*** and ***parallel loans***. In a back-to-back loan, firm X, resident in country A, lends to firm Y, resident in country B in the currency of A, in return for Y lending to X in the currency of B. Thus, a UK firm with good access to domestic sterling market may keep a sterling deposit with the London branch of an American bank in return for a dollar loan from the parent bank in US. In a parallel loan, company X lends to a subsidiary of company Y located in country A, while company Y simultaneously lends to a subsidiary of company X located in country B. The two loan transactions are distinct, each with its own documentation, jurisdiction and no right of offset, i.e. a default on the part of the subsidiary of *Y* located in country *A* does not automatically cancel the obligation of the subsidiary of *X* to the parent *Y* in country *B*.

As exchange controls were liberalised in the eighties, currency swaps with the same functional structure replaced parallel and back-to-back loans. Swaps were more flexible and required simpler documentation. The entire deal is covered by a single documentation, subject to a single jurisdiction and has a right of offset built into the contract. Further, impetus to the growth of swaps was given by the realisation that swaps enable the participants to lower financing costs by arbitraging across a number of capital market imperfections, regulatory and tax differences. The disintermediation process of eighties in which more and more borrowers started approaching the investors directly rather than through banks, encouraged merchant and investment bankers to look for other sources of income such as front-end fees for arranging swaps.

In the early years, banks only acted as brokers to match the two counterparties with complementary requirements and market access. Thus, when a firm wishing to swap out of a floating rate liability approached a bank, the bank located a counterparty wishing to swap out of a fixed rate liability, arranged a swap and collected a fee.[18] Normally such deals were associated with new borrowings.

With the increase in the use of swaps as an active asset/liability management tool, banks became market makers, i.e. the bank would "take a swap on its own books" by itself becoming a counterparty in a swap. As market makers, they provide bid/offer quotes for both interest rate and currency swaps. Subsequently, the bank will lay off its exposure by entering into one or more swaps to achieve an overall balanced book in terms of currency and interest rate basis – floating and fixed. In the meanwhile, it would hedge its exposure using other instruments such as futures, FRAs, treasury notes and *T*-bills.

With banks prepared to act as market makers, there was a tremendous increase in the liquidity of the swap markets in major convertible currencies. The Bank for International Settlements in its quarterly review of June 2013 has reported outstanding notional principal amount of 370 trillion US dollars for interest rate swaps and a little over 25.4 trillion US dollars for currency swaps as of December 2012.

When a bank takes the swap onto its books, it subjects itself to a variety of risks. It assumes the credit risk of the counterparty[19], exchange rate risk, interest rate risk, basis risk, and so forth. Even with laying off the swaps, it is impractical to attempt to find an exact match in terms of currency, maturity, payment frequencies, floating index, etc. for each swap in its portfolio of swaps. Some residual risk always remains and may have to be hedged with other instruments. Also, there is the question of counterparty credit risk. Suppose a bank has a coupon swap with counterparty *A* in which it pays fixed and receives floating; it has offset this with another swap with counterparty *B* in which it pays floating and receives fixed. If counterparty *A* defaults, i.e. fails to make its floating payments, the agreement allows the bank to stop making the fixed payments to *A*. However, it must continue to meet its obligations under the swap with party *B*. Thus, now it has a mismatched structure with fixed payments coming in and floating payments going out. It faces the risk of rising interest rates. It might attempt to replace the swap with *A* by another swap with some counterparty *C*. But it may have to do so at rates which result in a net loss[20]. Lately, banks have realised that a large swap

[18]Such deals were almost always struck between counterparties with top credit ratings so that default risk concerns were minimised. Even then, the contract specified what are called "right of offset clauses" to handle events of default by either party.

[19]Even after it has laid off the swap with another counterparty, this risk persists since now it has taken on the credit risk of both the counterparties.

[20]As we will see below, counterparty *A* is likely to default only when swap rates have risen. Thus, in the replacement swap, the bank would have to pay a higher fixed rate than it is receiving from party *B*. The floating sides will cancel out and the bank has a net loss.

portfolio exposes them to risks which are very complex in nature and difficult to hedge[21]. The topic of managing the risk of a swap portfolio is beyond the scope of this book. The reader is referred to specialist works on the subject some of which are cited in the bibliography.

16.5 APPLICATIONS OF SWAPS: SOME ILLUSTRATIONS

- **Locking in a Low Fixed Rate**

  We have seen above how a plain vanilla coupon swap is used to exploit the quality spread differential to reduce the cost of funding. We now illustrate one more application of interest rate swaps.

  XYZ Co. raised 7-year fixed rate funding three years ago via a bond issue at a cost of 12% p.a. It then swapped into floating rate funding in which it received fixed at 11.75% annual and paid 6-month LIBOR. Thus, it achieved floating rate funding at LIBOR + 25 bp. The rates have now eased and the firm wishes to lock-in its funding cost. The swap market is now quoting a swap offer rate of 8.60% against 6-month LIBOR for 4-year swaps. XYZ enters into a 4-year swap in which it pays fixed at 8.60% annual and receives 6-month LIBOR. It has locked-in a fixed funding cost of 8.85% p.a. Figure 16.4 shows the resulting structure.

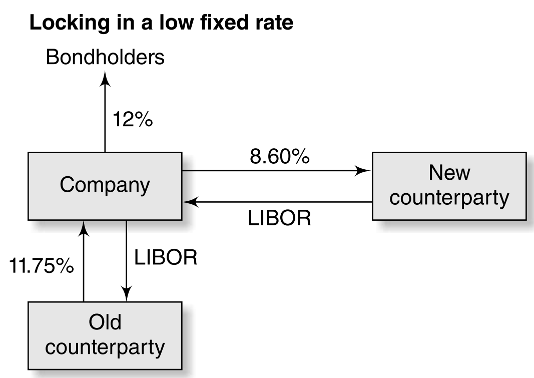

Fig. 16.4

- **The World Bank-IBM Currency Swap**[22]

  This particular swap deal is said to have really launched the swap market. It was a part of the World Bank's programme to diversify its sources of funding in low nominal interest rate currencies like the CHF and DEM (Deutschemark, the German currency at that time) since no single market could support a large borrowing requirement like the Bank's without getting saturated. In the summer of 1981, the World Bank wished to raise CHF and DEM funding for its lending programme. Instead of tapping these markets directly via fixed rate bond issues, it achieved the same objective by means of a currency swap with IBM.

[21]As long as banks were acting only as brokers, swaps could be regarded as "off balance sheet" transactions, i.e. while the bank earned a fee income, it acquired neither an asset nor a liability on its books. When the bank takes the swap on its books, this is no more the case. For instance, in an interest rate swap as a fixed rate payer, it effectively has a fixed rate liability and a floating rate asset. This meant that the banks had to acquire additional own-capital to meet the capital requirements norms imposed by bank regulators. The Basle Committee guidelines specify capital ratios for swaps based on the type of swap and its maturity.

[22]This example has been taken from Bock (1985). It is an oft-quoted illustration of currency swaps.

In exploring the swap avenue, the Bank had three primary guidelines:

1. The cost of borrowing via a swap must be no higher than that via direct borrowing
2. The counterparty must be of top credit-worthiness and
3. No currency exposure must be created

At that time, IBM had several outstanding bond issues in CHF and DEM on which a potential capital gain had been made because of the strengthening of the dollar against these two currencies. IBM wished to realise the gain by converting its liabilities to dollars[23].

The steps in designing the swap were as follows:

1. On August 11 1981, the Bank launched a bond issue in the US market with a face value of $210 million, maturity 4.6 years. Net of commissions and expenses at 2.15%, it realised $205,485,000. The bond issue was settled on August 25 which also became the effective date for the swap. How this amount was arrived at is explained below.
2. IBM's CHF and DEM liabilities called for annual interest payments of CHF 12.375 million and DEM 30 million starting March 30, 1982 with bullet repayments of principal of CHF 200 million and DEM 300 million, respectively on March 30, 1986. An all-in cost of 8% for CHF and 11% for DEM was acceptable to the Bank. The CHF and DEM cash flows associated with the IBM bonds were discounted at these rates to find their present value as of August 25, 1981. The only minor complication here is that the discount factors had to incorporate the first fractional year period – August 25, 1981 to March 30, 1982 or 215 days[24]. The cash flow schedules and the discount factors are set out in Table 16.2 below.

   The present values of these flows (as of August 25, 1981) were CHF 191,367,478 and DEM 301,315,273, respectively. On August 11, 1981, the World Bank bought forward these amounts of CHF and DEM against the dollar, for delivery on August 25. The rates it obtained were CHF/USD 2.18 and DEM/USD 2.56. At these rates, the above CHF and DEM amounts translate into $87,783,247 and $117,701,753, respectively for a total of $205,485,000. To realise this net amount, the face value of the dollar issue had to be $210 million, issued at par.
3. Dollar funding cost acceptable to IBM was 16%. Dollar cash flows to be paid by IBM to the Bank were calculated by applying this coupon to the principal amount of $210 million, with bullet repayment on March 30, 1986, again taking account of the first fractional year period. The dollar cash flows are set out in Table 16.3.

Table 16.2

Exchange Date	*CHF Flows (Mill)*	*CHF Discount Factor*	*DEM flows (Mill)*	*DEM Discount Factor*
30/3/82	12.375	0.95507746	30.00	0.93957644
30/3/83	12.375	0.88433099	30.00	0.84646526

(Contd.)

[23]There is another issue here which makes swaps attractive. IBM could have realised the capital gain by borrowing dollars to retire its DEM and CHF liabilities. However, then it would pay a capital gains tax. The swap allowed it to lock in the gain without realising it thus deferring the tax liability.

[24]Thus, the discount factor for the first cash flow occurring on March 30, 1982, at 8% discount rate is

$$1/(1.08)^{\mathbf{215/360}} = 1/(1.08)^{\mathbf{0.597222}} = 0.95507746$$

For the subsequent cash flows occurring on March 30, 1983, 1984, etc., the exponents in the discount factors would be 1.597222, 2.597222, etc. Similarly, for the DEM cash flows with a discount rate of 11%.

30/3/84	12.375	0.81882499	30.00	0.76258132
30/3/85	12.375	0.75818128	30.00	0.68702010
30/3/86	212.375	0.70201045	330.00	0.61892811

Table 16.3

Date	*Dollar Cash Flow*
30/3/1982	20,066,667
30/3/1983	33,600,000
30/3/1984	33,600,000
30/3/1985	33,600,000
30/3/1986	243,600,000

4. The World Bank and IBM agreed to exchange the CHF and DEM flows in Table 16.1 against the dollar flows in Table 16.2[25].

   Gain to the World Bank was a lower cost of funding than via direct borrowing[26]. IBM gained in two ways, viz. exchange gain and capital gain due to changes in DEM and CHF interest rates. Consider IBM's DEM liability. Suppose the DEM value of this liability is L_0 and the DEM/USD exchange rate when it was contracted (early 1980) was S_0. If the dollar has appreciated to S_1 by August 1981, the exchange gain is:

   $$L_0(S_0 - S_1)$$

   In addition, if DEM interest rates have increased, the present value of its future DEM outflows at the now higher interest rate is less than L_0[27]. IBM could have achieved this gain without the swap by borrowing dollars and prepaying the DEM and CHF liabilities. However, there are usually penalties for prepayment unless the bonds have a call provision in which case, a higher coupon has to be paid.

- **A Multi-Party Swap**
  This is a hypothetical example of how the three main types of swaps – interest rate, currency and cross-currency interest rate – can be combined into a single structure to simultaneously serve the needs of several parties.

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[25]Effectively, a set of synthetic forward exchange rates have been worked out for IBM selling dollars against DEM and CHF.

[26]One must of course ask why the World Bank wishes to borrow in DEM and CHF in the first place. It could borrow in dollars, convert spot to DEM and CHF and on-lend these currencies. The higher nominal interest rate on dollar loans reflects the expected depreciation of the dollar. The World Bank's decision to borrow in DM and SFr must be based on its assumption that dollar will not depreciate as much as the interest differential.

[27]The value of the DEM liability is now

$$L_1 = L_0\left[\frac{i_{m0}}{i_{m1}} - \frac{i_{m0}}{i_{m1}}(1+i_{m1})^{-T} + (1+i_{m1})^{-T}\right]$$

where i_{m0} is the DEM interest rate at the time the liability was contracted, i_{m1} is the interest rate at the time the swap was done and T is the number of periods remaining to maturity.

When $i_{m1} = 0$, $L_1 = (T\, i_{m0}\, L_0 + L_0)$,

when $i_{m1} = i_{m0}$, $L_1 = L_0$ and

$\partial L_1/\partial i_{m1} < 0$. Thus, $L_1 > L_0$ if $i_{m0} > i_{m1}$ and $L_1 < L_0$ if

$i_{m0} < i_{m1}$. If DEM interest rate has risen, IBM has made a capital gain. See Park (1984).

In late 1985 XYZ Gmbh., a medium sized German engineering firm decided to raise a 5-year US dollar funding of $100 million to initiate some operations in the US. The firm was unknown outside Germany and initial exploration revealed that it will have to pay at least 10% on a fixed rate medium-term dollar borrowing. It could acquire a floating DEM loan at a margin of 75 bp over 6-month LIBOR. It approached a large German bank (referred to as "the Bank" in what follows) for advice.

The Bank located four smaller German banks who were willing to acquire fixed dollar assets, but could fund themselves only in the euroDEM market on a floating rate basis. They were willing to lend dollars to XYZ on the following terms:

Amount	:	$100 million
Interest rate	:	9.5% p.a. payable annually
Up-front fee	:	1% of the principal
Repayment	:	Bullet in January 1991

The effective cost for XYZ works out to 9.76%[28], 24 bp below what it would pay in a direct approach to the market. The syndicate of banks wished to convert their DEM liability into a dollar liability to match this dollar asset. The Bank did cross-currency fixed to floating swap with the four banks in the syndicate as follows:

- Each bank in the syndicate sold DEM 40 million to the bank in return for $24.75 million.
- Each bank agreed to pay fixed dollar payments annually beginning January 1987 to the Bank calculated as 9% interest on $25 million.
- Each bank received 6-month LIBOR on DEM 40 million in January and July beginning July 1986, the last payment being in January 1991.
- Each bank agreed to exchange $25 million against DEM 40 million with the Bank in January 1991.

The Bank acquired $99 million in the spot market at the rate of DEM 1.59/USD. The Bank now has a series of fixed dollar inflows against floating DEM outflows.

PMW, a large German automobile firm had an outstanding fixed rate liability of $100 million, at a coupon of 8.5% annual, bullet repayment in January 1991. The liability was contracted in January 1981, when the exchange rate was DEM 2.50/USD. PMW wished to lock in the capital gain on this by exchanging it for a fixed rate DEM liability. The Bank did a currency swap with PMW as follows:

- Beginning January 1987, the Bank will pay PMW each year till January 1991, fixed dollars at the rate of 8.50% on $100 million.
- Beginning January 1987, PMW will pay the Bank fixed DEM at 8% on DEM 160 million annually till January 1991.
- In January 1991, the Bank will pay PMW $100 million in exchange for DEM 160 million.

Now the Bank has laid off its fixed dollar inflow from the syndicate banks. It now has a fixed DEM inflow and a floating DEM outflow.

A well-known German financial institution specialising in floating rate housing loans was planning to enter the capital market with an issue of fixed rate DEM bonds. It wished to convert this liability into a floating rate liability. The terms of the bond issue were:

Amount	:	DEM 160 million
Maturity	:	5 years, bullet repayment in January 1991

[28]This is the IRR for the stream –99, 9.5, 9.5, 9.5, 9.5, 109.5.

Coupon	:	7.5% annual
Commissions and expenses	:	1.5% of the face value
Agency fee	:	0.10% on coupon

The effective all-in cost of this borrowing works out to 7.88% p.a.

The Bank and the financial institution entered into a fixed-to-floating interest rate swap on the following terms:

- Beginning January 1987, the Bank paid the financial institution a fixed amount of DEM 12.012 million, every year till January 1990, representing the coupon plus agency fee on the latter's bond issue. In January 1991, it paid DEM 13.512 million representing the coupon, agency fee and the commission and expenses.
- Each July and January, beginning July 1986 till January 1991, the financial institution paid the Bank 6-month LIBOR on DEM 160 million.

The Bank has now laid off all its exposures. The requirements of all participants have been catered to. Figure 16.5 is a diagrammatic representation of the complete structure of this deal. (To avoid cluttering up the figure, we have not shown the exchanges of principals that take place between the Bank and the syndicate banks as well as the final exchange between PMW and the Bank).

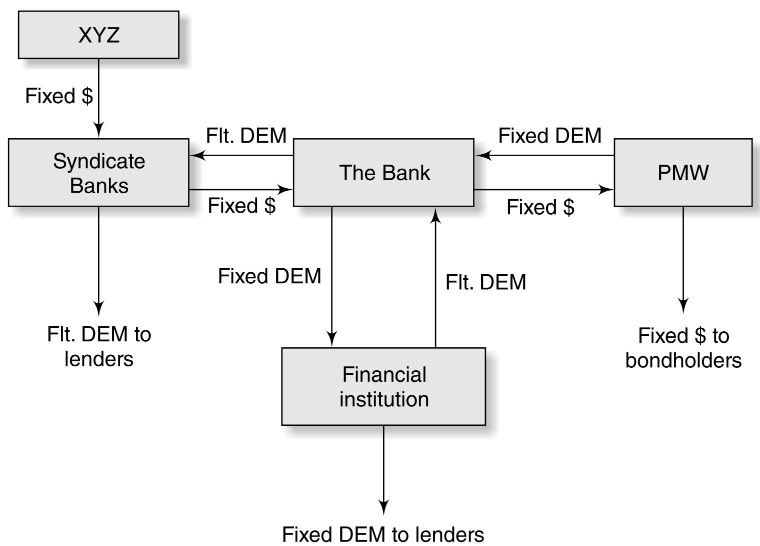

Fig. 16.5 A Multiparty Swap

Let us work out the Bank's position after all transactions have been executed. Note that the semiannual floating DEM flows cancel out. Tables 16.4 and 16.5 show the Bank's cash flows in dollars and DEM, respectively. In each column of these tables, a minus indicates outflow from the Bank to the party while a plus indicates inflows to the Bank from the party.

Thus, the Bank has generated for itself a tidy income stream. Of course, it has subjected itself to counterparty credit risk.

Table 16.4 The Bank's US Dollar Cash Flows (Millions)

Date	*Syndicate Banks*	*PMW*	*Market*	*Total*
January 86	–99		+99	—
January 87	+ 9	–8.5		+0.5
January 88	+ 9	–8.5		+0.5
January 89	+ 9	–8.5		+0.5
January 90	+ 9	–8.5		+0.5
January 91	+109	–108.5		+0.5

Table 16.5 The Bank's DEM Cash Flows (Millions)

Date	*Syndicate Banks*	*PMW*	*Market*	*Financial Institution*	*Total*
Jan. 86	+160		–157.41		+3.3
Jan. 87		+12.8		–12.012	+0.788
Jan. 88		+12.8		–12.012	+0.788
Jan. 89		+12.8		–12.012	+0.788
Jan. 90		+12.8		–12.012	+0.788
Jan. 91	–160	+172.8		–13.012	–0.212

- **A Basis Swap Coupled with a Plain Vanilla Interest Rate Swap**

Beidelman (1985) cites the case of a large US manufacturing firm which preferred fixed dollar funding. It had prime-based floating rate funding. It was willing to pay 175 bp over 5-year treasuries and receive floating prime. However, it was found to be very difficult to locate a counterparty which would do a fixed-to-prime dollar swap. An intermediary structured a three-party swap as follows:

1. A group of Japanese banks paid LIBOR in return for fixed dollar at 100 bp over 5-year treasuries.
2. A US based bank with LIBOR based funding and prime based assets was willing to receive floating dollars at LIBOR and pay floating dollars at prime minus 75 bp. This is a basis swap. Figure 16.6 shows the structure of this three party swap.

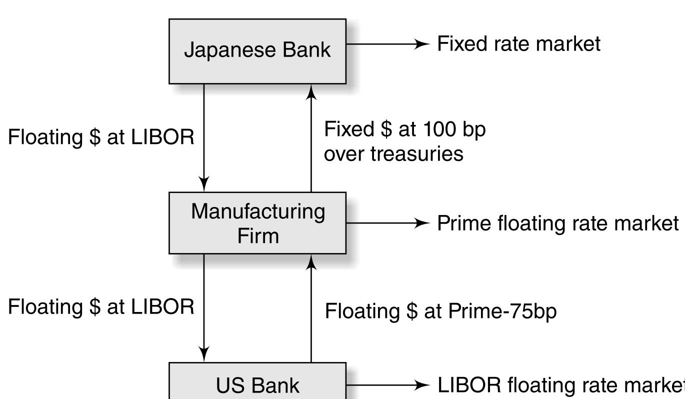

Fig. 16.6 A Basis Swap Coupled with a Coupon Swap

16.6 FURTHER INNOVATIONS

The swap markets have evolved several innovative products during the last five or so years. Most of them are over-the-counter products offered by commercial and investment banks often with somewhat confusing proprietary names. They originated as a response to specific needs of investors and borrowers to achieve customised risk profiles or to enable them to speculate on interest rates or exchange rates when their views regarding future movements in these prices differed from the market. We will briefly look at some of them which have gained considerable popularity over the years.

A ***Callable Coupon Swap*** is a coupon swap in which the fixed rate payer has the option to terminate the swap at a specified point in time before maturity. A ***Puttable Swap*** can be terminated by the fixed rate receiver. Let us look at a particular application of a callable swap.

- **Transforming Callable Debt into Straight Debt**
  Recall from Chapter 6 that a callable bond has a provision for early redemption at the option of the issuer. The issuer will exercise the option if interest rates have fallen. A firm issues a 7-year bond, callable at par after three years. The issue is priced to yield 12.20% which is 20 bp above what the firm would have paid for a straight, i.e. non-callable bond. The firm then sells a seven-year swap callable after 3 years in which it receives fixed at 12.40% and pays 6-month LIBOR. The counterparty to this swap has paid a 40 bp premium for the option to terminate the swap prematurely. The firm now has floating rate debt at LIBOR-20 bp. It then combines this with a plain vanilla coupon swap in which it pays 12% fixed and receives 6-month LIBOR. The entire structure is shown in Figure 16.7.

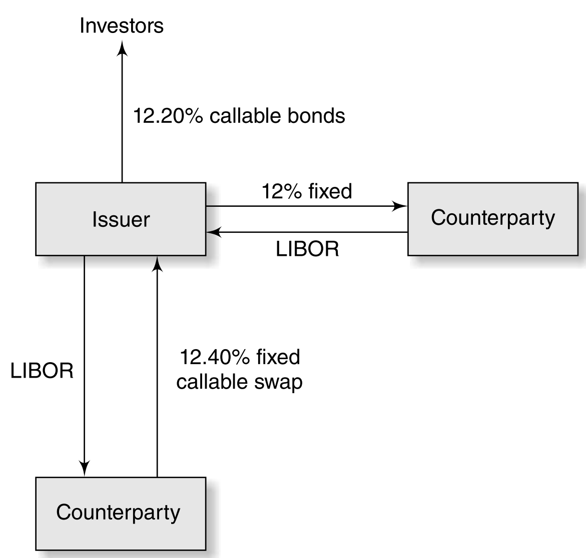

Fig. 16.7 Transforming Callable Debt with a Callable Swap

After 3 years, if interest rates have risen, the bond will not be called. Also, the callable swap will not be terminated. The firm has fixed rate funding at 11.8% for the entire seven-year period.

If the rates have fallen, the firm will redeem the bond issue and fund itself with a floating rate liability. Suppose it is able to do this at LIBOR. The counterparty in the callable swap will wish to terminate the swap. The plain vanilla swap will continue. The firm now has fixed rate funding at 12% for the remaining four years.

Swaption, as the name indicates is an option to enter into a swap at a specified future date, the terms of the swap being fixed at the time the swaption is transacted.

Consider first an interest rate swaption[29]. An industrial firm has an ongoing $500 million commercial paper programme in which it rolls over its paper every thirty days. Rates have recently crept lower, but the firm wants to protect itself and possibly benefit from a rise in rates.

The rate it has to pay on its paper tracks a market index known as Federal Reserve's composite commercial paper index for AA rated companies. The firm entered into a deal with Lehman Brothers which the latter have christened a "Reversal Swaption". The features of this deal are as follows:

1. The maturity of the contract is two years. Under the terms, the company receives from Lehman Brothers the commercial paper composite rate and pays 8.35% fixed. This is 15 bp below the market swap rate for a two-year fixed vs. commercial paper swap.
2. At the end of three months, Lehman Brothers had the option of entering into a swap with maturity of 1 year and 9 months which would essentially reverse the first swap if the option is exercised. Under this second swap, Lehman Brothers would pay the firm 8.60% fixed and the firm would pay the commercial paper composite rate.

If, at the end of 3 months, the 21-month fixed-to-CP swap rate is greater than 8.60%, Lehman Brothers would exercise its option. The firm would borrow every month at the market CP rate, but make a gain of 25 bp on the swaps (pay 8.35% fixed and receive 8.60% fixed). Its borrowing cost would be 8.35% for the first three months and 25 bp below the CP rate for the remaining 21 months. If the swap rate is below 8.60%, the option would not be exercised and the firm's borrowing cost would be fixed at 8.35% for two years.

A ***Cross Currency Swaption*** (also known as ***Circus Option***) is an option to enter into a cross-currency swap with any combination of fixed and floating rates. Party *A* sells/buys the right to enter into a currency swap with party *B*, on a specified date, wherein party *A* pays a stated fixed/floating rate in currency *X* and receives a stated fixed/floating rate in currency *Y*. The amounts of the two currencies for the final exchange of principals are also specified. There may or may not be an initial exchange of principals. The following example illustrates an application[30].

- A Swedish agency issues 5-year SEK notes with 9.30% coupon for a total amount of SEK 500 million. The investors have a one-time option expiring in one year, to convert the notes into dollar notes with a coupon of 8.75% at an exchange rate of USD/SEK 5.00. The investor pays for this option in the form of a lower coupon. To hedge its risk in the event of exercise by the investors, the issuing agency enters into a cross-currency fixed-to-fixed swaption with the following features:
  - $ principal 100 million payable at maturity by the swaption writer.
  - SEK principal 500 million payable at maturity by the Swedish agency.
  - Maturity: 4 years from exercise.
  - Writer of the swaption pays 8.50% semiannual fixed dollars.

[29]The example described here is from a special supplement to Euromoney (April 1990) sponsored by Lehman Brothers.

[30]The example is taken from ***Dictionary of Derivatives 1992,*** published by Euromoney Publications, London.

◇ The Swedish agency pays 9.30% s.a. fixed SEK.
◇ No initial exchange of principals.
◇ Premium: 2.53% i.e. SEK 12.65 million paid by the Swedish agency.

How do the borrower and the investor view this deal?

From the borrower's point of view, a borrowing cost of 9.97% has been locked in irrespective of whether or not the investor exercises the conversion option. This is somewhat lower than the agency's usual funding cost of 10% annual in SEK. The investor hopes to gain from currency and interest rate movements. A dollar appreciation increases the value of the conversion option and protects the investor against rising dollar interest rates.

Another innovation which has gained some popularity in recent years is called ***switch LIBOR swaps***, also known as ***currency protected swaps*** **(CUPS)** and ***differential swaps*** (Diffs). Conceptually, it is a cross-currency basis swap ***without currency conversion***. The basic idea can be explained with an example. Suppose short-term interest rates in the US are very low and the yield curve is steeply rising. On the other hand, short rates in Europe are high and the yield curve is inverted. A US investor with floating dollar assets would like to increase the immediate yield on its assets without taking on exchange risk. It enters into a differential swap with a bank under which it hands over floating payments on a notional dollar principal indexed to say the US 6-month LIBOR and receives from the counterparty floating payments, in dollars, on the same notional principal at 6-month EURIBOR minus a spread. The spread reflects differentials in long-term interest rates between the two currencies. The counterparty, usually a bank, would create the "diff" using two separate interest rate swaps. It would pay the floating dollars in return for fixed dollars in one swap, convert these fixed dollars into EUR and use the EUR to pay fixed in a fixed-to-floating EUR interest rate swap. The floating EUR received are converted to dollars to be paid to the US investor[31]. The spread under EURIBOR that the investor must accept[32], compensates the bank for the difference in dollar and EUR swap rates. Underlying the deal are differences in expectations about movements in short-term rates. The US investor does not expect dollar rates to rise as sharply or EUR rates to fall as sharply or both as reflected in the two yield curves. For further analysis of diff swaps, see Litzenberger (1992).

A ***Yield Curve Swap*** is, like a basis swap, a floating-to-floating interest rate swap in which one party pays at a rate indexed to a short rate such as 3- or 6-month LIBOR while the counterparty makes floating payments indexed to a longer maturity rate such as 10-year treasury yield. Both rates are reset quarterly or semi-annually. The long maturity rate is generally the Constant Maturity Treasury (CMT) yield which is the par yield for a US government treasury security with the exact maturity of the given number of years. This rate is computed by fitting a zero-coupon yield curve to the price data on actually traded securities. Many other innovations are discussed in Das (2001).

In a ***fixed-to-floating commodity swap***, one party makes a series of fixed payments and receives floating payments tied to a commodity price index or the price of a particular commodity. In an ***equity swap***, one party pays the total return on an equity index such as S&P 500 and receives payments tied to a money market rate such as LIBOR. The total return consists of dividend distributions on the underlying stocks as well as capital gains.

[31]Thus, the bank is exposed to exchange risk. The number of dollars to be received under the dollar interest rate swap is known, but not the EUR/USD exchange rate at which these dollars can be converted into EUR to pay fixed on the EUR interest rate swap. Similarly, the number of EUR to be received in the floating leg of the EUR swap is also unknown.

[32]Alternatively, he must pay a spread over dollar LIBOR.

16.7 INTEREST RATE SWAPS IN THE INDIAN MARKET

In the RBI Governor's statement on Mid-Term Review of Monetary and Credit Policy for 1998-99 announced on October 30, 1998, it was indicated that RBI would facilitate introduction of interest rate swaps (IRS) as another step towards liberalising and deepening the Indian money markets. Guidelines on FRAs and IRS were issued on July 7, 1999.

Banks and financial institutions are permitted to make a market in interest rate swaps without any restrictions on the size of the notional principal and the tenor of the agreement. Corporates are allowed to enter into IRS agreements only to hedge underlying exposures and market making banks are required to obtain evidence to that effect before making a deal with a corporate client. Banks are allowed to assume uncovered positions. Limits on these positions in different maturity buckets should be evolved by the bank's top management board and vetted by RBI. Banks must observe capital adequacy norms and the procedure for computing minimum capital ratios has been specified in the guidelines. We have described it in the appendix to this chapter. Details pertaining to documentation, accounting treatment and reporting of swaps are also contained in the guidelines which are available on RBI's website.

The guidelines state that the benchmark rate for the floating side of the swap can be any domestic money or debt market rate which is market determined provided the methodology for computing it is objective and transparent. In practice, since term money markets are not very deep or liquid, most deals have used the overnight MIBOR as the benchmark. The tenors of most deals done so far have been quite short sometimes as short as one week. The following example of a 7-day deal illustrates the calculations:

Notional Principal : ₹50 crore
Days : 7
Fixed rate : 8.00%
Floating rate : Overnight MIBOR

Overnight index for 7 days

Day 1	$R_1 = 7.80\%$	$F\,1 = 1.0002137 = (1 + R_1 \times 1/365)$
Day 2	$R_2 = 7.95\%$	$F\,2 = 1.0002178 = (1 + R_2 \times 1/365)$
Day 3	$R_3 = 8.15\%$	$F\,3 = 1.0002233 = (1 + R_3 \times 1/365)$
Day 4	$R_4 = 8.20\%$ (weekend)	$F\,4 = 1.0004493 = (1 + R_4 \times 2/365)$

(This rate is compounded for two days over the intervening weekend)

Day 5	$R_5 = 8.15\%$	$F\,5 = 1.0002233 = (1 + R_5 \times 1/365)$
Day 6	$R_6 = 8.25\%$	$F\,6 = 1.0002260 = (1 + R_6 \times 1/365)$

Overnight index compounded average for 7 days (Rf)

$$= ((F1 \times F2 \times F3 \times F4 \times F5 \times F6) - 1) \times 365/7 = 8.11\%$$

Interest accrued on fixed leg

$$= 1{,}000{,}000{,}000 \times 8.00\% \times 7/365 = 767{,}123.29$$

Interest accrued on floating leg

$$= 1{,}000{,}000{,}000 \times 8.11\% \times 7/365 = 777{,}205.70$$

Net interest payment by the floating rate payer

$$= 777{,}205.70 - 767{,}123.29 = 10{,}082.41$$

16.8 VALUATION OF SWAPS

As we saw above, a swap is equivalent to a borrowing plus an investment. The value of a swap therefore is the difference between the present values of all inflows and all outflows. The market valuation of a series of cash flows depends upon the discount rate used. This, in turn, incorporates risk-free interest rate and a risk premium.

Valuation of a swap is necessary for the purpose of reporting to the shareholders as well as when the contract is terminated prematurely by negotiation or default.

The problem of pricing a swap is closely related to that of valuation. In essence, the pricing problem is to determine what rate should be quoted for one leg of the swap (e.g. the fixed rate in an interest rate swap), for a specified sequence of counter payments (e.g. floating payments at LIBOR), so that the two sequences have equal present values.

We will discuss here the problem of valuing default-free, "plain vanilla" swaps[33]. Further, we will assume a flat term structure of interest rates. In the apppendix to this chapter, we will take the discussion a bit farther.

A ***par swap*** is a swap which values to zero. Consider, for instance, a fixed-to-floating 5-year interest rate swap. A market maker bank is willing to swap a fixed payment at 8.5% semiannual, against 6-month LIBOR, paid every six months. It will quote these rates for a top credit. By definition, the present values of the fixed and floating legs of the swap must be equal. (In practice, a market maker would quote a bid and an offer swap rate as we have seen above. The spread is the market maker's compensation). The value of the swap as of today is zero. Consider a currency swap. Again, suppose a market maker is willing to exchange 6% fixed on sterling with 4.5% fixed on an equivalent CHF principal for five years. This means that the present value of the sterling payments at 6% is equal to the present value of the CHF payments at 4.5% both expressed in a common currency. Like a forward foreign exchange contract at market rates, a swap at market rates has zero value.

We will discuss two issues in relation to valuation and pricing of swaps. First, how to value an existing or "seasoned" swap entered into at some time in the past which is yet to mature. Second, how to price an off-market swap or a swap with some special features.

- **Value of an Existing Interest Rate Swap**

  A financial institution has a fixed-to-floating interest rate swap on its books under which it receives 11% fixed sterling semiannually and pays 6-month sterling LIBOR. The swap was entered into 15 months ago, had a maturity of 5 years and a notional principal of £1 million. The last payment and reset date was 3 months ago. The LIBOR for the current semester was set at 10.5%. The current 3-month sterling LIBOR is 9.5% and the market swap rate for 4-year swaps is 10% semiannual versus LIBOR flat. We wish to determine the value of this old swap.

  First consider the floating payments. Think of it as an FRN (Floating Rate Note) with par value £1 million paying interest at LIBOR. On the next reset date and every reset thereafter, the floating rate will be set equal to the then 6 month LIBOR. Hence, on the next reset date, the FRN will be valued at par. As of now, however, the market value of this FRN is

  $$£[(1000000)(1 + 0.0525)]/[1 + (0.095/4)] = £1,028,083.$$

[33]Thus, valuation of swaps with non-standard features such as delayed reset, swaps where reset frequency and maturity of the floating index are not equal, etc., is not dealt with here. These require term structure modeling. The interested reader can refer to works cited in the bibliography.

This is just the present value today, of the face amount plus the interest to be received 3 months from now.

Now consider the fixed leg. Think of it as a fixed rate bond with face value £1 million, paying semiannual coupons at 11%. There are 8 coupons to be received each of £55,000, with the first payment three months from now. Thus, the cash flow schedule from the fixed leg is:

Months from Now	***Cash Flow (£)***
3	55,000
9	55,000
15	55,000
21	55,000
27	55,000
33	55,000
39	55,000
45	1,055,000

We must find the present value of this with a discount rate of 10.0%, the four year swap rate. This works out to £1,056,206[34].

Selling this swap is equivalent to selling an asset worth £1,056,206 along with a liability worth £1,028,083. The value of the swap is, therefore, £28,123, 2.8123% of the face value. The firm can realise this gain by assigning the swap to another party.

Note that we have ignored several refinements in this calculation. We have used the four-year swap rate to value the fixed payments on a swap which has 3 years and 9 months to maturity and ignored the fact that the first fixed payment has to be made in 3 and not 6 months time. This is not strictly correct. Also, we have not used the precise day count fractions in finding present values. In the appendix to this chapter we will illustrate a more refined method.

- **Valuation of a Cross-Currency Interest Rate Swap**

Sometime ago, EmpireCorp a British exporter of cheeses and other processed foods to US swapped a floating 9.5 million USD liability into a GBP 5 million fixed rate liability. Under the swap, the firm has to pay fixed GBP semiannually at 9% p.a. and receives floating USD at 6-month LIBOR. At initiation the swap had a maturity of 7 years. It is now 1 year and 10 months later. The market rate for a 5-year fixed GBP versus 6-month USD LIBOR flat is now 10%. The last reset date was 4 months ago when the USD LIBOR for the current semester was set at 8%. The current 2-month USD LIBOR is 7% and the dollar has depreciated to USD 1.8 per GBP. The firm wishes to know how much it can gain up-front if it sells the swap.

As before, the present value of the floating leg is

USD [9.5(1.04)]/[1 + (0.07/6)] million = USD 9,766,062.6

(Once again we argue that on the next reset date 2 months from now, the floater will be valued at par).

[34]This is found as follows. The value as of 3 months from today is :

55000, +, PV of a 7 period annuity of 55,000, +, PV of 1,000,000 to be received 7 periods from now.

The discount rate is 5.00%. This is further discounted to today with the 3-month discount factor.

The pound sterling cash flows on the fixed leg are:

Months from Now	*Cash Flow (GBP)*
2	225,000
8	225,000
14	225,000
20	225,000
26	225,000
32	225,000
38	225,000
44	225,000
50	225,000
56	225,000
62	5,225,000

Using a discount rate of 5% per semester, the present value of this stream is GBP 4,950,860.10. This translates into USD 8,911,548.10 at the current GBP/USD exchange rate of 1.80.

Since the sale of the swap amounts to selling a fixed GBP liability and a floating USD asset, the net value of the swap is:

USD (9,766,062.6 – 8,911,548.1) = USD 854,514.5

The firm can lock in this gain by selling the swap.

We will conclude with an example of pricing off-market swaps.

- **Pricing an Off-Market Cross-Currency Interest Rate Swap**

An Indian firm had issued fixed rate sterling bonds 3 years ago with a face value of £10 million. The coupon is semiannual at 11% and the repayment is bullet 7 years from now. The firm would like to swap this into a floating dollar liability under which it will receive fixed sterling at 11% s.a. and pay floating dollars indexed to 6-month LIBOR. A swap bank is quoting sterling fixed at 9.5% s.a. versus dollars 6-month LIBOR flat. The dollar fixed-to-floating swap rate is 8% s.a. The present \$/£ spot rate is 1.6400. We wish to determine the margin over LIBOR which the bank would charge the firm. The trick is to create cash flow schedules with equal present values.

Under the swap desired by the firm, the bank would be paying 1.5% more than its market swap rate. This is an annuity with 14 payments. The relevant discount rate is the current swap rate of 9.5%. The present value of the annuity is found from the usual annuity formula:

$$\mathrm{PVA}(A, m, n, R) = A \times \frac{\left[1 - \dfrac{1}{\left(1 + \dfrac{R}{m}\right)^{mn}}\right]}{\left[\dfrac{R}{m}\right]}$$

where, PVA (A, m, n, R), is the present value of an annuity of size A, paid m times a year, for n years and the discount rate is R p.a. In the present case, A is 1.5, m is 2, n is 7 and R is 0.095 (9.5%). The resulting PV is 16.0882.

Now, we find the margin over LIBOR such that the resulting annuity will have the same PV. In the above equation, we put $R = 0.08$, $m = 2$, $n = 7$ and PVA = 15.0882 and solve for A.

This gives 1.43. Since this is calculated on bond-equivalent basis, we convert this into money market equivalent basis by multiplying by (360/365) to yield 1.41. Thus, the firm would be asked to pay 1.41% above the 6-month dollar LIBOR to receive 11% fixed sterling[35]. There is no exchange of principals at the beginning; at the end, the firm will pay $16.4 million and receive £10 million which reflects the current spot rate. (The dollar floating payments will be on this principal).

These few examples illustrate the procedures for valuing and pricing swaps. A more advanced and rigorous discussion of swap valuation and pricing can be found in Sundaresan (1991). Numerous examples of how market participants value swaps are contained in Miron and Swannell (1991).

As mentioned above, one of the critical aspects of swaps from the point of view of the swap bank is credit risk. The problem is much less severe in the case of interest rate swaps which only involve exchanges of interest payments. Default by one of the parties relieves the other party of its obligations. Also, for a swap market-maker with a large diversified portfolio, roughly half of the swaps will require it to pay fixed and receive floating while the remaining require the reverse. This permits better management of default risk. [See Smith et al. (1988)]. Inclusion of default risk makes the problem of swap valuation and pricing more difficult. The problem of credit risk is considerably more severe in the case of currency swaps which call for exchange of principals. Goodman et al. (1991) have addressed the problem of credit exposure of cross-currency swaps.

It has been observed that the swap rates quoted in the market do not reflect differences in borrowing costs between different counterparties[36]. Litzenberger (1992) has addressed this issue. Part of the explanation may lie in the legal treatment of an interest rate swap in the event of default.

Summary

Financial swaps have transformed asset liability management into a complex and interesting area. Swaps by themselves and in combination with other derivatives permit borrowers, investors and treasurers to achieve unbundling of various risks and achieve the desired currency, interest rate and maturity mix of assets and liabilities at minimum cost or optimum returns. Starting from a modest beginning, the swap market has grown by leaps and bounds so that the notional principal underlying outstanding coupon and currency swaps now stands at several trillion dollars. Recently some derivatives exchanges have also introduced swap futures.

Swap structures have also been utilized for unbundling credit risks. Interest rate swaps were introduced in the Indian money and debt markets in July 1999 and the market has seen some activity in short-tenor deals. Earlier, starting around mid-1980s, some Indian corporations have done currency swaps as a part of their currency risk management. RBI has consistently encouraged the use of swaps for laying off currency and interest rate risks.

[35]Note that as mentioned at the beginning of this section, we are ignoring all problems related to credit risk. In practice, this firm would probably pay a higher margin on this account.

[36]This means that one firm with rating of say "A" may have to pay say a 150 bp premium over the rate obtainable by a AAA firm if both issue fixed rate debt while in the swap markets, they may be asked to pay fixed at rates which differ only by say 50 bp.

Questions and Problems

1. Critically review the explanations offered for the emergence and popularity of financial swaps.
2. A company *XYZ* Corp., is seeking fixed rate funding for 5 years. It can borrow fixed with a bond issue at an effective cost of 9.25% or floating at a spread of 15 b.p. over 6-month LIBOR. Fixed to floating swaps are trading at LIBOR versus fixed at 20 b.p. over 5 years treasuries. The yield on 5-year treasuries is 8.65%. Show how *XYZ* Corp., can reduce its funding cost via an interest rate swap. What is the source of the gain to *XYZ*?
3. A company has been traditionally borrowing floating funds at a spread of 15 b.p. over 6-month LIBOR from its bankers. It finds that it can issue 5-year fixed rate bonds at 35 b.p. over treasuries which are yielding 8.20%. Fixed to floating swaps are trading at 65 b.p. over treasuries versus LIBOR. Show how the company can reduce the cost of its floating rate funding.
4. Three years ago, *ABC* Corp., borrowed fixed rate 7-year funds at 11.25%. The rates have moved down since then and four year treasuries are yielding 8.20%. Fixed to floating 4-year swaps are trading at 50 b.p. above treasuries versus 6-month LIBOR. The current 6-month LIBOR is 8.10%. The treasurer feels that the average level of LIBOR will be considerably less than 11.25% over the remaining life of the loan. How can he reduce the funding cost for the remaining years? How much is the gain? What are the risks?
5. Charlie Brown Toys Inc., has floating rate funding at 6-month New York prime plus 1.5%. It wishes to convert this into fixed rate funding for 5 years. It approaches USBANK for a swap. USBANK is quoting prime/fixed swaps 100/120 over 5-year treasuries which are yielding 8.25%. USBANK agrees to do the swap.
   (a) What is the fixed rate achieved by the company?
   (b) Apart from the credit risk, what risk has USBANK taken on?
   UKBANK is launching a Eurobond issue at an all-in cost of 8.975%. It would like LIBOR based funding. USBANK is quoting LIBOR/fixed 5-year swaps at 85/95 b.p. UKBANK does a fixed-to-floating swap with USBANK.
   (c) What is the floating rate cost achieved by UKBANK?
   (d) What is the position of USBANK after this swap? What should it do to remove the mismatch?
   SMALLBANK has prime based assets funded with LIBOR based deposits. It wants to match its assets and liabilities. It is willing to pay (prime –1.25%) in return for LIBOR both semi-annual. Its assets yield prime +1% semiannual. It does a swap with USBANK.
   (e) What is the final position of USBANK? How much is its overall net gain?

   Show the entire structure diagrammatically indicating the various flows between the parties.
6. A US firm has an outstanding fixed rate DEM liability with 10 years to maturity. The principal is CHF 18 million to be repaid at maturity. The coupon is 9.50% payable semi-annually. The firm wishes to swap this into a floating dollar liability under which it will receive fixed CHF at 9.50% s.a. and will pay floating dollar s.a. The swap bank is quoting the following rates for a CHF-$ fixed to floating 10-years swaps:
   CHF 10-year T-notes – (1/8)%   CHF 10-year T-notes + (1/8)% vs. US$ 6-month LIBOR.
   CHF 10-year T-notes are quoted at 7.10% s.a.

This means that the bank will pay fixed CHF [7.10 – (1/8)]% s.a. in return for US$ 6-month LIBOR and it will pay US$ LIBOR in return for fixed CHF at [7.10 + (1/8)]% US$ 10-year notes are quoted at 9.75% s.a. What margin over LIBOR should the bank quote for the firm? Remember that fixed rates are on Bond Equivalent Yield (BEY), i.e. 365 days in a year while floating rates are on Money Market Yield (MMY) basis, i.e. 360 days in a year. At maturity, the parties will exchange the principle at a predetermined exchange rate of CHF 1.65 per $.

7. Sometimes ago a French firm swapped a EUR 5 million fixed rate liability into a US$ 4.5 million floating rate liability. At the time, the EUR/$ exchange rate was 0.9000 and the fixed EUR vs. 6-month dollar LIBOR swap rate was 6%. Both the fixed and floating payments are semi-annual. Since then the fixed EUR rate has fallen and the current 5-year swap rate is 4.5%. Also the dollar has depreciated to EUR/$ 0.9500. The swap has 5 years and 3 months to maturity. The dollar LIBOR for the current semester was fixed 3 months ago at 6% while the current 3-month dollar LIBOR is 5.5%. The firm reckons that it can lock in a nice profit by selling the swap. Find the market value of the swap.

8. An interest rate swap was entered into at a fixed rate of 13% against LIBOR both annual. The swap has 5.25 years to go. The current 5-year swap rate is 10%, the 3-month LIBOR is 7% and the one-year LIBOR at the last reset date 9 months ago was 11%. Compute the swap's value.

9. A currency swap was entered into at the historic swap rates of HC 12%/ FC 6% and the spot rate was 6(HC/FC). The swap has 3.25 years to go. The current 3-year swap rates are HC 10%/ FC5% and the spot rate is 8. Compute the swap's value.

10. This problem illustrates one approach to pricing amortising swaps. Consider a 3-year fixed to floating interest rate swap in which the floating rate is at 6-month LIBOR. The notional principal is $2.5 million which is repaid in 5 equal instalments of $500,000 starting six-months from the start date. How should the bank quote the fixed rate? One answer to this is to use the concept of duration. Find the T-note which has the same duration as a 3-year bond with six-monthly sinking fund provision. The problem is duration depends upon the yield which is what we have to find. Alternatively, define the average life for a debt instrument as

$$AL = \frac{\Sigma P(t) \times t}{P_0}$$

where AL denotes average life, $P(t)$ is the amount of principal retired at time t (time is measured in years) and P_0 is the initial principal. Use the T-note with maturity equal to AL to price the fixed leg of the swap.

11. An Indian firm wishes to fund acquisition of imported capital goods from Germany. A fixed rate 3-year DEM loan with bullet repayment and semi-annual interest payments can be acquired at an all-in cost of 8.5%. The firm can avail of concessional financing from the German EXIM bank at a cost of 8% but the loan has to be amortised in 5 equal six-monthly instalments. The firm exports to Middle East and is confident about earning a steady stream of dollars. It can get dollar funding at the rate of 10.5%. A bank quotes a fixed DEM vs. fixed dollars swap wherein the bank will pay fixed DEM at 7.5% and receive fixed dollar at 9.5% both payable semi-annually. The current spot rates are Rs/$30.00, Rs/DEM 28.00. Historically, the DEM has appreciated on an average at 7% p.a. and the dollar at 5% p.a. against the rupee. The amount involved is DEM 10 million. Analyse the various options open to the firm. Make suitable assumptions wherever necessary.

12. Explain how a standard interest rate swap can be regarded (almost) as a portfolio of FRAs.

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Apart from these, a large number of other works have appeared in recent years which deal with various aspects of financial swaps. The Euromoney publications ***Management of Currency Risk (2 Vols.),*** (Euromoney Publications, London, 1989) and ***Management of Interest Rate Risk***, (Euromoney Publications, London, 1988) edited by B. Antl contain several examples of applications of swaps as well as papers dealing with documentation and tax issues.

A very accessible introduction to swap financing can be found in:

Marshall, J.F. and K.R. Kapner (1990): ***Understanding Swap Finance***, South-Western Publishing Co. Cincinnati, Ohio.

Following three volumes are specialist works on swaps:

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Datttreya, R., R.E.S. Venkatesh and V.E. Venkatesh (1994): ***Interest Rate & Currency Swaps***, Probus Publishing Co., Chicago, Illinois.

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Swap applications, aspects of valuation and documentation and tax issues are discussed in:

Francis, J. and A.S. Wolf (Eds.) (1994): ***The Handbook of Interest Rate risk Management***, Irwin Professional Publishing, Burr Ridge, Ill.

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The following volumes contain discussion of accounting issues related to swaps:

Tiner, J.I. and J.M. Conneely (1987) ***Accounting for Treasury Products***, Woodhead-Faulkner, Cambridge, UK.

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The Euromoney volume titled ***Swap Finance***, cited above also contains several case studies of swaps.

APPENDIX

A.16.1 TERMS OF A GENERIC US DOLLAR COUPON SWAP

General Terms:

Maturity: 1 to 15 years
Effective Date: Five business days after the trade date
All-in-cost: The value of the swap quoted as the semi-annual YTM of the fixed coupons versus the floating index flat.

Fixed Side:

Fixed Coupon: Current market rate quoted as swap spread over treasury rate.
Payment Frequency: Semiannual or Annual
Day Count Basis: 30/360

Floating Side:

Floating Index: LIBOR, *T*-Bill, CP Composite, Prime
Spread over the Index: None
Quote Source: A publicly quoted source (e.g. Reuters)
Payment Frequency: The term of the floating index
Day Count Basis: Actual/360 (Actual/Actual for *T*-Bill)

Reset Frequency: Same as the term of the floating index
First Coupon: Current market rate for the index

Trade Date: The parties agree to the swap
Effective Date: Interest begins accruing
All-in-cost: The rate fixed rate payer will pay

INDICATIVE RUPEE INTEREST RATE SWAP QUOTES

Indicative Terms & Conditions : INBMK Swap

Notional Amount: INR 25 crore
Party *A*: SBI Treasury
Party *B*: ABC
Trade Date: 7th June 2007
Start Date: 8th June 2007
Maturity: 8th June 2012
Frequency of Interest Payment: Yearly

INR Fixed Rate Payer: Party *A*

Party *A* Pays: 8.30% p.a. on outstanding principal
Frequency: Yearly
Interest Rate Basis: Actual/365
Rollover Convention: Modified Following
Documentation: ISDA Agreement

INR Floating Rate Payer: Party *B*

Floating Rate Index: 1Yr INBMK
Party *B* Pays: Floating Rate on outstanding notional
Interest Rate Basis: Actual/365
Frequency: Yearly
Floating Rate Fixing: Yearly

Floating Rate Reset Definition: Yearly Fixing. One business day prior to the start date as per REUTERS INBMK Page. The rate will be extrapolated or interpolated (as the case may be) by reference to the Indian Government Securities benchmark rate for the designated maturity.

INDICATIVE RUPEE-DOLLAR CROSS-CURRENCY INTEREST RATE SWAP QUOTES

Notional Amount: USD 25 million
INR Notional: INR 101.50 crore
Party *A* : SBI Treasury
Party *B* : ABC
Trade Date: 07th June, 2007
Start Date: 11th June, 2007

Maturity: 30th September, 2014
Initial Exchange: Nil
Exchange of principal at the end: Party A receives INR and Pays USD

INR Fixed Rate Payer

Party *B* pays: 9.70% PA on outstanding INR Notional.
Frequency: Half-Yearly, Every 30th September and 31st March
Last Interest Payment: 30th September 2014
Interest Rate Basis: *A*/365
Rollover Convention: Modified Following

USD Floating Rate Payer

Party *A* pays : USD Libor 6m + 125 bps on outstanding USD Notional
Frequency: Half-Yearly, Every 30th September and 31st March
Interest Rate Basis: A/360
Rollover Convention: Modified Following
LIBOR Fixing: Half-Yearly, 1st on Trade Date
Business Centres: New York, Mumbai, London
Documentation: ISDA Agreement

A.16.2 COMPARISON SWAP METHOD OF VALUATION

In the text, we demonstrated a relatively crude method of valuing a seasoned coupon swap. Here, we illustrate a more refined method that removes some of its drawbacks. The exposition here draws on Miron and Swannel (1991). We will use the example in the text of a 5-year GBP coupon swap which has 3 years and 9 months to go.

To value the given swap, we construct a notional "comparison swap" with the following characteristics:

1. It must value to zero, i.e. it must be at a fixed rate that a swap dealer would be prepared to trade given the prevailing rates for standard swaps.
2. It should have an identical floating leg as the swap being valued except having no margin over the floating index and a "stub" first period.

The given swap has the following payment streams (stated as % of underlying notional principal):

Months from Now	*Fixed*	*Floating*
3	5.5%	–5.25%
9	5.5%	?
15	5.5%	?
21	5.5%	?
27	5.5%	?
33	5.5%	?
39	5.5%	?
45	5.5%	?

The "?" indicates that as of now we do not know the size of the floating payments. Now consider what stream of payments a swap dealer would be willing to exchange in a swap starting now and terminating 3 years and 9 months from now.

First, instead of using the four year swap rate, we must interpolate between the 3-year and 4-year swap rates. Assume that the 3-year rate is 9.75% semiannual payments and the 4-year rate as given in the text is 10% semiannual payments. The interpolated rate is given by:

$$9.75 + (9/12)[10.00 - 9.75] = 9.9375\% \text{ s.a.}$$

Further, since the first fixed payment is going to be 3 months from now, we must "decompound" this rate i.e. use a quarterly equivalent of this semiannual rate[37]. This works out to 9.8170% (see footnote 1). Thus, the first fixed payment on the comparison swap must be (1/4)(9.8170) = 2.45425%. Thus, the payments stream on the comparison swap would be (again as % of face value):

Months from Now	***Fixed***	***Floating***
3	2.45425	–2.625
9	4.96875	?
15	4.96875	?
21	4.96875	?
27	4.96875	?
33	4.96875	?
39	4.96875	?
45	4.96875	?

Once again, the "?" indicate the unknown floating payments. Since by construction, the comparison swap values to zero, the value of the given swap can be found by subtracting the cash flows of the comparison swap from those of the given swap and finding the present value of the residual cash flows. Notice than in this process, the unknown floating payments cancel out. The residual cash flows as per cent of the notional principal are:

Months from Now	***Residual Cash Flow***
3	0.42075
9	0.53125
15	0.53125
21	0.53125
27	0.53125
33	0.53125
39	0.53125
45	0.53125

[37]To understand why this must be so, consider this example. A two-year bond which pays a 10% coupon with semiannual payments and a 2½-year bond which pays 10.50% coupon, semiannual payments are both trading at par. Now consider a 2¼-year bond which will make the first payment 3 months from today and semiannual payments thereafter. The interpolated rate is 10.25%, semiannual payments are 5.125%. Consider the sequence of payments 2.5625, 5.125, 5.125, 5.125 and 105.125 with the first payment 3 months from now and the rest at 6-month intervals, You can convince yourself that the present value of this at a discount rate of 5.125% per semi annual period is not 100.00. We must find the quarterly equivalent of 10.25% semi annual using the formula:

$$R_m = m\{[1 + (R_n/n)]^{n/m} - 1]$$

where R_m and R_n are rates with m and n payments per year. Here $m = 4$, $n = 2$ and $R_n = 10.25\%$. Hence, $R_m = 10.1219\%$ and the first payment should be (1/4)(10.1219) = 2.5305 and not 2.5625. Then the 2¼ year bond with a rate of 10.25% would value to par as it should.

We have to find the PV of this stream, first as of 3 months from now using the interpolated rate of 9.9375% s.a. and discount this back to today at today's 3-month LIBOR which is 10.5%. This works out to 3.41% of the underlying principal. Recall that the method used in the text had resulted in a value of 2.81% of the underlying principal because of the fact that we used the higher 4-year swap rate to discount the fixed payments due to the firm.

A.16.3 INTRODUCTION TO ZERO-COUPON PRICING

We will briefly discuss the basic ideas underlying a method of swap pricing known as "Zero-Coupon Pricing". A more extensive discussion can be found in Miron and Swannell (1991).

Consider a standard interest rate swap. Floating payments are tied to an index such as LIBOR with maturity τ and the interval between payments is also τ. The floating rate is set in advance paid in arrears. Frequency of fixed payments is identical with that of floating payments. The maturity is T. Figure A.16.1 shows such a swap with $T = 3$ years and $\tau = 6$ months. Assume that the currency is dollars.

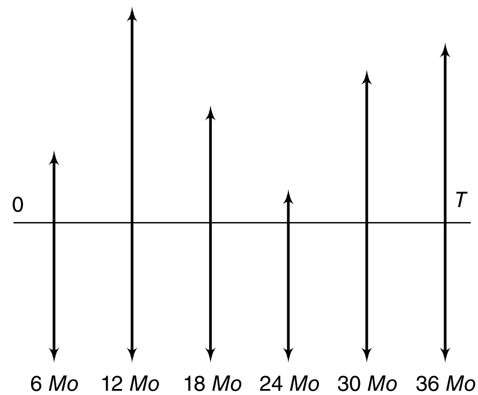

Fig. A.16.1 A Fixed-to-Floating Swap

The problem of pricing consists in finding a sequence of fixed payments C at τ, 2τ,... which has the same present value as the sequence of floating payments. *If* we know the floating payments at each of these dates, we can discount them back to the start date by an appropriate discount factor and then find C. The difficulty is we *do not know* the size of floating payments. The obstacle looks more formidable than it really is.

Suppose we are at time t. A floating payment is due at time D_2. The floating rate will be set at D_1, $t < D_1 < D_2$. The payment will equal

$$P \times r_{D1D2} \times \delta_{D1D2}$$

where P is the notional principal, r_{D1D2} is the applicable rate to be set at D_1 and δ_{D1D2} is the day-count fraction between D_1 and D_2, e.g. $(D_2 - D_1)/360$ for dollar swaps. We do not know r_{D1D2} but we do know the ***forward rate*** implied by the two observed rates r_{tD1} and r_{tD2}. The forward rate ρ_{D1D2} is given by

$$(1 + r_{tD1}\delta_{tD1})(1 + \rho_{D1D2}\delta_{D1D2}) = (1 + r_{tD2}\delta_{tD2}) \quad \text{(A.16.1)}$$

Denoting by F_i the discount factor applicable at time t to date D_i, we have

$$F_i = 1/[1+r_{tDi}\delta_{tDi}]$$

F_i is just the value at time t of a pure-discount or zero-coupon bond which pays \$1 at D_i[38]. Then from (A.16.1),

$$\rho_{D1D2} = (1/\delta_{D1D2})[(F_1/F_2) - 1] \quad \text{(A.16.2)}$$

[38]Hence, the name "zero-coupon pricing".

With $r_{\mathbf{D1D2}}$ unknown, the best we can do is to use $\rho_{\boldsymbol{D1D2}}$ in its place. Therefore, the floating payment due at D_2 is

$$P \times \rho_{\boldsymbol{D1D2}} \times \delta_{\boldsymbol{D1D2}} = P[(F_1/F_2) - 1]$$

and its present value at time t is

$$F_2P[(F_1/F_2) - 1] = P(\mathrm{F}_1 - F_2) \tag{A.16.3}$$

This is simply the PV of an inflow of P at D_1 and an outflow of P at D_2. Thus, a floating payment can be simply looked at as a combination of an inflow and an outflow of the underlying principal amount.

Now consider a two-year fixed to LIBOR swap with effective date D_1 and four floating payments every six months starting D_2. This is equivalent to an inflow of P at D_1 and an outflow of P at D_5 two years later. Figure A.16.2 illustrates. The present value of this sequence is then:

$$P(F_1 - F_5)$$

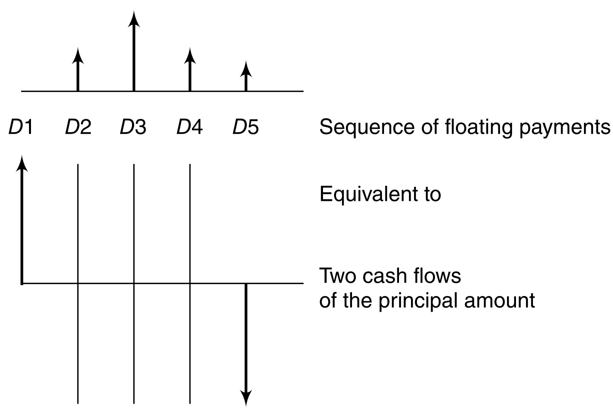

Fig. A.16.2

To price the swap, find the size C of an annuity such that

$$\sum_{j=2}^{j=5} CF_j = P(F_1 - F_5) \tag{A.16.4}$$

C expressed as per cent of P, converted to annual equivalent is the fixed rate which would value the swap to zero at trade date t.

To implement the procedure, we must get the discount factors F_1, F_2 ...etc. As seen above, these are values at time t of zero-coupon bonds which pay \$1 at D_1, D_2...etc. We will now briefly discuss the procedure for constructing the zero-coupon yield curve. Our exposition draws on Miron and Swannell (1991) who provide a comprehensive treatment.

A.16.3.1 Constructing the Zero-Coupon Yield Curve

The curve is constructed from observed cash rates and/or futures prices and FRA quotes. We will first focus on the use of cash rates.

The necessary inputs are:

1. A set of par money market rates
2. A set of par swap rates

The structure of the associated instruments (such as accrual basis, coupon payment frequency, etc.) is assumed to be known.

The discount function constructed from these inputs must satisfy the following conditions:

1. Par instruments must value to par.
2. The valuation process must be additive. This means that if there are two cash flows at time t_i and t_j of C_i and C_j, the PV of these must be $(F_iC_i + F_jC_j)$ where F_i and F_j are discount factors for t_i and t_j respectively.
3. The resulting discount function must be smooth.

Start with a one-year par USD swap with a principal P = USD 1 million. Suppose the one-year swap rate R_{1y} is 9.00% vs. 6-month LIBOR and the day count basis is Actual/360. Figure below shows the cash flows. Note that the LIBOR flows are accounted for by the principal cash flows at the start and maturity.

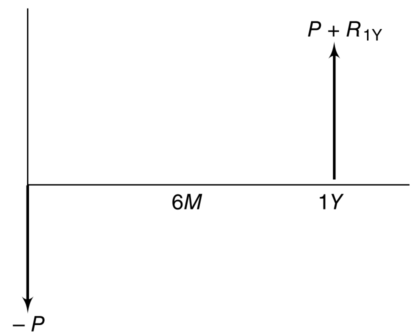

Fig. A.16.3 Cash Flows of a One-year Swap

The present value of these flows is given by:

$$-PF_0 + PF_{1Y}(1 + R_{1Y}\alpha_{0,1})$$

where F_0 and F_{1Y} are the discount factors applicable to time 0 and 1 year respectively and $\alpha_{0,1}$ is the day-count fraction between the spot date and termination date.

By definition F_0 = 1. Since the swap is a par swap, its present value must be zero. Hence,

$$F_{1Y} = 1/[1 + R_{1Y}\alpha_{0,1}]$$

Using R_{1Y} = 9% and assuming $\alpha_{0,1}$ = 365/360

$$F_{1Y} = 0.91638$$

Now consider a two-year par swap with rate R_{2Y} = 9.75%. Along similar lines

$$-PF_0 + R_{2Y}\alpha_{0,1}PF_{1Y} + R_{2Y}\alpha_{1,2}PF_{2Y} + PF_{2Y} = 0$$

which leads to

$$F_{2Y} = [1 - R_{2Y}\alpha_{0,1}F_{1Y}]/[1 + R_{2Y}\alpha_{1,2}]$$

Again assuming that the day count between 1Y and 2Y is 365 days,

$$\alpha_{1,2} = 365/360 \quad \text{and}$$
$$F_{2Y} = [1 - 0.0975 \times (365/360) \times 0.91638]/[1 + 0.0975(365/360)] = 0.82760$$

Proceeding further along these lines

$$F_{3Y} = \frac{1 - R_{3Y}[\alpha_{0,1}F_{1Y} + \alpha_{1,2}F_{2Y}]}{1 + R_{3Y}\alpha_{2,3}}$$

The general recursive relation is

$$F_{nY} = \frac{1 - R_{nY} \sum_{i=1Y}^{i=(n-1)Y} \alpha_{i-1,i}\, F_i}{[1 + R_{nY}\alpha_{n-1,n}]}$$

The index i runs from the first fixed coupon to the last but one coupon. Floating leg is assumed to start when the first fixed coupon begins accruing and ends when the last coupon is paid. No assumption is made regarding the frequency of the floating payments.

Thus, this "bootstrap" method can be used to compute discount functions for all points coinciding with the maturities of traded swaps. For intermediate points, a simple method is to interpolate linearly between available neighbouring points. Thus, if 7-year swaps and 10-year swaps are traded while 8-year swaps are not, R_{8Y} can be approximated by $[(2/3)R_{7Y} + (1/3)R_{10Y}]$.

For maturities shorter than one year, discount factors are computed from money market rates. Since these instruments pay only a single coupon, the discount factors are simply found from the relation:

$$F_m = 1/[1 + R_m\alpha_{0,m}]$$

We will illustrate this procedure with an example. For the US dollar market, suppose the following money market and swap rates are available for value date October 10, 2000:

Grid Point	*Date*	*Par Rate*
O/N	11/10/00	6.25
1W	17/10/00	6.125
1M	11/11/00	6.25
2M	10/12/00	6.375
3M	12/01/01	6.375
6M	10/04/01	6.50
1Y	10/10/01	6.75
2Y	11/10/02	7.05
3Y	10/10/03	7.40
4Y	10/10/04	7.80
5Y	10/10/05	8.40

Here O/N refers to "overnight" and "W", "M" and "Y" denote week, month and year respectively. Rates shorter than 1Y are money market rates while the rest are swap rates

The one-month and six-month discount factors F_{1M} and F_{6M} are

$$F_{1M} = 1/[1 + 0.0625(31/360)] = 0.99465$$

$$F_{6M} = 1/[1 + 0.065(182/360)] = 0.96818$$

The one-year discount factor is

$$F_{1Y} = 1/[1 + 0.0675(365/360)] = 0.93595$$

The two-year discount factor is

$$F_{2Y} = [1 - 0.0705(365/360)0.93595]/[1 + 0.0705(365/360)]$$
$$= 0.87085$$

The other discount factors can be computed using the recursion relation above. Table below presents the results.

Table A.16.1 Discount Function for the Dollar Market

Grid Point	*Discount Factor*
O/N	0.99983
1W	0.99881
1M	0.99448
2M	0.98931
3M	0.98380
6M	0.96818
1Y	0.93595
2Y	0.87085
3Y	0.80411
4Y	0.73537
5Y	0.65884

Valuation of a given swap may often require discount factors for dates which fall between two grid points. Thus, suppose we need the discount factor for a date that is between 3M and 6M, say, 3M and 42 days. Assume that the number of days between 3M and 6M is 92. Simple linear interpolation would yield a discount factor given by

$$(42/92)F_{6M} + (50/92)F_{3M}$$

However, a more precise method is exponential interpolation. To understand this note that for any two grid points $T1$ and $T2$,

$$F_{T1} = e - R_{T1}(D_{T1T0})$$
$$F_{T2} = e - R_{T2}(D_{T2T0})$$

Here (D_{TiT0}) is the day count fraction between start date $T0$ and date Ti, $i = 1, 2$, i.e. actual number of days between $T0$ and Ti divided by the basis (360 or 365) and R_{Ti} is the annualised zero coupon rate applicable to Ti.

Now consider a date $T3$ between $T1$ and $T2$. First linearly interpolate the zero coupon rate R_{T3} applicable to $T3$

$$R_{T3} = \lambda R_{T2} + (1 - \lambda)R_{T1}$$

where $$\lambda = (D_{T3T1})/(D_{T2T1})$$

The required discount factor F_{T3} is given by

$$F_{T3} = e^{-R_{T3}(D_{T3T0})}$$

This method takes account of the fact that the discount factor for any time T is an exponential function of the time interval between T and the start date.

A few additional complications arise in case of currencies such GBP where par swaps involve semiannual fixed payments. This requires that discount factors for 1.5Y, 2.5Y, etc. must be worked out. We refer the reader to Miron and Swannell (1990) for more details.

Computing discount functions in this manner implicitly assumes that expected future spot rates equal the forward rates implied by current spot rates, i.e. the expectations theory of the term structure.

Zero coupon yield curves can be constructed by other methods which do not require such an assumption. One popular approach is to fit a class of mathematical functions called "spline functions" to observed data on prices of traded treasury bonds both coupon and zero coupon. The discount factor corresponding to each date is modeled as a polynomial function of time and the parameters are chosen so as to achieve best fit between observed prices of traded bonds and their prices implied by the fitted curve. Still another possibility is to use an equilibrium model of the term structure of interest rates. [See Sundaresan (1991)].

An alternative to using cash market rates is to use quoted futures prices. Recall that the price of a eurodollar futures contract implies a 90-day interest rate for the period from the expiry of the contract to 90 days thereafter. Also recall that at time T_0 if the forward rate for the period T_1 to T_2 is R_{12}, then

$$R_{12}(D_{T1T2}) = [(F_{T1}/F_{T2}) - 1]$$

Thus, the forward rates implied by futures prices can be used to construct discount factors in addition to the money market and par swap rates. In the same manner, quoted FRA rates can also be utilised. We will illustrate the pricing of swaps off LIBOR futures using a simple example.

- Pricing a 2-Year Swap off LIBOR Futures
  Suppose on June, 16 2006, the following cash market and futures prices were seen:
  3-month USD LIBOR: 5.75%   6-month LIBOR: 5.78%

  CME Euro$ Futures Prices:

Expiry Month	*Futures Price*	*Implied Forward Rate (FR) (%)*	*Compounding Factor (CF) [1 + (FR/100) × 0.25]*
September 06	94.28	5.72	1.0143
December 06	94.15	5.75	1.014625
March 07	93.84	6.16	1.0154
June 07	93.38	6.62	1.01655
September 07	92.98	7.02	1.01755
December 07	92.59	7.41	1.018525
March 08	92.20	7.80	1.0195

We will assume that the futures contracts mature at quarterly intervals starting from the initial date 16 June 2006. Also, in compounding and discounting, we will simply assume that a quarter or 3 months is 1/4th of a year instead of using the actual day count fractions. These details can be easily incorporated. The compounding factor CF for the June to September 2006 period is calculated from the 3-month LIBOR on June 16, 2006. It equals [1 + 0.0575 × 0.25] = 1.014375

Now suppose we start with a \$1, 3-month deposit on June 16, 2006 and keep rolling it over every three months. The expected terminal values of this deposit at each rollover date are given below. For the first 3-month period, the interest rate is the cash market 3-month LIBOR; for subsequent rollovers, the rates are those implied by the futures prices.

Deposit in	*Rate R (%)*	*Matures in*	*Starting Value (S)*	*Terminal Value (S × CF)*
June 06	5.75	Sep 06	1.00	1.014375
September 06	5.72	Dec 06	1.014375	1.02881
December 06	5.75	Mar 07	1.02881	1.043928
March 07	6.16	Jun 07	1.043928	1.060004
June 07	6.62	Sep 07	1.060004	1.077548
September 07	7.02	Dec 07	1.077548	1.096458
December 07	7.41	Mar 08	1.096458	1.11677
March 08	7.80	Jun 08	1.11677	1.138547

We now derive zero coupon rates – the so called spot rates – from these terminal values. The n-year spot rate is given by

$$(SR)_n = [(TV)_n]^{1/n} - 1$$

TV_n is the terminal value of \$1 at the end of the n-year period. The spot rates so calculated are given below for $n = 0.25$ year (3 months) to 2 years (24 months) starting June 16, 2000.

Period (Months)	*Spot Rate*
3	0.05875
6	0.05860
9	0.05900
12	0.06000
15	0.06157
18	0.06331
21	0.06514
24	0.06703

We now compute 6-month forward rates. The 6-month forward rate for the period December 16, 2006 to June 16, 2007 is given by

$$\{[TV\text{ (Jun 07)}/TV\text{(Dec 06)}] - 1.0\}/0.5$$
$$= \{[(1.060004)/(1.02881)] - 1.0\}/0.5 = 6.05$$

In a similar fashion, we can compute 6-month forward rates for the periods June 2007 to December 2007, and December 2007 to June 2008. For pricing the two-year swap, floating payments will be computed at these rates.

June 2007-December 2007: 6.878%
December 2007-June 2008: 7.677%

The first floating payment, made in December 2006 would have been at the 6-month cash market LIBOR on June 16, 2006, viz. 5.78%.

The floating side of the swap is equivalent to a 2-year FRN with a face value of 100 on which the rate is reset every 6 months equal to the 6-month LIBOR. The current market value of such an FRN would equal its face value. The floating payments would occur in December 16, 2006, June 16, 2007, December 16, 2007 and June 16, 2008. We have computed the zero coupon rates for these dates. To find the swap rate, i.e. the fixed rate to be paid by the fixed rate payer, find the value of X which satisfies:

$$X/(1 + SR_{\text{Dec00}})^{0.5} + X/(1 + SR_{\text{Jun01}}) + X/(1 + SR_{\text{Dec01}})^{1.5} + (100 + X)/(1 + SR_{\text{Jun02}})^{2} = 100$$

i.e.

$$X/(1.0586)^{0.5} + X/(1.06) + X/(1.06331)^{1.5} + (100 + X)/(1.06703)^{2} = 100$$

This yields a value of $X = 3.283$. With annual payments, it would translate into 6.57% of face value. This is the swap rate which a swap market maker would have quoted for this swap.

What if futures contracts do not mature at quarterly intervals from the starting date? Suppose the starting date is July 16, 2006 and the cash market 2-month LIBOR is 4.80%. The September 06, December 06, March 07, etc. Eurodollar futures prices are available. We need to compute terminal values of a 1 dollar deposit at 6 months, 12 months, etc. starting from July 16, 2006. These occur in January 2007, July 2007, etc. Terminal values for these can be interpolated from terminal values of preceding and succeeding dates. Alternatively, rollovers can be assumed for periods shorter than 3 months at 3-month LIBORs.

Off-market swaps can be priced using the same procedure. For instance, consider a swap which requires the bank to pay floating at a margin over LIBOR. Since the magin is known, it is simply treated as an annuity over and above the floating payments at LIBOR. The fixed rate has to be adjusted upwards by the amount of the margin.

Pricing of currency swaps is now straightforward. For a fixed-to-fixed swap, cash flows in each currency are discounted by the relevant discount functions and the PV of one stream is translated into the other currency at the current spot rate. For a fixed to floating swap, the floating payments are valued as above.

A.16.4 INTEREST RATE SWAPS AND FRAS

Recall that an FRA also involves exchange of two interest payments. The seller of an FRA on a floating index pays the buyer the difference between the floating rate and the strike rate on a notional principal if the index exceeds the strike and receives the difference if the strike exceeds the index. This is similar to a swap in which you pay floating and receive fixed. The only difference is that swap payments are made at the end of the period while FRA settlement is the discounted amount at the beginning of the period.

Thus, consider a one-year swap with semiannual payments. It is almost equivalent to a portfolio consisting of a 0-6 FRA and a 6-12 FRA. Of course the 0-6 FRA is settled right away and is equivalent to a 6-month loan at the current 6-month floating index and a 6-month deposit at the strike rate (apart from the fact that the difference is settled at the start). This near-equivalence between a strip of FRAs and swaps presents an opportunity to hedge swaps with FRAs as also arbitrage between the two markets. Thus, a two-year swap in which you pay fixed and receive floating, both semiannual, can be hedged by selling a "strip" of FRAs — 6-12, 12-18 and 18-24 with the same notional principal and the same floating index[39].

You can also see that there are similarities between options on interest rate swaps, i.e. swaptions and interest rate caps and floors. Consider, for instance, a one-year cap on 3-month LIBOR with

[39]The hedge is not exact because of the difference in timings of settlements. An exact hedge can in principle be achieved by varying the amounts of principals underlying the FRAs. See Miron and Swannell (1990), Chapter 9.

3-month reset versus a 3-month option on a one-year fixed-to-floating swap with quarterly payments and resets. The swaption, if exercised commits you to receive fixed and pay floating throughout the maturity while the cap being a portfolio of calls gives more flexibility. It should be intuitively obvious that the cap is more valuable than the swaption. Similarly, a floor is more valuable than a swaption in which you pay fixed and receive floating.

A.16.5 CREDIT RISK AND SWAP SPREADS

In a generic interest rate swap, a fixed payment is exchanged against a floating payment at LIBOR, the reset frequency being equal to the maturity of the floating index. In the absence of transactions costs and credit risk, the fixed rate should equal the yield on a bond with the same maturity as the swap, issued at par.

To make this clearer, consider, say, a 3-year swap in which a party *X* pays fixed to a swap dealer and receives 6-month LIBOR floating. The cash flows associated with this swap, can be replicated by *X* by issuing a three-year coupon bond at par with a coupon equal to the swap dealer's swap offer rate and principal amount equal to the swap's notional principal and investing the proceeds at 6-month LIBOR. Every six months, *X* takes the interest on the deposit and reinvests the principal. It pays fixed on the bond it has issued. Hence, the proposition that, the swap rate should equal the yield on a par bond of the same maturity.

How does credit risk and transactions cost affect this equivalence of a swap and a bond? Sundaresan et al. (1993)[40] investigate this issue in a recent paper. Transactions costs imply that there will be a bid-offer spread both in the swap market and in the inter-bank market (the spread between LIBOR and LIBID). Credit risk in a swap is of a different nature than in a straight loan or bond. First, in an interest rate swap, the principal amount is not at risk since only interest payments are exchanged. Second, both parties to the swap carry the credit risk of the other party. The swap dealer faces the risk that *X* will default when the market value of the swap to the dealer is positive (which will be the case if the market swap rates have declined after the swap is settled) and *X* faces the risk that the dealer may default when the value of the swap to *X* is positive (swap rates have increased). Even with an offset provision[41], the party which holds a swap with a positive value will find it difficult to realise this value if the counterparty defaults. The risk to the dealer depends on the joint probability that the value of the swap is positive ***and*** *X* will default. In a straight bond, the principal is also at risk and only the issuer can default. Hence, the swap offer rate should be less than the par bond yield to *X*. Further, the offer rate of a better rated dealer should be higher than a lesser rated dealer.

By a similar logic, the swap bid rate should be less than par bond yields calculated with LIBID and the bid rate of a better rated dealer should be lower than that of a lesser rated dealer. Thus, the spread in swap rates should be larger for a better rated dealer.

All these hypotheses are confirmed by the data examined by Sundaresan et al. They also examine the relation between US treasury rates and swap rates, and eurodollar market rates and swap rates. The interested reader can consult the paper for further insights into swap pricing. A formal analysis of credit risk in off-balance sheet transactions including swaps can be found in Hull (1993).

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[40]Sun, Tong-Sheng, S.Sundaresan and Ching Wang (1993): "Interest Rate Swaps – An Empirical Investigation" ***Journal of Financial Economics*** 34, p.77-99.

[41]Recall that this means that if *X* does not make the fixed payment, the dealer has no obligation to make the floating payment and vice versa.

A.16.6 CAPITAL ADEQUACY NORMS FOR FRAS AND INTEREST RATE SWAPS

The guidelines issued by the Reserve Bank of India specify the following capital adequacy norms for banks making a market in FRAs and interest rate swaps.

For reckoning the minimum capital ratio, the computation of risk weighted assets on account of FRAs/IRS should be done as per the two steps procedure set out below:

Step 1:
The notional principal amount of each instrument is to be multiplied by the conversion factor given below:

Original maturity	*Conversion factor*
Less than one year	0.5 per cent
One year and less than two years	1.0 per cent
For each additional year	1.0 per cent

Step 2:
The adjusted value thus obtained shall be multiplied by the risk weightage allotted to the relevant counterparty as specified below:

Banks/All India Financial Institutions	20 per cent
All others (except Governments)	100 per cent

CASE STUDY

"Ready for take off", voice of the Captain crackles over announcement system and brings you back to present. You are returning after attending the glittering function where 'CFO of the Year' award was presented. While coming out of the function, you overheard someone saying, "That's no big deal! If this person is really great, then why not try and get the 'Financial Engineer of Year' award!!" The comment was definitely aimed at you, the winner of this year's award.

Your company is one of the leading software companies in India, having a turnover of over USD 500 million in the last financial year. Now, for reasons best known to them, the board members are keen that the company should diversify into commodity trading. As you savour the gourmet meal, the aircraft starts shaking suddenly and an announcement is made, "We have hit an air-pocket. We expect more turbulence ahead. Please occupy immediately the nearest vacant seat available and fasten seat-belts for your safety." There is near commotion in the cabin, and the next moment you find a middle-aged gentleman seated next to you whose face is familiar; you exchange greetings with each other.

You start talking and as the discussion builds up you find that the other person was also there during the presentation ceremony and he was, in fact, 'Financial Engineer of the Year' last year. He shows keen interest in your company and appears to know a lot about your company's future plans. He offers to exchange you purchase of coffee worth USD 10 million options floating in return for sugar futures fixed, over next six months. You struggle to see the reason and remain non committal.

On your return to office you find that your company needs to enter into interest rate swap for its forthcoming commodity trading project. But this activity will be starting in about nine months from now and it will involve a series of swaps, required to be settled every month for about JPY

100 million fixed against AUS dollar floating. This is coming from your overseas software business in these countries, where your company had taken a perpetual loan from the local banks due to the Government's policy to demonstrate that you have long-term business interests in those countries.

You are keen to manage the risk of your foreign currency receivables portfolio, typically in EUR, with variable timing by having a cross currency swap with a hardware vendor from China. You have not yet decided about the currency which will be profitable against EUR.

While, you are in this process, your phone rings and the winner of 'Financial Engineer of the Year' award is on line asking you to join him for a dinner meeting next Friday. You sense that it could be good opportunity for you to learn a few things from him.

You have about ten days time on your hand, and you are keen to get 'Financial Engineer of the Year' award next year.

Question: How will you proceed to structure this situation? What all information will be needed? What is your perception of the risks involved in the proposed structure?

Chapter **17**

Short-term Financial Management in a Multinational Corporation

17.1 INTRODUCTION

Management of short-term assets and liabilities – cash, investments, inventories, receivables, payables – is an important part of a finance manager's job. Funds flow continually in and out of a corporation as goods are sold, receivables are collected, short-term borrowings are availed of, payables are settled and short-term investments are made. The essence of short-term financial management can be stated as:

1. Minimise the working capital needs consistent with other policies (e.g. granting credit to boost sales, maintain inventories to provide a desired level of customer service, etc.)
2. Raise short-term funds at the minimum possible cost and deploy short-term cash surpluses at the maximum possible rate of return consistent with the firm's risk preferences and liquidity needs.

In a multinational context, the added dimensions are the multiplicity of currencies and a much wider array of markets and instruments for raising and deploying funds.

This chapter will focus on cash management in a multinational corporation. Other aspects of short-term financial management, e.g. inventories, receivables, etc., are not discussed since there is no substantive difference between a multinational and a purely domestic firm when it comes to management of these assets. Cash management can be considerably more complex because of possibility of raising and deploying cash in many currencies, many locations, and profit opportunities presented by imperfections in international money and foreign exchange markets.

Even a purely domestic firm or a firm with imports and exports, but having no cross-border manufacturing facilities can "internationalise" its cash management if the government of the country permits free capital inflows and outflows. Thus, an American firm serving largely domestic markets can, if it wishes to, raise short-term funding in offshore markets to meet its working capital needs as also park its temporary cash surpluses in foreign securities or eurodeposits.

In India as of now, the capital account has not been fully opened up. It is the avowed policy of the government to discourage short-term foreign borrowing and capital outflows are regulated. There has been a gradual trend towards liberalisation of the capital account. Indian firms have been permitted access to foreign money markets (through domestic banks) for pre-shipment credits for exports and settlement of import payments. The Exchange Earners Foreign Currency (EEFC) account facility allows exporters to maintain up to 50% of their foreign currency earnings in a foreign currency denominated account with domestic banks which can be used for all permissible current account transactions[1]. These limits are periodically reviewed. In August 2008, with a view to giving an opportunity to small and medium enterprises (SMEs) to manage challenges in the global markets, all Exchange Earners' Foreign Currency (EEFC) account holders were permitted to maintain outstanding balances to the extent of US $1 million in the form of term deposits up to 1 year maturing on or before October 31, 2008. However, they do not as yet have full freedom to access foreign money markets for their day-to-day cash management purposes. The foreign subsidiaries of Indian companies are of course governed by the exchange controls regulations of the host country and may be in a position to employ some of the techniques discussed in this chapter.

The distinction between a passive, defensive approach and an active, opportunistic approach applies to cash management too. The passive approach confines itself to minimising cash needs and currency exposure as well as optimal deployment of cash balances arising out of the firm's operating requirements. The active approach deliberately creates cash positions to profit from perceived market imperfections or the firm's supposedly superior forecasting ability.

17.2 SHORT-TERM BORROWING AND INVESTMENT

International money markets particularly in well-developed financial centres like London, New York and Tokyo offer a variety of instruments to raise short-term financing as well as place short-term funds. The principal dimensions of the borrowing-investment decisions are the instrument, currency, location of the financial centre and any tax related issues. Between them, they decide the cost of or return on funds, extent of currency exposure, the ease with which funds can be moved from one location and currency to another and thus the overall efficiency of the cash management function. In this section we will focus on the cost/return dimension. The other considerations – location, currency etc. – will be taken up later.

Apart from bank loans, the other major instruments for short-term funding are commercial paper and, in the US domestic money market, bankers' acceptances. Commercial paper as a funding device is accessible only to corporations with high creditworthiness. For such entities, it is a cheaper form of funding than a bank loan.

We have seen in Chapter 8 that on a covered basis, yields are equal (apart from transactions cost) across Eurocurrencies. Hence, on a covered basis, the choice of currency of borrowing does not matter. Only when the borrower firm holds views regarding currency movements which are different from market expectations as embodied in the forward rate, does the currency of borrowing become an important choice variable.

The international Fisher open condition discussed in Chapter 11 says

$$i_A - i_B = \hat{S}^e(A/B) \tag{17.1}$$

[1] 100% EOUs are permitted to keep 70%. Also certain other recipients of foreign exchange are allowed to have Resident Foreign Currency (RFC) Accounts.

$\hat{S}^e(A/B)$: Expected depreciation of currency A against currency B

However, if speculators are risk averse, a risk premium must be incorporated in the above relationship:

$$i_A - i_B = \hat{S}^e(A/B) + RP \tag{17.2}$$

where RP denotes the risk premium.

This coupled with the interest parity relation implies

$$F(A/B) = S^e(A/B) + RP \tag{17.3}$$

where $F(A/B)$ is the relevant forward rate and $S^e(A/B)$ is the expected future spot rate.

Note that the risk premium can be negative or positive depending upon whether speculators as a group are required to be net short or long in the forward market. Thus, the forward rate can ***on average*** equal the future spot rate even in the presence of a constant risk premium. However, in a particular instance, a firm may have reasons to believe that the forward rate is an underestimate or overestimate of the future spot rate. In such cases, the firm should compare the effective expected cost of borrowing across different currencies and choose the least cost alternative. Note that this involves risk and any saving on borrowing cost reflects compensation for the added risk.

Following the same reasoning, on a covered basis, the firm should be indifferent between various currencies when it comes to placing temporary excess funds since the covered yields are identical. Considerations such as availability of various investment vehicles – deposits, CDs, CP, treasury bills etc. – and their liquidity may lead to one currency being favoured over another. A firm willing to take on added risk, can make uncovered investments hoping to profit from its superior forecasting ability.

17.3 WHERE SHOULD SURPLUS CASH BE HELD?

In a multinational corporation with production and selling subsidiaries spread around the world, cash inflows and outflows occur in diverse currencies. Apart from cost and return considerations, several other factors influence the choice of currencies and locations for holding cash balances.

The bid-ask spreads in exchange rate quotations represent transaction costs of converting currencies into one another. There may of course be other costs such as telephone calls, telexes, other paperwork, etc. Minimising transaction costs would require that funds be kept in the currency in which they are received, if there is possibility that they might be needed later in the same currency. A related but distinct consideration is that of liquidity viz. funds should be held in a currency in which they are most likely to be needed. This may not be the same as the currency in which the cash comes in. Militating against these factors is the political risk dimension. The parent firm may want to hold all surplus cash in its home currency to minimise the risk of its assets being frozen by a foreign government. However, this consideration would influence the location of the financial centre where the funds are held rather than the currency and is likely to be of some importance only in the case of politically highly unstable countries.

Availability of investment vehicles and their liquidity is another important factor. Major money market centres such as London, New York, Zurich and so forth offer a wide variety of highly liquid money market instruments so that the firm does not need to hold practically any idle cash balances.

Finally, withholding taxes may influence the choice. If balances are held in interest bearing assets in a country which has a withholding tax on non-resident interest income, and the tax rate exceeds the parent's home country tax rate, the parent may not be able to get full credit for the foreign tax paid and such a location may, therefore, become unattractive for holding funds[2].

17.3.1 Investing Surplus Funds

Once the treasurer has identified the cash flows and determined how much surplus funds are available in which currencies and for what durations, he or she must choose appropriate investment vehicles so as to maximise the interest income while at the same time minimising currency and credit risks and ensuring sufficient liquidity to meet any unforeseen cash requirements.

The major investment vehicles available for short-term placement of funds are: (1) short-term bank deposits (2) fixed-term money market deposits such as CDs and (3) financial and commercial paper. The main considerations in choosing an investment vehicle can be summarised as follows:

Yield: Total return on the investment including interest income and any capital gain or loss. Very often, security and liquidity considerations may take precedence over yield.

Marketability: Since liquidity is an important consideration, the ease with which the investment can be unwound is important. Instruments like CDs have well-developed secondary markets while CPs and trade related paper have limited liquidity.

Exchange Rate Risk: If funds eventually required in currency *A* are invested in currency *B*, there is exchange rate risk. If covered, then as we saw above, there is no advantage to switching currencies.

Price Risk: If a fixed-term investment such as a CD or a *T*-bill has to be liquidated before maturity, there is the risk of capital loss, if interest rates have moved up in the meanwhile.

Transactions Costs: Brokerage commissions and other transactions costs can significantly lower the realised yield particularly on short-term investments.

Money-market investments are often available in fixed minimum sizes and maturities which may not match the size of the available surplus and the duration for which it is available. For instance, consider the case of a treasurer who has a surplus of USD 180,000 for 90 days. 90-day USD CDs are an attractive instrument offering 10% return, but the denomination is USD 100,000 per CD. The treasurer can purchase one CD and invest 80,000 dollars in a bank deposit earning 6% or borrow USD 20,000 via an overdraft facility at 13% and purchase two CDs. Which course of action is preferable?

Let us cast the problem in more general terms. Let M denote the minimum size of the investment instrument, S the surplus funds, i the interest on the instrument, d the interest rate on the bank deposit and b the interest rate on borrowing or overdraft. Then the breakeven size of excess funds is given by

$$M \times i - (M - S^*) \times b = S^* \times d$$

i.e. $$S^* = M[(b - i)/(b - d)]$$

If excess funds on hand exceed S^*, money should be borrowed to invest in the money market instrument; otherwise the excess funds should be left in a bank deposit.

In the example at hand, $M = 100{,}000$, $i = 0.10$, $d = 0.06$ and $b = 0.13$.

The breakeven size of surplus funds is

$$100{,}000[(0.13 - 0.10)/(0.13 - 0.06)] = 42{,}857.14$$

[2]A related consideration is the tax treatment of exchange gains and losses. If exchange gains are treated as capital gains and taxed at a lower rate, the firm should hold funds in currencies which are at a forward premium against its home currency.

Since the treasurer has USD 80,000 excess, it is preferable to borrow USD 20,000 and purchase two CDs.

A similar problem arises when the duration for which surplus funds are available does not match the term of a money market investment. Suppose a treasurer has EUR 250,000 available for 10 days. A 30-day fixed deposit is paying 7% p.a. Thus, the gap is 20 days. The money can be placed in a current account earning 2% p.a. Overdraft facility can be availed of for 20 days at a cost of 9% p.a. Here, we can define a "breakeven" period such that if the actual period for which funds are available exceeds the breakeven period, money should be borrowed to take advantage of the higher return on the fixed deposit. (Alternatively, define a breakeven gap and if the actual gap is shorter than the breakeven gap, funds should be borrowed for the duration of the gap). We leave this as an exercise for the reader.

17.3.2 Financing Short-Term Deficits

Just as judicious management of short-term surplus funds can earn extra income for the firm, careful handling of short-term deficits can lead to significant savings. The treasurer's objective in this regard should be to minimise the overall borrowing requirement consistent with the firm's liquidity needs and to fund these at the minimum possible all-in cost.

One of the cheapest ways of covering short-term deficits is internal funds. In a multinational firm with several subsidiaries, it often happens that while one division has a short-term funds requirement, another has surplus funds. While the former may have to take an expensive bank loan or overdraft facility, the latter may not have very attractive investment opportunities beyond bank deposits. A centralised cash management system with cash pooling described below can efficiently allocate internal surpluses so as to optimise interest earnings net of interest costs for the corporation as a whole. However, cross-border inter-company loans are a complex area. There are issues related to differences in tax regimes, existence of double taxation treaties, differences in accounting norms, and exchange risk. Specialist advice is usually necessary to exploit these opportunities in an optimal fashion.

External sources of short-term funding consist of overdraft facilities, fixed-term bank loans and advances and instruments like commercial paper, trade and bankers' acceptances. Apart from the all-in cost of funding, considerations such as collateral or security requirements, flexibility in terms of repayment schedule, speed with which a new facility can be arranged, effect on firm's credit rating and so forth also play a role in evaluating the funding options. The size and maturity mismatch problems arise here too. For instance, suppose a treasurer determines that he has a requirement of USD 60,000 for 30 days. An overdraft facility would cost him 8% while a 30-day term loan is available at 6%, but the minimum amount is USD 100,000. Surplus funds can be kept in a deposit earning 3%. The problem again is to determine the "breakeven" size of funding requirement such that if the actual need is larger than this, it is preferable to go in for the term loan rather than an overdraft facility. In another case, an amount of USD 100,000 is needed for 18 days whereas a term loan is for a minimum of 30 days. Once again, the reader can determine the breakeven gap above which it is preferable to take the loan and place the funds in a deposit during the days they are not needed.

All-in cost must be determined on a post-tax basis. Withholding taxes, deductibility of interest, fees and other charges related to a funding facility, tax treatment of inter-subsidiary interest payments and tax treatment of exchange gains and losses if funding is availed of in a different currency are among the issues which must be carefully analysed.

17.4 CENTRALISED VERSUS DECENTRALISED CASH MANAGEMENT

A multinational corporation with subsidiaries in different parts of the world has cash flows in a variety of currencies and countries. It can leave cash management to individual subsidiaries (who will also manage their currency exposures) or have a centralised cash management system. In the latter case, it can create a "Cash Management Centre" which may be a part of the parent company, located at one of the subsidiaries or a separate entity incorporated for that purpose. Centralised cash management has several advantages which we will discuss below. Some examples of real-life cash management systems can be found in the references cited in the bibliography. Many international banks such as Chase Manhattan, CitiCorp offer their own cash management systems often suitably modified to take into account a particular corporation's needs.

17.4.1 Netting

In a typical multinational family of companies, there are a large number of intra-corporate transactions between subsidiaries and between subsidiaries and the parent. If all the resulting cash flows are executed on a bilateral, pairwise basis, a large number of currency conversions would be involved with substantial transaction costs. With a centralised system, ***netting*** is possible whereby the cash management centre (CMC) nets out receivables against payables and only the net cash flows are settled among different units of the corporate family.

Consider the case of an American multinational with subsidiaries in France, Switzerland and the UK. The parent operates a cash management centre. By a specific date each month, say the 15th, all units, the subsidiaries as well as the parent, acquire the necessary currencies at the spot rate ruling at that time (two days before the settlement date). Any exchange gains or losses are attributed to the individual units.

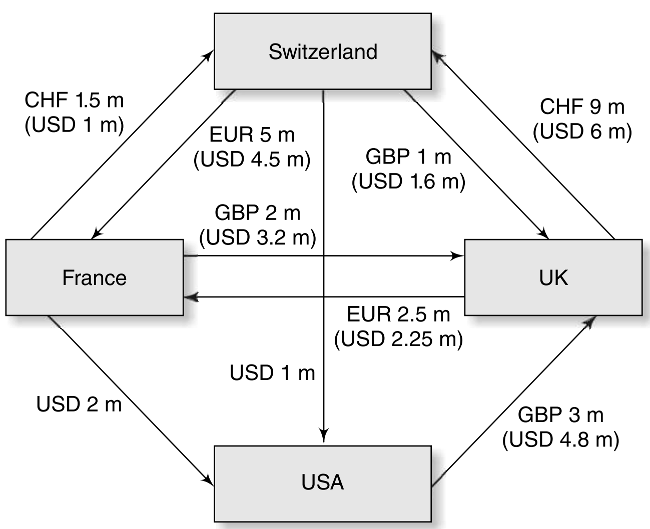

Fig. 17.1 Intra-Corporate Obligations before Netting

The net positions of the various units, in millions of dollars, are as follows:

(+ sign indicates inflow and a – sign an outflow):
US Parent: + 2 + 1 – 4.8 = –1.8
UK Subsidiary: +4.8 + 3.2 + 1.6 – 2.25 – 6.0 = –1.8
France Subsidiary: + 4.5 + 2.25 – 1.0 – 3.2 – 2.0 = 0.55
Switzerland Subsidiary: + 1.0 + 6.0 – 4.5 – 1.6 – 1.0 = –0.1

Figure 17.2 shows the net positions between each pair of units (the dashed lines) and the actual payments (solid lines).

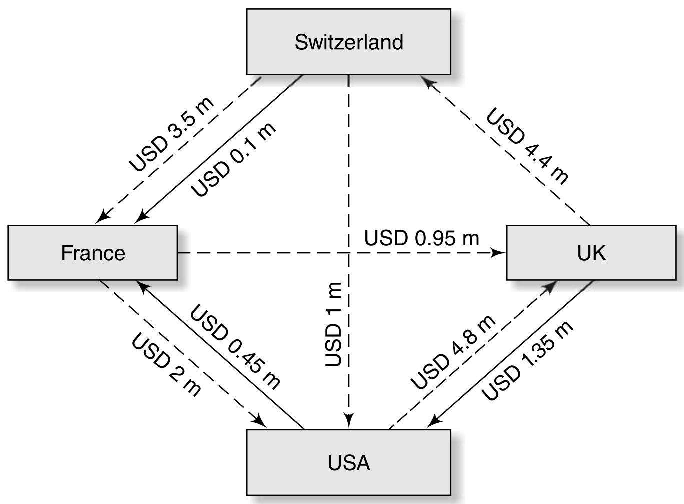

Fig. 17.2 Intra-Corporate Payments after Netting

Netting has reduced the total number of currency conversions from eight to three, implying savings on transactions costs[3].

Netting need not be confined to intra-corporate transactions. Transactions with third parties can also be incorporated.

More flexibility can be achieved in cash management if netting can be combined with leading and lagging as discussed in Chapter 13. Payments to cash surplus units can be lagged (with appropriate compensation at the ruling rates of interest) and those to cash deficit units can be accelerated to manage overall cash needs and minimise the use of bank credit lines.

17.4.2 Exposure Management

If individual subsidiaries are left to manage their currency exposures, each will have to access the forward market (or other appropriate hedging devices), once again increasing transactions costs. The CMC can adopt a corporate perspective and look at the overall currency composition of receivables and payables. Since the overall portfolio will be fairly diversified, currency risk is considerably reduced. The CMC can match and pair receivables and payables and exploit the close correlations between some currencies – e.g. EUR and GBP – to achieve some degree of natural hedge.

[3]The problem of manoeuvring liquidity between different divisions of a multinational corporation can be formulated as a linear programming problem. See Rutenberg (1970). We will provide a small illustration in the appendix to this chapter.

17.4.3 Cash Pooling

The CMC can act not only as a netting centre but also the repository of all surplus funds. Under this system, all units are asked to transfer their surplus cash to the CMC which transfers them among the units as needed and undertakes investment of surplus funds and short-term borrowing on behalf of the entire corporate family. The CMC can, in fact, function as a finance company which accepts loans from individual surplus units, makes loans to deficit units and also undertakes market borrowing and investment. By denominating the intra-corporate loans in the units' currencies, the responsibility for exposure management is entirely transferred to the finance company and the operating subsidiaries can concentrate on their main business, viz. production and marketing of goods and services. Cash pooling will also reduce overall cash needs since cash requirements of individual units will not be synchronous.

The concept of CMC can be combined with that of a ***re-invoicing centre***. Under this system, notionally all subsidiaries sell their output to the re-invoicing centre which is located in a low-tax country. The sales are invoiced in the selling company's currency. The re-invoicing centre takes title to the goods and in turn sells to third party customers as well as other members of the corporate family which may be production and/or sales subsidiaries. The actual deliveries are made from the selling units to the buying units. For intra-corporate sales, the buying units are invoiced in their respective currencies. Thus, the entire currency exposure is transferred to the re-invoicing centre which can use matching and pairing to minimise recourse to forward markets or other hedging devices. Also, the re-invoicing centre can access foreign exchange markets more efficiently than individual subsidiaries. Leading and lagging can be used to transfer funds from cash-surplus units to cash-deficit units.

CMCs, finance companies and re-invoicing centres are generally located in major money market centres where active markets in foreign exchange and a variety of money market instruments are available. Also, the presence of an efficient banking system can facilitate speedy settlement of receivables and payables.

The concepts and applications of netting centres, re-invoicing centres and finance company have been discussed in greater detail by Borenstein [see Antl (1989) Chapters 19-21].

Some important issues have to be sorted out before setting up a centralised cash management system with netting and cash pooling. If the CMC uses a single currency as the common denominator to compute net positions, this will lead to transactions exposure for individual subsidiaries. Hence, the choice of the common currency must be made in the light of local currencies of the individual divisions, existence of sufficiently active forward markets and other hedging products between these currencies and the common currency and so forth. The second issue is rules governing settlement of debts within the system. If an individual subsidiary has a net debtor position, how much time should it be given to settle, how much interest should it be charged on overdues, how to prevent a subsidiary from arbitraging between its local money market and the CMC (e.g. if a subsidiary can earn a much higher rate in the local money market than what it has to pay on overdues to the centre, it will have incentive to delay payments) are among the considerations which must be thoroughly analysed.

17.4.4 Disadvantages of Centralised Cash Management

Despite these advantages, complete centralisation of cash management and funds holding will generally not be possible. Some funds have to be held locally in each subsidiary to meet unforeseen payments since banking systems in many developing countries do not permit rapid transfers of funds. Also, some local problems in dealing with customers, suppliers, etc., have to be handled on the spot for which purpose local banks have to be used and local banking relationships are essential. Each corporation must evolve its own optimal degree of centralisation depending upon the nature of its global operations, locations of its subsidiaries, etc. Further, conflicts of interest can arise if a subsidiary is not wholly owned, but a joint venture with minority local stake. What is optimal with regard to cash and exposure management from an overall corporate perspective need not be necessarily so from the point of view of local shareholders.

17.5 CASH TRANSMISSION

An important but frequently overlooked aspect of cash management is minimising the unnecessary costs in the process of collecting cash from debtors and making payments to creditors. These costs arise from the so called "float". A debtor issues a cheque or a draft in favour of the firm but funds do not become available to the firm till the instrument is cleared through the banking system. This delay is the float. The treasurer must try and minimise the float in the cash collection cycle and take advantage of the float in the cash payment cycle.

The banking systems in various countries have evolved clearing mechanisms which aim at reducing the delays between a payment instruction being received and the payee actually being able to use the funds. The CHIPS in the US, CHAPS in the UK are examples of such systems. SWIFT is an electronic network for cross-border funds transfers[4]. A treasurer operating in a multinational framework needs a good working knowledge of these systems. Similarly, banks around the world offer various facilities to their clients to speed up funds transfers. Direct debits, lock-box facilities and other such devices can help in cutting down these delays often enabling realisation of value the same day. A good exposition of efficient cash transmission techniques can be found in Austen and Reyniers (1986). With the rapid strides in technology of banking and innovations like Internet banking, it may be possible to virtually eliminate the delays and effect instant cash transfers from the payer to the payee.

Summary

This chapter focuses on the critical issues involved in discharging the cash management function in a multinational corporation. Within the constraints imposed by the exchange control and other regulations, a MNC has access to a much wider menu of funding avenues and investment vehicles for short-term funds management. If the firm is not willing to expose itself to exchange risk on account of its short-term funding and investment decisions, the currency of short-term borrowing and investment is irrelevant from the point of view of cost of funding or return on investment. There may, however, be other factors, such as political risk and taxation, which may influence this decision.

Apart from funding and investment avenues, the mechanics of efficient cash transmission and configuration of bank accounts is an important aspect of cash management in a MNC.

Finally, the decision to centralise cash management in a separate cash management centre needs to be carefully evaluated. There are significant gains from centralising the cash management and

[4]CHIPS: Clearing House Interbank Payments System.
CHAPS: Clearing House Automated Payments System.
SWIFT: Society for Worldwide Inter-Bank Financial Telecommunications.

exposure management functions particularly when substantial intra-corporate payments are involved. There are, however, a few disadvantages, especially from the local subsidiary point of view, which must be clearly understood and incorporated in the overall performance appraisal framework.

Questions and Problems

1. The treasurer of an Indian firm wishes to borrow three-month funds in the euromarket. The accessible rates are as follows:

3-month EUR: 6.50%	3-month £: 10.25%
3-month CHF: 4.50%	3-month \$: 8.75%

The three-month spot and forward rates against the rupee are:

\$/Rs Spot: 48.00	90-day forward: 49.3211
EUR/Rs Spot: 42.00	90-day forward: 42.9964
£/Rs Spot: 69.00	90-day forward: 70.0419
CHF/Rs Spot: 21.75	90-day forward: 23.1050

If the corporate policy is to cover all exchange risks, in which currency should she borrow?

2. The treasurer of another company faces the same rates as in Problem 1. However, his company subscribes to a currency advisory service. Their forecasts of spot rates 90 days from now are as follows:

\$/Rs: 48.75   EUR/Rs: 43.25   £/Rs: 69.80
CHF/Rs: 24.00

The treasurer has great faith in this service's forecasting ability. Also, his company is willing to take on exchange risk. Where should he borrow?

3. With the rates as in Problem 1, where should a 3-month surplus be invested by an Indian firm if it does not wish to take on any exchange risk?
4. Explain succinctly the various considerations involved in deciding where and in which currency a multinational should hold funds.
5. Which of the advantages of centralisation of cash management are related to foreign exchange exposure management?
6. "Foreign exchange market efficiency does not rule out speculative profits." Discuss and explain.
7. A US based MNC manufacturers and sells paper and wood products. It has subsidiaries in Canada, UK and Ireland. Each subsidiary specialises in a particular product but all products are sold in all markets. This gives rise to a network of intra-corporate payments and receipts. Each subsidiary handles its own exposure and financing needs. Corporate policy is to cover all exposures unless there is a definite trend or cost of cover is too high. The interpretation of "definite trend" and "too high" is left to the subsidiaries. A daily bulletin informs all treasurers of financing needs and exposures of all others.

   Today's situation is as follows:

   (i) UK needs working capital. It seems the Bank of England has restricted bank borrowing. Business is strong but credit is needed to take advantage of it.
   (ii) Canada has excess liquidity.
   (iii) Irish situation is normal.

(iv) HQ also needs financing but the Federal Reserve is in a relaxed mood and credit is readily available in the US. HQ has a payable due to Canada in two days and to UK in one month in their respective currencies. There are no capital or exchange controls but HQ's cost of borrowing in the home money market is somewhat lower than in the Euromarket.

The HQ treasurer is trying to figure out whether he can simultaneously solve the financing problems and cover his own exposure. His main concern is that, in doing so he must not incur a higher cost of cover than what it would be if he leaves the subsidiaries to solve their own financing and expsoure problems. The accessible market rates are as follows:

£/$ Spot 1.6795
1-month forward: 45 points discount on USD.
Domestic $ borrowing rate: 14.50% p.a.
Euro-£ deposit rate: 17.75%
Euro-£ borrowing rate: 18.00%
Advise the HQ treasurer and justify your advice.

8. Explain the merits and demerits of centralised cash management for an MNC.

9. On a certain day, the observed market rates implied that for a US MNC, a domestic 90-day investment would yield 6% while a covered investment in Mexican peso would have yielded 7.5%. Why would such a discrepancy arise and persist?

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Appendix

A.17.1 LINEAR PROGRAMMING FORMULATION OF NETTING

A US parent company has subsidiaries in Canada, UK, Germany, The Netherlands and South Korea. Table A.16.1 shows the intra-corporate receivables and payables reported to the CMC at the parent HQ on the 15th of a particular month. The amounts shown are dollar equivalents of the actual flows to be settled.

Table A.17.1 Intra-Corporate Receivables and Payables (US $ Million)

From \ To	Canada	UK	Germany	Holland	South Korea	US
Canada	—	5.80	2.50	—	4.75	15.00
UK	8.25	—	5.85	2.75	1.50	3.45
Germany	2.65	1.40	—	3.40	0.50	1.95
Holland	—	2.55	4.70	—	3.90	2.35
South Korea	1.55	3.45	9.50	5.45	—	5.85
US	8.35	1.55	7.45	3.80	0.25	—

Table A.17.2 shows the net amounts to be paid or received by each unit after netting.

Table A.17.2 Net Amounts to be Paid or received ($ million)

Unit	Total Receivables	Total Payables	Net
Canada	20.80	28.05	–7.25
UK	14.75	21.80	–7.05
Germany	30.00	9.90	+20.10
Holland	15.40	13.50	+1.90
S.Korea	10.90	25.80	–14.90
US	28.60	21.40	+7.20

The CMC must decide the amounts to be transferred between the units so that each surplus unit receives an amount equal to its net surplus and each deficit unit pays an amount equal to its net deficit. Table A.17.3 shows these amounts in algebraic notation. Thus, X_1 is the amount to be paid by UK to Germany, X_5 is the amount to be paid by Canada to Holland, etc. The row total for each paying unit equals its net deficit and the column total for each receiving country equals its net surplus. The numbers in the top-right corner of each cell show the cost of transferring the funds as percent of the amount to be transferred[5]. It is assumed that these percentages do not vary with the amounts to be transferred.

[5]These numbers are purely illustrative and therefore hypothetical.

Table A.17.3

From \ To	Germany	Holland	US	Total
UK	$X_1^{0.10}$	$X_2^{0.10}$	$X_3^{0.12}$	7.05
Canada	$X_4^{0.15}$	$X_5^{0.15}$	$X_6^{0.10}$	7.25
South Korea	$X_7^{0.18}$	$X_8^{0.18}$	$X_9^{0.16}$	14.90
Total	20.10	1.90	7.20	29.20

The objective of the CMC is to determine the values of $X_1 \ldots X_9$ so as to minimise the total cost of transferring funds with the constraint mentioned above, viz. each surplus unit must receive its net surplus and each deficit unit must pay its net deficit.

This is a very simple linear programming problem of a special type known as transportation problem. This can minimise the total cost of funds transfer while ensuring that each unit pays or receives the net payment due from it or to it. Mathematically, it can be formulated as follows:

$$\textbf{Minimise: } (0.001X_1 + 0.001X_2 + 0.0012X_3 + 0.0015X_4 + 0.0015X_5 + 0.001X_6 + 0.0018X_7 + 0.0018X_8 + 0.0016X_9)$$

Subject to the constraints:

$X_1 + X_2 + X_3 = 7.05$ Total payments from UK
$X_4 + X_5 + X_6 = 7.25$ Total payments from Canada
$X_7 + X_8 + X_9 = 14.90$ Total payments from S. Korea
$X_1 + X_4 + X_7 = 20.10$ Total payments to Germany
$X_2 + X_5 + X_8 = 1.90$ Total payments to Holland
$X_3 + X_6 + X_9 = 7.20$ Total payments to US.

This problem can be solved by one of the standard methods in mathematical programming[6]. The optimal solution is exhibited in Table A.17.4. The amounts are in millions of dollars.

Table A.17.4 Optimum Funds Transfers

From \ To	Germany	Holland	US	Total
UK	7.05	0.00	0.00	7.05
Canada	0.05	0.00	7.20	7.25
South Korea	13.00	1.90	0.00	14.90
Total	20.10	1.90	7.20	29.20

The optimal solution involves five funds transfers and the total cost works out to $41,145.

[6]See any basic text on Operations Research or Mathematical Programming. The optimal solution need not be unique.

Chapter 18

International Equity Investment

18.1 INTRODUCTION

The twentieth century has seen massive cross-border flows of capital. However, till the 1980s, it was predominantly debt capital in the form of bank loans and bond issues. The international new issues equity market with globally syndicated offerings emerged during the eighties and grew rapidly till the stock market crash of October 1987. While some emerging stock markets remained bullish despite the crash, institutional investors reduced their exposure to equities in general during 1988 and 1989[1]. The trend turned upward again and after some initial hesitation, the emerging economies of East Asia and some in Latin America became the darlings of global portfolio managers in developed economies. The years 1991-1996 saw a substantial increase in the flow of equity investment in emerging markets. The Asian currency crisis of 1997 followed by the Russian debacle in 1998 and an almost-crisis in Brazil put a damper on the enthusiasm shown by rich country investors towards emerging stock markets for much of 1998 and early 1999. By then, some of the Asian economies had recovered from the crisis and their domestic stock markets were booming driven to some extent by the boom on US exchanges and investor euphoria over technology stocks. The long-feared slowdown in the US economy appeared to have finally struck during the closing days of 2000. However, emerging economies got on to a rapid growth trajectory beginning in 2001 and have continued to grow at significant rates till end of 2006.

The sub-prime crisis in US began in August 2007 and reached its peak by September 2008. By March 2009, the equity markets had reached a state of massive sell-offs. The S&P500 dropped to three-digit level, Dow-Jones fell sharply and so did several stock markets in developed countries as well as emerging economies. With FIIs withdrawing substantial amount of funds from equity markets of emerging economies to meet their obligations in their home countries, stock markets in emerging economies like India too turned down after a five-year long bull run. The markets recovered by the

[1]The market break in October 1989 further reinforced the bearish tendency among investors.

second quarter of 2009. Between March 2009 and September 2009, markets climbed back more than 50%.

The initial thrust to cross-border flows of equity investment came from the desire on the part of institutional investors to diversify their portfolios globally in search of both higher return and risk reduction. Financial deregulation and elimination of exchange controls in a number of developed countries at the beginning of eighties permitted large institutional investors to increase their exposure to foreign equities.

Table 18.1 presents some recent data on announced international equity issues by selected countries and country groups. The volume of equity flows to developing countries decelerated to some extent after the Asian crisis in 1997 but recovered the rate of growth by 2000. As seen in Table 18.1, there has been a significant upward shift between 2005 and 2006. Table 18.2 provides data on equity raised by Indian companies from global investors. This is either investment by foreign institutional investors in Indian stock markets or by means of the depository receipts mechanism.

The decade of 1990s witnessed opening up of equity markets of developing countries like South Korea, Taiwan, Indonesia and India to foreign investors albeit with some restrictions. A number of companies from these countries have raised equity financing in developed country stock markets.

Table 18.1 Announced International Equity Issues
Selected Countries and Regions (Billions of US Dollars) (By Nationality of Issuer)

Country/Group	*2009*	*2010*	*2011*	*2012 (Q1 + Q2)*
All Countries	734.8	114.6	485.3	234.8
Developed Countries	595.7	78.8	362.7	178.2
Developing Countries	120.3	30.6	102.5	47.3
(1) Africa & Middle East	5.6	2.5	4.4	3.7
(2) Asia & Pacific	83.2	17.9	58.0	30.7
China	51.4	4.3	31.8	13.3
India	17.4	9.1	8.4	6.9
S.Korea	3.9	1.6	8.0	2.4
(3) Europe	11.1	4.2	16.6	2.9
(4) Latin America	20.5	6.1	23.5	5.4

Source: Bank for International Settlements ***Quarterly Review*** December 2011, September 2012
Note: 2012 data are only for two quarters.

The trend towards global integration of equity markets is unmistakable though it is punctuated by intermittent crises and consequent regulatory interventions and investor retreat.

Table 18.2 Foreign Portfolio Investment in India (US Dollars Million)

	2008-09	*2009-10*	*2010-11*	*2011-12*	*2012-13*
Total	–13855	32375	29471	2026	27770
GDRs/ADRs	1162	3328	2049	2026	187
FIIs	–15017	29047	29422	—	27583
Offshore Funds & Others	16	298	—	—	—

Source: ***Reserve Bank of India Bulletin*** Various Issues

It has been argued that an investor can "globalise" his portfolio without necessarily having to invest in foreign countries' equity markets. He can simply buy stock in MNCs based in his country, but which have operations and markets around the world. Also, in recent times, the benefits of global diversification are being subjected to a re-examination. Diversification within a country and across borders is expected to result in reducing unsystematic risk because the correlations between the performance of different companies and industries within a country and between performances of different economies are supposed to be low. But with increasing globalisation and integration of all economies, how long will this last? In near future, will we see all countries going into a recession or an economic boom at the same time? If the co-variances of returns in different countries' stock markets keep on rising, risk reduction effect of cross-border diversification will weaken.

Equity capital can flow to a developing country in one or more of three ways. Developed country investors can directly purchase shares in the stock market of a developing country. Or, companies from developing countries can issue shares (or depository receipts) in the stock markets of developed countries. Finally, indirect purchases can be made through a mutual fund which may be a specific country fund or a multi-country regional fund.

While stock markets in developing countries are quite small in size compared to the major developed country markets – the US, Japan and the UK – the turnover ratios of many of them are comparable to those in the latter. Later we will examine some further characteristics of these markets which have a bearing on their attractiveness as investment outlets for portfolio investors in developed countries.

The purpose of this chapter is to investigate the determinants of foreign equity investment decision and address the issues related to capital market integration and valuation of foreign equities.

18.2 RISK AND RETURN FROM FOREIGN EQUITY INVESTMENT

18.2.1 Comparing Investments in a Risk-Neutral World

Consider a US investor who is comparing two equity investments – shares of a domestic firm with shares of an Indian firm. The expected annual dividend yields in the two investments are δ_{US} and δ_{IN}, the expected annual average rates of capital appreciation are α_{US} and α_{IN}. The (INR/USD) exchange rate is S_0 dollars per rupee. After k years, a dollar invested in the US firm is expected to accumulate to:

$$\$(1 + \delta_{US} + \alpha_{US})^k$$

while a dollar invested in the Indian shares is expected to accumulate to:

$$\$(1/S_0)(1 + \delta_{IN} + \alpha_{IN})^k(S^e)_k$$

where $(S^e)_k$ denotes the expected (INR/USD) exchange rate at the end of k years (We are assuming reinvestment of dividend earnings at a rate equal to the dividend yield).

Assume for the moment that the investor is risk-neutral. Also, ignore differential taxation of dividend income and capital gains. The investor would invest in the Indian stock if

$$\left(\frac{1}{S_0}\right)(1 + \delta_{\text{IN}} + \alpha_{\text{IN}})^k (S^e)_k \succ (1 + \delta_{\text{US}} + \alpha_{\text{US}})^k \qquad (18.1)$$

and in the US stock if the reverse inequality holds. The condition can be further simplified. Let $\hat{S}^e$ denote the expected annual proportionate rate of change of the exchange rate S. Then

$$[(S^e)_k/S_0] = (1 + \hat{S}^e)^k$$

Hence, the inequality (18.1) can be written as

$$(1 + \hat{S}^e)(1 + \delta_{\mathbf{IN}} + \alpha_{\mathbf{IN}}) > (1 + \delta_{\mathbf{US}} + \alpha_{\mathbf{US}})$$

Since $\hat{S}^e$, $\delta_{\mathbf{IN}}$, $\alpha_{\mathbf{IN}}$ would be very small in magnitude, their cross products would be infinitesimal and can be ignored. Hence, the above inequality can be approximated as follows:

$$1 + \hat{S}^e + \delta_{\mathbf{IN}} + \alpha_{\mathbf{IN}} > 1 + \delta_{\mathbf{US}} + \alpha_{\mathbf{US}}$$

or

$$\hat{S}^e > (\delta_{\mathbf{US}} - \delta_{\mathbf{IN}}) + (\alpha_{\mathbf{US}} - \alpha_{\mathbf{IN}}) \tag{18.2}$$

Thus, even if Indian stocks give a lower dividend yield and capital gains, investment in Indian equities can be attractive for a US investor if the rupee is expected to appreciate strongly against the investor's home currency USD.

Presence of differential tax treatment of ordinary income and capital gains can reinforce the bias in favour of foreign equities if exchange gains are treated as capital gains and capital gains are taxed at a lower rate. Let θ_y and θ_k be tax rates for ordinary income and capital gains, respectively with θ_y being higher than θ_k.

The after-tax returns on the US and Indian investments are:

US Investment: $(1 - \theta_y)\delta_{\mathbf{US}} + (1 - \theta_k)\alpha_{\mathbf{US}}$

Indian Investment: $(1 - \theta_y)\delta_{\mathbf{IN}} + (1 - \theta_k)(\alpha_{\mathbf{IN}} + \hat{S}^e)$

The latter will exceed the former, if

$$\hat{S}^e > \frac{(1-\theta_y)}{(1-\theta_k)}(\delta_{\mathrm{US}} - \delta_{\mathrm{IN}}) + (\alpha_{\mathrm{US}} - \alpha_{\mathrm{IN}}) \tag{18.3}$$

For a given $\hat{s}^e$, (18.3) is more likely to hold than (18.2) when θ_y exceeds θ_k as assumed.

Of course, ignoring risk is a drastic simplification which makes the choice problem rather trivial. Foreign equities in contrast to domestic equities have the added risks of exchange rate fluctuations and the co-variance of exchange rate with local returns, i.e. the possibility that when the returns measured in local currency are low, the local currency is weak against the investor's home currency. For a US-based investor, the risk of investing in Indian equities is compounded if rupee weakens against the dollar whenever the Indian stock markets are performing badly. There could also be some degree of political risk. How should these risks be factored into investor's decision? We turn now to that question.

18.2.2 Risk and Gains from International Diversification

In assessing the risk from a foreign equity investment, the investor must consider three components of risk, viz. variability of the return in local currency, fluctuations in the exchange rate and the association between the two – the co-variance risk mentioned above. Let $R_{\mathbf{IN}}$ denote the return in rupee terms from an Indian equity share[2]. From a US investor's point of view, the dollar return from this investment, denoted $\rho_{\mathbf{US}}$, is $(R_{\mathbf{IN}} + \hat{S}^e)$. Then the expected value $E(\rho_{\mathbf{US}})$ and variance $Var(\rho_{\mathbf{US}})$ of the dollar return are given by:

$$E(\rho_{\mathbf{US}}) = E(R_{\mathbf{IN}}) + E(\hat{s}^e) = \delta_{\mathbf{IN}} + \alpha_{\mathbf{IN}} + \hat{S}^e$$

$$\mathrm{Var}(\rho_{\mathbf{US}}) = \mathrm{Var}(R_{\mathbf{IN}}) + \mathrm{Var}(\hat{s}^e) + 2\mathrm{Cov}(\mathrm{R}_{\mathbf{IN}}, \hat{S}^e)$$

[2] $E(R_{\mathbf{IN}}) = \delta_{\mathbf{IN}} + \alpha_{\mathbf{IN}}$ where $E(.)$ denotes expected value.

Eun and Resnick (1988) have studied these three sources of risk from a US investor's point of view for investments in some developed country stock markets. Table 18.3 presents some of their findings. It is seen that the contribution of the co-variance term is generally small – less than 20% in most cases – whereas the relative importance of the other two sources of risk varies from country to country. While comparable findings are not available for developing country stock markets, Divecha et al. (1992) find that these markets are significantly more volatile, i.e. the variance of local returns in these markets is significantly higher than that in developed markets. Table 18.4 presents some of their findings.

Table 18.3 Decomposition of the Total Variance of US Dollar Returns on Individual Foreign Stock Markets

Country	*% Contribution to Total Variance from*		
	Exchange Rate Variance	*Local Return Variance*	*Co-variance*
Canada	4.26	84.91	10.83
France	29.66	61.79	8.55
Germany	38.92	41.51	19.57
Japan	31.85	47.65	20.50
Switzerland	55.17	30.01	14.81
U.K.	32.35	51.23	16.52

Source: Eun and Resnick (1988).

Table 18.4 Volatility of Returns on Selected Developing and Developed Country Stock Markets

Country	*Annual Standard Deviation (%)*
Argentina	108
Brazil	74
Chile	29
Hong Kong	31
India	31
Indonesia	39
Korea	29
Mexico	56
Singapore	33
Taiwan	63
Thailand	31
Developed Countries	
Japan	22
U.K.	19
U.S.	17

Source: Divecha *et al.* (1992).

Risk reduction through diversification is a well-established result in portfolio theory. As long as returns on different risky assets are not perfectly positively correlated, risk can be reduced by spreading total wealth across a portfolio of assets. More generally, a given target expected return can be achieved at a smaller risk by combining risky assets than by investing the entire wealth in a single asset.

Within a single economy, different assets exhibit some degree of independence, i.e. lack of perfect correlation in their returns. Risk reduction benefits from diversification within a single market are well established. However, due to the dependence of all industries in an economy on a common set of macroeconomic factors and uncertainties (e.g. weather, political events), there is some irreducible minimum amount of correlation between asset returns and a limit on risk reduction through purely domestic diversification.

Intuitively, since countries differ in their economic and industrial structures and since business cycles in different parts of the world are not synchronous, one would expect further risk reduction to be possible through diversification beyond national boundaries. For a given expected return, an internationally (optimally) diversified portfolio should afford smaller risk than a purely national optimal portfolio.

Note that this risk reduction is supposed to be achieved due to absence of perfect correlation between different national stock markets. However, as we have seen above, foreign assets have additional risks attached to them. On balance, is it true that these added risks are more than outweighed by the reduction in overall risk due to imperfect correlations?

Divecha et al. (1992) present some estimates of correlations among developed country markets, among emerging markets and between developed and emerging markets for the period February 1986 to March 1991. The lack of perfect correlations between markets is amply borne out by these data[3]. Also, the degree of association among the emerging markets as well as between the emerging and developed markets is much smaller than that among the developed markets. Thus, ***prima facie*** equity investment in emerging markets appears to present substantial opportunities for risk reduction from the point of view of investors in the developed countries.

However, during more recent years, there is a growing feeling among market participants that with increasing integration among national capital markets and economies, business cycles may coincide across countries.

Now consider an internationally diversified portfolio. The total risk of such a portfolio can once again be broken down into three components:

1. Exchange Rate Risk: Variances of changes in exchange rates of the component currencies in terms of the base currency and co-variances among these.
2. Local Returns Risk: Variances of local rates of return and co-variances among these.
3. Local Returns – Exchange Rates Co-variance Risk: Co-variance between each exchange rate change and each local return.

The extent of risk reduction due to exchange rate co-movements depends upon the investor's home currency and the composition of his portfolio. For instance, a US investor with a portfolio limited to, say, German, Japanese, and Swiss equities may, in fact, be taking on ***added risk*** on this account as EUR, JPY and CHF show similar movements against the dollar. Whether diversification across a broader group of currencies will significantly reduce exchange rate risk is an empirical issue. Some evidence presented by Eun and Resnick (***op. cit***) on decomposition of the variance of dollar returns on a ***portfolio*** of European and Japanese stocks (as against individual country stocks presented in Table 18.4) seems to indicate that significant reduction in exchange rate risk may not be possible via this route[4]. Of course, exchange risk can be hedged by using forward markets, currency options and futures and foreign currency borrowing. The co-variances among local returns depend upon the extent of integration or segmentation among national capital markets, an issue we will return to later in this chapter. The correlations presented above seem to indicate that developed country markets are getting more and more integrated, thus reducing the scope for risk reduction through diversification confined to these markets whereas the emerging markets may continue to offer considerable opportunities in that direction[5].

The association between exchange rate movements and performance of a national market depends upon a complex set of economic factors and probably varies from one period to another. Thus, during some period, a strong yen may go hand in hand with a booming Japanese stock market while at other times it may be the reverse[6].

On balance, it is impossible to assert on purely ***a priori*** grounds that international diversification can lead to significant risk reduction. We must look at empirical work.

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[3]Calculations by other researchers for other time periods also confirm this. See, for instance, Eun and Resnick (1988), Lessard (1976) and Levy and Sarnat (1970).

[4]The Eun and Resnick portfolio consists of stocks from countries many of whom show common movements against the dollar e.g. Yen, DEM, CHF and FRF.

[5]However, recent events (circa April 2001) seem to indicate that stock markets even in emerging economies like India are apparently driven by the bulls and bears of NASDAQ.

[6]The first half of 1994 witnessed sluggish Japanese stock market which many analysts have attributed to appreciation of the yen against the US dollar.

A number of researchers have studied the problem of gains from international diversification. One of the earliest and oft-quoted work is Solnik (1974). Solnik examines risk reduction from the point of view of a US investor, from pure domestic diversification versus international diversification with and without a hedge for exchange risk. His results seem to indicate significant gains even without hedging for exchange risk. However estimates of risk reduction vary considerably according to the period studied and whose viewpoint is considered[7].

One important problem with some of these studies is the fact that they used historical data on returns to form efficient internationally diversified portfolios rather than using distributions of ***expected future*** returns as called for by portfolio theory. This tends to give an upward bias to estimates of benefits of international diversification[8].

Jorion (1985) has attempted to remove this bias by using statistical procedures that account for sort of "outlier" behaviour in past returns data. His estimates indicate that earlier studies have considerably overestimated the benefits of international diversification.

Despite the differences in estimates and technical problems, there is a general agreement that international diversification does pay in terms of risk reduction. Availability of products to hedge exchange rate risk further reinforces this conclusion. However, it is not clear whether hedging exchange rate risk would reduce expected returns at the same time as it reduces risk.

18.3 THE INTERNATIONAL CAPITAL ASSET PRICING MODEL

One of the pillars of modern financial theory is the **Capital Asset Pricing Model (CAPM)** developed by Sharpe (1964), Lintner (1965) and Mossin (1965). It links the expected (excess) returns on a risky asset to its risk in an **efficient portfolio**. Its starting point is the mean-variance portfolio selection model due to Markowitz (1952).

The expected excess return on a risky asset or a portfolio of assets is its expected return over and above the risk-free return such as the return on a treasury bill. A portfolio is said to be **efficient,** if among all possible portfolios with the same excess return it has the lowest variance. Alternatively, among all portfolios with a specified level of risk as measured by variance, the efficient portfolio has the highest return. Consider a portfolio consisting of assets $i = 1,2...., N$. As demonstrated in the appendix to this chapter, a necessary condition for a portfolio to be efficient is

$$\frac{E(r_i^* - r)}{E(r_i^* - r_p^*)} = \theta \quad \text{for} \quad \text{all } i = 1, 2, \ldots N \tag{18.4}$$

where r_i^* and r_p^* denote, respectively return on asset i and the portfolio. The numerator is the contribution of asset i to the portfolio's excess return while the denominator is the contribution of asset i the portfolio's variance[9] or risk. The parameter θ is known as the investor's **relative risk**

[7]Levy and Sarnat (1975) bring out this point. During a particular period, the correlation between Japanese and US securities was –0.06 from a US investor's point of view and +0.91 from an Israeli investor's point of view.

[8]Suppose during a particular sample period, stocks on a particular country market have done extremely well. The efficient portfolio will have a heavy weight for these stocks and it would naturally outperform a purely domestic portfolio for the sample period. The crucial question is will it do so out of sample? That particular stock market cannot be expected to perform so well persistently. Therefore, in a future-oriented portfolio it should not receive such a large weight. This point has also been emphasized by Levi (1990).

[9]In a well-diversified portfolio, the unsystematic risk of any asset does not matter; what matters is its systematic risk, i.e. the co-variance of its return with the portfolio return. This is the well-known proposition from Markowitz's portfolio selection theory.

aversion and is a measure of his or her attitude towards risk. Another result from the theory of portfolio selection is the "two fund theorem" which says that in equilibrium, all investors will hold some combination of the risk-free asset and the so-called "tangency portfolio".

One of the crucial ingredients in the CAPM is the notion of **Market Portfolio**. In principle, this is to be understood as the aggregate asset holdings of a specified group of investors. In the usual one-country version of the CAPM, this is identified with the group of resident investors while in empirical applications of CAPM, the market portfolio is represented by a diversified stock index such as SENSEX or NIFTY in India or the S&P 500 in the United States.

Equation (18.4) when applied to the market portfolio becomes

$$\frac{E(r_i^* - r)}{\text{cov}(r_i^*, r_m^*)} = \theta \quad \text{for} \quad \text{all } i = 1, 2, \ldots N \tag{18.5}$$

where r_m^* is the return on the market portfolio. This is rewritten as

$$E(r_i^* - r) = \theta \, \text{cov}(r_i^*, r_m^*) \tag{18.6}$$

and

$$E(r_i^* - r) = \theta \; \sigma_m^2 \; (\sigma_{im}/\sigma_m^2) \tag{18.7}$$

where σ_{im} denotes the co-variance between the returns on asset i and the market portfolio and σ_m^2 denotes the variance of the return on the market portfolio.

The expression $[\sigma_{im}/\sigma_m^2]$ is the familiar **"Beta"** of the asset i, denoted β_i which measures the co-variance of asset i with the market portfolio (scaled by the variance of the market portfolio)[10].

The parameter β_i is estimated by means of a regression of realised historical returns on asset i on the realised historical returns on the market portfolio:

$$r_i^* = \alpha_i + \beta_i \, r_m^* + u_i \tag{18.8}$$

To arrive at the well-known Sharpe-Lintner-Mossin one-country CAPM, we need to know the parameter θ. This is easily done. Let the weight of asset i in the market portfolio be x_i. Multiply equation (18.6) by x_i and sum over all i:

$$\sum_{i=1}^{i=N} x_i E(r_i^* - r) = \theta \sum_{i=1}^{i=N} x_i \, \text{cov}(r_i^*, r_m^*)$$

The LHS of this equation can be written as

$$E(\Sigma x_i \, r_i^* - r) = E(r_m^* - r)$$

while the RHS can be written as

$$\theta \, \text{cov}(\Sigma x_i \, r_i^*, r_m^*) = \theta \, \text{cov}(r_m^*, r_m^*) = \theta \; \sigma_{mm} = \theta \; \sigma_m^2$$

Thus, we have

$$\theta = [E(r_m^* - r)/\sigma_m^2] \tag{18.9}$$

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[10]Beta of an asset can also be given another interpretation. Suppose we wish to construct a portfolio consisting of the market portfolio and the risk-free asset such that this portfolio mimics the performance of asset i as closely as possible. Then it can be shown that the share of the market portfolio in the replicating portfolio should equal beta of the asset.

Now in equation (18.7), replace $[\theta\ \sigma_m^2]$ by $E(r_m^* - r)$ and recall the definition of the beta of asset i to get

$$E(r_i^* - r) = \beta_i\, E(r_m^* - r) \tag{18.10}$$

Equation (18.10) is the famous equilibrium **Capital Asset Pricing Model** for a single country. Using the market portfolio as the benchmark, it says that the excess return on any risky asset i equals the excess return on the benchmark portfolio multiplied by the asset's beta which in turn measures the co-variation of the (return on) asset i with the (return on) the benchmark portfolio.

Suppose the SENSEX is being used as a proxy for the market portfolio and the expected (monthly) excess return on the index is 1.25%. If a stock has a beta of 1.5, its **equilibrium** expected monthly excess return is 1.875%[11].

18.3.1 Extending the One-Country CAPM

The question we now wish to address is:

> "Can the one-country CAPM be extended to a multi-country version so that it can provide an equilibrium framework to price risky assets in a global context?"

The answer to this question has implications for the choice of cost of capital in project appraisal. Suppose an Indian firm is evaluating an investment project at home. It has carefully identified all the cash flows and analysed their sensitivity to various parameters, e.g. sales growth rate, etc. It plans to finance the project solely by equity. What rate of discount should it use to find the NPV of these cash flows? The answer obviously is the rate of return the firm's shareholders expect from projects with similar risk characteristics. Can this be estimated with the CAPM applied to the Indian capital market using, say, the SENSEX or NIFTY50 as the market portfolio and data on historical returns on similar businesses?

Recall that the notion of "market portfolio" is to be understood as the aggregate of all assets held by a specified group of investors. A market index such as SENSEX or NIFTY50 is at best a proxy for all the stocks issued by firms resident in India. The market portfolio would be identical (at least to an approximation) with these indices only if resident investors hold exclusively assets issued by resident firms and foreign investors are not allowed to hold these assets. We then say that the Indian capital market is fully **segmented** from the global capital market. The one-country CAPM can then be utilised to price risky Indian assets.

In recent years, legal and informational barriers to cross-border equity investments have been coming down and investors from many countries are actively diversifying their portfolios globally. Even developing country capital markets – the so-called "emerging markets" – are attracting significant amounts of foreign equity capital both through the direct participation of foreign investors in their domestic capital markets – e.g. FIIs in the Indian stock markets – and through mechanisms like ADRs and GDRs. Capital markets of most countries are certainly not **fully segmented**.

Suppose we then go to the other extreme and consider the case where there are no restrictions whatsoever on investors in a country holding foreign assets **and** foreign investors investing in

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[11]Note the emphasis on "equilibrium". In empirical applications, the CAPM is estimated with a regression like

$$(r_i - r) = \alpha_i + \beta_i(r_m - r) + u_i$$

Here, α_i is interpreted as "disequilibrium" mispricing of asset i.

domestic assets. In other words, we assume that global capital markets are **fully integrated**[12]. Now consider the portfolio consisting of all the stocks issued by all the firms in such an integrated world. Can we replace the market portfolio of a single country by this "world market portfolio" and continue to use the one-country version of CAPM?

To answer this question, we need to carefully examine the assumptions underlying the traditional CAPM. Apart from the usual assumptions of perfect markets, it requires the further assumption that **all investors must have identical expectations regarding the performance of any risky asset.** In other words, their ex-ante probability distributions of returns from any asset must be the same[13]. It is well known that if investor expectations are heterogeneous, they will not agree on the composition of the "tangency portfolio"; in other words, each investor would face an efficient set that is unique to him or her.

Under what conditions would this requirement be met? Let us consider an example. Suppose our "world" consists of three countries, viz. the USA, Germany and the UK. Investors in all the countries are free to invest in any asset and there are no informational asymmetries. Consider the stock of say IBM. All investors agree that the expected nominal return on this stock **measured in US dollars** is 15% per annum. The starting price is US $100, the expected year-end price is US$110 and a US $5.00 dividend is expected to be paid at the end of the year. The exchange rates at the start of the year are EUR/USD 1.2500 and GBP/USD 1.6000. Over the year, inflation is expected to be 5% in the US, 3% in Germany and 7% in the UK. The year-end expected exchange rates are EUR/USD 1.3000 and GBP/USD 1.5000. **Investors would compare the real returns measured in their own currencies.** For US investors, the IBM stock yields a 9.5238% real return. For German investors it is 7.356% while for UK investors it is 14.6417%[14]. It is easy to see that such wide differences are caused by the failure of the relative Purchasing Power Parity or changes in real exchange rates[15].

Thus, it is clear that having fully integrated capital markets is not enough; in addition, there must be no real exchange rate risk, i.e. relative PPP must hold. Since there is ample evidence that it does not hold (except approximately over the long run), the asset pricing model must take account of exchange rate risk in addition to the co-variance risk with the world market benchmark portfolio.

Investors in a given country would choose their portfolios in the light of their estimates of expected returns, variances of returns and co-variances **measured in their reference currency, their home currency.** As we have seen above, in a multi-currency portfolio, the following parameters are relevant:

1. Expected excess return on a portfolio, measured in some numeraire currency:

   $$\Sigma x_i E(r_i^* - r)$$

   where x_i is the share of asset i, r_i^* is its return measured in the numeraire currency and r is the risk-free rate in the numeraire currency.

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[12]Note that this requires not only that there are no legal restrictions on cross-border equity flows but also that there are no informational advantages enjoyed by resident investors over foreign investors and that there are no differential tax treatments.

[13]In the mean-variance framework, this means that they must agree on expected returns, variances and co-variances of returns from all risky assets.

[14]For German investors, the initial investment is EUR 80. Year-end value of their investment is EUR (115/1.30) = EUR 88.46. After adjusting for 3% inflation, the real return is {[(88.46/80)] /1.03 – 1.0} = 7.356%. For UK investors, an initial GBP 62.5 investment yields year-end value of GBP 76.67, nominal return of 22.67% and real return of 14.64%.

[15]If relative PPP had held, year-end exchange rates would have been EUR/USD 1.2743 and GBP/USD 1.5700. At these rates, real returns would have been identical for all the three groups of investors.

2. Variance of portfolio returns

$$\sigma_p^2 = \text{cov}(\Sigma x_i r_i^*, r_p^*) = \Sigma x_i \text{cov}(r_i^*, r_p^*)$$

3. Co-variance of portfolio return and changes in the exchange rate between the numeraire currency and other currencies, i.e. $\text{cov}(\Sigma x_i r_i^*, \hat{S}_i)$ where $\hat{S}_i$ is the proportionate change in the spot rate of currency i with respect to the numeraire currency.

The remaining parameters, viz. expected values and variances of $\hat{S}_i$ do not enter portfolio choice because the portfolio weights x_i are not affected by them.

18.3.2 Incorporating Exchange Rate Risk: A Two-Country Model

In the one-country version of CAPM, market risk is taken account of by the co-variance of the asset or portfolio with the market portfolio. Let us extend this idea to exchange rate risk. In what follows, we will assume away inflation uncertainty so that real exchange rate risk and nominal exchange rate risk are equivalent. We will later see how to relax this restriction. Also, we will assume that the "global" capital market consists of two countries, say Germany and the US, referred to as "GE" and "US". This restriction will also be relaxed later. Let S denote the EUR/USD exchange rate and $\hat{S}$ be the proportionate change in S over the relevant period.

Consider a German investor who is evaluating the return from a US T-bill, a risk free asset. The annualised return measured in USD is denoted $r_{\mathbf{US}}$. The return measured in EUR, denoted $r_{\mathbf{GE}}$, is given by

$$r_{\mathbf{GE}} = r_{\mathbf{US}} - \hat{S}$$

Thus, measured in EUR, the return from this asset changes one-for-one with the exchange rate.

Now consider the same investor contemplating investment in the stock of a US company. Unlike the US T-bill, the USD return on this stock may be influenced by the EUR/USD exchange rate. Suppose the firm is an exporter to Europe. A strong dollar – low value of S – may adversely affect the performance of this firm and reduce the dollar return on this stock. However, appreciation of the dollar may outweigh this factor. Thus, measured in EUR, the return from this investment may have a negative co-variance with the exchange rate – EUR return would increase as S decreases. If, however, the dollar return on the stock decreases very strongly when dollar appreciates, EUR return may also decrease thus leading to a positive co-variance between EUR return and exchange rate.

Finally, what about a German stock? Arguing along similar lines, a strong dollar may benefit a German firm and increase the return from its stock measured in EUR. This of course is by no means a certainty, but only a strong probability. Once again, the co-variance with exchange rate would be positive.

In general, suppose we estimate a regression equation as follows:

$$(r^*)_{i\mathbf{GE}} = \alpha_i + \gamma_i \hat{S} + u_i \tag{18.11}$$

where $(r^*)_{i\mathbf{GE}}$ denotes the EUR return on an asset i, the coefficient γ_i will equal

$$\text{cov}[(r^*)_{i\mathbf{GE}}, \hat{S}]/\text{var}(\hat{S})$$

which is a measure of asset i's co-variation with the changes in exchange rate. For a US T-bill γ_i will be –1.0; for a German stock, γ_i is likely to be negative; for a US stock it may be positive or negative. Just as an asset's beta is a measure of its "market risk", its gamma can be interpreted as a measure of its exchange rate risk.

18.3.3 A Two-Country CAPM

Let us now posit an equilibrium asset pricing model in this two country world. Now for any asset, there are two sources of risk, viz. "world market risk" and "exchange rate risk". Extending the one-country CAPM, the equilibrium expected excess return on asset i measured in EUR is given by

$$E[(r^*)_{i\mathbf{GE}} - r] = \theta \operatorname{cov}[(r^*)_{i\mathbf{GE}},(r^*)_W] + \delta \operatorname{cov}[(r^*)_{i\mathbf{GE}}, \hat{S}] \tag{18.12}$$

The parameters θ and δ are prices of world market and exchange rate co-variance risks, and $(r^*)_W$ is the return on the world market portfolio measured in EUR. [The excess return is being measured with respect to the risk-free return in Germany.]

In the one-country CAPM, the excess return on an asset was determined by its co-variance with a benchmark portfolio, viz. the market portfolio of that country. We now have two benchmark portfolios:

1. The world market portfolio
2. The foreign riskless asset.

The first of these should be obvious; the second will be brought in below. These two portfolios take account of the market risk and the exchange rate risk of an asset.

To operationalise the two-country CAPM, equation (18.9), we need to know how to measure θ and δ. We will use the same approach that we used in the standard CAPM.

First consider the world market portfolio. From (18.12)

$$\begin{aligned} E[(r^*)_W - r_{\mathbf{GE}}] &= \theta \operatorname{cov}[(r^*)_W,(\mathrm{r}^*)_W] + \delta \operatorname{cov}[(r^*)_W, \hat{S}] \\ &= \theta \operatorname{var}[(r^*)_W] + \delta \operatorname{cov}[(r^*)_W, \hat{S}] \end{aligned} \tag{18.13}$$

Now consider a foreign (i.e. US) T-bill.

$$\begin{aligned} E[r_{\mathbf{US}} - \hat{S} - r_{\mathbf{GE}}] &= -\theta \operatorname{cov}[\hat{S}, (r^*)_W] + \delta \operatorname{cov}(\hat{S}, \hat{S}) \\ &= -\theta \operatorname{cov}[\hat{S}, (r^*)_W] + \delta \operatorname{var}(\hat{S}) \end{aligned} \tag{18.14}$$

Note that the only random element in the excess return on US T-bill (from a German investor's point of view) is the change in exchange rate. In the appendix we demonstrate how to use these equations to obtain values of θ and δ. The resulting two-country CAPM is:

$$E[(r^*)_{i\mathbf{GE}} - r_{\mathbf{GE}}] = \beta_i [(r^*)_W - r_{\mathbf{GE}}] + \gamma_i E[r_{\mathbf{US}} - \hat{S} - r_{\mathbf{GE}}] \tag{18.15}$$

The assets' beta and gamma have to be jointly estimated from a multiple regression with historical data:

$$(r^*)_{i\mathbf{GE}} = \alpha_i + \beta_i(r^*)_W + \gamma_i \hat{S} + u_i \tag{18.16}$$

Let us consider an example. Suppose the risk-free rate in Germany is 3% and in the US it is 5%. A US T-bill is expected to outperform a German T-bill by 1% when measured in EUR. The world market portfolio is expected to outperform German T-bill by 5%. Historical regression of (EUR) returns on a US stock X gives the following estimated equation:

$$(r^*)_X = 0.05 + 1.2(r^*)_W - 0.20\,\hat{S}$$

Here $\beta_X = 1.2$ and $\gamma_X = -0.20$. The equilibrium expected return on the stock is given by

$$\begin{aligned} E[(r^*)_X] &= r_{\mathbf{GE}} + 1.2[(r^*)_W - r_{\mathbf{GE}}] - 0.20(r_{\mathbf{US}} - \hat{S} - r_{\mathbf{GE}}) \\ &= 0.03 + 1.2(0.05) - 0.20(0.01) = 0.088 \text{ or } 8.8\% \end{aligned}$$

To use the international CAPM, we need (1) the estimates of the asset's beta and gamma (2) the estimate of excess return on the world market portfolio and (3) the excess return on a foreign risk-free asset measured in the investor's currency. Later we will briefly discuss how to obtain these estimates.

Extension to a multi-country CAPM is straightforward. We now need to take account of exchange rate risk from several exchange rate changes in addition to the co-variance risk with the world market portfolio.

Using a more general notation

$$E[(r^*)_{iH} - r_H] = \beta_i E[(r^*)_W - r_H] + \gamma_{i1} E[\hat{S}_1 + r_{F1} - r_H] + \gamma_{i2} E[\hat{S}_2 + r_{F2} - r_H] + \gamma_{iK} E[\hat{S}_K + r_{FK} - r_H] \tag{18.17}$$

Here r_H denotes riskfree rate in investor's currency, $r_{F1}\ r_{FK}$ are risk-free rates in foreign currencies 1....K and $\hat{S}_1 \ldots \hat{S}_K$ are the changes in exchange rates of these currencies measured as units of home currency per unit of foreign currency. The parameters β_i, $\gamma_{i1} \ldots \gamma_{iK}$ have to be obtained from a multiple regression with historical data:

$$(r^*)_{iH} = \alpha_i + \beta_i (r^*)_W + \gamma_{i1}\ \hat{S}_1 + \ldots + \gamma_{iK}\ \hat{S}_K + u_i \tag{18.18}$$

If inflation risk is to be accounted for, all returns must be deflated with the reference currency inflation rate and the gammas must be obtained with respect to real exchange rate changes. Adler and Dumas (1983) show how this can be done. Also, their empirical work provides some evidence that this adjustment may not be very important in practice[16].

18.3.4 Global Capital Markets: Segmented or Integrated?

The validity and usefulness of the International Capital Asset Pricing Model (ICAPM) can be viewed from two different angles. To begin with, we examine whether the underlying assumption of no constraints on cross-border capital flows are valid. Obviously the prima-facie answer is "no". A number of countries have restrictions on how much non-residents can invest in the equity of resident companies as well as on what proportion of residents' portfolio can be invested in foreign stocks. Such restrictions exist even in developed countries like Japan and Spain and certainly in most emerging markets like India. Of course, a more pertinent question might be whether these restrictions are binding, i.e. left to themselves, non-resident investors would like to go beyond these constraints[17]. There is some evidence that such constraints may have been binding prior to 1980 among the developed capital markets but are gradually weakening[18].

Apart from legal restrictions, informational asymmetries can and do create barriers to cross-border capital flow. Foreign investors may not be familiar with other relevant aspects like local accounting standards, disclosure requirements and institutional structure, trading and settlement procedures of the local capital markets. If the cost of acquisition of such information is high, then their holding of local equity may be suboptimal. Such barriers, however, can be expected to come down with the passage of time.

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[16]Because of low correlations between asset returns and inflation rates, co-variances between real asset returns and nominal asset returns are almost identical.

[17]For instance, pension funds in Spain are not allowed to put more than 30% of their portfolio in foreign equities. In practice, they hold far less.

[18]See Bonser-Neal et al. (1990), Hietala (1989), Guletkin et al. (1989), Halliday (1989).

Next, we examine the evidence from empirical testing of the ICAPM. There have been a number of empirical investigations to determine whether the markets are segmented or integrated. In one type of tests, attempt is made to isolate the dependence of security returns on world market versus domestic factors. If the markets are completely integrated, domestic factors would be irrelevant while if they are completely segmented, only domestic market return would be relevant. Jorion and Schwartz (1986) in an investigation of Canadian stocks found evidence of some segmentation. An early test by Solnik (1973) supported his version of ICAPM which is a special case of (18.14). Stehle (1976), like Jorion and Schwartz examines whether US stocks are priced with reference to world market portfolio or domestic portfolio. He ignores the exchange risk. Dumas and Solnik (1991) using data from major developed countries find evidence of non-zero exchange risk premia [δ in equation (18.14)] and also evidence against one-country CAPM. Thus, their results appear to support ICAPM at least for major OECD countries.

Other researchers have employed indirect tests of the segmentation hypothesis[19]. All tests lead to the conclusion that international capital markets are not fully integrated.

A number of recent empirical studies have examined transmission of volatility across national stock markets and across currency markets and stock markets. It has been an accepted fact for a long time that stock market volatility is not constant over time. Volatility clustering has been observed in almost all national stock markets and financial economists have estimated models with time varying volatility – the so called ARCH and GARCH models which allow conditional volatility to vary in response to abnormal returns and past volatility. A new twist to this is the possibility that abnormal returns in NASDAQ may impact on the volatility of BSE or NSE and, abnormal behaviour of the rupee-dollar exchange rate may also impinge on the conditional variances and co-variances of exchange rate changes and stock market returns which affect the variance of a multi-currency equity portfolio. These findings will force a reworking of the international asset pricing models. We will not pursue these matters here. The interested reader will find some references in the bibliography.

18.3.5 Estimation of the Risk Premia

As mentioned above, to use the ICAPM for asset pricing we need to estimate the beta and gammas for the asset and the risk premia $E[(r^*)_W - r_H]$, $E[\hat{S}_1 + r_{F1} - r_H]$ … $E[\hat{S}_K + r_{FK} - r_H]$.

This is by no means an easy task. Expected excess returns on world market portfolios vary substantially over time though we can safely say that there is a positive risk premium. Exchange risk premia are also time variant and possibly close to zero in the long run. In practice, they are often ignored. However, the estimates of betas are still obtained from a regression like (18.18).

18.4 EQUITY FINANCING IN THE INTERNATIONAL MARKETS

As mentioned in the introduction, the volume of new equity issues in the international markets increased dramatically between 1983 and 1987. During the 1990s, institutional investors from developed countries increased their exposure to equity from emerging markets though there was a setback to this trend after the Asian currency crisis. From the side of the issuers, the driving force was the desire to tap low cost sources of financing, broaden the shareholder base, acquire a springboard for international activities such as acquisitions and grant of ESOPs to foreign employees and generally improve access to long-term funding. From the point of view of investors, the primary

[19]See, for instance, Alexander, Eun and Janakiraman (1988), Agmon and Lessard (1977).

motive has been diversification. The technology boom of the 1990s has also attracted investors from developed markets towards technology stocks from emerging markets. During the first decade of this century, institutional investors from developed countries brought in huge amount of funds into emerging markets like India, Korea and so forth as these economies were growing much faster and offering more attractive returns on equity even after allowing for exchange rate risk. As we have seen above, this trend continued till 2007 when the sub-prime crisis hit the US economy and led to large withdrawal of FII funds from emerging economies. By mid 2010, the investor confidence improved and equity funds started flowing back into developing countries. Also, many emerging market economies liberalised their restrictions on inward and outward flows of equity capital.

Since many companies have accessed the global equity market primarily for establishing their image as global companies, the major consideration has been visibility and post-issue considerations related to investor relations, liquidity of the stock (or instruments based on the stock such as depository receipts which are listed and traded on foreign stock exchanges) in the secondary market and regulatory matters pertaining to reporting and disclosure. Other relevant considerations are the price at which the issue can be placed, costs of issue and factors related to taxation (such as withholding tax which can affect the attractiveness of the issue to investors).

As we have seen above, if the international markets were integrated, a given stock would be priced identically by all investors and there would be no advantage in choosing one market over another apart from the cost of issue considerations. However, with segmented markets, the price that can be obtained would vary from one market to another. Countries with high saving rates such as Japan (and those like Switzerland with access to others' investible funds) would normally have low cost of equity[20]. However, some of these markets may not be readily accessible except to very high quality issuers. When the issue size is large, the issuer may consider a simultaneous offering in two or more markets[21]. Such issues are known as *Euroequities.*

Issue costs are an important consideration. In addition to the underwriting fees (which may be in the 3-5% range), there are substantial costs involved in preparing for an equity issue, particularly for developing country issuers, unknown to developed country investors. Generally speaking, issue costs tend to be lower in large domestic markets such as the US and Japan.

Starting way back in 1970s, a number of European and Japanese companies have got themselves listed on foreign stock exchanges such as New York and London. Shares of many firms are traded indirectly in the form of ***Depository Receipts***. In this mechanism the shares issued by a firm are held by a depository[22], usually a large international bank, which receives dividends, reports, etc., and issues claims against these shares. These claims are called ***Depository Receipts*** with each receipt being a claim on a specified number of shares. The depository receipts are denominated in a convertible currency – usually US dollars. The depository receipts may be listed and traded on major stock exchanges or may trade in the OTC market. The issuer firm pays dividends in its home currency which is converted into dollars by the depository and distributed to the holders of depository receipts. This mechanism originated in the US – the so called ***American Depository Receipts or ADRs.*** Recent years have seen the emergence of ***European Depository Receipts (EDRs)***

[20]Once again, with integrated markets and free capital flows this would not be true. Capital would flow from capital-rich countries with relatively fewer investment opportunities at home to countries with a wide range of attractive investment opportunities but scarce capital. The rates of return on a given risk-class of securities would be equalised everywhere.

[21]For instance, a few years ago the National Australia Bank made a 55 million share offering simultaneously in the US, Europe, Japan and Australia. See ***Funding Techniques*** supplement to ***Euromoney*** January 1990, for a brief description of this deal.

[22]These shares are called depository shares.

and ***Global Depository Receipts (GDRs)*** which can be used to tap multiple markets with a single instrument. The early Indian issuers such as Reliance preferred the GDR route since listing and disclosure requirements are less onerous. In recent years, many Indian IT companies have preferred to use the ADR route with listing on major US exchanges such as NASDAQ and NYSE. The main reason for this is that their mergers and acquisition activity and foreign subsidiaries are mostly in US. Hence, it was crucial for them to get listed on US exchanges and use the dollar-denominated instruments as "currency" for acquisitions in the US and grant of ESOPs. Also, the US capital markets are the largest and most prestigious and a listing on the US exchanges gives the company a highly visible global image. The strict US standards pertaining to disclosure and reporting are also said to improve corporate governance. Transactions in depository receipts are settled by means of computerised book transfers in international clearing systems such as EUROCLEAR and CEDEL.

After a hesitant start in 1992, following the experience of the first ever GDR issue by an Indian corporate[23], a fairly large number of Indian companies have taken advantage of the improved market outlook to raise equity capital in international markets. As mentioned above, the initial issues were GDRs made in the European centres. More recent issues have been ADRs with listing on major US exchanges. The structure of a typical GDR issue is shown in Figure 18.1.

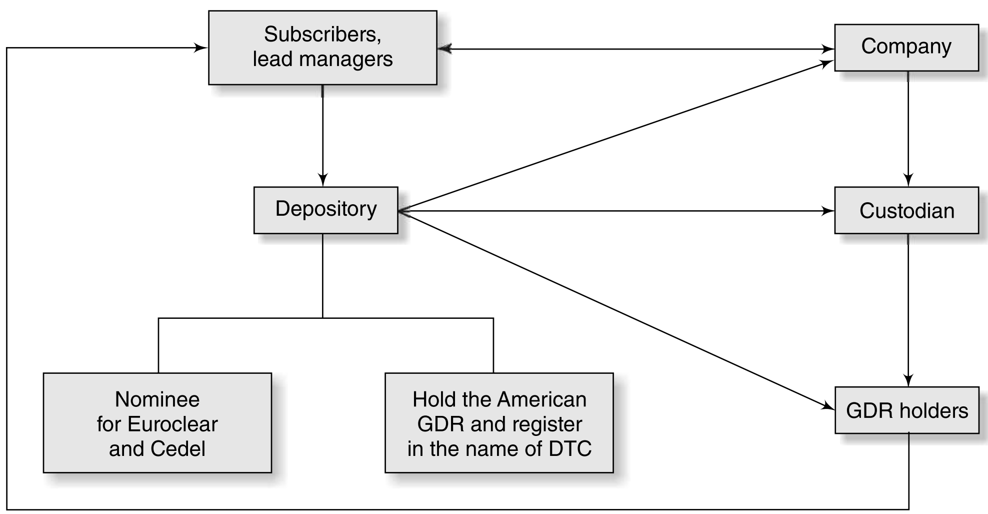


Fig. 18.1 The GDR Mechanism

From the point of view of the issuer, GDRs and ADRs represent non-voting stock with a distinct identity which do not figure in its books[24]. There is no exchange risk since dividends are paid by the issuer in its home currency. Apart from imparting global visibility, the device allows the issuer to broaden its capital base by tapping large foreign equity markets. The risk is that the price of GDRs may drop sharply after issue due to problems in the local markets and damage the issuer's reputation

[23]After the Reliance GDR issue in May 1992, the securities scam scandal broke out and the Indian stock market remained closed for some time. Other companies which were planning their own launches, either postponed them or reduced the size of the issue.

[24]This is because the shares are issued in the name of the depository which is expected to vote with the management. The GDR holders are not legally shareholders. The voting behaviour of the depository itself is subject to an agreement with the company. See the appendix to this chapter for further details.

which may harm future issues. From the investors' point of view, they achieve portfolio diversification while acquiring an instrument which is denominated in a convertible currency and is traded on developed stock markets. Of course, the investors bear exchange risk and all the other risks borne by an equity holder (dividend uncertainty, capital loss). There are also taxes such as withholding taxes on dividends and capital gains taxes. For instance, the Indian government imposes a 10% withholding tax on dividends and a 65% maximum marginal capital gains tax on short-term capital gains (tax on long-term capital gains is only 10%, thus encouraging the investor to hold on to the stock)[25].

A major problem and concern with international equity issues is that of ***flowback***, i.e. the investors will sell the shares back in the home stock market of the issuing firm[26]. Authorities of some countries have imposed a minimum lock-in period during which foreign investors cannot unload the shares in the domestic market[27].

Withholding taxes on dividends paid to non-residents reduce the attractiveness of the asset to foreign shareholders and consequently raises the cost to the issuer. Some giant multinationals have used the device of a finance subsidiary located in a tax haven country like the Bahamas to issue shares in the international markets. The usefulness and feasibility of this vehicle depends upon the tax laws and other regulations in the issuer's home country.

The RBI issues guidelines for ADR-GDR issues from time to time which specify the pre-issue approvals to be obtained under Companies Act and from FIPB (Foreign Investment Promotion Board), ceilings on issue related expenses such as lead manager's fees, underwriter's commission, etc., how quickly the funds raised have to be repatriated to India, the use to which the capital raised can be put and so forth. GDRs-ADRs issued against existing shares are treated as foreign direct investment and hence not permitted to companies operating in those sectors where FDI is prohibited. These guidelines are available on RBI website.

In 2000, Government of India first contemplated issuance of Indian Depository Receipts (IDRs) which would enable foreign companies to issue depository receipts denominated in rupees to Indian investors. The rules governing the issue of IDRs were notified in 2004 and have been amended a few times since then. The latest amendments took place in July 2009. Indian residents are allowed to invest in IDRs without being subject to any FEMA regulations. FIIs and non-resident Indians can invest in IDRs and hold them subject to relevant FEMA regulations in force at the time. When IDRs are converted into shares of the issuing company, holders of IDRs who are Indian residents will have to comply with relevant FEMA regulations. In early 2010, Standard Chartered Bank made the first IDR issue in which 10 IDRs represented one equity share in the bank.

SEBI has issued guidelines for issuance of IDRs in April, 2006, Some of the major norms for issuance of IDRs are as follows. SEBI has set ₹50 crore as the lower limit for the IDRs to be issued by the Indian companies. Moreover, the minimum investment required in the IDR issue by the investors has been fixed at ₹2 lakh. Non-Resident Indians and Foreign Institutional Investors (FIIs) have not been allowed to purchase or possess IDRs without special permission from the Reserve Bank of India (RBI). Also, the IDR issuing company should have good track record with respect to securities market regulations and companies not meeting the criteria will not be allowed to raise funds from the

[25]The capital gains tax is applicable only when the GDR holder converts it into shares and sells the shares to an Indian resident or inside India.

[26]Some people have conjectured that the stock market crash of October 1987 was caused in part by foreign investors selling the stock in domestic stock markets. The evidence is conflicting.

[27]The Government of India had also imposed a two-year lock-in period when Reliance made its first GDR issue. Subsequently, after the Indian stock market was opened up to foreign institutional investors, the lock-in period was removed. GDRs cannot be converted into shares and sold during the "cooling off" period which may vary from 45 to 180 days.

domestic market. If the IDR issuer fails to receive minimum 90 per cent subscription on the date of closure of the issue, or the subscription level later falls below 90 per cent due to cheques not being honoured or withdrawal of applications, the company has to refund the entire subscription amount received, SEBI said. Also, in case of delay beyond eight days after the company becomes liable to pay the amount, the company shall pay interest at the rate of 15 per cent per annum for the period of delay.

During 1993-94, GDR issues were a very popular device for many large Indian companies. Yields in developing country markets were rather low and many Indian issues offered attractive returns along with diversification benefits. The economic liberalisation policy of the government made Indian issues an attractive investment vehicle for foreign investors. In subsequent years, a variety of problems with the workings of the Indian capital markets – lack of adequate custodial and depository services, long settlement periods, delivery and payment delays, suspicions of price rigging, etc. – led to the wearing off of investor enthusiasm. Added to these factors was increasing political uncertainty as the elections were approaching. From roughly mid-1994 to nearly the end of 1995, market for Indian GDR issues remained lukewarm. There was a brief revival in 1996, but the Asian crisis again turned rich country investors away from emerging markets. Starting in 1999, a number of Indian IT companies have been successfully listed on US stock exchanges and their ADRs had been performing quite well till the NASDAQ nose-dived in late 2000-early 2001. The global stock markets are becoming increasingly integrated at least as far as investor sentiment is concerned and the NASDAQ appears to drive markets around the world. In the appendix to this chapter, we have provided a brief description of the salient features of the ADR/GDR mechanism and its use by Indian companies.

18.5 CROSS-BORDER MERGERS AND ACQUISITIONS

During the last few years, several Indian companies have stepped out of India and have undertaken cross-border mergers and acquisitions. Table 18.5 shows some of the international acquisitions by Indian companies.

There are three alternative modes for international acquisitions. When Buyers make acquisitions in a merger and acquisition (M&A) deal, those purchases can take the form of a complete, 100% buyout (mainly for PE firms), a majority investment, or even a minority investment.

Table 18.5 Foreign Acquisitions of Indian Companies

Acquirer	*Target Company*	*Country targeted*	*Deal value ($m1)*	*Industry*
Tata Steel	Corus Group Plc	UK	12,000	Steel
Hindalco	Novelis	Canada	5,982	Steel
Videcocon	Daewoo Electronics Corp.	Korea	729	Electronics
Dr. Reddy's Labs	Betapharm	Germany	597	Pharmaceutical
Suzlon Energy	Hansen Group	Belgium	565	Energy
HPCL	Kenya Petroleum Refinery Ltd.	Kenya	500	Oil and Gas
Ranbaxy Labs	Terapia SA	Romania	324	Pharmaceutical
TataSteel	Natsteel	Singapore	293	Steel
Videocon	Thomson SA	France	290	Electronics
VSNL	Teleglobe	Canada	239	Telecom

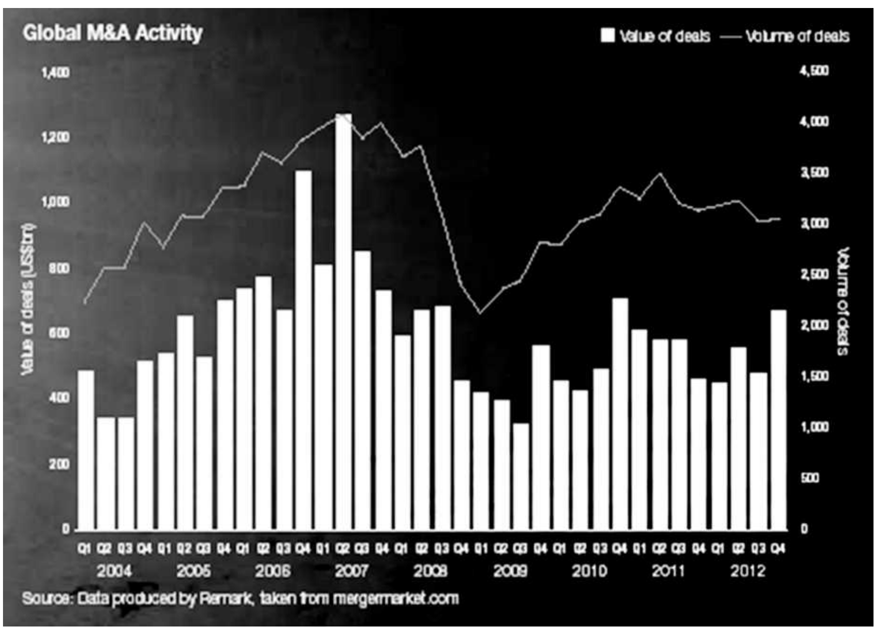
A **buyout** occurs when 100 per cent of a company is sold to another company. A buyout results in a change of control, and although 100 per cent of the outstanding stock may be acquired to effect the transaction, it is possible for the Buyer to acquire the Seller's assets (instead of buying stock) and still have a buyout.

A ***majority investment*** is when the Buyer acquires greater than 50 per cent of the company. A ***minority investment*** is when the Buyer acquires less than 50 per cent of the company.

Irrespective of whether the transaction is a majority or minority investment, in most deals, the Buyer buys the stock of the Seller. If the existing shareholder sells the stock to the Buyer, that transaction is called a ***recapitalisation***. In this case, no new shares are being created; existing ones are simply changing hands.

If the acquired stock is the result of a new issue, however, the money raised from selling those shares goes to the company. This set-up is often called ***growth capital*** because the company retains the money for the purposes of facilitating growth.

The chart below presents the recent history of the volume – i.e. the number of deals – and value of worldwide cross-border mergers and acquisitions.



Global Mergers and Acquisitions 2004–2012

Summary

This chapter examines the economics of cross-border equity investment using the standard capital asset pricing model as the frame of reference. It first addresses the question of gains from cross-border diversification in a risk-neutral world and then goes on to examine the same in a world populated by risk-averse investors. This is followed by a discussion of how to extend the standard capital asset pricing model to a multi-country context. The issues of segmentation versus integration of global capital markets are briefly addressed. In a segmented market, exchange rate risk has to be explicitly accounted for and methods for doing this are discussed. The next section provides a description of the depository receipts mechanism used by non-resident firms to tap equity markets in US and Europe.

Questions and Problems

1. What factors one has to consider while investing internationally? Distinguish between the characteristics of segmented and integrated capital markets.
2. What factors aid in making the international capital markets more integrated? Explain the importance of emerging capital markets in international investing.
3. Describe the various hedging strategies one can use to hedge against foreign exchange risk, using forward contracts, futures contracts, and option contracts.
4. Explain the concept of investing via deposit receipts scheme, say ADRs or GDRs, to achieve international diversification.
5. The returns, in percentage, for international security markets are as follows:

Year	*France*	*Germany*	*Japan*	*UK*	*USA*
19X1	28.00	25.00	27.00	5.00	10.00
19X2	23.75	28.30	–2.50	7.50	9.75
19X3	4.84	10.75	21.06	5.25	11.56
19X4	–3.56	–10.75	23.75	–5.70	15.57
19X5	–25.00	–50.00	37.82	–6.80	25.29
19X6	10.00	28.00	–5.50	3.00	–5.26
19X7	15.50	23.00	–10.23	4.50	–3.18
19X8	13.23	21.00	15.00	3.85	6.78

   (a) Compute the variance of returns over this period for each country.
   (b) Compute the correlation between the returns for all the possible equally-weighted two country combinations over this period.
   (c) Compute the variance of returns for portfolios of equal proportion of investing in two, three, four and five country combinations.
6. The spot exchange rates at the beginning and end of 20XX and were ₹47.53 and ₹45.53 per US$ respectively. If the percentage return on the American securities was
   (a) –50% (b) –25% (c) 25% (d) 50%
   over the previous year, then compute the net return to an Indian investor.
7. The risk-free rate of return is 8% and the market portfolio's rate of return is 25%. The security's beta is 1.15 and the variance of its returns is 20%. The ₹ has been depreciating relative to the US$ at the rate of 5% p.a. say, with a variance of 15%.

   Compute the return and total risk an US investor can expect from this security, assuming that the correlation between the returns on the security and the exchange rate is 0.25.

8. The spot exchange rate in 19X1 was ₹45 per US$. The interest rates were 9% in India and 4% in USA for that year. What would be the expected percentage return to an American investor for that year, if the percentage return on Indian securities is
(a) 10% (b) 30% (c) 50%

9. The spot exchange rate in 19X1 was ₹45 per US$. The annual inflation rates were 11% in India 3% in USA. Compute the expected percentage return to an Indian investor for that year, if the percentage return on American securities is:
(a) –5.0% (b) 15% (c) 50%

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APPENDIX

A.18.1 LAUNCHING A GDR ISSUE

The first Indian GDR issue was made by Reliance in May 1992. During the latter half of 1993, a number of Indian companies successfully tapped the global capital markets by means of GDR and foreign currency convertible bond issues. A few companies had taken this route earlier, but the number and frequency of issues increased significantly during this period. Towards the end of 1994, the market became lukewarm towards issues from India. The investors' interest in emerging markets suffered a further setback following the Asian crisis in the summer of 1997. In 1999, IT majors from India began venturing out to the US capital markets by using the ADR mechanism to get themselves listed on the US stock exchanges to pave the way for acquisitions in the US as also issue stock options to their US employees. Table A.18.1 presents the list of corporates which have raised capital using the GDR/ADR route over the period 1992-2006[1].

Globally, firms raised about \$21 billion in 1999 through ADR offerings – more than double the \$10 billion raised in 1998. More than 43 per cent of the total was from telecommunications, media and technology. Investors flocked to Indian issues because of the enormous growth potential offered by India knowledge-based and manpower related companies. Indian software companies' cutting edge technology and E-commerce drive helped them score over other companies.

A comprehensive updated list of all Indian companies that have made ADR/GDR issues can be accessed on the following web link of BNY Mellon:

In the 1990s, the compounded annual growth rate of Depository Receipt trading and dollar trading volume globally has been 30% and 22%, respectively. In addition, an estimated 1.50 billion Depository Receipts, valued at $20-25 billion, are traded on an average in the Over-The-Counter Exchange and European markets every year.

During the years from 2007 to early 2010, there have been more than eighty Depository Receipts issues by Indian companies and about half of them were not for raising funds, but to establish the presence of the company in foreign markets. In the year 2010, till the month of August, twenty firms have approached the Depository Receipts market of which nineteen issues were for raising funds.

India has the distinction of having the largest number of GDR/ADR issues by any country. The first issue was by Reliance Industries ($150 million) in May 1992. Since then, the Depository Receipt concept developed considerably in India with a total of 60 Indian companies raising over US $6.5 billion.

At the time of writing, some more companies have obtained the necessary approvals and are in the process of launching their ADR/GDR issues.

As mentioned in the text, companies found the external capital markets an attractive source of funds for several reasons. The cost of capital was much lower, it enabled the company to broaden its investor base and helped create a presence in international markets (with possibly creating global awareness of company's products too). For IT companies, ADR issues provided a currency for foreign acquisitions and grant of ESOPs. GDR/ADR issues provide apparently cheap capital with no forex risk – unlike bond issues or other forms of borrowings – and no risk of dilution of control since GDR/ADR holders have no voting rights. Voting rights vest in the Depository which is the registered owner of the underlying shares.

Table A.18.1 Indian Companies With GDR Issues (As of August 15, 2013)

S. No.	*Name*	*Ticker*	*Exchange*	*Sector Name*
1	ABL Bio-Technologies Ltd		Luxembourg	Biotechnology
2	Accentia Technologies Ltd	ACTLG	Singapore	Internet
3	Aditya Birla Nuvo	ADYBY	Portal	Building Materials
4	Aftek Infosys Ltd	AILFF	Luxembourg	Computer Software
5	Aksh Optifibre Ltd		Luxembourg	Communications Equipment
6	Alps Industries Limited	ALPIG	Luxembourg	Household Furnishings & App
7	Ambuja Cements Ltd	GUJTF	Luxembourg	Building Materials
8	Ambuja Cements Ltd	AMBUY	Portal	Building Materials
9	Amtek Auto Ltd	AMKD	London	Engineering & Construction
10	Anant Raj Industries Ltd	ARIX	Luxembourg	Real Estate
11	Apollo Hospitals Enterprise Ltd	APHG	Luxembourg	Health Care (Hospital Mgmt)
12	Apollo Hospitals Enterprise Ltd	APOQF	Portal	Health Care (Hospital Mgmt)
13	Aptech Ltd	APLKF	Luxembourg	Services (Commercial Consum)
14	Arvind Ltd	ARVNF	Luxembourg	Textiles
15	Arvind Ltd	ARZMY	Portal	Textiles

(Contd.)

16	Asahi Infrastructure & Projects Ltd	ACHF	Luxembourg	Engineering & Construction
17	Ashco Niulab Industries Ltd	ASHN	Luxembourg	Biotechnology
18	Avon Corporation Ltd	AVOC	Luxembourg	Electronics
19	Axis Bank Ltd	AXB	London	Banks (Regional)
20	Axis Bank Ltd	AXBKY	Portal	Banks (Regional)
21	Bag Films & Media Ltd	BAGF	Luxembourg	Broadcasting (TV, Radio, Cable)
22	Bajaj Auto Ltd		London	Miscellaneous Transportation
23	Bajaj Finserv Ltd		London	Financial (Diversified)
24	Bajaj Hindusthan Ltd	BJJHY	London	Agricultural Products
25	Bajaj Hindusthan Ltd	BAJ	Luxembourg	Agricultural Products
26	Bajaj Holdings And Investment	BJAUF	London	Miscellaneous Transportation
27	Ballarpur Industries Ltd	BLPFF	Luxembourg	Paper & Forest Products
28	Ballarpur Industries Ltd	BLPQY	Portal	Paper & Forest Products
29	Balrampur Chini Mills Limited	BRCMGS	Luxembourg	Foods
30	Balrampur Chini Mills Limited	BRCMGA	Portal	Foods
31	Beckons Industries Ltd	AGK	Luxembourg	Power Producers (Independ)
32	Beckons Industries Ltd	BECKI	Luxembourg	Paper & Forest Products
33	Bharat Hotels Ltd	BHHTF	Luxembourg	Lodging-Hotels
34	Bihar Tubes Ltd	BTUB	Luxembourg	Metal Fabricators
35	Birla Cotsyn India Ltd	BCOT	Luxembourg	Textiles
36	Birla Power Solutions Ltd	BLPS	Luxembourg	Machinery
37	Bombay Dyeing & Manufacturing Co Ltd	BDYMF	Luxembourg	Textiles
38	Bombay Rayon Fashions Ltd	BRFLG	Singapore	Textiles
39	Brushman India Ltd	BRUSH	Luxembourg	Manufacturing (Specialized)
40	BSEL Infrastructure Realty Ltd	BSELG	Luxembourg	Engineering & Construction
41	CALS Refineries Ltd	CALS	Luxembourg	Oil & Gas (Refining & Mktg)
42	Carol Info Services Ltd	WKHTF	Luxembourg	Health Care (Drugs/Pharms)
43	Cat Technologies Ltd	CATT	Luxembourg	Computer Software
44	Cat Technologies Ltd	CCRC	Luxembourg	Computer Software
45	Century Textile & Industries Ltd	CTXTY	Portal	Textiles
46	CESC Ltd	CSCUY	Portal	Electric Companies
47	Cipla Ltd	CIPLG	Luxembourg	Health Care (Drugs/Pharms)
48	Cipla Ltd	CPLFY	Portal	Health Care (Drugs/Pharms)
49	Confidence Petroleum India Ltd	CONFG	Singapore	Oil & Gas (Domestic Integrated)
50	Coral Hub Ltd	VITL	Luxembourg	Internet
51	Core Healthcare Ltd	CPARG	Luxembourg	Health Care (Drugs/Pharms)

(Contd.)

52	Country Club India Ltd	CCI	Luxembourg	Leisure Time (Products/Service)
53	Cranes Software International Ltd	EDC	Luxembourg	Computer Software
54	Crest Animation Studios Ltd	CRSC	Luxembourg	Entertainment
55	Crew Bos Products Ltd	CREWG	Luxembourg	Retail Specialty-Apparel
56	Crompton Greaves Ltd	CPGZF	London	Electrical Equipment & Components
57	Crompton Greaves Ltd	CPGVY	Portal	Electrical Equipment & Components
58	Cybermate Infotek Ltd	CILX	Luxembourg	Computer Software
59	DCW Ltd	DCWRF	Luxembourg	Chemicals
60	DCW Ltd	DCWFY	Portal	Chemicals
61	Dhampur Sugar Mills Ltd	DHSGZ	Luxembourg	Beverages (Alcoholic)
62	Dhampur Sugar Mills Ltd	DHSGY	Portal	Beverages (Alcoholic)
63	Dish TV India Ltd	DITV	Luxembourg	Broadcasting (TV,Radio,Cable
64	Dwarikesh Sugar Industries		Luxembourg	Foods
65	Easun Reyrolle Relays & Devices Ltd	ERRG	Singapore	Electrical Equipment & Compone
66	EID Parry India Ltd	EIDXF	Luxembourg	Manufacturing (Diversified)
67	EID Parry India Ltd	EIDXY	Portal	Manufacturing (Diversified)
68	EIH Ltd	EIHZF	London	Lodging-Hotels
69	EIH Ltd	EIHLY	Portal	Lodging-Hotels
70	Elder Pharmaceuticals Ltd	EDLPF	Luxembourg	Health Care (Drugs/Pharms)
71	Electrosteel Castings Limited	ECS	London	Metal Fabricators
72	EMCO Ltd	EMCO	Luxembourg	Machinery
73	Empower Industries India Ltd	EMPO	Luxembourg	Services (Commercial Consum)
74	Era Infra Engineering Ltd	ERCG	Luxembourg	Engineering & Construction
75	Eveready Industries India Limited	EVRI	Luxembourg	Manufacturing (Specialized)
76	Farmax India Ltd	FARM	Luxembourg	Manufacturing (Specialized)
77	FCS Software Solutions Ltd	FCS	Luxembourg	Computer Software
78	Federal Bank Ltd	FEDS	London	Banks (Major Regional)
79	Federal Bank Ltd	FDBAY	Portal	Banks (Major Regional)
80	Financial Technologies India Ltd	FTIS	London	Financial (Diversified)
81	Financial Technologies India Ltd	FTIA	Portal	Financial (Diversified)
82	Finolex Cables Ltd	FNXBY	Portal	Communications Equipment
83	GAIL India Ltd	GAILF	London	Natural Gas-Distr-Pipeline
84	GAIL India Ltd	GAILY	Portal	Natural Gas-Distr-Pipeline
85	Gammon India Limited	GMON	Luxembourg	Building Materials
86	Garden Silk Mills Ltd	GNSKF	Luxembourg	Textiles

(Contd.)

87	Gateway Distriparks Limited		Luxembourg	Services (Commercial Consum)
88	Gateway Distriparks Limited		Portal	Services (Commercial Consum)
89	Gitanjali Gems Ltd	GITG	London	Gold/Precious Metals Mining
90	Gitanjali Gems Ltd	GTJLY	Portal	Gold/Precious Metals Mining
91	Glory Polyfilms Ltd	GPOL	Luxembourg	Multi-Industry
92	Granules India Limited	GRAN	Luxembourg	Health Care (Drugs/Pharms)
93	Grasim Industries Ltd	GRSJY	London	Textiles
94	Great Eastern Energy Corporation Ltd	GEEC	London	Oil & Gas (Exploration & Production)
95	Great Eastern Shipping Co	GESGF	Luxembourg	Shipping
96	Great Eastern Shipping Co	GESGY	Portal	Shipping
97	Gujarat Narmada Valley Fertilizers Co Ltd		Luxembourg	Chemicals
98	Gujarat Narmada Valley Fertilizers Co Ltd	GUJVY	Portal	Chemicals
99	GV Films Ltd	GVFG	Luxembourg	Entertainment
100	HDFC Bank Ltd	HDFCB	Luxembourg	Banks (Major Regional)
101	Hexaware Technologies Ltd	HXWZF	London	Computer Services
102	Hexaware Technologies Ltd	HXWRY	Portal	Computer Services
103	Himachal Futuristic Communications	HFCD	London	Communications Equipment
104	Himachal Futuristic Communications	HIFDF	Luxembourg	Communications Equipment
105	Himachal Futuristic Communications	HIFCY	Portal	Communications Equipment
106	Himatsingka Seide Ltd	HSS	Luxembourg	Textiles
107	Himatsingka Seide Ltd	HMKAY	Portal	Textiles
108	Hindalco Industries Ltd	HNDNF	London	Diversified Metals
109	Hinduja Foundries Ltd	HVLX	Luxembourg	Metal Fabricators
110	Hindustan Construction Limited	HIN	London	Engineering & Construction
111	Hiran Orgochem Ltd	HO	Luxembourg	Health Care (Drugs/Pharms)
112	IKF Technologies Ltd	IKFX	Luxembourg	Computer Software
113	India Cements Limited	IAMUF	Luxembourg	Building Materials
114	India Cements Limited	IAMZY	Portal	Building Materials
115	India Cements Ltd	ICEMR	Luxembourg	Building Materials
116	India Cements Ltd	IAMUY	Portal	Building Materials
117	Indiabulls Financial Services Ltd	IBULLG	Luxembourg	Consumer Finance
118	Indiabulls Financial Services Ltd	IBLFY	Portal	Consumer Finance
119	Indiabulls Real Estate Ltd	IBREL	Luxembourg	Real Estate
120	Indiabulls Real Estate Ltd	IBRE	Portal	Real Estate
121	Indiabulls Securities Ltd	INDBL	Luxembourg	Investment Banking/Brokerage
122	Indian Hotels Co Ltd	IDHCF	London	Lodging-Hotels

(Contd.)

123	Indian Hotels Co Ltd	IDHUY	Portal	Lodging-Hotels
124	Indo Rama Synthetics	IDRMY	Portal	Textiles
125	Ind-Swift Laboratories	ISL	Luxembourg	Health Care (Drugs/Pharms)
126	Indusind Bank Ltd	IBL	Luxembourg	Banks (Major Regional)
127	Ispat Industries Ltd	IPIZF	Luxembourg	Steel
128	Ispat Industries Ltd		Portal	Steel
129	IT People India Ltd	ITPI	Luxembourg	Computer Software
130	Jain Irrigation Systems Ltd	JNIRF	Luxembourg	Building Materials
131	JCT Ltd	JCCWF	Luxembourg	Textiles
132	JCT Ltd	JCCTY	Portal	Textiles
133	Jindal Cotex Ltd	JCOT	Luxembourg	Textiles
134	Jindal Saw Limited	JIN	Luxembourg	Engineering & Construction
135	Jindal Saw Limited	JNDLY	Portal	Engineering & Construction
136	Jindal Stainless Ltd	JDSL	Luxembourg	Steel
137	JK Paper Limited	CPMG	Luxembourg	Paper & Forest Products
138	Jubilant Organosys Ltd	JUBO	Luxembourg	Chemicals
139	Jubilant Organosys Ltd	JUBLY	Portal	Chemicals
140	Jupiter Bioscience Ltd	JPO	Luxembourg	Biotechnology
141	K Sera Sera	KSSX	Luxembourg	Broadcasting (TV, Radio, Cable)
142	Kaashyap Technologies		Luxembourg	Computer Services
143	KBS Capital Management Ltd	MLTF	Luxembourg	Financial (Diversified)
144	KEI Industries Limited	KEII	Luxembourg	Electrical Equipment & Components
145	Kemrock Industries & Exports Ltd	KRI	Luxembourg	Chemicals
146	Kesoram Industries Ltd	KRIDF	Luxembourg	Multi-Industry
147	Kesoram Industries Ltd	KSRPYP	Portal	Multi-Industry
148	KLG Systel Ltd	KLGX	Luxembourg	Computer Software
149	Kohinoor Broadcasting Corp Ltd	KNBC	Luxembourg	Financial (Diversified)
150	Kotak Mahindra Bank Ltd		Luxembourg	Financial (Diversified)
151	Kotak Mahindra Bank Ltd	KMBKY	Portal	Financial (Diversified)
152	KRBL Limited	KRBG	Luxembourg	Foods
153	KS Oils Ltd	KSOG	Singapore	Manufacturing (Specialized)
154	K-Sera Sera Productions Ltd	KSSP	Luxembourg	Entertainment
155	Larsen & Toubro Ltd	LTOUF	London	Multi-Industry
156	Larsen & Toubro Ltd	LTORY	Portal	Multi-Industry
157	LIC Housing Finance		Luxembourg	Financial (Diversified)
158	LIC Housing Finance	LHFLY	Portal	Financial (Diversified)

(Contd.)

159	LLOYD Electric & Engineering Limited	LLD	London	Building Materials
160	LYKA Labs Ltd.	LYKA	Luxembourg	Health Care (Drugs/Pharms)
161	Maars Software International Ltd	MRSSI	Luxembourg	Computer Software
162	Madhucon Projects Limited	MDHG	Luxembourg	Engineering & Construction
163	Mahindra & Mahindra Ltd	MAHMF	London	Automobiles
164	Mahindra & Mahindra Ltd	MAHDY	Portal	Automobiles
165	Malanpur Steel Ltd	MPURF	Luxembourg	Holding Companies
166	Malanpur Steel Ltd	MPURY	Portal	Holding Companies
167	MARG Ltd	MRGC	Luxembourg	Engineering & Construction
168	Mascon Global Ltd	ALSF	Luxembourg	Computer Services
169	Mawana Sugars Ltd	MWNSF	London	Agricultural Products
170	Mawana Sugars Ltd	MWNSY	Portal	Agricultural Products
171	Micro Technologies		Luxembourg	Computer Software
172	Morepen Laboratories Ltd	MORE	Luxembourg	Chemicals
173	Moschip Semiconductor Technology Ltd	MCST	Luxembourg	Semiconductors
174	Moser Baer India Ltd		Luxembourg	Computers (Peripherals)
175	Nagarjuna Construction Co	NAG	Luxembourg	Engineering & Construction
176	Nagarjuna Construction Co	NGRJI	Portal	Engineering & Construction
177	Nectar Lifesciences Ltd	NLSC	Luxembourg	Health Care (Drugs/Pharms)
178	NEPC India Ltd	NPINF	Luxembourg	Manufacturing (Diversified)
179	NEPC India Ltd	NPIDY	Portal	Manufacturing (Diversified)
180	Nissan Copper Ltd	NCOP	Luxembourg	Diversified Metals
181	Noida Toll Bridge Company Limited	NTBC	London	Engineering & Construction
182	Northgate Technologies Ltd	NGTS	London	Computer Software
183	Northgate Technologies Ltd	NGTCL	Portal	Computer Software
184	Orchid Chemicals & Pharmaceuticals Ltd.	OCP	Luxembourg	Health Care (Drugs/Pharms)
185	Org Informatics Ltd	SREX	Luxembourg	Computers (Networking)
186	Oriental Hotels Ltd	OTHZF	Luxembourg	Lodging-Hotels
187	Paramount Communications	PRMCG	Luxembourg	Cellular/Wireless Telecomms
188	Pentasoft Technologies Ltd	PFZTF	Portal	Computer Software
189	Proto Developers & Technologies Ltd	PDTL	Luxembourg	Integrated Telecom
190	PVP Ventures Ltd	PVPVF	London	Computer Software
191	PVP Ventures Ltd	PVPVY	Portal	Computer Software
192	Rainbow Papers Ltd	RBWP	Luxembourg	Paper & Forest Products
193	Ranbaxy Laboratories Ltd	RBXZF	London	Health Care (Drugs/Pharms)
194	Ranbaxy Laboratories Ltd	RBXLY	Portal	Health Care (Drugs/Pharms)
195	Raymond Ltd	RYWLY	Portal	Textiles

(Contd.)

196	REI Agro Limited	REA	London	Foods
197	REI Agro Limited	REIAY	Portal	Foods
198	Reliance Capital Limited		Portal	Financial (Diversified)
199	Reliance Communication Ltd	RLCMZ	Luxembourg	Integrated Telecom
200	Reliance Communication Ltd	RLCMY	Portal	Integrated Telecom
201	Reliance Industries Ltd	RLNIY	Portal	Multi-Industry
202	Reliance Infrastructure Ltd	RELFF	London	Electric Companies
203	Reliance Infrastructure Ltd	RELEY	Portal	Electric Companies
204	Reliance Natural Resources Ltd	RLCNX	Luxembourg	Oil & Gas (Services)
205	Reliance Natural Resources Ltd	RLCNY	Portal	Oil & Gas (Services)
206	Resurgere Mines & Minerals India Ltd	RMML	Luxembourg	Metals Mining (other)
207	Rishabhdev Technocable Ltd	RDTL	Luxembourg	Electrical Equipment & Components
208	Rolta India Ltd	RTI	London	Electrical Equipment & Components
209	Rolta India Ltd	RLTAY	Portal	Electrical Equipment & Components
210	Ruchi Soya Industries Ltd	RSIH	Luxembourg	Foods
211	Ruchi Soya Industries Ltd	RCSYY	Portal	Foods
212	Sanghi Polyesters Ltd	SGHP	Portal	Textiles
213	SANRA Media Ltd	SNRS	Luxembourg	Computer Software
214	SE Investments Ltd	SEIN	Luxembourg	Consumer Finance
215	SEL Manufacturing Co Ltd		Luxembourg	Textiles
216	SEL Manufacturing Co Ltd	3464952Z	Luxembourg	Textiles
217	Shah Alloys Ltd	SAX	Luxembourg	Steel
218	Shree Ashtavinyak Cine Vision Ltd	SACV	Luxembourg	Entertainment
219	Shreyas Shipping & Logistics Ltd	SRYSG	Luxembourg	Shipping
220	Silverline Animation Technologies Ltd	SATL	Luxembourg	Media
221	Silverline Technologies Ltd	SLVT	Luxembourg	Computer Software
222	Silverline Technologies Ltd	SLVTX	Luxembourg	Computer Software
223	Soma Textiles & Industries	STIX	Luxembourg	Textiles
224	SREI Infrastructure Finance Ltd	SRI	London	Financial (Diversified)
225	SREI Infrastructure Finance Ltd	SIFLY	Portal	Financial (Diversified)
226	State Bank of India Ltd	SBKFF	London	Banks (Money Center)
227	State Bank of India Ltd	SBKIY	Portal	Banks (Money Center)
228	Steel Authority of India	SAUKF	London	Steel
229	Steel Authority of India	3557T	Portal	Steel

(Contd.)

230	Sterling Biotech Ltd	SBOTF	Luxembourg	Biotechnology
231	Sterling International Enterprises Ltd	SIEL	Luxembourg	Financial (Diversified)
232	Subex Ltd	SUBX	London	Computer Software
233	Subex Ltd		Portal	Computer Software
234	Subex Ltd	SBXZY	Portal	Computer Software
235	Sujana Metal Products Ltd	SJS	Luxembourg	Metal Fabricators
236	Sujana Towers Ltd	SUTL	Luxembourg	Communications Equipment
237	Sujana Universal Industries Limited	SJU	Luxembourg	Household Furnishings & App
238	Suzlon Energy Ltd	SUEL	Luxembourg	Electrical Equipment & Components
239	Sybly Industries Ltd	SYBLY	Luxembourg	Textiles
240	Taneja Aerospace & Aviation Limited	TAA	Luxembourg	Manufacturing (Diversified)
241	Tata Global Beverages Ltd	TTAZF	London	Beverages (Non-Alcoholic)
242	Tata Global Beverages Ltd	TTAEY	Portal	Beverages (Non-Alcoholic)
243	Tata Motors Ltd	TTMT	Luxembourg	Automobiles
244	Tata Motors Ltd	TENKY	Portal	Automobiles
245	Tata Power Co Ltd	TATG	Luxembourg	Electric Companies
246	Tata Power Co Ltd	TPCL	Luxembourg	Electric Companies
247	Tata Power Co Ltd	TAATY	Portal	Electric Companies
248	Tata Steel Ltd	TTST	London	Iron/Steel
249	Tata Steel Ltd	TATLY	Luxembourg	Steel
250	Tele Data Informatics Ltd	TELDF	Luxembourg	Computers (Networking)
251	Teledata Technology Solutions Ltd	TLTS	Luxembourg	Computer Services
252	Tricom India Ltd	TRCG	Luxembourg	Computer Services
253	Tube Investments of India	TIOIF	Luxembourg	Steel
254	Tube Investments of India	TIOZY	Portal	Steel
255	Uflex Ltd	FLXG	Luxembourg	Containers/Packaging (Paper)
256	Uflex Ltd	UFLXY	Portal	Containers/Packaging (Paper)
257	Ultra Tech Cement Ltd	UCLQY	Portal	Building Materials
258	Uniphos Enterprises Ltd	UEPLF	Luxembourg	Chemicals
259	United Spirits Ltd	MCDOW	Luxembourg	Beverages (Non-Alcoholic)
260	Usha Martin Education & Solutions Ltd	USHAF	Luxembourg	Communications Equipment
261	Usha Martin Ltd	UHBZF	Luxembourg	Communications Equipment
262	Usha Martin Ltd	UHBTY	Portal	Communications Equipment
263	Uttam Galva Steels Ltd	BR8.SG	Singapore	Steel
264	Valecha Engineering Ltd	VLCEG	Luxembourg	Engineering & Construction
265	Vedanta Resources PLC	VEDG	Luxembourg	Diversified Metals

(Contd.)

266	Videocon Industries Ltd	VDIN	Luxembourg	Household Furnishings & App
267	Visesh Infotecnics Ltd	VISG	Singapore	Computer Software
268	Visu International Ltd	VILW	Luxembourg	Services (Commercial Consum)
269	Vyapar Industries Ltd	EH4.SG	Singapore	Manufacturing (Diversified)
270	Wanbury Ltd	WANB	Luxembourg	Health Care (Drugs/Pharms)
271	Websol-Energy Systems Ltd	WSESG	Singapore	Semiconductors
272	West Coast Paper Mills Ltd	WCPMG	Singapore	Paper & Forest Products
273	Wockhardt Ltd	WKHZF	Luxembourg	Health Care (Drugs/Pharms)
274	Zenith Birla India Ltd	ZB	Luxembourg	Manufacturing (Diversified)

Table A.18.2 Indian ADRs Trading on the US Markets

SS#	*Company*	*Ticker*	*Exchange*	*Industry*	*Sponsored/ Unsponsored*
1	Rediff.com India	REDF	NASDAQ	Software & ComputerSvc	S
2	SIFY	SIFY	NASDAQ	Software & ComputerSvc	S
3	Dr. Reddy's Laboratories	RDY	NYSE	Pharma. & Biotech.	S
4	HDFC Bank	HDB	NYSE	Banks	S
5	ICICI Bank	IBN	NYSE	Banks	S
6	Infosys	INFY	NYSE	Software & ComputerSvc	S
7	Sterlite Industries	SLT	NYSE	Indust. Metals & Mining	S
8	Tata Communications	TCL	NYSE	Fixed Line Telecom.	S
9	Tata Motors	TTM	NYSE	Industrial Engineer.	S
10	Wipro	WIT	NYSE	Software & ComputerSvc	S
11	WNS Holdings	WNS	NYSE	Support Services	S
12	Igate Computer Systems Ltd	PTI	NYSE		S
13	Fufeng Group Ltd	FFNGY	OTC		
14	Grasim Industries Ltd	GRSXY	OTC		
15	India Hospitality Corp	INHZY	OTC		S
16	JK Lakshmi Cement Ltd	JKLCY	OTC		S
17	Satyam Computer Services Ltd	SAYCY	OTC		S
18	Silverline Technologies	SVRTY	OTC	Software&ComputerSvc	S
19	Mahanagar Telephone Nigam	MTENY	OTCQX		S

A scheme for issue of foreign currency convertible bonds and ordinary shares (through the GDR/ADR mechanism) was first formulated and notified by the Government of India in November 1993. It has been modified several times thereafter, the last major revision having been effected in February 2005. At the time of writing, the latest guidelines and regulations are contained in ***Master Circular on Foreign Investment in India*** issued by RBI on July 1 2010. Some of the salient points pertaining to GDR/ADR issues can be summarised as follows:

- The original guidelines had specified a track record requirement such as a three-year record of consistent profitability for a company to be eligible to issue GDRs/ADRs. This requirement and the associated two-stage approval process was abolished in 2000. Indian companies raising money through ADRs/GDRs through registered exchanges would henceforth be free to access the ADR/GDR markets through an automatic route without the prior approval of the Ministry of Finance, Department of Economic Affairs. Private placement of ADRs/GDRs would also be eligible for the automatic approval provided the issue is lead managed by an investment banker. (For the purpose of this scheme, an Investment Banker would be defined as an Investment Banker registered with the Securities and Exchange Commission in the USA, or under Financial Services Act in the U.K., or the appropriate regulatory authority in Europe, Singapore or in Japan.) The track record condition will not be operative for ADR/GDR issues.
- ADR/GDR are reckoned as part of Foreign Direct Investment (FDI). Accordingly, such issues would need to conform to the existing FDI Policy and only in areas where FDI is permissible. Prior approval of FIPB (Foreign Investment Promotion Board) is required.
- In all cases of automatic approval mentioned above, the mandatory approval requirement under FDI policy, approvals such as under the Companies Act, approvals for overseas investments/ business acquisition (where ADR/GDR proceeds are utilised for overseas investments), etc., would need to be obtained by the company prior to the ADR/GDR issues. The issuer company would need to obtain RBI approval under the provisions FERA/FEMA prior to the overseas issue.
- While no detailed end uses are specified, the bar on investments in stock markets and real estate mentioned in the earlier guidelines would continue to be operative. Earlier guidelines used to contain a fairly detailed specification of permitted uses of the funds raised.
- Retention and deployment of funds abroad would be as prescribed by RBI.
- The Custodian shall be a ‘Domestic Custodian Bank’ (This was notified in the November 1993 scheme).
- There is no restriction on the number of issues floated by a company during a financial year. (In the 1993 guidelines there were such restrictions).
- GDR issues would not be counted towards the ceiling imposed on foreign portfolio investment in a company’s equity which was raised to 49% in the Budget 2001-02.
- Originally, there as only a one-way fungibility, viz. a GDR/ADR holder could convert the DRs into underlying shares and hold them or sell them to a resident. Re-conversion back into DRs was not permitted. The Budget 2001-02 introduced a two-way fungibility. Also, when the volume of outstanding GDRs/ADRs declines because of redemption by investors, companies are now permitted to make fresh issues without having to again obtain government approval.
- Funds raised with the ADR/GDR issue have to be kept abroad till actually required in India. The July 1, 2010 master circular cited above specifies the instruments in which the funds can be invested abroad till repatriated to India.
- An Indian company can also sponsor an issue of ADR/GDR. Under this mechanism, the company offers its resident shareholders a choice to submit their shares back to the company on the basis of which ADRs/GDRs are issued abroad. The funds raised are remitted back to India and distributed among the resident investors who had offered their shares for conversion.

While dividends paid on the underlying shares are not subject to any withholding tax, the company has to pay a 10% tax on dividends paid. After converting the DRs into shares, if such shares are held for longer than 12 months and then sold, any capital gains would be taxed at a rate of 10%. If the period is less than a year, the gains would be subject to normal income tax rates.

Along with the liberalisation of the guidelines governing the issue of GDRs/ADRs, the government has also been relaxing restrictions on overseas acquisitions and investments by Indian companies in selected industries such as IT and Pharmaceuticals. Procedures and restrictions governing grant of ESOPs to overseas employees using GDRs/ADRs are also being progressively simplified.

GDRs could be offered to US investors only if very stringent requirements of registration with the SEC are complied with. However, under an exemption granted by Rule 144A of the Securities Act, securities can be offered to Qualified Institutional Buyers without going through the registration process. As to ADRs, offerings at various levels are possible with more and more stringent accounting and disclosure requirements as one goes from lower to higher levels. The four types of ADRs are briefly described below:

- Unsponsored Depository Receipts
  These are issued by one or more depositories in response to market demand, but without a formal agreement with the company. Today, unsponsored Depository Receipts are considered obsolete.
- Sponsored Level I Depository Receipts
  This is the simplest method for companies to access the U.S. and non-U.S. capital markets. Level I Depository Receipts are traded in the U.S. OTC market and on some exchanges outside the United States. The company does not have to comply with U.S. Generally Accepted Accounting Principles ("GAAP") or full SEC disclosure. Essentially, a Sponsored Level I Depository Receipt programme allows companies to enjoy the benefits of a publicly traded security without changing its current reporting process.
- Sponsored Level II And III Depository Receipts
  Companies that wish to either list their securities on an exchange in the U.S. and raise capital use sponsored Level II or III Depository Receipts, respectively. These types of Depository Receipts can also be listed on some exchanges outside the United States. Each level requires different SEC registration and reporting, plus adherence to the U.S. GAAP. The companies must also meet the listing requirements of the national exchange (New York Stock Exchange, American Stock Exchange) or NASDAQ, whichever it chooses.

Each higher level of Depository Receipt programme generally increases the visibility and attractiveness of the Depository Receipt. Level II is used when the company does not wish to raise funds, i.e. just acquire listing while level III is used when funds are to be raised. Correspondingly, the requirements for conformity with the US GAAP are stiffer for a level III offering.

In addition to the three levels of sponsored Depository Receipt programmes that trade publicly, a company can also access the U.S. and other markets outside the U.S. through a private placement of sponsored Depository Receipts. Through the private placement of Depository Receipts, a company can raise capital by placing Depository Receipts with large institutional investors in the United States, avoiding SEC registration and to non-U.S. investors in reliance on Regulations. A Level I programme can be established alongside a 144A programme. Table A.18.3 provides a quick summary of the features of the three levels of ADR programmes.

Table A.18.3 Types of ADR Programmes

Type of Programme	*SEC Filing Required*	*Exchange Listing*	*Capital Raising*
Level I	F-6[(1)]	Not permitted	Not permitted
Level II	F-6, 20-F[(2)]	NYSE, AMEX, NASDAQ	Not permitted
Level III	F-6, 20-F[(2)] F-1[(3)] or F-3[(4)]	NYSE, AMEX NASDAQ	Permitted
Rule 144A	None	Not permitted	Permitted

(1) F-6 is used for the registration of shares deposited with the depository bank.
(2) 20-F is an annual report similar to the 10K filed by US Domestic issuers and must contain financial statements with a US GAAP reconciliation.
(3) F-1 is used to register shares to be issued in a public offering. Contains 20-F information plus additional disclosure.
(4) F-3 is a short form of F-1. If the existing public market value of the stock issuer's stock (excluding stock held by affiliates of the issuer) is greater than $75 million, F-3 can be used.

The key parties involved in a GDR/ADR issue apart from the issuing company are:

- The Lead Manager(s): An investment bank which has the primary responsibility for assessing the market and successfully marketing the issue. It helps the company at all stages from preparing the documentation, making investor presentation, selection of other managers (subscribers) and post-issue support. It also owes a responsibility to investors of presenting an accurate picture of the company's present status and future prospects, to the best of its knowledge. This means that it must exercise due diligence in collecting and evaluating all possible information which may have a bearing on the issue.
- Other managers or subscribers to the issue agree to take and market parts of the issue as negotiated with the lead manager.
- Depository: A bank or financial institution, appointed by the issuing company which has certain duties and functions to be discharged vis-a-vis the GDR holders and the company. For this it receives compensation both from the company as well as the GDR holders.
- Custodian: A bank appointed by the Depository, generally in consultation with the issuing company which keeps custody of all deposited property such as share certificates, dividends, right and bonus shares, etc. It receives its fees from the Depository.
- Clearing Systems: EUROCLEAR (Brussels), CEDEL (London) are the registrars in Europe and Depository Trust Company (DTC) are the registrar in USA who keep records of all particulars of GDRs and GDR holders.

The key steps involved in the GDR mechanism after obtaining the necessary approvals from the Government can be summarised as follows:

- The amount of issue is finalised in US dollars. The company considers factors such as gearing, dilution effect on future earnings per share, etc. The lead manager assesses the market conditions.
- The lead manager and other managers agree to subscribe to the issue at a price to be determined on the issue date. These agreements are embodied in a subscription agreement signed on the issue date.
- Usually, the lead manager has an option to subscribe to specified additional quantity of GDRs. This option called *green shoe* has to be exercised within a certain number of days.

- Simultaneously, the Depository and the Custodian are appointed and the issuer is ready to launch the issue.
- The company issues a share certificate equal to the number of GDRs to be sold. This certificate is in the name of the Depository, kept in custody of the Custodian. Before receipts of the proceeds of the issue, the certificate is kept in escrow.
- Investors pay money to the subscribers.
- The subscribers (i.e. the lead manager and other managers to the issue) deposit the funds with the Depository after deducting their commissions and expenses.
- The company registers the Depository or its nominee as holder of shares in its register of shareholders.
- The Depository delivers the *European Master GDR* to a common depository for CEDEL and EUROCLEAR and holds an *American Master GDR* registered in the name of DTC or its nominee.
- CEDEL, EUROCLEAR and DTC allot GDRs to each of the ultimate investors based on the data provided by the managers through the Depository.
- The GDR holders pick up their GDR certificates. Anytime after a specified "cooling off" period after close of the issue they can convert their GDRs into the underlying shares by surrendering the GDR to the Depository. The Custodian will issue the share certificates in exchange for the GDR.
- The GDRs are listed on stock exchanges in Europe such as Luxembourg and London. ADRs level II and III are listed on one or more US exchanges.

Keep in mind that this is a very bland summary of the procedural steps. In reality, the whole issue process is quite complex involving obtaining the various clearances, preparation and scrutiny of various documents, pinning down all the legal details, a series of meetings between the Company, the lead managers, the legal advisers, presentations to potential investors, and so forth.

The costs of the issue consist of various fees, commissions and expenses paid to the lead manager and other managers, fees and expenses paid to the depository, preparation of documents, legal fees, expenses involved in investor presentation (road shows, etc.), listing fees for the stock exchanges, stamp duties, etc. Fees and commissions paid to managers vary but are generally in the neighbourhood of 3-4% of the issue amount.

A very large number of documents have to be prepared prior to launching the issue. Apart from the various internal and government approvals, the key documents from the point of view of presentation to the subscribers are the ***offering circular*** and the ***research report***. The lead manager compiles the former, while the latter is prepared by an independent agency on the basis of information provided by the company and other independent sources. Even though the lead manager is required to exercise due diligence in compiling the offering document, primary legal obligation for any misrepresentation or withholding material facts is on the issuing company. As to the research document, the liability is with the managers. Both these documents are circulated prior to the "road shows" and one-to-one meetings with prospective investors. Road shows are gatherings of potential investors organised in the major financial centres of the world where the company with the assistance of the lead manager makes a presentation and holds discussions to assess investor interest.

GDR/ADR holders have the right to dividends, the right to subscribe to new shares and the right to bonus shares. All these rights are exercised through the depository. The depository converts the dividends from rupees to foreign currency. DR holders have no voting rights. The depository may vote, if necessary as per the provisions in the Depository Agreement.

Chapter 19

Long-term Borrowing in the Global Capital Markets

19.1 INTRODUCTION

> "For us here at the World Bank, the last ten years have been the equivalent of the financial industrial revolution. We began 1980 having never issued a Eurobond. And 1980 was the same as 1970, only bigger. The 1990 programme bears no similarity at all – today we are borrowing in 20 different currencies, using interest rate and currency swaps, reverse currencies, zero coupons and perpetuals. The 1980s have exploded".

(Don Roth, treasurer at the World Bank quoted in ***Capital Markets: The New Order.*** A supplement to **EUROMONEY** May 1991).

The above quote dramatically underscores the phenomenal changes that swept financial markets around the world during the 1980s and the 1990s and continued in the 21st century. The "financial revolution" has been characterised by both a tremendous quantitative expansion and an unprecedented qualitative transformation in the institutions, instruments and regulatory structures.

Global financial markets are a relatively recent phenomenon. Prior to 1980, national markets were largely isolated from each other and financial intermediaries in each country operated principally in that country. The foreign exchange market and the Eurocurrency and Eurobond markets based in London were the only markets that were truly global in their operations.

Financial markets everywhere serve to facilitate transfer of resources from surplus units (savers) to deficit units (fund raisers), the former attempting to maximise the return on their savings while the latter looking to minimise their funding costs. An efficient financial market thus achieves an optimal allocation of surplus funds between alternative uses. Healthy financial markets also offer the savers a wide range of instruments enabling them to diversify their portfolios.

Globalisation of financial markets which began in the 1980s has been driven by two underlying forces. Growing (and continually shifting) imbalance between savings and investment within individual countries, reflected in their current account balances, has necessitated massive cross-border financial flows. For instance, during the latter part of the seventies, the massive surpluses of the OPEC countries had to be recycled, i.e. fed back into the economies of oil importing nations. During the eighties, the large current account deficits of the U.S. had to be financed primarily from the mounting surpluses in Japan and Germany. During the nineties, developing countries as a group have experienced huge current account deficits and have also had to resort to international financial markets to bridge the gap between their incomes and expenditures as the volume of concessional aid from official bilateral and multilateral sources has fallen far short of their perceived needs. Table 19.1 presents some data on global savings – investment balance. Tables 19.2 and 19.3 provide some illustrative data on current account balances of the industrial and the developing countries, respectively, and, for the latter, the financing of these deficits.[1]

Table 19.1 Global Savings and Investment (Percentage of GDP)

Category and Group	*1999-2006 (Average)*	*2010*	*2011*	*2012*	*2013#*
SAVING					
Advanced Economies	20.4	18.2	18.3	18.4	18.7
Emerging and Developing Countries	27.6	32.9	33.3	32.8	33.1
Developing Asia	36.1	44.8	43.6	43.0	43.2
World Total	22.0	23.3	23.8	23.9	24.4
INVESTMENT					
Advanced Economies	21.1	18.5	18.8	18.8	19.0
Emerging and Developing Countries	25.6	31.5	31.5	31.5	32.2
Developing Asia	33.3	42.3	41.9	41.9	42.1
World Total	22.1	23.0	23.4	23.6	24.2

Note: World savings and investment differ because of statistical discrepancies in the national data sources.
2013 figures are projections
Source: ***World Economic Outlook*** April 2013, IMF, Washington DC.

Table 19.2 Current Account Balances of Industrialised and Developing Countries (Billion US $)

Country/Group	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*
U.S.	–800.6	–710.3	–677.1	–381.9	–442.0	–465.9	–475.0	–473.5
Euro Area	53.6	46.1	–96.9	30.6	64.5	78.4	221.4	294.9
Japan	170.9	212.1	159.9	146.6	204.0	119.3	59.0	63.5
Other Advanced Economies	149.9	134.3	135.3	150.7	164.4	190.9	136.5	65.1
EM and Developing Countries	635.8	619.1	675.8	268.9	334.9	486.8	394.4	296.3

Note: 2013 figures are IMF projections. EM denotes "Emerging Markets"
Source: ***World Economic Outlook*** April 2013. IMF, Washington DC.

[1]The data in these tables should be viewed only as indicative of the orders of magnitudes involved. Due to errors and omissions, timing asymmetries, etc., the reported BOP data do not add up. Similarly, the net borrowing figures in Table 19.3 are not comparable with data on year-to-year changes in external debt of developing countries reported in the same source.

Table 19.3 Deficits and External Financing Emerging Market and Developing Countries (US$ Billion)

	2009	*2010*	*2011*	*2012*	*2013*
1. Current Account Balance	268.9	334.9	486.8	394.4	296.3
2. Changes in Reserves (– = increase)	–520.6	–843.1	–747.7	–402.3	–634.6
3. Net Private Financial Flows*	320.9	600.0	495.3	144.9	336.3
4. Net Official Financial Flows**	139.2	68.2	–59.5	–41.7	–48.8

*Net private financial flows consist of net direct investment, net portfolio investment and other net private flows.

** Net official financial flows does not include grants and includes transactions in external assets and liabilities of official agencies. 2013 data are IMF projections.

Source: ***World Economic Outlook*** April 2013 IMF, Washington DC.

The other force driving the globalisation of capital markets is the increasing preference on the part of investors for international diversification of their asset portfolios. This would result in large cross-border financial flows even in the absence of current account imbalances though the net flows would be zero. Several investigators have established that significant risk reduction is possible via global diversification of portfolios.

These demand-side forces by themselves would not have sufficed to give rise to the enormous growth in cross-border financial transactions, if they had not been accompanied by liberalisation and integration of financial markets.

In virtually all the major industrial economies, elimination or significant relaxation of regulations governing the operations of financial markets has been already effected or is under way. Exchange controls, functional and geographical restrictions on financial institutions, restrictions on the kind of securities they can issue and hold in their portfolios, interest rate ceilings and withholding taxes, barriers to foreign entities accessing national markets as borrowers and lenders and to foreign financial intermediaries offering various types of financial services have been already dismantled or are being gradually eased away. Finally, the markets themselves have proved to be highly innovative, responding rapidly to changes in investor preferences and increasingly complex needs of the borrowers by designing new instruments and highly flexible risk management products.

The combined result of these processes has been the emergence of a vast, seamless global financial market transcending national boundaries. It is by no means true that controls and government intervention have entirely disappeared. In some countries, e.g. Italy, the government continues to exercise strict control over pension funds, insurance companies, mutual funds and unit trusts restricting much of the outward flow of capital. Capital markets of the newly industrialising South East Asian economies, e.g. Korea, Taiwan, permit only limited access to foreign investors. Even in an advanced economy like that of Germany, the structure of corporate financing is such that most of the companies rely on loans from domestic banks for investment and investors do not appear to show much interest in foreign issues. However, despite all these reservations, it can be asserted that the dominant trend is towards globalisation of financial markets.

Table 19.4 gives a break-up by instrument and by two broad groups of borrowers, of the total debt raised on the international markets in recent years. There are fluctuations in the relative importance of different types of instruments as markets respond to changing investor/borrower needs and changes in financial environment. It is clear that for developing countries, as far as debt finance is concerned, external bonds and syndicated credits are the two main sources of funds.

Table 19.4 Borrowing on International Capital Markets (Billions of US Dollars)

Type Country/Group	*2010*	*2011*	*2012*	*2013Q1*
1. Syndicated Credit Facilities	1723.7	2492.2	1840.5	436.4
Borrowers from				
(i) Developed Countries	1398.8	2081.8	1525.4	337.5
(ii) Developing Countries	267.6	343.2	276.0	86.5
2. Debt Securities (Net Issues)	656.4	474.2	704.9	40.2
Issuers from				
(i) Developed Countries	347.5	107.8	32.4	–67.0
(ii) Developing Countries	205.0	145.5	237.2	33.9
2a Money Market Instruments	–24.1	41.9	20.3	10.4
2b Bonds and Notes	680.5	432.3	684.7	29.8

Source: ***International Banking and Financial Market Developments*** Quarterly Review, December 2012, June 2013. Bank for International Settlements, Basle.

Indian entities began accessing external capital markets towards the end of seventies as gradually the amount of concessional assistance became inadequate to meet the increasing needs of the economy[2].

The initial forays were very low-key. The pace accelerated somewhat around mid-eighties, but even then, the authorities adopted a selective approach and permitted only a few select banks, all India financial institutions, and large public and private sector companies to access the market. Further, liberalisation took place as a part of the reform package initiated in 1991. Table 19.5 provides some data on net external commercial borrowings, i.e. net of repayments of earlier borrowings, by Indian entities on the global markets. Table 19.6 taken from the website of HINDU Business Line provides some recent data on gross external commercial borrowings by Indian companies.

Table 19.5 India's Net External Commercial Borrowings (Million US Dollars)

Year/Period	*Net Inflows*
2003-04	–2925
2004-05	5194
2005-06	2508
2006-07	16103
2007-08	22609
2008-09	7941
2009-10	2522
2010-11	7300
2011-12	35710
2012-13	32046

Source: Monthly Review of the Indian Economy, July 2010, Centre for Monitoring Indian Economy (CMIE), RBI Monthly Bulletin various issues.

After a sharp rise in 1993-94, the rising trend continued till the end of the decade when partly as a result of Asian crisis and partly due to economic slowdown there was a sharp decline. There has been a strong revival thereafter. Till recently, India's borrowings had been by way of syndicated bank loans, buyers' credits and lines of credits. Other instruments such as foreign and eurobonds, EMTNs were employed much less frequently though a number of companies made issues of euroconvertible bonds after 1993. Prior to that, only apex financial

[2]Much of the material that follows about India's recourse to global debt markets draws upon the recent comprehensive work of Dr. P.R. Joshi (1996).

Table 19.6 Gross External Commercial Borrowings by Indian Companies

ECBs (April 2006 – February 2007)			(in $ million)
Year	***Month***	***Number of cos.***	***Borrowings***
2006	April	60	1321
2006	May	75	2052
2006	June	72	1053
2006	July	65	1089
2006	August	76	1271
2006	September	74	1706
2006	October	64	3324
2006	November	74	1242
2006	December	85	2700
2007	January	81	1292
2007	February	86	3194
		812	**20244**

institutions and the public sector giant ONGC had tapped the German, Swiss, Japanese and eurodollar bond markets. In recent years, the number of companies tapping the global bond markets has increased.

Throughout the eighties, there was a steady improvement in the market's perception of the creditworthiness of Indian borrowers. This is manifested in the steady decline in the spreads they had to pay over LIBOR in the case of euroloans. The 1990-91 crisis sent India's sovereign rating below investment grade and the foreign debt markets virtually dried up to be opened up again after 1993. The Asian crisis resulted in a slowdown again during the closing years of the last millenium.

The onset of the 21st century brought about a significant enhancement in India's global status as an economy with strong growth prospects and investor-friendly policy environment. Apart from sustained interest by FIIs in the Indian stock market, there has been a significant improvement in the creditworthiness of Indian corporates in the eyes of global investors.

The Indian government has also been liberalising its policy framework governing external commercial borrowings. According to a policy circular dated July 1, 2010, titled ***"Master Circular on External Commercial Borrowings and Trade Credits"***, external commercial borrowings under the "automatic route" do not require prior approval of either the Government of India or RBI. Corporates, NGOs engaged in microfinance, units located in SEZs, etc., are allowed to raise up to 500 million US dollars under this route with borrowings up to 20 million having minimum average maturity of three years while borrowings beyond that should have minimum average maturity of five years. A ceiling of 300 basis points over 6-month LIBOR is specified for loans with maturities between three to five years, while the ceiling is 500 basis points for longer maturities. Some restrictions are imposed on end uses of the funds raised, guarantees and securities that can be provided, prepayment and so forth. The funds can be kept abroad or remitted to India pending utilisation. The circular specifies the assets in which the funds can be invested, if kept abroad. For certain categories of borrowers and beyond a ceiling specified on the amount of borrowing, prior approvals have to be obtained from the Ministry of Finance and RBI. The amount can be up to 750 million dollars with average maturity of more than ten years. Here again, restrictions are specified on end uses, cost ceilings and so forth. The policy circular cited above is accessible on the website: **rbi.org.in**.

The purpose of this chapter is two-fold. First, we wish to provide an overview of the major segments of the global debt markets in terms of funding avenues, general regulatory framework, accessibility and some procedural aspects. It is not our intention to provide an in-depth treatment since such a task would necessitate a separate volume in itself. There are several excellent sources dealing with each of the major market segments and periodic updates are provided by financial periodicals[3]. An excellent, comprehensive treatment, particularly valuable from the point of view of potential borrowers from India, can be found in Joshi (2001). Second, we wish to examine the analytics of the international financing decisions from the borrower's point of view and risk-return considerations from the investor's point of view.

19.2 MAJOR MARKET SEGMENTS

The funding avenues potentially open to a borrower in the global capital markets can be categorised as follows:

(A) Bonds

- (A.1) Straight Bonds
- (A.2) Floating Rate Notes (FRNs)
- (A.3) Zero-coupon and deep discount bonds
- (A.4) Bonds with a variety of option features embedded in them

(B) Syndicated Credits

These are bank loans, usually at floating rate of interest, arranged by one or more lead managers (banks) with a number of other banks participating in the loan. A number of variations on the basic theme are possible. We will discuss these in some detail below.

(C) Medium Term Notes (MTNs)

Initially conceived as instruments to fill the maturity gap between short-term money market instruments like commercial paper and long-term instruments like bonds, these subsequently evolved into very flexible borrowing instruments for well-rated issuers, particularly in their "Euro" version, viz. **Euro Medium Term Notes (EMTNS)**.

(D) Committed Underwritten Facilities

The basic structure under this is the **Note Issuance Facility (NIF).** We will discuss this and some of its variants below. Introduced in 1980s, these instruments were popular for a while before introduction of risk-based capital adequacy norms rendered them unattractive for banks.

(E) Money Market Instruments

These are short-term borrowing instruments and include commercial paper, certificates of deposit and bankers' acceptances among others.

In addition to these, export related credit mechanisms such as buyers' and suppliers' credits, general-purpose lines of credit, forfaiting are other sources of medium-to-long-term funding. These were discussed in some detail in the appendix to Chapter 4.

[3]See among others, OECD Financial Market Trends, a monthly publication and supplements published by **Euromoney** from time to time dealing with individual market segments.

Figure 19.1 gives some idea of the size of the syndicated credit markets and the credit spreads over LIBOR charged to emerging market borrowers on new dollar loans. Figure 19.2 presents a picture of the debt securities segment, viz. international bonds and notes.

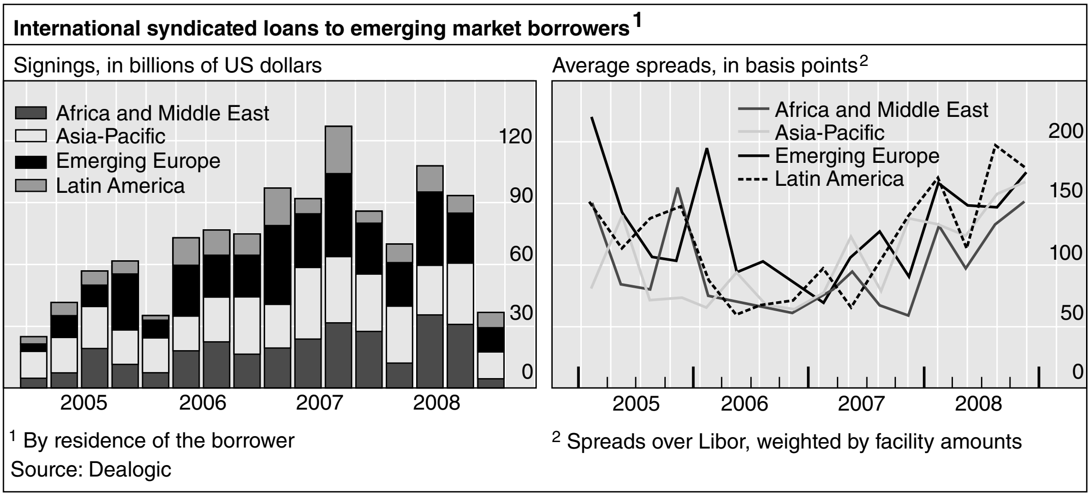

Fig. 19.1
(Source: BIS Quarterly Review, March 2009)

Another innovation to have emerged during the 1990s is **Project Finance.** While it uses one or more of the funding instruments mentioned above, its novelty lies in the way the financing package is put together including the rights and obligations of the parties involved, allocation of various operating and financial risks to those who are best equipped to bear them, incorporation of various guarantees and so forth. Designed to finance single large projects, such as the Eurotunnel, it has been applied to infrastructure development and other projects (e.g. building prisons). By now, it has become a highly specialised field. We will discuss it briefly below.

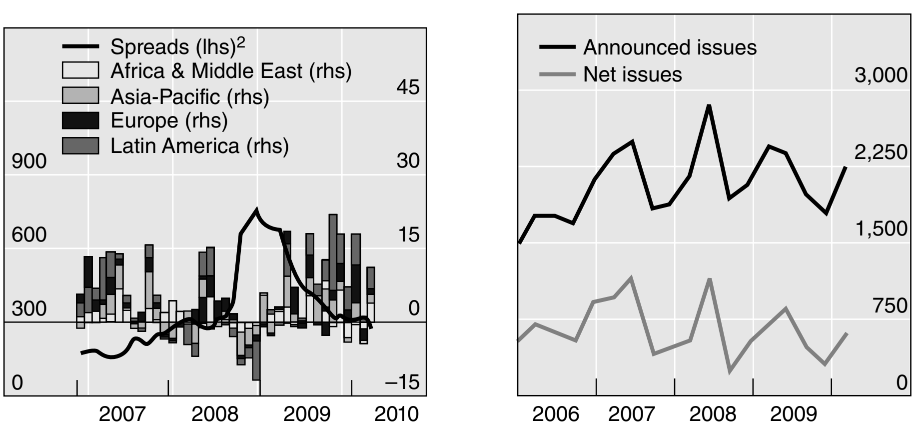

Fig. 19.2 Net Issues of International Bonds and Notes
(Source: BIS Quarterly Review, April 2010)

Like in the case of banking and money markets discussed in Chapter 6, most of the funding instruments discussed above also have their "domestic" and "offshore" segments. The main differentiating dimension is regulatory requirements which, in turn, influence the disclosure, accounting and rating discipline that a potential borrower must subject itself to. The legal framework governing the rights and obligations of the borrower and the lenders also differs. Public issues in the domestic segment have to be registered with the appropriate securities regulatory body while issues made in offshore segments are like bearer bonds[4]. Of course, within the domestic segment, as we shall see below, funding avenues such as private placements are available which have less stringent requirements and, therefore, are easier to access.

The designation of an instrument such as a bond varies according to the segment tapped and the nationality of the issuer. Thus, when a non-resident company issues a US dollar-denominated bond in the US capital market, it is called a ***Foreign Dollar Bond*** whereas a US dollar bond issued outside the US may be referred to as a ***Eurodollar Bond*** or more generally as an "international" dollar bond. Foreign and international bonds taken together are referred to as ***External Bonds***[5].

Borrowers often access a currency-market segment which offers ease of access, cheaper all-in cost or some other attractive feature and then use swaps to reconfigure their liabilities in terms of currency and interest rate basis. We have seen examples of this in Chapter 16.

19.2.1 Bond Markets

A bond is a debt security issued by the borrower, purchased by the investor, usually through the intermediation of a group of underwriters.

The traditional bond is the ***straight bond***. It is a debt instrument with a fixed maturity period, a fixed ***coupon*** which is a fixed periodic payment usually expressed as percentage of the ***face or par value***, and repayment of the face value at maturity. (This is known as ***bullet repayment*** of the principal). The market price at which such a security is bought by an investor either in the primary market (a new issue) or in the secondary market (an existing issue made sometime in the past) is its ***purchase price***, which could be different from its face value. When they are identical the bond is said to be selling at ***par***, when the face value is less than (more than) the market price, the bond is said to be trading at a ***premium (discount)***. The difference could arise because the coupon attached to this bond is different from the rates of interest ruling on bonds belonging to the same class, i.e. bonds with identical perceived credit risk and maturity or because market's perception of creditworthiness of the issuer is different. The ***yield*** is a measure of return to the holder of the bond and is a combination of purchase price and the coupon. However, there are many concepts of yield (See Appendix A at the end of the book). Coupon payments may be annual, semi-annual or some other periodicity. Maturities can be up to thirty years or in rare cases even longer. Bonds with maturities at the shorter end (4-10 years) are often called ***notes.***

A very large number of variants of the straight bond have evolved over time to suit varying needs of borrowers and investors.

A ***callable bond*** can be redeemed by the issuer, at issuer's choice, prior to its stated expiry date. The ***first call date*** is normally some years from the date of issue, e.g. a 15-year bond may have a call

[4]There may also be differences in the composition of the underwriting syndicates and investors.

[5]In the case of the former, the underwriting syndicate consists exclusively of banks and investment banks resident in the country of issue, while in the case of the latter, the syndicate is international in character. This distinction has not remained significant anymore.

provision which allows the issuer to redeem the bond at any time after 10 years. The ***call price,*** i.e. the price at which the bond will be redeemed is normally above the face value with the difference shrinking as maturity is approached. This feature allows the issuer to restructure his liabilities or refund a debt at a lower cost, if interest rates fall. In an environment of high interest rates (i.e. when they are expected to fall), the callable bond will have to give an incentive to the investor in the form of a higher yield compared to an otherwise similar non-callable bond. A ***puttable bond*** is the opposite of a callable bond. It allows the investor to sell it back to the issuer prior to maturity, at investor's discretion, after a certain number of years from the issue date. The investor pays for this privilege in the form of a lower yield.

Sinking fund bonds were a device, often used by small risky companies to assure the investors that they will get their money back. Instead of redeeming the entire issue at maturity, the issuer would redeem a fraction of the issue each year so that only a small amount remains to be redeemed at maturity.

A ***Floating Rate Note*** **(FRN)** is, as its name implies, a bond with varying coupon. Periodically (typically every six months), the interest rate payable for the next six months is set with reference to a market index such as LIBOR. In some cases, a ceiling may be put on the interest rate (capped FRNs), in some cases, a floor, while in some cases there may be a ceiling ***and*** a floor (collared FRNs)[6].

Zero coupon bonds (called simply "Zeros") are similar to the cumulative deposit schemes offered by companies in India. The bond is purchased at a substantial discount to the face value and redeemed at face value on maturity. There are no interim interest payments. One possible advantage can arise from tax treatment, if the difference between the face value and the purchase price, realised at maturity is deemed to be entirely capital gains and taxed at a rate lower than the rate applicable to regular interest received on coupon bonds[7]. In addition, there is no re-investment risk as in the case of coupon bonds where the intermediate coupon cash flows must be invested at rates ruling at the time coupons are paid. ***Deep Discount Bonds*** do pay a coupon but at a rate below the market rate for a corresponding straight bond. Bulk of the return to the investor is in the form of capital gains.

Convertible bonds are bonds that can be exchanged for equity shares either of the issuing company or some other company. The ***conversion price*** determines the number of shares for which the bond will be exchanged; the ***conversion value*** is the market value of the shares which is less than the face value of the bond at the time of issue. As the share price rises, the conversion value rises. There is generally a call provision attached which allows the issuer to redeem the bond when the share price rises above a certain level which forces the holder to convert in order to avoid losing the premium on the bonds. Convertible bonds carry a coupon below that of a comparable straight bond, thus reducing cash outflow on account of interest. Small but rapidly growing companies find it an attractive funding device. It is a form of deferred equity, effectively sold above the current market price. One motivation might be that the issuer believes that the market is currently under-pricing its shares.

Warrants are an option sold with a bond that gives the bondholder the right to purchase a financial asset at a stated price. The asset may be a further bond, equity shares or a foreign currency. (Currency warrants were particularly popular in the euromarkets during the eighties). The warrant may be

[6]A Perpetual FRN, an instrument which had a short life in the euromarkets was a debt security with no repayment of principal like the British consols.

[7]Another innovation, called *Strips*, effectively creates a series of zero coupon bonds from a coupon bond. Redemption of face value at maturity is also treated as a large zero coupon bond. Each of the coupon payment can then be sold separately at its current market price.

permanently attached to the bond or detachable and separately tradable. Initially warrants were used by issuers with lower than top credit ratings as an added incentive to the investor to keep the interest cost within reasonable limits. Recently, even high-grade companies have issued warrants[8].

A large number of other variants have been brought to the market. Among them are drop-lock FRNs, convertible FRNs, dual currency bonds, bonds with exotic currency options embedded in them, bonds denominated in artificial currency units such as ECU or SDR and so on. Short descriptions of some of these are given in the appendix to this chapter. An illustrative example is also provided in the appendix[9].

Bonds with embedded options will be priced to include the value of the option. If the issuer gets the option (e.g. a callable bond), the yield would have to be higher than a comparable straight bond; if the option is being granted to the investors, e.g. a puttable bond or a convertible bond, its value will be reflected in the lower yield.

The largest international bond market is the eurobond market which is said to have originated in 1963 with an issue of eurodollar bonds by Autostrade, an Italian borrower. The market has since grown enormously in size. It is still dominated by issuers from the OECD area. Supranational institutions and developing country borrowers constitute the rest of the market. As to currency composition of the issues, US dollar still accounts for the largest share, though over the years, its share has shown a declining trend. Eurobond markets in all currencies except yen are quite free from any regulation by the respective governments. The euroyen bond market, which really came into existence as late as 1984, is closely controlled and monitored by the Japanese Ministry of Finance.

Straight bonds are priced with reference to a benchmark, typically treasury issues. Thus, a eurodollar bond will be priced to yield a YTM (Yield-to-Maturity) somewhat above US treasury bonds of similar maturity, the spread depending upon the borrower's rating and market conditions.

While a formal credit rating, such as S&P or Moody's, is not absolutely mandatory for eurobonds, it helps in placing the issue at terms attractive to the borrower. The straight bonds segment is accessible only to highly rated borrowers. The FRN segment and the segment comprising convertibles and other types of option embedded bonds provide easier access to lesser rated issuers.

Many eurobonds are listed on stock exchanges in Europe. This requires that certain financial reports be made available to the exchanges on a regular basis. However, secondary market trading in eurobonds is almost entirely over-the-counter by telephone between dealers. Quotes are available on the exchange where the issue is listed.

Flotation costs of eurobond issues are generally higher than costs associated with syndicated eurocredits. In the appendix to this chapter, we have provided a brief description of the issue process. More details can be found in Fisher (1987) and Joshi (2001).

Among the national capital markets, the US market is the largest in the world. It is complemented by world's largest and most active derivatives markets, both OTC and exchange-traded. It provides a wide spectrum of funding avenues. It is in some ways a very strictly regulated market but at the same time offers a lot of flexibility to potential borrowers in terms of structuring their financing activities.

From a non-resident borrower's point of view, the most prestigious funding avenue is public issue of ***Yankee Bonds***. These are dollar denominated bonds issued by foreign borrowers. It is the largest and most active market in the world but potential borrowers must meet very stringent disclosure, dual rating and other listing requirements. Option features like call and put can be incorporated and

[8]Theoretically, if the warrant is attractive to the investor, it must be unattractive to the issuer. However, there is evidence, particularly in the case of currency warrants that the issuers are able to hedge their risk at a cost smaller than the interest saved due to warrants.

[9]The interested reader can consult the following references: Aldred (1987), Fisher (1988), Antl (1989), Scott-quinn (1990).

there are no restrictions on size of the issue, maturity and so forth. Syndication structures and fees are flexible and borrowers who satisfy the registration requirements and rating norms can get very fine terms. Shelf registration is possible for selected borrowers. Under this facility, the issuer can register the necessary documentation in advance of the issue of securities.

Yankee bonds can also be offered under Rule **144A** of the SEC. These issues are exempt from elaborate registration and disclosure requirements but rating, while not mandatory, is helpful. Finally, low rated or unrated borrowers can make private placements. Higher yields have to be naturally offered and the secondary market is very limited. For more details, see Joshi (2001).

It is also possible to float bonds denominated in foreign currencies in the US market. In the past, the commonly used currencies have been the Australian dollar, the Canadian dollar, the New Zealand dollar and the ECU. These are almost always swapped into US dollars via a currency swap.

The Japanese market was tightly regulated till 1980. Thereafter, the government implemented a series of regulatory reforms designed to integrate the Japanese financial markets with the global markets. Foreign institutions were allowed entry and regulations on cross-border borrowing and investment were relaxed. Within a span of fifteen years, Japanese capital markets have developed enormously both quantitatively and qualitatively.

Bond finance in yen available to foreign borrowers includes in addition to the euroyen segment, ***Samurai Bonds and Shibosai Bonds*****.** Samurai bonds are publicly issued yen denominated bonds and like Yankee bonds are the most prestigious funding vehicle. The Japanese Ministry of Finance lays down the eligibility guidelines for potential foreign borrowers. These specify the minimum rating[10], size of the issue, maturity, and so forth. Syndication and underwriting procedures are quite elaborate and so is the documentation. Hence, flotation costs tend to be high. Pricing is done with reference to the Long-Term Prime Rate (LTPR). Shibosai bonds are private placement bonds with distribution limited to institutions and banks. While eligibility criteria are less stringent, the MOF still controls the market in terms of rating, size and maturity of the issue.

In addition to these two, other vehicles are available to non-resident borrowers. ***Shogun Bonds*** are publicly floated bonds denominated in a foreign currency while ***Geisha Bonds*** are their private placement counterparts.

Indian entities have tapped the Japanese market to a considerable extent starting with the Shibosai issue made by IDBI in 1984. The strength of yen implies substantial exchange rate exposure for Indian borrowers who avail of yen finance. Correspondingly, the nominal interest rates are low. For details of bond issue procedures, the reader can consult Joshi (2001).

Non-resident deutschemark bond issues in the German market were all structured as euro bonds. These could be public issues or private placements depending upon the size of the issue and whether the issuer wishes the bonds to be listed on exchanges. After some activity in the late eighties, Indian borrowers have not approached the German bond market.

The Swiss capital market also provides bond finance avenues. Swiss investors do not attach great importance to formal rating preferring to rely on their own assessment of the borrower's creditworthiness. They tend to be quite selective. **Public Bonds** are floated through a prospectus, are fixed rate bullet redemption bonds and are normally used for large funding requirements in excess of Sfr100 million. Issuers need to get approval from the **Swiss National Bank (SNB)**. Issue costs tend to be rather high. **Unlisted Bonds** (referred to as **Notes** and not bonds) are for smaller financing and also for shorter maturities, sometimes as short as eighteen months. They are **not** private placements since the issue is publicised as much as a public offering. Unlike other foreign bonds, these can be

[10]The main rating agency in the Japanese market is Japan Bond Research Institute (JBRI).

amortised with annual repayments of principal. For still smaller amounts (less than CHF 10 million), **Mini** issues are available which are exempt from SNB approval. Convertible bonds or bonds with equity warrants also constitute a significant segment. India's recourse to the Swiss foreign bond market has been quite limited.

In addition to these, there are other smaller foreign bond markets. The UK market has developed the ***Bulldog Bond***, a sterling denominated foreign bond, priced with reference to UK gilts. Fixed rate and floating rate bonds (FRNs) denominated in French franc as well as convertible bonds are available to non-resident borrowers in the French market. The Dutch market had ***Rembrandt Bonds***, denominated in Dutch guilder. For details regarding regulation and historical evolution of these markets, see, among others, Joshi (2001), Foley (1991).

Table 19.7 presents data on the bond market and its selected segments.

Table 19.7 International Bonds and Notes Issues (Billion US Dollars)

Type, Sector and Currency	*Net Issues*			
	2010	*2011*	*2012*	*2013 Q1*
Total Issues	1499.0	432.3	684.7	29.8
Floating Rate	–129.4	–98.1	–416.6	–58.9
Straight Fixed Rate	1588.6	540.7	1106.0	82.1
Equity Related	39.8	–10.3	–4.7	6.6
Major Currencies				
US Dollar	1075.7	308.7	567.4	163.2
Euro*	326.6	100.1	76.0	–168.5
Pound Sterling	17.9	–51.4	14.7	16.0
Yen	–20.9	–33.1	–22.5	–28.8
Swiss Franc	0.0	–13.8	–10.9	–12.8

Source: Bank for International Settlements, Quarterly Review, March 2012, June 2013.
Negative figures indicate that redemptions exceeded new issues.

19.2.2 Syndicated Credits

We have briefly mentioned this mode of financing in Chapter 6. Here, we explore some further characteristics and procedural aspects related to this form of funding. A useful reference on euroloans is the monograph by Melnik and Plaut (1991) which we have drawn upon in what follows.

A traditional syndicated loan is usually a floating rate loan with fixed maturity, a fixed drawdown period and a specified repayment schedule. One, two or even three banks may act as lead managers and distribute the loan among themselves and other participating banks. One of the lead banks acts as the agent bank and administers the loan after execution, disbursing funds to the borrower, collecting and distributing interest payments and principal repayments among lending banks, etc.

A typical eurocredit would have maturity between five and ten years, amortisation in semiannual instalments, and interest rate reset every three or six months with reference to LIBOR[11].

[11]In some cases, there may be a mismatch between reset frequency and maturity of the reference index. Thus, reset may be every six months, but with reference to the 3-month LIBOR.

In some cases, when the parties – lenders and the borrower – do not wish to publicise the deal, the standard practice is dispensed with and a credit is arranged on a private basis between the group of lending banks and the borrower. These are knowns as **Club Loans** [Joshi (2001)].

A revolving credit is similar to the above, but permits greater flexibility in the drawdown and repayment schedules allowing the borrower to repeatedly draw the loan or a portion thereof and to repay what it has drawn at its discretion or according to a formula [Melnik and Plaut op. cit.].

In a standby facility, the borrower is not required to draw down the loan during a fixed, prespecified period. Instead, he pays a contingency fee till he decides to draw the loan at which time interest begins to accrue.

Syndicated credits can be structured to incorporate various options. As in the case of FRNs, a drop-lock feature converts the floating rate loan into a fixed rate loan, if the benchmark index hits a specified floor. A multicurrency option allows the borrower to switch the currency of denomination on a rollover date.

Security in the form of government guarantee, bank guarantee or mortgage on assets is required for borrowers in developing countries like India[12]. A brief description of some of the procedural aspects of negotiating a syndicated loan is given in the appendix to this chapter. Much greater detail can be found in specialised works on the subject such as Joshi (2001).

The cost of a loan consists of interest and a number of fees – management fees, participation fees, agency fees and underwriting fees when the loan is underwritten by a bank of a group of banks[13]. Spreads over LIBOR depend upon borrower's creditworthiness, size and term of the loan[14], state of the market (e.g. the level of LIBOR, supply of non-bank deposits to the Eurobanks,) and the degree of competition for the loan[15]. Table 19.8 gives some idea about average spreads over LIBOR for international bank loans for different borrower groups.

Table 19.8 Average Spreads of International Bank Loans (Spreads: Basis Points)

Borrower Group	*Weighted Average Spreads*			
	1995	*1996*	*1997*	*1998*
Developed Countries				
(1) Public Sector	8	19	20	9
(2) Corporate Sector	57	65	69	107
(3) Financial Institutions	38	39	46	67
Developing Countries				
(1) Public Sector	192	82	60	136
(2) Corporate Sector	129	105	114	143
(3) Financial Institutions	73	69	94	102

Source: ***International Banking and Financial Market Developments****,* Quarterly Review, March, 1999, Bank for International Settlements, Basle.

[12]For public sector borrowers in India, a government guarantee would be normally demanded. For private corporates, a bank guarantee would be needed. The cost of a bank guarantee is in the neighbourhood of 2% per annum. Since a bank guarantee receives a 100% risk weightage in calculating the bank's risk adjusted capital adequacy, banks are not very enthusiastic about providing such guarantees. Since 1999, GOI has decided not to provide government guarantee for PSU borrowings.

[13]When the loan is not underwritten, it is on a "best efforts" basis.

[14]Normally, large sized loans will have either larger spreads or higher fees. Similarly, spreads normally increase with the term or may increase in later years.

[15]For an empirical analysis of the determinants of spreads, see Ahmad (1989).

Apart from the euromarkets, syndicated credits can be arranged in some of the national capital markets too. These are the so-called "foreign loans". In the Japanese market, yen finance can be raised via bank loans. Syndication and documentation are less expensive than bond issues and MOF criteria are less demanding. Syndicated eurodem loans could be arranged from German banks though this form of financing is not very common. In the Swiss market too, these are very rare and the SNB does not favour the use of CHF for euro CHF credits.

Data from Bank for International Settlements (BIS), Basel and RBI indicate that Indian borrowers have accessed this funding route since 1980 for financing, ranging from as little as $4.2 million to as high as a billion dollars in recent years. In the year 2006, Indian firms raised a little over fourteen billion dollars by way of syndicated loans. Maturities have ranged from 3 years to 15 years in case of floating rate loans. The mean spread over LIBOR which was as high as 107 basis points in 1980 had come down to a little over 15 basis points by 1989. The rising trend was temporarily reversed in early 1990s and during the period 1990-93, the only known syndications were some short-term oil import finance facilities arranged for the Indian Oil Corporation at spreads considerably higher than the average paid during the eighties [Joshi (2001)]. The up-trend resumed thereafter and has accelerated since 2000. The Indian government has been consistently liberalising its regulatory provisions pertaining to external commercial borrowing by Indian firms and the credit ratings of large Indian firms have also steadily improved so that the spreads they have to pay over LIBOR have shown a downward trend. Another recent development has been the emergence of Indian banks as lenders in global loan markets. As of now, almost all of their lending has been to clients based in Europe and the US.

19.2.3 MTNS and EMTNs

Medium Term Notes (MTNs) represent a medium term, non-underwritten, fixed interest rate source of funding. This form of funding originated in the US capital market and was introduced to the Euro market – Euro Medium Term Notes – during the eighties. It was a part of the disintermediation process in which borrowers were approaching investors directly rather than going through the bank loan route.

The main advantage of borrowing via an MTN or EMTN programme is its flexibility and much less onerous formalities of documentation compared to a bond issue. Documentation for a borrowing programme of a given size can be prepared once for all and then the borrower can issue notes in several tranches timing each issue to take advantage of favourable "windows of opportunity". Each tranche may carry a different coupon[16] and have a different maturity date. Mutli-currency option allows different tranches to be issued in different currencies. While dollar remains the most popular currency, EMTNs have been issued in other currencies including the ECU.

Euromarkets have also come up with Global MTNs (GMTNs) which are designed to tap both the American and other markets. A beginning has been made in floating rate EMTNs.

The market is accessible only to issuers with good credit rating. So far, banks, supranational institutions and sovereigns have been the predominant borrowers. Corporate borrowers have not used this market very much.

[16]The interest rate a particular borrower has to pay depends upon his credit rating, reputation in the market and the general interest rate environment.

19.2.4 NIF and Related Facilities

During the eighties, several novel trends emerged in the financial markets. A process of disintermediation began in which highly rated borrowers decided to short circuit the banks and raise financing directly from investors by issuing their own paper. Investor preferences shifted towards short-term commitments. Due to enforcement of capital adequacy norms and intense competition in the traditional business of taking deposits and making loans, banks started looking around for ways of making money without inflating their balance sheets. The combined result of these factors was the emergence of whole new ways of arranging funding for borrowers with good track record and reputation. **Note Issuance Facilities (NIFs)** and its variants was one of them.

According to the BIS definition, "A NIF is a medium-term legally binding commitment under which a borrower can issue short-term paper in its own name, but where underwriting banks are committed either to purchase any notes which the borrower is unable to sell, or to provide standing credit" [Joshi (2001)]. The borrower obtains medium-term funding by repeatedly rolling over its short-term notes. If at any rollover the borrower is unable to place the entire issue with the market, the underwriting banks either take up the remainder or provide a short-term loan. The arrangement under which the banks provide credit to make up the shortfall is known as a **Revolving Underwriting Facility (RUF).**

Cost of funding with an NIF includes interest and participation and underwriting fees where relevant. The interest rate is set as a margin over LIBOR[17].

A number of flexible structures emerged after the NIF made its entry in 1981. These relate to different ways of "placing" the notes with the investors – sole placing agency, tender panel system and continuous tender panel. For details of these arrangements as well as the mechanics of issue, documentation, etc., the reader is advised to consult Joshi (2001). Another innovation was the Multi Option Facility (MOF). Under this, the borrower could draw funds in a number of different ways as a part of a given NIF programme. With the imposition of capital adequacy norms against such commitments as well as thinning fees, NIFs and related devices have lost their popularity.

19.2.5 Project Finance

Since early eighties, specialised funding packages have been developed to finance large projects such as power projects, road construction, port and harbour development, hotels, theme park developments, etc. Two of the most famous such projects are the Eurotunnel linking France and England and the EuroDisney amusement park near Paris. A very comprehensive reference on project financing is Nevitt (1989). Pollio (1999) also deals with project finance in addition to appraisal of international projects.

The central idea in project financing is to arrange a financing package which will permit the transfer or sharing of various risks among several parties including project promoters with a no recourse or limited recourse feature. The lenders evaluate the project as an independent entity and have claims on the cash flows generated by the project for their interest payments and principal repayments. They have no claims on any other assets or cash flows belonging to the sponsors or promoters. The borrowing may be in one or more of the forms described above viz. bank loans, bond issues, etc.

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[17]Highest quality borrowers, e.g. sovereign governments in Europe, have been able to get very low rates, often sub-LIBID. Most facilities set a ceiling on borrowing costs in relation to the market index. For prime quality borrowers, the ceiling may be set at LIBOR flat and may range up to LIBOR + 25 bp. [Melnik and Plaut (1991)].

In a pure project finance transaction, the lenders would naturally wish to monitor control on all aspects of the execution and subsequent operation of the project till their money is recovered. For instance, they will have a substantial say in the choice of the contractor(s) to build the project and may insist on giving the contract on a turnkey basis to a reputed construction firm to minimise construction delays. Also such limited recourse finance will generally be available only in cases where the lenders are satisfied that the project output has a ready market, assured supplies of raw materials, energy, etc. and are satisfied with the technological feasibility of the project. Some of these risks can be reduced or eliminated by devices such as unconditional take-or-pay contracts[18], requiring the project contractors to put in some equity stake into the project and bringing in export finance agencies who will finance part of the acquisition of project equipment.

In other cases, the lenders may require guarantees. An obvious choice of guarantor is the project's sponsors. This implies that the project's debt appears as a liability on the sponsor's balance sheet. In some circumstances, third party guarantees can be arranged e.g. from the government of the project's host country, user of the project's output, a major supplier to the project, the project contractor or a multilateral institution such as the World Bank or a regional development bank. A reputed financial institution may agree to provide a guarantee for a fee. Such guarantees cover a variety of risks. For some types of risks, insurance may be available. The guarantees need not always cover the entire borrowing but may be limited in amount or time of coverage. For instance, guarantees only to cover project cost overruns or a guarantee which provides cover only till the start-up time. Depending on the nature of the project, lenders may be satisfied with such limited guarantees.

The sources of equity and debt finance for projects have been numerous. Commercial banks, institutional lenders, finance and leasing companies, project contractors, suppliers of raw materials and users of project output, multilateral institutions and government export financing agencies such as EXIM banks have all been involved in project finance.

An innovation in project finance is the **BOT** device which stands for **B**uild, **O**wn and **T**ransfer (sometimes also called **BOOT** – Build, Own, Operate and Transfer). Under this arrangement, a foreign company undertakes to design, finance and construct the project, operate it for a specified number of years and then transfer the ownership to a local agency such as the host government. During the last few years, a number of projects in countries such as Turkey have been initiated using such a structure. See Barrett (1987) for a brief description of some BOT deals.

In the context of project finance, mention must be made of the concept of **co-finance.** Introduced by the World Bank in the mid-seventies, it refers to an arrangement in which funds provided by supranational development institutions such as the World Bank, the Asian Development Bank, etc., are combined with other sources of external finance to fund a major project or programme. Apart from providing funds, the development institution also provides its expertise in appraising the project which the other providers of funds may not possess. The other sources of funds may be government departments, export credit agencies and private financial institutions. All the lenders pool their information and agree on a common set of procedures for appraising the project and subsequently administering the loan. There are a number of alternative forms of co-financing. The reader can consult Joshi (2001) for further details.

Project finance has become a very complex area in recent years. A variety of funding techniques, risk sharing strategies and risk management tools such as swaps and options are packaged together

[18]Under such an arrangement, a user of the project output agrees to purchase certain minimum quantities at specified prices. The contract calls for unconditional payment of certain minimum amounts whether or not actual deliveries are made/ accepted. This ensures certain minimum cash flows from the project.

for a large project. Apart from Nevitt's work cited above, the interested reader may also consult the special supplement on project financing published by Euromoney [Euromoney (1988)].

This completes our brief survey of markets and instruments which potential borrowers can employ to raise medium- and long-term funding in the global debt markets. The reader is reminded that aside from these, medium-term funding facilities related to exports of capital goods, project exports and so forth are also available. Some of these were discussed in the Appendix to Chapter 4. It should also be kept in mind that the nature of all these markets and instruments is very dynamic. Different market segments undergo cycles of boom and bust. New products and variations of existing products are continually emerging. Regulatory changes and changes in financial norms and practices keep these markets in a constant state of flux. Our treatment here is no more than an introductory perspective. References cited at the end of the chapter will enable the reader to gain more in-depth knowledge of this topic. Even then, at any given point of time, the best source of up-to-the-minute knowledge and information are the practitioners who are operating in these markets on a day-to-day basis. In the Indian context, another aspect to bear in mind is the Indian government's regulatory stance on accessing these funding avenues. This too is subject to frequent changes. In the appendix to this chapter, we have provided the salient features of the most recent (July 1999) guidelines issued by the MOF, Government of India.

19.3 THE INTERNATIONAL FINANCING DECISION

The previous section provided a broad picture of the funding options open to a corporation in the global debt market. In the present section, we proceed to analyse the various issues involved in the financing decision.

The issue of the optimal capital structure and subsequently the optimal mix of funding instruments is one of the key strategic decisions for a corporation. Our aim is to bring out the critical dimensions of this decision in so far as it involves international financing and examine the analytics of the cost-return tradeoff. The actual implementation of the selected funding programme involves several other considerations such as satisfying all the regulatory requirements, choosing the right timing and pricing of the issue, effective marketing of the issue and so forth. We only touch upon some of these aspects. Exhaustive treatments can be found in specialist works on the subject such as Joshi (2001). Figure 19.3 presents a schematic view of the international financing decision.

The optimal capital structure for a firm or in other words corporate debt policy has been a subject of a long running debate in the finance literature since the publication of the seminal paper by Modigliani and Miller (1958). The reader can consult any one of a number of texts on corporate finance to get a flavour of this controversy. We assume here that the firm has somehow resolved the issue of what is the appropriate level of debt it should carry.

Next comes the issue of the optimal composition of a firm's liability portfolio. The firm usually has a wide spectrum of funding avenues to choose from. The critical dimensions of this decision are discussed below.

1. Interest rate basis: Mix of fixed rate and floating rate debt.
2. Maturity: The appropriate maturity composition of debt.
3. Currency composition of debt.
4. Which market segments should be tapped?

Note that these dimensions interact to determine the overall character of the firm's debt portfolio. For instance, long-term financing can be in the form of a fixed rate bond or an FRN or short-term

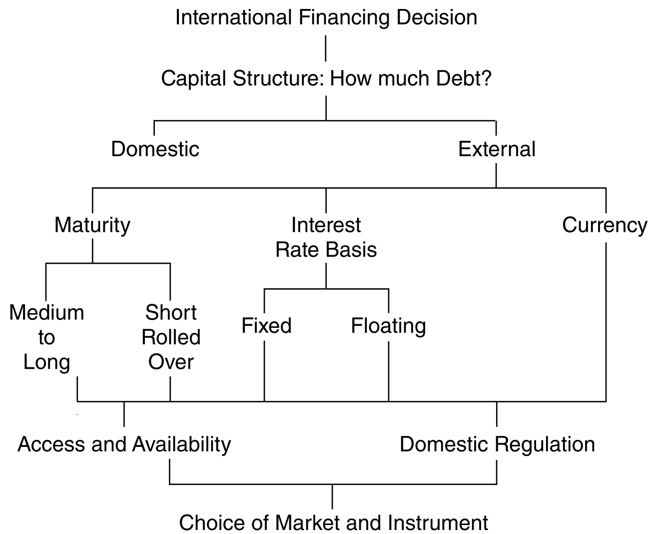

Fig. 19.3 The International Financing Decision

debt like commercial paper repeatedly rolled over. Each option has different risk characteristics. Further, the possibility of incorporating various option features in the debt instrument or using swaps and other derivatives can enable the firm to separate cost and risk considerations. Individual financing decisions should thus be guided by their impact on the characteristics of the overall debt portfolio such as risk and cost as well as possible effects on future funding opportunities.

Next let us address the question: "What should be the overall guiding principles in choosing a debt portfolio?" Giddy (1994) provides the following answer:

> "The nature of financing should normally be driven by the nature of the business, in such a way as to make debt-service payments match the character and timing of operating earnings. Because this reduces the probability of financial distress, it allows the firm to have greater leverage and therefore a greater tax shield[19]. Deviation from this principle should occur only in the presence of privileged information or some other market imperfection. Market imperfections that provide cheaper financing exist in practice in a wide range of circumstances".

Let us discuss this recommendation in a little more detail. What it seems to say is that there should be some correspondence between, on the one hand, the sensitivity of the firm's operating cash flows to environmental risk factors such as exchange rates and interest rates, and the sensitivity of debt-service payments to the same factors. Also, the time profile of debt-service payments should be similar to that of operating cash flows. Deviations from this are justified either when the firm possesses superior information so that it can "beat the market" or some market imperfection allows it to raise cheaper funding.

Let us see how this principle should be applied to the different dimensions of the borrowing decision mentioned above. Consider the choice between fixed and floating rate financing. Firms such as utilities, manufacturing firms, etc., have relatively stable earnings or at least their operating

[19]The optimal amount of debt is determined by the tradeoff between the tax advantage afforded by debt finance — the fact that interest is deductible for tax calculations — and the costs of financial distress which are likely to be greater in highly leveraged firms particularly when their operating earnings have high volatility.

cash flows are not highly sensitive to interest rate fluctuations. Such firms should naturally prefer fixed rate funding. On the other hand, financial institutions with floating rate assets would be natural floating rate borrowers. If a firm has stable revenues in US dollars, it can reduce the probability of financial distress by borrowing in fixed rate dollars. Companies undertaking long gestation capital projects should ensure that sufficient financing on fixed terms is available for long periods and hence should prefer to stretch out their debt servicing obligations by borrowing for long terms. A factoring company, on the other hand, should finance itself with short-term borrowings.

Note, however, that this principle should not be followed blindly. Suppose, for instance, that the yield curve is currently steeply sloping upward; a manufacturing firm is convinced (on the basis of superior information or analysis) that it will flatten out fairly soon. It may choose to borrow short-term and roll over such funding rather than lock itself into high-cost long-term debt. Or consider another example. Borrowing cost for Swiss franc loan is 5% whereas a dollar loan would cost 9%. The UIP condition tells us that this reflects market's expectation that the CHF is likely to appreciate with respect to the dollar at roughly 4% per annum. A firm has export revenues in dollars but believes that the strength of the CHF is overestimated. It may choose to borrow in Swiss francs despite the additional exposure it is subjecting itself to. Sometimes, such a decision may be motivated by considerations of market access or special factors such as availability of concessional finance from state supported export finance agencies. At other times, some peculiar features of tax legislation may render borrowing in a particular currency more attractive even though the firm has no natural hedge against fluctuations in that currency.[20] There have been cases where firms have been able to raise cheap funding by offering the investors some options embedded in the debt instrument which were otherwise inaccessible to them because of regulatory restrictions[21]. Recall the discussion in Chapter 16 where we saw that many swap deals are motivated by the various imperfections in global capital markets which allow a borrower to tap one market and then swap the liability to achieve the desired structure.

Overriding these considerations are issues of regulation and market access. Governments in some countries impose restrictions that prevent a firm from tapping a particular market segment even though that may be the optimal borrowing route under the circumstances. For instance, during the first half of 1990s, Indian government decided to discourage recourse to external debt finance and, in particular, did not permit short-term borrowing in foreign currency. On the other side, a particular market segment may be closed to a firm either because of its inadequate credit rating, investor unfamiliarity or inability of the firm to meet all the requirements – accounting standards, disclosure, etc. – specified by the regulatory agency supervising the market.

In viewing the risks associated with funding activity, a portfolio approach needs to be adopted. Diversification across currencies and instruments enables the firm to reduce the overall risk for a given funding cost target. It also helps to increase investors' familiarity with the firm which makes future approaches easier.

Finally, it should be kept in mind that currency and interest rate exposures arising out of funding decisions should not be viewed in isolation. The firm should take a total view of all exposures, those arising out of its operating business and those on account of financing decisions.

[20]An example of this is the so-called "tax spared loan". Double taxation treaties between some countries are so phrased that when lenders in one make loans to borrowers in the other, tax authorities in the former allow the lenders to claim deduction for taxes paid on interest in the borrower's country even though in fact no such taxes have been paid.

[21]An example of this are bond issues with embedded currency options aimed at Japanese institutional investors in early eighties when these investors where not allowed to buy or write currency options. We will illustrate one such instrument called Indexed Currency Option Notes (ICONS) in the appendix to this chapter.

In evaluating a particular borrowing alternative, the following parameters have to be examined under alternative scenarios.

(a) The all-in cost of a particular funding instrument. The term "all-in" means that among the costs should be included not just the interest but all other fees and expenses. We will illustrate below how to compute the all-in cost for a specific funding alternative.
(b) Interest rate and currency exposure arising from using a particular financing vehicle. Floating rate borrowing or short-term borrowing repeatedly rolled over exposes the firm to interest rate fluctuations. In the latter case, even the spread the firm will have to pay over the market index becomes uncertain. On the other hand, a long-term fixed rate borrowing without a call option locks the firm into a given funding cost so that the firm is unable to take advantage of falling rates. Funding in a foreign currency exposes the firm to all forms of currency exposure – transactions, translation and operating.

We will now look at an example of how to evaluate competing borrowing alternatives. This example will serve to illustrate computation of all-in cost as also the dependence of these computations on the assumptions made about evolution of exchange rates and interest rates.

- In early 2006, a firm needed 5-year funding of amount $25 million or equivalent. The following three options were proposed by the investment bank which was rendering advice:
  (a) A five-year, fixed rate bond issue with a coupon of 6% p.a. payable semiannually. The floation costs would be 2% of the face value up-front and in addition, there will be administrative expenses related to servicing of the bond which will amount to $10,000 every six months, payable with the coupon. Bonds will be denominated in US dollars.
  (b) A five-year FRN at 6-month LIBOR plus a spread of 150 basis points, semiannual payments and reset. Flotation costs will amount to 2% up-front and there will be administrative expenses of $10,000 every six months. The currency of denomination of the FRNs will be US dollars.
  (c) A five-year, fixed rate Euro loan, face amount EUR 20 million at 5% p.a., interest payable semiannually on balance outstanding, principal to be amortised in five after a 2½ years grace period. Up-front fees and costs will amount to EUR 250,000, and servicing costs will be EUR 75,000 every six months.

The spot exchange rates at that time were:

USD/INR: 40.43 EUR/INR = 55.04

On the basis of past trends and current inflationary forecasts, the dollar was expected to appreciate at the rate of 3% per year against the rupee and the EUR at the rate of 2.5% per year. The 6-month eurodollar LIBOR was 3.5%. The following interest rate scenario was considered to be reasonable:

Period	***Expected USD LIBOR***
6mo-12mo	4.00%
12mo-18mo	4.75%
18mo-24mo	4.75%
24mo-30mo	5.25%
30mo-36mo	5.50%
36mo-42mo	5.00%
42mo-48mo	5.50%
48mo-54mo	5.25%
54mo-60mo	6.00%

Tables 19.9 and 19.10 provide the dollar and rupee cash flows for the first and second of the above three alternatives and the implied IRR of rupee flows which gives the cost of each alternative. Table 19.11 provides similar calculations for the Euro loan alternative.

Table 19.9 Cash flows of the USD Bond Issue

USD Cash Flow (Million)	*USD/INR*	*INR Cash Flow (Million)*
24.50	40.43	990.41
–0.76	41.03	–31.18
–0.76	41.65	–31.65
–0.76	42.27	–32.13
–0.76	42.91	–32.61
–0.76	43.55	–33.10
–0.76	44.20	–33.59
–0.76	44.87	–34.10
–0.76	45.54	–34.61
–0.76	46.22	–35.13
–25.76	46.91	–1208.53

IRR: 9.88692%

Table 19.10 Cash Flows of the USD FRN Issue

USD (Million)	*USD/INR*	*INR (Million)*
24.5	40.43	990.41
–0.635	41.03	–26.05
–0.6975	41.65	–29.05
–0.7913	42.27	–33.45
–0.7913	42.91	–33.95
–0.8538	43.55	–37.18
–0.885	44.20	–39.12
–0.8225	44.87	–36.90
–0.885	45.54	–40.30
–0.8538	46.22	–39.46
–25.9475	46.91	–1217.32

IRR: 10.30517%

The all-in costs, conditional upon the assumed interest rate and exchange rate scenarios are calculated by computing the IRRs of the rupee net cash flows in Tables 19.9, 19.10 and 19.11, respectively[22]. Note that these are semiannual rates. They have to be annualised using the formula:

$$\text{Effective Annual Cost} = (1 + \text{Semiannual Rate})^2 - 1$$

[22]Keep in mind that the in usual calculations of IRR, a negative net cash flow is followed by positive net cash flows as in a typical investment project. Here the sign pattern is reversed.

Table 19.11 Cash Flows of Euro Loan

EUR (Million)	*EUR/INR*	*INR (Million)*
19.75	55.04	1087.02
–0.5	55.73	–27.86
–0.5	56.42	–28.21
–0.5	57.13	–28.56
–0.5	57.84	–28.92
–0.5	58.57	–29.28
–4.5	59.30	–266.84
–4.5	60.04	–270.18
–4.5	60.79	–273.55
–4.5	61.55	–276.97
–4.5	62.32	–280.44

IRR: 9.23021%

The effective annual costs are, respectively, 9.89%, for the USD fixed rate bond, 10.30% for the USD FRN and 9.23% for the EUR fixed rate loan.

Based on these calculations, the fixed rate EUR loan appears to be the least cost alternative. However, remember that this conclusion is contingent upon a particular set of assumptions about the future evolution of interest rates and exchange rates. A more rigorous examination would require that we simulate a large number of scenarios for the future evolution of interest rate and exchange rates, repeat the calculations under different scenarios and look at the expected cost and the variance in the cost of borrowing.

Consider a firm which is contemplating a fixed rate foreign currency loan (or a fixed rate foreign currency bond issue). The nominal rate of interest is I (expressed as a fraction not percentage), the maturity is N years, interest is paid annually and repayment is bullet. The principal amount is A. The rate of exchange at time t is denoted S_t expressed as units of home currency per unit of foreign currency.

The real cost of this loan consists of three components, viz. the nominal interest, appreciation of the foreign currency and domestic inflation:

$$R = I + \hat{S} - \pi$$

where $\hat{S}$ denotes proportionate change in the spot rate and π is the domestic rate of inflation. The variance of the real cost therefore is[23]

$$\text{Var(R)} = \text{Var}(\hat{S}) + \text{Var}\ (\pi) - 2\text{Cov}\ (\hat{S}, \pi)$$

To compare loans denominated in alternative currencies, since the domestic inflation rate enters in both, expected real cost comparison can be based on comparison of effective nominal costs. However, to compare the variances of real costs, the covariance term is important. Between two currencies, if the variance of both is nearly equal, the one which obeys PPP with the home currency more closely will have a lower variance of real cost of borrowing.

[23]Note that the nominal interest rate I is assumed to be fixed. When it is a floating rate debt, we have the variance of the nominal rate as well as its co-variances with exchange rate changes and domestic inflation rate to worry about.

If the real cost risk is ignored, the choice of currency should be based on a comparison of effective interest rates which consist of the nominal interest rate *I*, and the expected rate of appreciation of the foreign currency S^e.

When the nominal interest rate itself is not fixed – as with a floating rate loan or FRNs – an additional source of risk is introduced, viz. the variance of the nominal interest rate and its covariances with the exchange rate and domestic inflation rate. The volatility of nominal interest rates during the decade of nineties and thereafter has been more moderate compared to the eighties but still represents a source of considerable risk.

It is possible to cast the problem of choosing an optimal currency portfolio of foreign borrowing in the standard mean-variance framework[24]. To operationalise the framework, however, one needs estimates of variances and covariances of exchange rates, interest rates and inflation rates.

Invariably, these have to be obtained from past data and one has to assume that the structure of variances and covariances remains unchanged over time[25].

Summary

This chapter has provided a bird's eye view of the various segments of the global debt market. The spectrum of choices available to a potential borrower is indeed very wide. The markets are in a constant state of flux with new instruments emerging and some of the old ones going into a decline. The regulatory structures are also constantly evolving and so are institutional arrangements for tapping a particular segment.

We have also discussed the various dimensions of the international financing decision. Apart from the effective cost of borrowing via a particular vehicle, considerations of exchange rate and interest rate exposure, market access and portfolio diversification issues are critical. Exchange rate and interest rate risks must not be viewed in isolation for each particular financing decision, but as a component of the global corporate portfolio of assets and liabilities.

Questions and Problems

1. Summarise the various considerations that enter into the decision to choose the currency, market and vehicle for long-term borrowing.
2. What are the crucial aspects in negotiating a syndicated bank loan?
3. An Indian firm needs to borrow \$5 million or equivalent to finance capital goods imports. It can borrow fixed rate dollars at 11.75%, semi-annual interest payments and bullet repayment and floating dollars at a spread of 75 b.p. over six-month LIBOR. Alternatively, it can borrow CHF 7.5 million at 100 b.p. over six-month LIBOR. The term is three years. The current 6-month LIBORS are 9.5% for eurodollars and 6.5% for CHF. The present spot exchange rates are ₹48.00 per \$ and ₹28 per CHF. The dollar and CHF yield curves are as follows:

[24]See, for instance, Cotner (1991)

[25]More sophisticated approaches to the problem of managing a portfolio of foreign debt have been offered in the literature on managing external debt for a country. For one example, see Kroner and Claessens (1991). It is, however, a macro-level analysis.

Maturity	*$ Rate*	*CHF Rate*
6 m	9.50	6.50
12 m	9.75	6.50
18 m	9.80	6.75
24 m	10.00	6.75
30 m	10.25	7.00
36 m	10.25	7.00

The firm believes that dollar will continue to appreciate on an average at 5% p.a. while CHF will appreciate at 9% p.a. against the rupee. Dollar fixed-to-floating 3-year swaps are being quoted at 10.5% vs. 6-month LIBOR and CHF swaps at 7.25%. A 3-year dollar interest rate cap with a strike rate of 10% is available for a premium of 50 b.p. while a 3-year cap with strike rate of 6.75% is available for a premium of 40 b.p. for CHF. Evaluate the various options open to the firm.

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Apart from these, ***Euromoney***, publishes periodical updates on the various segments of the global capital markets and articles on new products and instruments introduced in these markets.

The following book contains a good, authoritative treatment of international banking and capital markets:

Giddy, I.H. (1997): ***Global Financial Markets***, A.I.T.B.S. Publishers and Distributors, New Delhi.

APPENDIX

A.19.1 PROCEDURAL ASPECTS OF NEGOTIATING A FOREIGN CURRENCY SYNDICATED LOAN

While the loan syndication procedures and documentation have become fairly standardised, there may be considerable room for negotiations in a particular case. The purpose of this section is to provide a brief summary of the steps involved in negotiating a credit, documentation, etc. A more detailed description can be found in a document, titled ***Issues in Negotiating International Loan Agreements with Transnational Banks***, prepared by the United Nations Centre on Transnational Corporations [UN, 1983 New York]. Keep in mind, however, that regulatory framework and market practices are dynamic. Joshi (1996) is a very useful recent source.

Later in this appendix, we provide the salient features of the Government of India guidelines pertaining to external commercial borrowing which were in force at the time of writing.

In the pre-negotiation phase, the borrower must prepare an ***Information Memorandum***. This is particularly necessary for borrowers who are new to the market as also in cases where a consortium of banks has to be put together for a large loan and not all potential members of it have dealt with the borrower in the past. This document must contain information about the borrower (organisation, assets, financial statements, etc.), the amount and maturity of the desired loan, intended use of the loan, a survey of the borrower's country and its economy and so forth. If the loan is for funding a specific project, details of the project should also be included. The Information Memorandum constitutes the basis of decision making by the banks and should be as accurate and comprehensive as possible.

The borrower then sends invitations to submit credit proposals to various banks accompanied by the Information Memorandum. Usually, these are sent to banks with whom the borrower has had dealings in the past or banks who have informally expressed interest. The approach should be on a confidential basis and a closing date should be indicated.

The borrower should then constitute a loan negotiating panel consisting of its top management officials, finance manager(s), an operating officer and a legal officer. The panel should ensure that the necessary approvals to negotiate the loan have been obtained from the borrower's Board of Directors and any government authorities.

The replies from the banks would spell out the "business terms" under which they would be willing to provide a loan or undertake to form a syndicate to provide the loan. These terms would indicate the interest rate (spread over LIBOR in case of floating rate loans), management fees, commitment fees, participation fees, etc., maturity, repayment schedule, grace period and so forth. It would also specify whether the proposal is on a "best efforts" basis or "underwritten" basis. In the latter case, the bank commits to provide the full amount with or without the participation of other banks. The proposal may also indicate whether the banks would need third party guarantees, collateral or any other form of security. This is an important aspect and may subsequently involve extensive negotiations[26]. The offer letter will indicate how long the offer is valid and in some cases (e.g. sovereign or public sector borrowers wanting a large loan) may also stipulate that the government should avoid any other loan approaches being made to the market for sometime by another borrower from the same country[27]. In case of a large loan, more than one banks may submit a joint proposal.

After a scrutiny of all proposals received, the borrower awards a mandate to a bank or a group of banks to be the ***Lead Manager(s).*** The acceptance of the proposal implies acceptance of the business terms and other conditions of the offer. There is little scope for negotiating the business terms during the formal negotiation phase though some tradeoffs can be negotiated (e.g. a lower spread in exchange for a larger front-end fee). Along with awarding the mandate, the borrower may also wish to indicate certain preferences to the lead bank which will help the latter in selecting banks to be invited to participate in the loan, e.g. the borrower may wish to have broadly based group including Japanese as well as European and US banks, a balanced mix of regional versus national and international banks, etc.

The negotiation phase follows next, leading to the ***Loan Agreement***. The borrower should, whenever possible, get hold of sample agreements and study the provisions carefully. The banks present the borrower with a draft agreement at the start of the negotiations and the negotiations proceed sequentially through all the provisions. The major provisions pertain to:

1. **The Business Terms:** This section spells out the financial obligations of the borrower to the lenders such as interest payments, commitment and agency fees, repayment schedules, etc. It also specifies the method for computing the value of the index on each reset date in a floating rate loan[28], penalties for failure to pay when due and so forth. The front-end fee is not mentioned in the loan agreement but in a separate "Management Fee" letter between the borrower and the agent bank.
2. **Change of Circumstances:** In this section, the lending banks insert provisions which enable them to adjust the terms of the loan reflecting significant changes in markets, e.g. substantial increases in the banks' funding costs, market collapse, changes in applicable law which force a bank to withdraw from funding the loan, etc.
3. **Declarations of the Borrower (Representations and Warranties):** This section contains representations of facts pertaining to the borrower's financial, legal and other relevant issues, compliance with all applicable governmental stipulations, etc. A significant clause here is the ***pari passu*** clause.

[26]Obviously, it would be better for the borrower to secure a loan without any form of collateral or guarantees. It not only establishes his credit standing in the market but also saves on guarantee fees.

[27]This is to avoid bunching of loan demands from the same country which may make market acceptance of the loan difficult.

[28]This would involve specifying the reference banks from whom LIBOR quotes are to be obtained at a specific time and the method of using these quotes to compute the reference rate to which the spread is to be added, e.g. "arithmetic average of the quotes after discarding the lowest and the highest, rounded off to the nearest 1/16 per cent".

4. **Conditions of Closing:** This part contains the conditions with which the borrower must comply before drawing down the loan can begin such as continuing validity of the representations, statement of having obtained all the necessary approvals, etc.
5. **Guarantees and Collateral:** This section specifies the security to be provided by the borrower such as financial guarantees, stand-by letters of credit, mortgage on property, etc.
6. **Positive and Negative Covenants:** This section deals with the promises made by the borrower to perform or to refrain from performing certain acts so as to maintain the financial condition and integrity of the borrower.
7. **Fiscal Treatment:** Provisions dealing with withholding taxes, sharing of any tax credit obtained by the lenders when the borrower has compensated them for the tax, etc.
8. **Events of Default:** This is an important section. It identifies the events which, should they occur, would give the lenders the right to terminate the commitment and accelerate the maturity. There is a wide variety of default clauses and the borrower must exercise utmost care in keeping their number and scope down to the minimum possible. A very important clause sometimes inserted in loan agreements with borrowers in less developed countries is the so-called "Cross-Default Clause". The general idea is that should the borrower default on any other loan from among a specified class of existing loans, he would be deemed to be in default of the loan being negotiated.
9. **Agency:** Deals with appointment of one of the banks (most often the lead bank) as the "Agent" of the syndicate. The agent disburses the loan, receives and distributes interest payments and repayments, etc.
10. **Applicable Law, Jurisdiction and Immunity:** Specifies the law to which the agreement is subject, jurisdiction in which disputes will be adjudicated and how the immunity normally granted to sovereign borrowers can be waived for the purpose of this agreement.

The final loan agreement and related documentation has to be forwarded to the Ministry of Finance (MOF) for approval. Subsequently, documentation is also kept on record by the MOF and the RBI. The following flow chart summarises the steps involved in raising a loan.

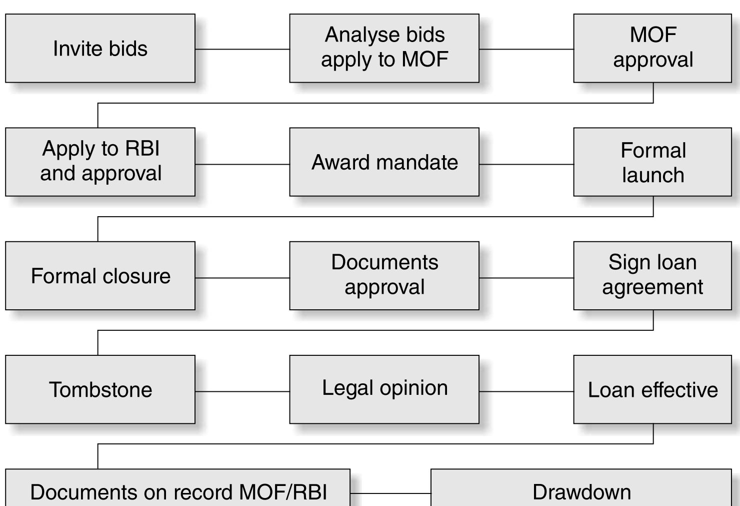


Fig. A.19.1 Flowchart of the Syndicated Loan Mechanism

A.19.2 THE NEW ISSUE PROCEDURE FOR EUROBONDS

The procedure for making a new eurobond issue has evolved over time essentially to expedite the whole process. The traditional procedure is briefly described in this section in the form of a sample time schedule and activities during the various phases. This is a bare-bones description and the reader should consult Fisher (1987) for further details as well as the variations from the traditional format.

The three crucial dates in a typical Eurobond issue are illustrated in Figure A.19.2. The sample schedule taken from Fisher's book lists the activities to be performed prior to and after the launch or announcement date.

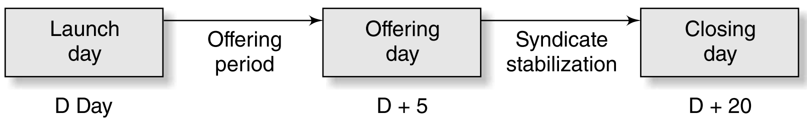


Fig. A.19.2 Significant Dates in a Eurobond Offering

The sample schedule of activities is described below.

- **Week of D-14**
  1. Initial organisational meeting with the issuer company to discuss basic terms and conditions, time schedule and allocation of responsibilities, marketing and syndication strategy, general form and content of offering circular, selection of trustee, fiscal agent, etc.
  2. Work begun on offering circular, agreement among issue managers, subscription agreement, press release, listing application, etc.
- **Week of D-7**
  1. Final authorisation, Board approvals obtained
  2. Working party meetings for preparation of documents
  3. Draft documents to printers
  4. Borrowers and lead managers discuss preannouncement terms and commission ideas
  5. Preparation of sales materials
- **D-Day (announcement day)**
  1. Announcement released to press and stock exchanges
  2. Lead manager sends invitation telexes to co-managers, underwriters and selling group members
  3. Listing application made
  4. Documents and letters sent to printer for final printing
- **D+1**
  1. Co-managers and underwriters telex acceptance of underwriting commitments to lead manager
  2. Underwriters are mailed preliminary offering circular and execution copies of underwriting agreements. Selling group members are sent preliminary offering circular and copies of selling group agreements
- **D+1 to D+3**
  Syndicate tours, indications of syndicate and investor interest monitored, pre-allotments made, documents sent to listing agent, preparation of pricing information and other arrangements for pricing day, etc.

- **D+3**
  Allotments determined internally by the lead manager and telexed to syndicate
- **D+4 (pricing day)**
  1. Deadline for receipt by co-managers of draft agreements requiring signature and draft of prospectus
  2. Final pricing meeting with borrower (if an open-priced issue)
- **D+5 (offering day)**
  1. Syndicate agreements, subscription agreements signed
  2. Final press announcement, final terms released to listing agent, bond printer and advertising agency for preparation of tombstone advertisement
  3. Printing of final prospectus
- **D+11 to D+20**
  1. New issue supported by syndicate bid till distribution judged complete. Syndicate notified when trading restrictions are lifted.
  2. Printing of definitive bonds, final copy of tombstone advertisement, fiscal agency agreement signed, listing application scrutinised, closing memorandum reviewed, delivery and payment instruction forms received from underwriters and selling group members.
- **D+19**
  1. Co-managers, underwriters etc. make payment for securities acquired through EURO-CLEAR or CEDEL
  2. Pre-closing meeting held to determine receipt of all necessary authorisations, legal opinions, etc. Packaging and delivery arrangements for bonds checked.
- **D+24 (closing day)**
  1. Closing documents delivered
  2. Payment for delivery of securities
  3. Paying agency agreement signed
- **D+23 to D+30**
  1. Publication of tombstone advertisement
  2. Preparation of Bible, containing offering document and closing papers
  3. Syndicate stabilisation can also continue up to 30 days after closing.

The ***offering circular*** contains a detailed description of the borrower including a review of its history, business and management, recent audited financial statements, capital structure and intended use of funds. It then goes on to describe the security being offered – principal amount, currency, coupon, maturity, status, security provisions, ratings if obtained, redemption schedule, any call/put features, events of default, etc. Finally, it describes the underwriting terms and gives a list of underwriters.

Subscription agreement defines the relationship between the borrower and the management group or underwriting group. Among its contents, the most important is the obligations of the underwriters to purchase bonds which cannot be placed with investors. The ***(sub) underwriting agreement*** defines the relationship between the lead manager and the individual underwriters. The ***selling group agreements*** commit the members of the selling group (including underwriters who also act as sellers) to pay for the bonds allotted to them and observe any restrictions on countries where the new issue cannot be sold[29], price at which the bonds can be sold, etc. A ***trust deed*** (or a ***fiscal***

[29]For instance, a new eurobond issue cannot be sold to resident US investors for a certain period of time after the issue.

agency agreement) sets out the obligations of the borrower as to payment, default and covenants. It also specifies the mechanics of interest payments and redemption.

The structure of a traditional syndicate called the UK/European Three Tier Framework is illustrated in Figure A.19.3 taken from Fisher (1987).

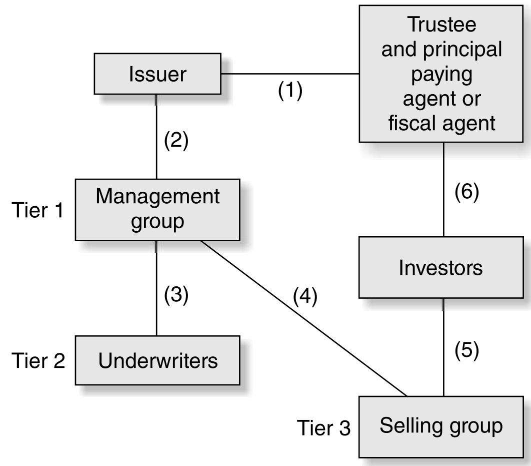


Fig. A.19.3 The UK/European Three-tier Structure

When there is a trustee to the bond issue, the relationship between the borrower and the trustee is governed by the trust deed. The trustee is the representative of the investors and is supposed to monitor the borrower's covenants, pledges, etc. to safeguard investors' interests. The principal paying agent appointed to act on behalf of the issuer is responsible for the mechanics of interest payments and repayments of principal, keeping records, etc. In the absence of a trust deed, the fiscal agent performs the functions of the principal paying agent.

The management group is committed to the borrower to purchase the entire issue if necessary. They, in turn, put together an underwriting syndicate. The latter's relationship with the issuer is through the management group.

The management group sells bonds directly to the selling group who in turn place them with the final investors. The management group as well as the underwriters may also sell directly to the final investors. The selling group agreement governs the sellers' obligations and rewards.

A traditional issue is an open-priced issue, i.e. the final price which governs the yield to maturity (and, therefore, the borrower's cost of funds) is not decided till the end of the offering period during which the managers, underwriters and sellers take the pulse of the market. In a pre-priced issue or a Bought Deal, the management group commits to buy the entire issue at a pre-negotiated price and sell it themselves or along with a sub-underwriting group. The third tier in the three-tier structure, viz. the selling group is eliminated and the total time involved is reduced. The total number of institutions involved is also much smaller than in a traditional issue.

A.19.3 GUIDELINES FOR EXTERNAL COMMERCIAL BORROWING (ECB) AND EUROISSUES

The Department of Economic Affairs, Ministry of Finance, Government of India monitors and regulates Indian firms' access to global capital markets. From time to time, they announce guidelines on policies and procedures for External Commercial Borrowing (ECB) and Euroissues. Reserve Bank of India periodically puts out a circular titled **"Master Circular on External Commercial Borrowings and Trade Credits"** which specifies the various regulatory aspects pertaining to Indian companies and financial institutions accessing global debt markets. ECBs include bank loans, suppliers' and buyers' credits, fixed and floating rate bonds (without convertibility) and borrowings from private sector windows of Multilateral Financial Institutions such as International Finance Corporation. Euroissues include euroconvertible bonds, GDRs and ADRs. The latest guidelines in force at the time of writing were announced in the Master Circular dated July 1, 2013. The full document is available on the websites of RBI (www.rbi.org.in) and Ministry of Finance (www.finmin.nic.in). Our purpose here is to provide a brief outline of their salient features. We briefly provide details of a few key aspects taken from the July 1, 2013 master circular pertaining to External Commercial Borrowings – **ECBs.**

The policy focuses on these aspects:

(1) There are two routes for accessing external debt markets. Some entities are allowed to follow the "automatic route", i.e. raise external debt without having to obtain approvals of Finance Ministry and RBI. Others such as banks and financial institutions, SPVs set up to finance infrastructure projects, etc. have to obtain prior approvals.
(2) Eligibility criteria for accessing external markets such as a track record of good financial performance for three years in the case of euroissues. These requirements are relaxed in the case of certain entities such as infrastructure projects and 100% export oriented units. In early 2000, the track record requirements were relaxed for all corporates which were eligible to make ADR/GDR issues. The 2010 master circular specifies that an NGO engaged in microfinance activities can avail an ECB provided it has had a satisfactory borrowing relationship with a scheduled commercial bank for at least three years.
(3) The total volume of borrowings to be raised and their maturity structure. The policy seeks to keep an annual cap on the total volume and within this encourage longer maturities. The 2010 July guidelines for instance require that ECBs should be of a minimum maturity of three years for borrowings up to USD 20 million and five years for amounts in excess of that. Concessions are made in the case of 100% EOUs and infrastructure. In these cases, average maturity can be three years for borrowings of any size. When borrowings under a single approval are raised in tranches of different maturities, the weighted average maturity must satisfy the above restrictions. Also, convertible debt is preferred to straight debt. Corporates other than those in services and software sectors have an upper limit of USD 500 million under the automatic route during a financial year while those in services and software sectors have an upper limit of USD 100 million. The document also specifies "recognised lenders", i.e. institutions from whom the borrower can take a loan.
(4) End uses of the funds raised. The general orientation is to discourage the use of the funds to finance rupee expenditures, but again some exceptions are made for selected categories. Also, in the case of euroissues, the Government aims to limit the use of funds for working capital purposes. Finally, the guidelines are very firm on preventing the use of funds raised through the ECB route for investment in stock markets and real estate. After the latest relaxation, end-use restrictions have been almost eliminated except the ones which prohibit the use of these funds for stock market and real estate investments.

In addition, the Government also controls the cost of funding. The July 2013 circular specifies a ceiling of 300 basis points over 6-month LIBOR for ECBs with maturity periods between three and five years and 500 basis points for more than five years. The policy specifies institutions which can provide guarantees as well as what security the borrower can provide and where the funds raised can be parked. The guidelines spell out the detailed procedures to be followed in accessing the external commercial borrowings route such as various approvals to be obtained, documents to be submitted, as well as tax treatment of interest paid to lenders and so forth. The details of these are not relevant for our purposes. Also, keep in mind that the policy is periodically revised and fresh guidelines are issued which supersede existing guidelines. Often, certain parts or sections of existing guidelines are modified by issuing specific notifications. A company contemplating access to the ECB route must obtain the services of a competent investment bank to advise it on all the aspects of regulation and compliance.

Since these regulations are frequently modified, practitioners must keep track of the latest version by accessing the circulars and guidelines released by RBI and the MOF.

A.19.4 AN ILLUSTRATIVE EXAMPLE OF A SECURITY WITH AN EMBEDDED CURRENCY OPTION

We discuss below an example of a bond issue with an embedded currency option from a class of instruments called **Indexed Currency Option Notes (ICONS).** It is taken from Das (1989) who discusses several very interesting applications of securities with embedded options.

- In 1985, Bankers Trust (BT) lead managed for Long-Term Credit Bank (LTCB) of Japan an issue of \$120 million eurobonds with a coupon of 11.5% p.a. and maturity of 10 years. The redemption amount at maturity will depend upon the value at that time of the spot ¥/\$ exchange rate S as follows:

  If $S \geq 169$,
  R = \$120 million
  If $S < 169$

  $$R = \text{US\$}120{,}000{,}000 \times \left(1 - \frac{169 - S}{S}\right)$$

  where R denotes the redemption amount.
  Effectively, the investors in the bond have granted LTCB a put option on dollars against yen at a strike price of ¥169.00/\$ for an amount of \$120 million. To see this, note that the gain to the holder of such a put when $S < 169$ is

  ¥[120(169 – S)] million.

  For the LTCB, the saving in terms of yen is

  $$\text{Yen}\left\{\left[120 - 120\left(1 - \frac{169 - S}{S}\right)\right]S\right\}\text{ million}$$

  = ¥[120(169 – S)] million.

  The premium for the option is implicit in the slightly higher coupon – approximately 60 bp per annum – than what the investors would have got on a straight issue of comparable credit quality.

  BT purchased the put option from LTCB in return for a reduction in LTCB's borrowing cost. This was achieved as follows. It arranged for an issue of yen bonds with a coupon of 6.65% p.a., 10-year maturity and face amount of ¥24,240,000,000, converted this to \$120 million at the then spot rate of ¥202/\$ and loaned the dollars to a counterparty at 10.7% p.a. Yen interest payments on the bonds were covered by means of a series of \$/¥ forward contracts and the yen principal was left unhedged. The market rates at the time were:

  10-year US treasury bond rate was 10.5% p.a.
  10-year Japanese Government bond rate was 6.5%.

  At maturity of the yen bond issue (and the dollar loan), the worst-case scenario for BT is it will have to buy yen at the rate of ¥169/\$. For \$120 million, this will yield ¥20,280,000,000 leading to a shortfall of ¥[24,240,000,000 – 20,280,000,000] = ¥3,960,000000. This translates into an annual payment of ¥293,454,573[30]. The net result is that BT realises a profit stream which is equivalent to a 10-year annuity of $1,566,024 at a discount rate of 10.5%[31]. If all of this gain is passed on to LTCB (which is unlikely), LTCB's borrowing cost will come down to 10.2% p.a[32]. In the actual case, LTCB swapped its fixed interest liability into a floating rate liability at approximately 40 bp below LIBOR.

A variation on the same theme was the so-called "Heaven or Hell" bond issue for IBM lead managed by Nomura. In this too, the redemption amount was linked to the ¥/$ spot rate at maturity. However, the amount of redemption was greater than the face value, if yen weakened beyond ¥169/$ and smaller than the face value, if it strengthened below the same value, reaching zero, if it strongly appreciated to ¥84.50/$ or less. In effect, the investors granted a call option to IBM and simultaneously, purchased a put option, both at the same strike price. See Das (1989) for details of this structure.

The possibilities of embedding options in a capital market instrument are almost limitless. Innovative bankers can tailor-make a structure to suit the requirements of a particular borrower and/or to exploit some market imperfections to reduce borrowing costs or improve return to investors.

A.19.5 RISK OF A FOREIGN BOND FROM THE INVESTOR'S VIEWPOINT

In the text, we have looked at the risk of foreign borrowing from the borrower's point of view. Here, we will analyse the risk for an investor who buys a foreign bond. Our presentation draws on Dym (1991).

Recall from Chapter 9 that the sensitivity of the price of a coupon bearing instrument to changes in interest rate is measured by the duration of the security:

$$D = -\frac{\frac{DP}{P}}{\frac{d(1+r)}{(1+r)}} \tag{A.19.1}$$

where P is the price of the bond and r is the yield. Thus, duration is the (negative) of the elasticity of bond price with respect to the discount factor $(1 + r)$. A simple measure[33] of duration known as "Macaulay Duration" (MD) is given by

$$MD = \frac{\sum_{t=1}^{t=T} t \frac{CF_t}{(1+r)^t}}{\sum_{t=1}^{t=T} \frac{CF_t}{(1+r)^t}} \tag{A.19.2}$$

[30]That is the future value of an annuity of 293454573 for 10 years at 6.5% p.a. is 3960000000. The future value factor for n years at r% per year is $[(1+r)^n - 1]/r$.

[31]For details of the calculations see Das (1989).

[32]Interest on $120,000,000 at 11.5% is $13,800,000. Subtracting the annuity of $1,566,024 gives interest payment of $12,233,976 which is 10.2% of $120 million.

[33]It is simple because it assumes a flat yield curve since r is assumed to be independent of t. Other measures such as the Fisher-Weil duration allow for a rising yield curve.

where CF_t is the cash flow from the bond at time t and T is the maturity. In words, Macaulay duration is the sum of present values of cash flows from the bond each weighted by the time at which it occurs divided by the current price of the bond.

Now consider a foreign bond. Its price in its currency of denomination (the "foreign currency") is denoted P. To an investor with a different "home" currency, its value in that currency is

$$V = PS \tag{A.19.3}$$

where S is the spot rate in units of home currency per unit of foreign currency. Take logs and differentiate to yield

$$d \ln V = d \ln P + d \ln S \tag{A.19.4}$$

But $\quad d \ln P = dP/P = -D[dr/(1 + r)]$

from the definition of duration. Substituting in (A.19.4)

$$dV = -D\frac{dr}{(1+r)}PS + d \ln S\ PS \tag{A.19.5}$$

Here we have used the fact that $d \ln V = dV/V$ and $V = PS$. From (A.19.5), the variance of dV, the change in the value of the bond from the point of view of the investor depends upon

1. Variance of the changes in foreign long term yield r.
2. Variance of the changes in the spot rate, S.
3. Covariance of these two changes.

The variance of dV is given by

$$\text{Var}(dV) = (PS)^2\{a^2\text{Var}(dr) + \text{Var}(d \ln S) - 2a\ \text{Cov}(dr, d \ln S)\} \tag{A.19.6}$$

where $\quad a = D/(1 + r)$.

Thus, risk of a foreign bond from the investor's viewpoint depends not only upon the duration of the security but also upon how volatile interest rates are in the country of the currency of denomination of the bond, the volatility of the spot rate and the covariance of the two. Dym (1991) has estimated the contribution of yield volatility, exchange rate volatility and the covariance to the total risk of foreign bonds, from the viewpoint of a US-based investor over the period 1984-1990. He finds that for bonds denominated in currencies such as DEM, CHF, Dutch Guilder and Belgian Franc, the contribution of yield volatility is low (7-13%), while that of exchange rate volatility is quite high (70-90%). For currencies such as the Italian lira, Canadian dollar and Swedish kroner, the yield volatility component is substantial (45-60%) and exchange rate volatility component is also of similar orders of magnitude. The covariance component is generally low except for currencies such as the yen, the British pound and the Irish punt where it exceeds 20%.

Dym goes on to analyse the risk of bonds whose principal value is hedged against currency risk by means of a forward foreign exchange contract. The interested reader may consult the original article for details.

A word of caution. Equation (A.19.4) is a ***linear approximation***, i.e. it should be used for small changes in P and S. This caveat is of particular importance in the light of the huge changes that occur in local currency values of assets and exchange rates during crises like the Asian currency crisis. Neglecting the fact that it is only an approximation can sometimes lead to absurd conclusions such as "loss on Indonesian stock markets (from US perspective) was 123%". Obviously one cannot lose more than 100% in the worst case scenario. The exact version of (A.19.4) is

$$dV/V = dP/P + dS/S + (dP/P)(dS/S)$$

When (dP/P) and (dS/S) are "small", we can ignore their cross product which leads to (A.19.4). But when the local currency values and exchange rate changes are large, the approximation breaks down. For instance, suppose local currency price P declines by 70% and the local currency declines by 50% in terms of US dollar. The change in the dollar value of the asset is not –120% but

$$-70\% + (-50\%) + (-70\%)(-50\%) = -85\%.$$

A.19.6 EXPECTED EXCHANGE RATES, TAXES AND CURRENCY OF BORROWING

In this chapter, we saw that the choice of currency of borrowing depends upon the expected real cost which in turn depend upon nominal interest rates and expected changes in exchange rates. In addition, tax considerations will also play an important role.

Tax treatment of foreign exchange gains and losses on foreign currency liabilities will determine the after-tax cost of borrowing for the borrower. If exchange losses on foreign currency liabilities are allowed to be set off against operating profits like interest payments, then a post-tax comparison of effective borrowing cost between two currencies will yield same result as pre-tax comparison. Thus, suppose an Indian company is planning to borrow for one year. The choice is between a dollar borrowing and a yen borrowing. The nominal rates are 8% and 4%, respectively and the expected appreciation is 5% for the dollar and 9% for yen. The effective pre-tax cost is 13% for both dollar and yen. If the Indian company's tax rate is 50%, the post-tax costs are 6.5%. On either basis, the company would be indifferent between the two.

From the investor's point of view, if exchange gains are treated as capital gains and taxed at a lower rate, bonds denominated in a faster appreciating currency would be more attractive. Thus, suppose the above Indian company's lenders are dollar-based investors who have identical expectations about exchange rate movements so that they expect the yen to appreciate 4% against the dollar. Suppose the tax rates for these investors are 40% on interest income and 20% on exchange gains. Then the after-tax return would be 4.8% on the dollar asset [= (1 – 0.4) × 8%] and 5.6% on the yen denominated asset [= (1 – 0.4) × 4% + (1 – 0.2) × 4%]. This would make the yen investment more attractive. The consequence of this may be lower nominal interest rate on the yen borrowing making it a preferred borrowing vehicle.

A.19.7 COUNTRY RISK ASSESMENT IN INTERNATIONAL LENDING

Since the eruption of the debt crisis in Latin America (Mexico in 1982, Brazil in 1987), international banks and institutional investors have become increasingly concerned about ***country risk*** **or** ***sovereign risk***. While the banks' immediate reaction was to try and pull out of LDC lending, in the long run this is not an attractive business strategy not only because there are substantial capital flows into and out of LDCs but also because banks' other businesses – derivative products, financial services – requires their presence in these countries as markets become more and more competitive. Proper assessment of country risk therefore has assumed great significance in international lending over and above the usual credit appraisal that banks have always been doing. We provide here a brief introduction to the parameters usually considered in country risk assessment. A fairly large amount of literature has appeared in recent years dealing with this topic[34]. Periodicals such as ***Euromoney*** and ***Institutional Investor*** publish their own sovereign ratings each year. Rating agencies such as Standard and Poor, and Moody's also rate sovereign debt. Many commercial and investment banks have their own in-house systems of country risk analysis with varying degrees of inputs from published information, external consultants' reports and assessments of their own field staff.

The essence of country risk analysis is an assessment of factors that will affect a country's ability and willingness to service its external obligations. A variety of political, economic and psycho-social considerations are relevant. Many rating systems have been evolved which attempt to precisely define, measure and weight these factors to arrive at a single indicator of a country's creditworthiness.

The economic factors can be broadly grouped into three categories. The first of these pertains to the resource base of the country. This category includes natural resources like land, mineral deposits, etc., human resources including quality and depth of managerial and technical skills, strength of the entrepreneurial spirit and trainability of the labour force and financial resources which pertains to saving rate of the economy. The second set of factors refers to macroeconomic performance and the quality of economic management. High and steady growth, high per capita income, high rate of capital formation, etc., indicate good macroeconomic performance. Lenders tend to be favourably biased towards political and legal systems that provides incentives to individual enterprise with minimum of government regulation, and fiscal and monetary conservatism. Professional competence of key officials in the finance ministry and the central bank of the country, a well-trained cadre of middle level officials, a relatively independent monetary authority, an efficient and facilitative bureaucracy and a government with the political will to implement tough decisions are highly valued[35]. Bankers prefer a long-term development strategy that emphasises output growth, stable prices, an "outward" orientation and "sound external finance". Administered interest rates, subsidies, administrative credit allocation, overvalued exchange rates, exchange controls, etc., are generally frowned upon.

The third set of factors refers to the external position of the country. This is the bottom line. Several indicators are used to assess the country's ability to generate sufficient foreign exchange to service its liabilities. Among the most important of these are:

1. State of the current account. Chronic deficits are regarded as a danger signal.
2. A rapid and stable growth of exports and a diversified export base are desirable attributes.
3. Existing Debt/GDP ratio and the debt service ratio. The latter is defined as the ratio of debt service payments on existing liabilities to the export earnings. A value in excess of 25% is a cause for concern.
4. Ratio of reserves to normal imports.
5. The country's access to IMF for meeting temporary BOP difficulties.

Apart from these economic considerations, lenders are also sensitive to political dimensions. Their principal concern is the possibility of political events occurring which will bring a government to power that may not respect their interests. Revolutions, coups, and other political developments

[34]As a sample, the reader is referred to Cataquet (1988), Lowenstein (1992). Euromoney's country risk rankings for 1992 along with a brief description of their methodology can be found in the September 1992 issue.

[35]This might explain the bias of the international financial community in favour of free-market economies with authoritarian political regimes.

that will change the political regime and may otherwise interfere with the country's ability and willingness to honour its external commitments are sought to be predicted[36]. As several analysts have pointed out, predicting political changes is less important than assessing the impact of various possible scenarios on the country's repayment ability and willingness. Several consultants specialise in assessing political risks.

Despite all the care and apparent precision of weighted indices, it is easy for various biases to influence the risk analyst's assessment. The same numbers are capable of yielding quite different interpretations. Political disturbances which may appear very routine to insiders can be exaggerated by an outsider. Consultants may be influenced to produce unduly optimistic reports and vice versa. Ideological biases can creep into what is apparently an objective assessment[37]. Systematic quantification certainly helps, but a large element of intuitive insights, derived from the detailed knowledge of the country and judgement born out of experience, are equally, if not more, vital.

[36]The likelihood of such disturbances is greater if the country is already in severe payments difficulty and adjustment programmes imposed by IMF or other external agencies require the government to implement politically unacceptable fiscal austerity measures such as removing food subsidies.

[37]Because of all these reasons, any rating assessment, particularly one that downgrades a country's rating is always controversial. The low rating of Australia sometime ago and the downgrading of India's rating in May 1990 both provoked severe criticisms of the rating agencies.

Chapter 20

International Project Appraisal

20.1 INTRODUCTION

The post-war years have witnessed a phenomenal growth in the spread of multinationals around the world. As we have seen in Chapter 1, several factors have induced companies to acquire a global presence. Foreign direct investment has been the most important manifestation of the drive towards globalisation. Developing countries like India which so far had been extremely reluctant to allow foreign direct investment, have, in recent years, shifted towards a much more liberal policy stance. Till the eighties, the bulk of the cross-border direct investment flow was among developed countries and some from the developed countries to the more welcoming developing countries. In the years to come, we are sure to see entrepreneurs from the relatively more industrialised developing countries venturing out to lesser developed countries and even to some of the developed countries.

The recent trends in outbound investments from India indicate that in the years to come, major Indian corporations will rapidly spread their wings abroad. Initially, they will probably follow the cross-border merger and acquisition route and then work their way towards significant foreign direct investment in new ventures. Figure 20.1 shows the significant increase in outward FDI after 2007.

Indian outbound deals, which were valued at US $0.7 billion in 2000-01, increased to US $4.3 billion in 2005, and reached a level of over US$20 billion in 2008. In fact, 2006 will be remembered in India's corporate history as a year when Indian companies covered a lot of new ground. They went shopping across the globe and acquired a number of strategically significant companies. This comprised 60 per cent of the total mergers and acquisitions (M&A) activity in India in 2006. And almost 99 per cent of acquisitions were made with cash payments. Acquisitions bring with them major benefits – existing customers, a foothold in the destination market and also niche technologies they require. As we have seen in Chapter 1, starting in 2006-07, there has been a sharp uptrend in Indian companies' foreign direct with the volume of outbound direct investment reaching above twenty billion US dollars by 2008-09. Overseas direct investment by Indian companies stood at US $3.24 billion in July 2013, registering an increase of 89.5 per cent from US $1.71 billion invested in

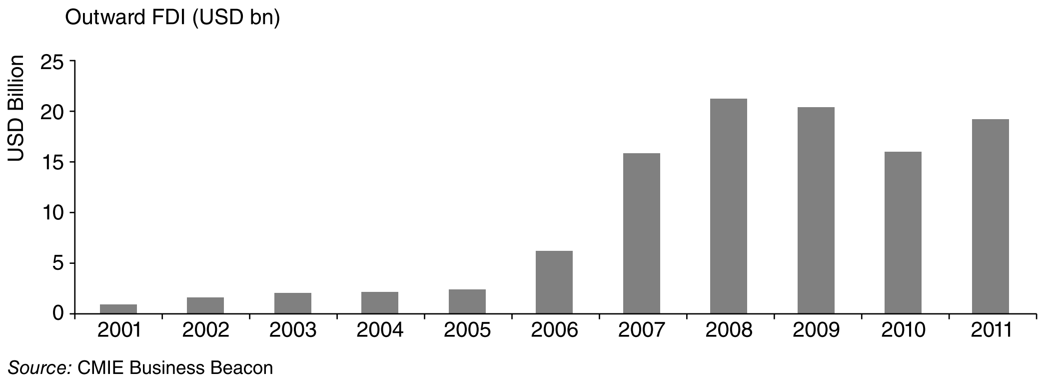
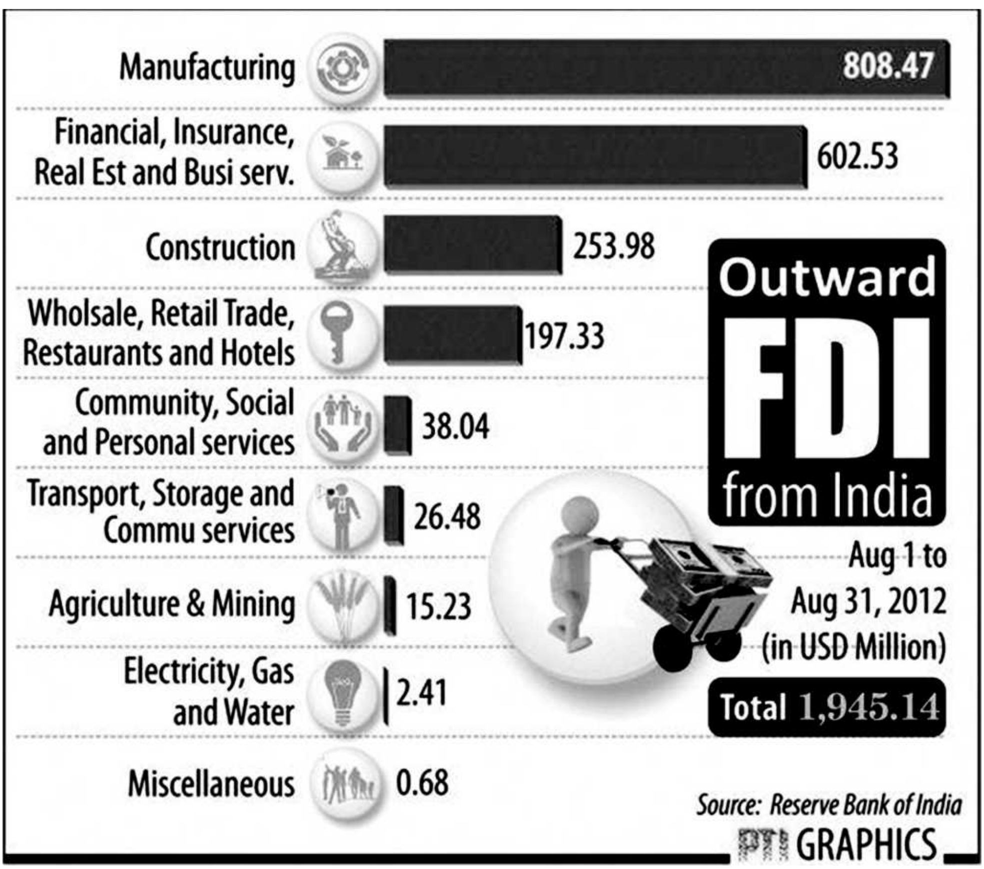


Fig. 20.1

June 2013, according to data released by the Reserve Bank of India Exhibit 20.1 shows the industry-wise composition of FDI by Indian companies during the month of August 2013.

Exhibit 20.1



In a bid to give further impetus to outbound investments by Indian companies, the Reserve Bank of India has been gradually liberalising overseas investment norms for both direct and portfolio investment. It has:

- Hiked the overseas direct investment limit from 200 per cent of the net worth to 300 per cent of the net worth;
- Hiked the limit on overseas portfolio investment from 25 per cent of their net worth to 35 per cent of their net worth;
- Allowed Indian residents to remit up to US $1,00,000 per financial year, from US $50,000 previously, for any current or capital account transaction or a combination of both.
- Allowed mutual funds to invest funds to the tune of US $4 billion in overseas avenues, from an earlier cap of US $3 billion.

Reacting to the changed policy structure, a number of financial services providers and brokerages are drawing plans to provide offshore investment products to Indian customers.

What accounts for the phenomenal success achieved by MNCs? One would expect that in the local markets, local producers would enjoy greater advantages due to more intimate knowledege of local markets and natural preference on the part of local consumers and governments. MNCs should, in fact, face greater risks and higher costs compared to their local counterparts. Dunning (1993) attributes the MNCs' dominance to three factors:

1. MNCs enjoy ownership-specific advantages because of their proprietary access to assets such as brand names, patents, technologies and copyrights which their local competitors cannot reproduce. Obvious examples are Coke, Pepsi, Microsoft, McDonald's and so forth. Sometimes these "special" assets are more intangible in nature, e.g. marketing expertise or highly talented management team.
2. MNCs may enjoy location-specific advantages such as exclusive access to sources of critical raw materials, access to cheap skilled labour or ability to reduce tax burden by locating in tax havens.
3. Why can the local firms not reproduce or nullify the ownership-specific or location-specific advantages of MNCs? After all, they can invest in R&D and develop their own technology or buy/license it from an MNC. They can establish and nurture their own brands with investments in advertising and distribution. They can access global markets for capital and labour once their size and financial status grows beyond a certain critical level. What enables MNCs to sustain their advantages over the long run? A part of the answer lies in the famous work of Coase (1937) who explained why many activities are internalised within a firm and carried out within the framework of internal contractual arrangements rather than by means of contracts with independent external agents. Through vertical integration, exclusive supply contracts, patents and copyrights MNCs attempt to protect their proprietary technologies or access to cheap, high-quality inputs. By setting up transfer pricing and other intra-corporate financial arrangements they can minimise their tax burdens. Also, the sheer scale of their operations and ability to centralise many tasks allow them to achieve scale economies which their smaller local competitors cannot avail of.

Of course despite these advantages, MNCs sometimes fail to achieve leadership in certain markets because of cultural factors, their inability to adapt to local tastes and ways of doing business and finally political factors.

Since foreign direct investment is the most important avenue for achieving multinational presence, it is important to understand how MNCs might be evaluating such investment proposals. Though financial appraisal is only one part of the overall strategic decision making, it is an important input in the decision to establish cross-border presence.

In this chapter, we will develop a framework for appraising foreign investment projects. To begin with, we will consider the case of a parent company wishing to set up a wholly-owned foreign subsidiary for locally producing goods and services for sale in the local as well as export markets. Subsequently, we will examine the case of joint ventures. The latter are more difficult to evaluate since two different viewpoints are involved – that of the local partner and the multinational – and the same project may be valued differently by the two parties involved in collaboration.

In the next section, we will briefly review the standard NPV procedure used to appraise a project. We will discuss the various difficulties in implementing the procedure particularly those associated with estimating the appropriate cost of capital. In Section 20.3, we will present the **Adjusted Present Value** approach that seeks to overcome some of these difficulties. In Section 20.4, we will look at the added complications of foreign projects caused principally by international taxation and see how the APV framework can be extended to overcome these difficulties.

20.2 A REVIEW OF THE NPV APPROACH

Consider the well-known Net Present Value (NPV) formula widely used in evaluating domestic investment projects

$$\text{NPV} = -C_0 + \sum_{t=1}^{t=T} \frac{CF_t}{(1+k_w)^t} \tag{20.1}$$

Here, C_0 is the initial capital cost of the project incurred at $t = 0$ and CF_t is the net cash flow from the project at the end of period t. Each cash flow CF_t is discounted by the discount factor $(1 + k_w)^t$ where k_w is the weighted average cost of capital defined by

$$k_w = \alpha\, k_e + (1 - \alpha)(1 - \tau)k_d \tag{20.2}$$

In this equation, k_e is the cost of equity capital, k_d is the pre-tax cost of debt, τ is the corporate tax rate and α is the proportion of equity finance for the project[1,2].

Keep in mind that the cash flows in the numerator of equation (20.1) must be ***incremental cash flows*** attibutable to the project. This means among other things that (1) Any change in the cash flows from some of the existing activities of the firm which arise on account of the project must be attributed to the project[3](2) Only net increase in overheads which would be on account of this project should be charged to the project.

The virtue of the simple formula (20.2) is that it captures in a single parameter, viz. k_w all the financing considerations allowing the project evaluator to focus on cash flows associated with the

[1]There may be other sources of funding such as retained earnings and preference capital. The weighted average cost of capital (WACC) formula has to be appropriately modified to take account of the costs of these funding sources and their contribution to the capital structure. See Chandra (1997) for a lucid discussion of WACC and its computation.

[2]If the supply of funds to the firm is not perfectly elastic, the cost of each source of funds may increase as more funds are demanded from that source. In such cases, we must use "Marginal Weighted Average Cost of Capital". See Chandra (1997) Chapter 8.

[3]For instance, the new project may procure some inputs from an existing division of the firm which has excess capacity. The net profits on such sales should be counted as a part of the project's cash flows. Conversely, the new project may result in a diversion of demand from an existing unit which would reduce its profits; this must be charged to the new project.

project. The problem is, there are two implicit assumptions. One is that the project being appraised has the same business risk as the portfolio of the firm's current activities and the other is that the debt : equity proportion in financing the project is same as the firm's existing debt : equity ratio[4]. If either assumption is not true, the firm's cost of equity capital, k_e changes and the above convenient formula gives no clue as to how it changes. Thus, even in a purely domestic context, the standard NPV approach has limitations[5].

The Adjusted Present Value (APV) approach seeks to disentangle the effects of particular financing arrangements of the project from the NPV of the project viewed as an all-equity financed investment. In the next section, we will briefly review this approach for purely domestic projects before extending it to foreign ventures.

20.3 THE ADJUSTED PRESENT VALUE (APV) FRAMEWORK

The APV framework[6] described below allows us to disentangle the financing effects and other special features of the a project from the operating cash flows of the project. It is based on the well-known ***value additivity principle***. It is a two-step approach:

1. In the first step, evaluate the project as if it is financed entirely by equity. The rate of discount is the required rate of return on equity corresponding to the risk class of the project.
2. In the second step, add the present values of any cash flows arising out of special financing features of the project such as external financing, special subsidies, if any, and so forth. The rate of discount used to find these present values should reflect the risk associated with each of the cash flows.

Consider for a moment a purely domestic project. It requires an initial investment of ₹70 million of which ₹40 million is in plant and machinery, ₹20 million in land and the rest is in working capital. The project life is five years. The net salvage value of plant and machinery at the end of five years is expected to be ₹10 million and land is expected to appreciate in value by 50%. The projected cash flow statement is laid out in Table 20.1.

(For simplicity, we have used straight-line depreciation of fixed assets including land. The rate is 20% for plant and 10% for land).

The cash flows (₹ million) from the project are thus:

Year:	0	1	2	3	4	5
	(70.0)	22.0	23.2	31.0	31.0	81.0

The firm estimates that the required rate of return on an all-equity financed project is 20%. The NPV of the above cash flows at a rate of discount of 20% is ₹24.91 million. The gross present value (GPV) is ₹94.1 million.

[4]In other words, the project has the same degree of *financial risk* as the firm's existing business.

[5]As suggested by Modigliani-Miller, one can use the alternative formula for cost of capital which allows for differences in the debt:equity ratio, viz.

$k_w = k_e(1 - \tau\alpha)$ where k_e is the "all equity" required rate of return reflecting the project's business risk. If the project's business risk differs from the existing portfolio of projects, one must estimate the project's beta and the required "all equity" return from the CAPM:

$$k_{ej} = R_f + \beta_j(R_m - R_f)$$

Here β_j is the beta of project j. There are difficulties with this approach too as pointed out by Myers (1968).

[6]For a detailed exposition of the APV framework, see Brealy and Myers (2000).

Now suppose, the firm estimates that based on the GPV of 94.1 million, it can raise fresh debt of ₹30 million. Since interest payments on debt are tax deductible, the present value of tax savings must be attributed to the project. In general, the additional borrowing capacity is given by

$$\Delta B = TDE \times GPV$$

where *TDE* is the target Debt:Equity ratio. If the pre-tax cost of debt is R_D and the tax rate is τ, the tax saving in each year equals:

$$(R_D \times \tau)\Delta B = (R_D \times \tau)(TDE \times GPV)$$

The PV of this is found using a discout rate equal to R_D. In the present example, suppose R_D is 15%. Then with ₹30 million of added borrowing capacity, the annual tax saving is $(0.15 \times 0.40)(30)$ = ₹1.8 million. The present value at 15% discount rate is ₹6.03 million.

Table 20.1 Cash Flows from the Proposed Project (₹ Million)

	Year					
	0	*1*	*2*	*3*	*4*	*5*
1 Plant & Machinery	(40.0)					
2 Land	(20.0)					
3 Working Capital	(10.0)					
4 Revenues		50.0	60.0	80.0	80.0	80.0
5 Costs (Other than Depreciation)		20.0	28.0	45.0	45.0	45.0
6 Depreciation		10.0	10.0	10.0	10.0	10.0
7 Profit before tax		20.0	22.0	35.0	35.0	35.0
8 Tax (@40%)		8.0	8.8	14.0	14.0	14.0
9 Profit after Tax		12.0	13.2	21.0	21.0	21.0
10 Net Salvage Value of fixed assets						40.0
11 Recovery of working capital						10.0

Further, suppose that the project would be located in a backward area and the government provides a cash subsidy of ₹5 million. The firm will have to raise new equity at an issue cost of ₹2 million. Thus, the APV of the project is:

$$24.91 + 6.03 + 5.00 - 2.00 = 33.94.$$

However, there are a couple of difficulties with this approach, in particular with computation of tax savings on account of increased borrowing capacity. First, we have assumed that the firm will be able to utilise the tax shield fully in every year; this may not be true if in a particular year the profit after interest is negative. Even if the tax shield is carried forward, it still represents loss of time value of money. Second, we have considered taxation only at the corporate level. Taxation is a complicated topic. Taxation at personal level may offset some of the benefits of tax saving at the corporate level; interest income may be taxed differently than dividend income and capital gains; shareholders may obtain credit for taxes paid at the corporate level. When the firm's shareholders and creditors are subject to diverse tax regulation, it is difficult to figure out who gets what share of the interest tax shield. The very fact that interest is tax-deductible, will motivate creditors to capture a part of the saving by raising the pre-tax rate they demand on their lending. In general, the calculation of the interest tax shield as presented here probably represents an overestimate of the true benefit from added borrowing capacity.

The essence of the APV approach is to separate out the investment and financing aspects of a project. As we will see below, this principle enables us to use a step-wise approach to evaluation of foreign projects.

20.4 PROJECT APPRAISAL IN THE INTERNATIONAL CONTEXT

A firm can acquire "global presence" in a variety of ways ranging from simply exporting abroad to having a wholly-owned subsidiary or a joint venture abroad. Spanning these two extremes are intermediate forms of cross-border activity such as having an agent abroad, technology agreements, joint R&D, licensing and a branch operation. Each mode of cross-border activity has distinct features both from a managerial control point of view and legal and tax point of view. Our focus here will be on a wholly-owned subsidaiary incorporated under the host country law. We will also briefly review some aspects of joint ventures towards the end of the chapter.

The main added complications which distinguish a foreign project from a domestic project can be summarised as follows:

- **Exchange Risk and Capital Market Segmentation**
  Cash flows from a foreign project are in a foreign currency and therefore subject to exchange risk from the parent's point of view. How to incorporate this risk in project evaluation? Also, what is the appropriate cost of capital when the host and home country capital markets are not integrated?
- **Political or "Country" Risk**
  Assets located abroad are subject to risks of appropriation or nationalisation (without adequate compensation) by the host country government. Also, there may be changes in applicable withholding taxes, restrictions on remmittances by the subsidiary to the parent, etc. How should we incorporate these risks in evaluating the project?
- **International Taxation**
  In addition to the taxes the subsidiary pays to the host government, there will generally be withholding taxes on dividends and other income remitted to the parent. In addition, the home country government may tax this income in the hands of the parent. If double taxation avoidance treaty is in place, the parent may obtain some credit for the taxes paid abroad. The specific provisions of the tax code in the host and home countries will affect the kinds of financial arrangements between the parent and the subsidiary. There is also the related issue of transfer pricing which may enable the parent to further reduce the overall tax burden.
- **Blocked Funds**
  Sometimes, a foreign project can become an attractive proposal because the parent has some funds accumulated in a foreign country which cannot be taken out (or can be taken out only with heavy penalties in the form of taxes). Investing these funds locally in a subsidiary or a joint venture may then represent a better use of such blocked funds.

In addition, like in domestic projects, we must be careful to take account of any interactions between the new project and some existing activities of the firm, e.g. local production will usually mean loss of export sales.

As in the case of domestic projects, we will adopt a step-wise approach to the evaluation of foreign projects. However, now we will include an additional step:

1. First treat the project as a branch operation of the parent company. All the cash flows generated by the project belong by definition to the parent since the project has no distinct identity. This allows us to focus on the pure economics of the project.
2. Next, consider the project as a fully equity financed, wholly owned subsidiary of the parent, incorporated under the host country laws, having a distinct legal identity. Now we focus on the various financial arrangements between the parent and the subsidiary and consider what means are available to the parent to increase the cash flow transfers between the subsidiary and the parent and minimise the overall tax burden.
3. Finally, as in the case of a domestic project, incorporate the effects of external financing such as the interest tax shield.

The reasons we consider intra-corporate financing separately from external financing are: first, their effects can be estimated more precisely than those of external financing; second, the nature of internal financing arrangements is sensitive to the particular features of the tax law in the host and home countries; and third, it always forces us to keep in mind that any change in the nature of intra-corporate financial relationships impinges only on the allocation of profits between the parent and the subsidiary and not a net gain or loss (except when it saves on overall tax burden).

We will now proceed to implement this approach with an example.

TITUS Ltd., an Indian company, was established seven years ago to manufacture quartz digital watches for the domestic market as well as the emerging export markets in Africa and the Middle East. From the beginning, the company focussed on the quartz digital segment and marketed a range of watches from medium priced to high priced models. It soon acquired market leadership in this segment due to its product quality, excellent after-sales service and a wide range of models catering to the various upper income market segments.

The company is considering a proposal to set up a wholly-owned manufacturing and sales subsidiary in Zimbabwe to serve the African and Middle-Eastern markets as well as to make a foray into the European market. It has had a preliminary discussion with Zimbabwean authorities who are keen on promoting direct foreign investment in the country and have shown willingness to offer some concessions. The various parameters of the proposed project are described below.

- The Proposed Quartz Watch Plant in Zimbabwe

  Initial Investment: Z$50,000,000

  The company has accumulated a balnce of Z$5,000,000 in a local bank from its earlier export sales. This can be repatriated to India after paying 48% tax.

  The construction of the plant will take two years. During the third year the production will be 600,000 units. From the fourth year on, the plant will produce at its full capacity of 750,000 units. The company has decided to adopt a 10-year horizon starting from now.

  Comparable watches imported from Europe and Japan are being currently sold at a price of Z$180 per watch. Inflation in Zimbabwe is running at an average rate of 12% per annum while in India the inflation rate is anticipated to be 10% p.a. The current spot rate is ₹6.00/Z$.

  The operating costs are estimated as follows:

  Materials : Z$120.00 per watch
  Labour : Z$ 25.00 per watch
  Selling and other expenses : Z$ 5.00 per watch.

Working capital requirements are 10% of the initial investment in the third year and will be recovered at the nominal value in the fifteenth year.

The initial fixed investment is depreciated over ten years by the straight line method. The salvage value will be negligible.

Currently the parent company exports 50,000 watches to Zimbabwe. These will be replaced by sales from the new plant. However, the company thinks that due to government policies in Zimbabwe and these exports would have declined at the rate of 5% per annum.

It is pointed out by one of the managers that out of the total material costs of Z$120, certain crucial components account for Z$70 at the current world prices. These will be supplied by the parent company at the "arms length" price, i.e. the price it charges to all its customers to whom it supplies these components. Its variable costs of manufacturing these are Z$45 at the current exchange rate. No extra capacity needs to be installed to meet the requirements of the new plant. The corporate income tax in Zimbabwe is 45%, while in India, it is 40%. There is a double tax avoidance treaty between the two countries under which full credit is given to Indian companies for taxes paid in Zimbabwe provided the rate does not exceed the Indian rate of 40%. The Zimbabwean authorities impose a 5% withholding tax on dividends remitted to the parent company by the subsidiary.

Table 20.2 presents revenues, costs, profits and cash flows from the project taking into account only the loss of exports. We have done this by reducing the quantity sold by the project by the volume of exports that would have occurred in the absence of the new plant.

Table 20.2 Titus Watch Project Projected Cash Flow Statement (Zimbabwe Dollars Million)

Year	*Revenue*	*Cost of Goods Sold*	*Profit Before Tax*	*Profit After Tax*	*Cash Flow*
0	0.00	0.00	0.00	0.00	–50.00
1	0.00	0.00	–5.00	–5.00	2.25
2	0.00	0.00	–5.00	–5.00	2.25
3	99.00	90.00	4.00	2.20	2.20
4	126.45	112.50	8.95	4.92	9.92
5	126.88	112.50	9.38	5.16	10.16
6	127.28	112.50	9.78	5.38	10.38
7	127.67	112.50	10.17	5.60	10.60
8	128.03	112.50	10.53	5.79	10.79
9	128.38	112.50	10.88	5.98	10.98
10	128.72	112.50	11.22	6.17	16.17

The operating cash flows have been calculated at constant (today's) prices. These are discounted at required real rate of return on similar projects in Zimbabwe which is 8%[7]. The tax savings due to depreciation are a contractually fixed cash flow which should be discounted at a nominal rate of return. We have used a 16% rate which implies a real discount rate of 4%. The lower rate of discount

[7]This is the simplest way of taking account of inflation in project appraisal, viz. compute the cash flows in constant prices and use the real rate of discount for cash flows which are not contractually fixed. The implicit assumption is that all revenues and costs will grow at the expected constant inflation rate. It would be possible to adopt more sophisticated approaches which forecast different rates of inflation for different items entering the cash flows.

reflects the lower risk associated with these cash flows. With these discount rates, the project NPV works out to Z$(-2.72) million.

We now take into account the fact that the project allows Titus to utilise the blocked funds. If these funds are repatriated, Titus will have to pay 48% tax. Thus, the opportunity cost of using these funds for the project is only Z$2.6 million. Thus, the project can be credited with a cash flow of Z$2.4 million in year zero. (This is the difference between the face value of the funds and their opportunity cost). The NPV thus goes up to Z$(–0.32) million.

Now consider the fact that the parent will supply components at a price of Z$70 per watch whereas its variable costs are Z$45. The difference will represent additional cash flows to the parent at the rate of Z$25 per watch manufactured by the new plant. The after-tax value of these cash flows should be credited to the project. To discount these cash flows, we use a discount rate of 6% since the risk associated with these cash flows is less than the risk of the entire project cash flows and they are not contractually fixed cash flows. The tax rate used is that of the parent in the home country. The present value of these flows works out to Z$60.29 million. Now the project NPV increases substantially to Z$59.97 million.

In the next step, we consider the financial arrangements between the parent and the subsidiary. It is pointed out that it may be possible to work out a technology licensing agreement between the parent and the subsidiary under which the latter can pay royalty to the parent. It is felt that the Zimbabwean government will permit at most 5% of sales as tax deductible royalty expense. Further, the Indian government will treat the royalty income in the hands of the parent as "technology exports" and tax it at a preferential rate of 20% rather than the regular corporate tax of 40%. Thus there is a net tax saving of 25% (45% tax saved by the subsidiary minus 20% tax paid by the parent) on the royalty payments. These tax savings should also be credited to the project. Once again, these cash flows are deemed to be less risky than the project cash flows and discounted at a rate of 6%. The present value works out to Z$8.51 million. The NPV of the project is thus Z$ 68.48 million.

In addition to this, it may be possible to further save on taxes by using devices like transfer pricing[8].

Now consider the possibility of external financing. The project will have a gross present value in excess of Z$100 million. Suppose the firm thinks that it can raise Z$30 million of additional borrowing. As we have seen above, the tax savings on account of this depend upon the pre-tax borrowing cost and the tax rate. However, as pointed above it is not clear what part of this can be captured by the shareholders. Assuming an interest rate of 15% and a tax rate of 45%, a 30 million loan would yield annual tax savings of Z$2.025 million. The risk attached to these cash flows is mainly the uncertainty as to whether the firm will be able to fully utilise the tax shield every year. These cash flows are in nominal terms (i.e. not sensitive to inflation) and hence should be discounted at a nominal rate of interest somewhat higher than the risk-free rate of interest.

When external funding is being considered, two issues arise. One is the currency of denomination of the loan and the other is who should borrow – the parent or the subsidiary? We have seen in Chapter 6, that in the presence of well-functioning forward markets and interest parity, the effective cost of borrowing is the same in all currencies provided interest income and exchange gains are taxed at the same rate[9]. As to whether the parent or subsidiary should borrow, an obvious but not

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[8]See the appendix to this chapter for a brief discussion of transfer pricing.

[9]We saw in Chapter 8 that if exchange gains are treated as capital gains and are taxed at a lower rate than ordinary income, borrowing in low nominal interest rate currencies would be better since the lender derives a larger part of income in the form of capital gains and so can offer better rates.

necessarily correct answer would be that the entity with higher tax rate should borrow to derive the maximum benefit of tax deductibility of interest. However, remember that profits and dividends are also taxable and what is saved on interest will show up in profits and hence, in dividends. Also, some governments may impose witholding taxes on interest paid to non-residents, but not on dividends paid to foreign shareholders. In such cases, merely comparing corporate tax rates is not adequate.

Foreign projects, particularly in developing countries, may have other attractions. Suppose, for instance, the Zimbabwean government offers a 5-year concessional loan of Z$5 million at 12% per annum interest with bullet repayment. If the firm's borrowing cost in the Zimbabwean market is, say, 15%, the loan adds to the project's NPV. This is found by discounting the cash outflows related to the loan at a discount rate of 15% and subtracting the discounted value from the face value of the loan, viz. Z$5 million.

Note that so far we have done all computations in Zimbabwean dollars. The project must be valued from the point of view of the parent firm's shareholders. To do this, we must compute the NPV of all cash flows which will accrue to the parent, valued in parent's functional currency. One modification immediately needed is to apply the withholding tax to all cash flows remitted to the parent. In addition, we must resolve the issues of exchange risk and the appropriate discount rate. As we will see below, the choice of discount rate depends upon the extent of integration of the capital markets of the home and host countries, a topic that was discussed in Chapter 18.

20.5 EXCHANGE RATE RISK AND COST OF CAPITAL

20.5.1 Valuing Foreign Currency Cash Flows

First consider the problem of valuing risk-free cash flows in foreign currency. There are three possible methods:

1. Find the present value of the cash flows in terms of foreign currency and translate at today's spot rate. Thus, if FCF_t is the cash flow at time t and r_F is the risk-free foreign currency discount rate, the home currency PV is

   $$[FCF_t/(1 + r_F)^t]S_0$$

   where S_0 is today's spot rate in terms of units of home currency per unit of foreign currency.
2. Translate each cash flow FCF_t at the forward rate $F_{0,t}$ and discount at the home currency risk-free discount rate. The PV is given by

   $$(F_{0,t})(FCF_t)/(1 + r_H)^t$$

3. Translate at the expected spot rate $E_0(S_t)$ and discount at a home currency discount rate that reflects exchange risk[10].

   $$[E_0(S_t)](FCF_t)/(1 + r_H)^t$$

   wherer r_H is the risk-adjusted home currency discount rate.

All the three methods would yield identical results if the home and host country capital and money markets are free and integrated[11]. When the markets are segmented, (1) and (2) cannot be

[10]Recall from Chapter 18 the method for obtaining the risk premium for exchange risk.

[11]The equivalence of (1) and (2) can be obtained from the interest parity condition. Equivalence of (2) and (3) is due to the fact that with free and integrated money markets, the forward rate is the market's certainty — equivalent of the future spot rate.

used. It may happen that a project which is financially viable when evaluated from the local point of view is not acceptable from the parent point of view or vice versa – a project may not be viable from the local point of view but appears acceptable from the parent point of view. We will demonstrate this with some simple numerical examples.

(a) Consider first the case where global capital markets are fully integrated, investors are risk neutral and all the parity conditions – Purchasing Power Parity (PPP), Covered Interest Parity (CIP) and Uncovered Interest Parity (UIP) – hold continuously. Suppoe an Indian firm is considering a project in Shangrila with the following cash flows measured in Shangrila dollars (SGD) million

Year	0	1	2
Cash Flow	–50	40	60

Suppose the risk-free real rates in India and Shangrila are 5% p.a., the inflation rate in India is 5% p.a. while inflation in Shangrila is 10% p.a. The nominal risk-free rates are 10.25% in India and 15.50% in Shangrila. The current SGD/INR exchange rate is 0.2000 (i.e. 5.00 SGD per INR) while the one- and two-year forward rates are 0.1909 and 0.1822. These in turn equal the spot rates expected at the end of year 1 and 2, respectively. The project evaluated from a local point of view yields an NPV of

$$\text{SGD } \{-50 + (40.0/1.1550) + [60.0/(1.1550)^2]\} \text{ million}$$
$$= \text{SGD } 29.61 \text{ million}$$

Translated into parent currency using the current spot rate, this gives an NPV of INR 5.92 million.

Now let us translate each SGD cash flow into its INR equivalent using the appropriate forward rate which also equals the expected spot rate at the relevant time and discount these using the risk free nominal rate in India. This yields an NPV of

$$\{(-50.0/5.0) + [(40.0 \times 0.1909)/(1.1025)] + [(60.0 \times 0.1822)/(1.1025)^2]\}$$
$$= \text{INR } 5.92 \text{ million}$$

This shows that when global capital markets are perfectly integrated and all the parity conditions are satisfied, evaluation of projects can be done from either local or parent perspective.

(b) Now consider the case when there are capital controls in place which segment the international capital markets. In particular, suppose the government of Shangrila has imposed capital controls which raise the real rate of interest in Shangrila. The inflation rates in India and Shangrila are, as before, 5% and 10% p.a., the real risk free rate in India is 5% but that in Shangrila is 10%. The risk-free nominal rates are therefore 10.25% in India and 26.50% in Shangrila. The forward rates are 0.1743 and 0.1519. However, due to capital controls and intervention on the part of Shangrila's central bank, the SGD is expected to remain at 0.20 INR. Consider a project in Shangrila with the following net cash flows (SGD million):

Year	0	1	2
Net Cash Flow	–50	30	40

Using a discount rate of 26.50%, the NPV of these cash flows is

$$\{-50 + (30/1.2650) + [40/(1.2650)^2]\} \text{ million SGD} = -1.29 \text{ mill. SGD}$$

Hence, from a local perspective, the project is unviable. Now translate these SGD cash flows into their INR equivalents using the expected spot rate of 0.20 INR per SGD through the life of the project and discount the resulting INR cash flows using a discount rate of 10.25%. The cash flows are (–10, 6, 8) million INR and the NPV is INR 2.02 million. Thus, it appears that the project is acceptable from parent perspective.

This would be a misleading conclusion. In accepting the project, the parent would really be hoping to make speculative gains by betting on the SGD/INR exchange rate. Instead it should look for projects which are viable from local perspective and undertake speculation directly via financial markets if permitted by exchange controls. For instance, it should buy SGD forward at the markets' quoted forward rates hoping to sell back at the expected spot rate of 0.20. Of course, it is possible that Shangrila's exchange controls would not permit such transactions and hence there would be an incentive for foreign firms to achieve the same result via direct investments.

(c) The opposite case is easy to construct. Consider a Shangrila firm contemplating a direct investment project in India under the same circumstances as in case (b) above. Suppose the cash flows from the project are (–10, 6, 8) million INR. With a discount rate of 10.25%, this yields an NPV of INR 2.02 million from the local perspective – which now is the Indian perspective. Translated into SGD at the expected spot rate of 0.2000 INR per SGD, these cash flows would be (–50, 30, 40) million SGD. With a discount rate of 26.50%, the NPV works out to be –1.29 million SGD. It appears that the project is viable from the local point of view, but not from parent point of view. What should the Shangrila firm do?

The answer is that it should try to acquire local financing for the project. Suppose it can borrow INR 12.02 million at 10.25% in India. It can finance the project construction with INR 10 million out of this and immediately remit the rest to the parent company. It invests the first year's net cash flow at 10.25%. At the end of two years, it has INR 14.61 million, which is enough to pay off its two-year loan.

These simple examples bring out the crucial point that when global capital markets are segmented and parity conditions are violated, the correct procedure is to value the project from parent perspective allowing explicitly for exchange rate risk. Also note that in these examples, we had assumed away the project's business risks by assuming the project's cash flows in local currency to be risk free. The problem becomes more complicated when the firm must take into account project-specific risks in addition to the exchange rate risk. We now turn to these issues.

When parity conditions are violated, exchange rate forecasting then becomes necessary and so does estimation of risk-adjusted required rate of return r_H. Neither task is very easy.

Next consider the case where the foreign currency cash flows are risky. Suppose in the case of the Titus watch project, the sales revenues depend upon the state of the economy in Zimbabwe. Cash flows to parent measured in rupees are subject to the further risk of exchange rate fluctuations. Table 20.3 below shows an illustrative calculation. Suppose we are estimating the cash flow in year 4. Depending upon whether the Zimbabwean economy is in a state of boom or recession, the sales will be 7,00,000 or 5,00,000 watches. The probability of a boom is estimated to be 60% and of a recession 40%. Exchange rate uncertainty is captured in two possible values of the ₹/Z$ exchange rate – ₹7.5/Z$ and ₹5.5/Z$ – each with a 50% probability. It is assumed that recession is more likely when the Zimbabwean currency is ruling high. Thus, the joint probability of a boom with ₹/Z$ at 7.5 is only 10% while the joint probability of a boom with ₹/Z$ at 5.5 is 50%. Joint probabilities of a recession are 0.30 (₹/Z$ = 7.5) and 0.10(₹/Z$ = 5.5), respectively.

Table 20.3

	After-Tax Cash Flow (Z$ million)	
	Boom	**Recession**
	(prob. = 0.6)	(prob. = 0.40)
	13.8	10.5
	Cash Flow Translated to Rupees (million)	
Z$/₹7.5	103.5	78.75
(prob. = 0.5)	(prob. = 0.1)	(prob. = 0.3)
Z$/₹5.5	75.9	57.75
(prob. = 0.5)	(prob. = 0.5)	(prob. = 0.1)

Once again, with integrated capital markets and validity of parity conditions, we can discount the expected foreign currency cash flow, Zimbabwe dollars [0.6 × 13.8 + 0.4 × 10.5] million, using a discount rate which equals the rate of return required by Zimbabwean investors from similar projects and translate into rupees at the current spot rate. In obtaining this discount rate, we must employ the international CAPM discussed in Chapter 18 which takes account of the covariance of the project with the world market portfolio and the ₹/Z$ exchange rate.

If host and home country capital markets are segmented, this procedure cannot be employed. The expected value in home currency, of a risky foreign currency cash flow at a future date is given by

$$E_t(CFH_T) = E_t(CFF_T) \times E_t(S_T) + \text{cov}[CFF_T, S_T]$$

Here CFH_T denotes the home currency value of the cash flow which will occur at time T, CFF_T is its foreign currency value and S_T is the spot rate at time T. All the three are random variables, E_t is the expectations operator and "cov" denotes covariance. In the example given above, the expected value is

$$(103.5 \times 0.1) + (75.9 \times 0.5) + (78.75 \times 0.3) + (57.75 \times 0.1)$$
$$= ₹77.7 \text{ million}$$

To estimate this, we need forecasts of future spot rate and an estimate of the covariance between the spot rate and the foreign currency cash flow. This has to be discounted at a rate equal to the rate of return required by home currency investors on similar projects. This must be estimated with a single-country CAPM augmented by exchange risk.

Thus, the main issue involved in handling exchange rate risk and choice of a discount rate is the degree of capital market integration. Since in the case of most developing countries, capital market integration has not proceeded very far, evaluation of foreign projects involves formidable difficulties. Reliable exchange rate forecasts are notoriously difficult to obtain; the only guideline available for long-run exchange rate forecasting is the purchasing power parity doctrine. However, as we have seen in Chapter 11, its empirical validity is far from firmly established. Linking the performance of the project with the exchange rate is no less difficult. If the project is intended to serve not only the host country market but also third-country markets, the issues are still more complex since the performance of the project now depends upon several exchange rates and not just the home country-host country exchange rate. Finally, the appropriate risk premium to be added for exchange risk is far from easy to estimate in practice.

International taxation introduces further complications. Treatment of dividend income by home country government, withholding taxes, treatment (by host and home country tax authorities) of other forms of transfers such as interest, royalties, etc. between the subsidiary and the parent, existence or otherwise of double taxation avoidance treaties and their scope, the possibility of using transfer prices which are different from arms-length prices are all highly complex issues best left to the specialists in this area.

In practice, firms use their all-equity required rate of return and add a risk premium which is supposed to reflect not only exchange risk but also other risks such as political or country risk and in some cases also the fact that the firm may be totally unfamiliar with the host country and may have to incurr additional costs[12]. This is a rather arbitrary procedure. Some kinds of political risks are insurable, and a better way to incorporate them is to debit the insurance premium to the project. Similarly, while foreign projects are subject to exchange risk, they also yield some diversification benefits to the parent. An arbitrary risk premium may err on the conservative side and result in the parent firm foregoing potentially high NPV projects. In general, some risks are better accounted for by adjusting the project cash flows rather than the discount rate. Lessard (1996) provides a taxonomy of the various risks which need to be taken into account in appraising a foreign project and discusses the issues involved in incorporating them via discount rate adjustments versus adjustments to the cash flows.

Despite these theoretical considerations, it appears that multinational corporations continue to use the discount rate adjustment procedure[13]. Given the conceptual difficulties involved in the estimation of the "correct" discount rate, this is not difficult to understand. Section 20.7 contains a brief discussion of how practitioners approach the task of evaluating foreign direct investment projects and in particular estimation of the appropriate cost of capital for such projects. We will see that given the enormous conceptual and empirical difficulties involved in extending the CAPM to international context and incorporating exchange rate risk most practitiones use some ad-hoc procedure of adding a risk premium to the cost of capital used for domestic projects.

20.6 OPTIONS APPROACH TO PROJECT APPRAISAL

The discounted cash flow approaches discussed above – whether NPV or APV – suffer from a serious drawback. Both ignore the various operational flexibilities built into many projects and assume that all operating decisions are made once for all at the start of the project. In many situations, the project sponsors have the freedom to alter various features of the project in the light of developments in input and output markets, competitive pressures and changes in government policies. Among these flexibilities are:

1. The start of the project may be delayed till more information about variables such as demand, costs, exchange rates, etc. is obtained. For instance, starting a foreign plant may be postponed till the foreign currency stabilises. Development of an oil field may be delayed till oil prices harden. For instance, consider a project to develop an oil field. The current oil price is \$15 a barrel and the project NPV is \$10 million. In one year's time, the oil price may rise to \$30 or fall to \$10. The NPV of the project then would be either \$18 million or –\$10 million. By delaying the start of the project, the firm can add greater shareholder value avoid getting locked into an unprofitable project.
2. The project may be abandoned if demand or price forecasts turn out to be over-optimistic or operating costs shoot up. It may even be temporarily closed down and re-started again when

[12]This is particularly true of ventures in emerging markets.

[13]See the report on the Bank of America Roundtable on Evaluating and Financing Foreign Direct Investment in ***Journal of Applied Corporate Finance***, Vol. 9, No. 3, Fall 1996, 64-79.

market conditions improve, e.g. a copper mine can be closed down when copper prices are low and operations re-started when prices rise. Some exit and re-entry costs may of course be involved.

3. The operational scale of the project may be expanded or contracted depending upon whether demand turns out to be more or less than initially envisioned.
4. The input and output mix may be changed or a different technology may be employed.

The conventional DCF approaches cannot easily incorporate these features. In recent years, the theory of option pricing has been applied to project appraisal to take account of these operational flexibilities. For instance, the option to abandon a project can be viewed as a put option – the option to sell the project assets – with a "strike" price equal to the liquidation value of the project. The option to start the project at a later date can be viewed as a call option on the PV of project cash flows with a strike price equal to the initial investment required for the project. Similarly, the option to expand capacity, if demand turns out to be higher than expected can be viewed as a call option on the incremental present value with the strike price being equal to the additional investment required to expand capacity.

In many cases, these choices can be incorporated and evaluated using a decision tree approach; in other cases, option pricing models such as the Black-Scholes model and its refinements can be employed.

In the appendix to this chapter, we will illustrate the basic principles of the options approach with a highly simplified example. An introductory exposition is available in Buckley (1996). A comprehensive but advanced treatment can be found in Trigeorgis (1996).

20.7 THE PRACTICE OF CROSS-BORDER DIRECT INVESTMENT APPRAISAL

How do practitioners approach the problem of appraising investment projects in foreign countries? Some survey results have been reported which seem to indicate that many participants use DCF methods with some version of asset pricing model to estimate the cost of capital but make lot of heuristic adjustments to the discount rate to account for political and exchange rate risks.

Keck, Levengood and Longfield (1998) have reported the results of a survey of practitioners pertaining to the methodologies they employ to estimate cost of capital for international investments. Their findings can be broadly summarized as follows:

1. A large majority of practitioners employ DCF as at least one of the methods for valuation.
2. Most practitioners are ***de facto*** multi-factor model adherents. More segmented the market under consideration, greater is the number of additional factors used in valuation. Even those who claimed to use the single factor CAPM include more than one risk factor proxies.
3. The use of local market portfolio as the sole risk factor is less frequent when the evaluator is dealing with countries which are not well integrated into the global capital markets. However, they then add other risk factors rather than using the global market portfolio. For integrated markets such as the US or the UK, global market portfolio is used more frequently.
4. In the case of less integrated markets like Sri Lanka or Mexico, exchange risk, political risk (e.g. expropriation), sovereign risk (e.g. Government defaulting on its obligations) and unexpected inflation are considered to be important risk factors in addition to market risk.
5. Most practitioners adjust for these added risks by adding ad-hoc risk premia to discount rates derived from some asset pricing model rather than incorporating them in estimates of cash

flows. This goes against the spirit of asset pricing models which are found on the premise that only non-diversifiable risks should be incorporated in the discount rate.

Godfrey and Espinosa (1996) present a "practical" approach to computing the cost of equity for investments in emerging markets. It essentially involves starting with the cost of equity for similar domestic projects and adding on risk premia to reflect country risk and the total project risk. The former is estimated by looking at the spreads on dollar denominated sovereign debt issued by the host country government and the latter by the volatility of the host-country stock market relative to the domestic stock market. For details, the reader is referred to the original article.

20.8 INTERNATIONAL JOINT VENTURES

The previous section dealt with the case of a foreign wholly-owned subsidiary. A more common form of cross-border investment is a joint venture and other modes of alliances between a firm in the host country and a foreign firm. The purpose of this section is to briefly discuss some key issues in evaluation of joint venture projects.

Over and above the pure economics of the joint venture project, the most crucial issue is the sharing of the synergy gains between the partners. Two or more partners join in a venture only because they have strengths in terms of technology, distribution, market access, brand equity and so forth that complement each other.. The joint venture is expected to yield gains over and above the sum of the gains each partner can obtain on its own.

Game-theoretic models of bargaining suggest that the synergy gains should be split equally[14]. One way of achieving this is through proportional sharing of project cash flows. Thus, of the two partners, *A* brings in 30% of the investment and *B* the remaining 70%, cash flows should be shared in the same proportion. This conclusion, however, needs modification when the two partners are subject to different tax regimes and tax rates.

Fair sharing of synergy, gains can also be achieved by other means. Thus, a properly designed licence contract wherein the joint venture pays one of the partners a royalty or licence fee for "know-how" can achieve the same result as proportional sharing of cash flows. Alternatively, one of the partners brings in some intangible asset (e.g. a brand name) the value of which is negotiated between the partners.

The topic of valuation of a joint venture under these different arrangements and related tax complications is not pursued here. The interested reader can consult Sercu and Uppal (1995) and the references cited therein.

Summary

This chapter addresses the issue of valuation of foreign direct investment projects. It begins with an exposition of the NPV framework which is used for appraisal of domestic projects and then goes on to present the Adjusted Present Value or APV approach which focuses on project cash flows and separates out the effects of financing and other special features of a project. We then discuss the special problems associated with international projects and how the APV framework can be

[14]See for instance Rubinstein (1982) and Sutton (1986).

adapted to evaluate international projects. An illustrative example is worked out in detail, followed by a discussion of some unresolved issues. The chapter concludes with a very brief discussion of appraisal of joint ventures.

Questions and Problems

1. In international project appraisal, the NPV of the foreign project has to be found in terms of the home currency. The following five alternatives are suggested:
   (a) Use real foreign currency (FC) cash flows, discount using real FC discount rate, translate into home currency (HC) using the starting spot rate.
   (b) Use nominal FC cash flows, discount using nominal FC discount rate translate using starting spot rate.
   (c) Forecast future spot rates, convert nominal FC cash flows into nominal HC cash flows, discount using nominal HC discount rate. Forecast exchange rates using relative PPP.
   (d) Determine real HC cash flows, discount using real HC discount rate.
   (e) Use relative PPP to forecast future exchange rates, convert foreign currency cash flows into HC, discount using real HC discount rate.

   Under what conditions if any will these five approaches yield identical answers?
2. A young financial analyst in a Canadian firm has been assigned the task of evaluating a direct investment project in Mexico. She has worked out the operating cash flows of the project for the next 7 years For finding the NPV of the project, she proposes the following four alternatives:
   (a) Discount the nominal MEP (Mexican Peso) cash flows using the Mexican nominal interest rate used for similar projects and translate into CAD using the current MEP/CAD spot rate.
   (b) Discount the real, i.e. inflation adjusted MEP cash flows using the Mexican real interest rate and translate at the current spot rate.
   (c) Forecast the MEP/CAD exchange rate for the next 7 years using PPP; translate nominal MEP cash flows into nominal CAD cash flows; discount using nominal CAD interest rate used for similar projects.
   (d) Adjust the nominal CAD cash flows for Canadian inflation and discount using real Canadian interest rate.

   Her boss says that if relative PPP and covered interest parity hold, the above alternatives would yield identical answers. Is he right? If not, can you correct him? Justify your answers with appropriate and sufficiently detailed arguments.
3. Consider a firm with a healthy cash flow but very low profits—because, for example, of high depreciation allowances. Your boss argues that such a firm should probably borrow in a strong (low-interest) currency, because the high-tax shield from weak-currency loans is more likely to be lost than the low tax shield from strong-currency loans. Is this analysis accurate?
4. Denote the initial investment by I_0, the operating cash flows by OC_t, the loan by D_0, and the service payments on this loan by Serv_t. The standard NPV is computed as

$$\sum_{t=T_1}^{t=T_N} \frac{OC_t}{(1+R)^t} - I_0$$

(a) Assume zero taxes and no uncertainty. One could, conceivably, compute an NPV from the shareholder's point of view by considering the cash flows after interest payments and the initial investment over and above the amount borrowed:

$$\sum_{t=T_1}^{t=T_N} \frac{(OC_t - \text{Serv}_t)}{(1+R)^t} - (I_0 - D_0)$$

Explain why, with zero taxes and no uncertainty, this produces the same answer as a standard NPV analysis. (Hints: (1) How does one compute the PV of a sum (all difference) of two risk-free cash flows? (2) What is the link between the PV of the service payments and the amount borrowed, D_0?)

(b) Does uncertainty affect this conclusion?

(c) Does the introduction of taxes affect this conclusion?

5. A British company is considering a project in Freedonia. Assume that the Freedonian Crown (FRK) cash flow can take on either of two (equally probable) values, FRK 150 or FRK 100, depending on whether the Freedonian economy is booming or in a recession. Let there also be two, equally probable time—T spot rates, GBP/FRK 1.2 and 0.8. Thus, measured in GBP, there are four possible cash flows: 150 × 1.2 = GBP 180, 150 × 0.8 = GBP 120, 100 × 1.2 = GBP 120, and 100 × 0.8 = GBP 80. These numbers are shown in the following table. In each cell, we also show the joint probability of each particular combination. When the FRK is expensive, a recession is more probable than a boom because an expensive currency means that Freedonia is not very competitive. The inverse happens when the Crown is trading a low level; then it is more likely that the economy will be booming. These effects are reflected in the probabilities shown in each of the four cells in the following table.

Table The Distribution of Home-Currency Cash Flow

	State of the Economy	
	State: Boom	State: recession
	FRK cash flow: 150	FRK cash flow: 100
	Probability: 0.50	Probability: 0.50
S_T high: FRK/GBP 1.2	Cash flow: GBP 180	Cash flow: GBP 120
Probability: 0.50	Joint probability: 0.15	Joint probability: 0.35
S_T low: FRK/GBP 0.8	Cash flow: GBP 120	Cash flow: GBP 80
Probability: 0.50	Joint probability: 0.35	Joint probability: 0.15

Discuss the methods for valuation of these cash flows. What inputs are needed to correctly value such risky cash flows?

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APPENDIX

A.20.1 TRANSFER PRICING

Transfer pricing is a device used by multinational corporations (MNCs) to price intra-corporate exchange of goods and services in a manner designed to maximise overall after-tax profit. It allows the parent company to control the amount and direction of intra-corporate transfers towards the attainment of a number of vital but often conflicting objectives. In recent years, opportunities in this direction are being severely restricted by legal constraints placed by many governments on the practice of transfer pricing.

Essentially, transfer pricing involves charging prices for intracorporate transactions which are different from those used for identical goods and services in transactions with third parties. The latter are called ***arms length prices.*** Suppose a multinational drug company has a subsidiary in a developing country. The parent supplies bulk formulations to the subsidiary. The tax rate in parent's country is low while that in the subsidiary's country is high. By charging high prices – higher than arms length prices – for the inputs supplied to the subsidiary, the reported taxable profit of the subsidiary is reduced while that of the parent is increased, thus reducing the overall tax liability.

Apart from tax saving, transfer pricing may be used to serve one or more of the following objectives:

1. Positioning of funds in locations that will suit corporate working capital policies.
2. Reducing exchange exposure and circumventing exchange controls and other restrictions on profit repatriation so that transfers from affiliates to the parent can be maximised.
3. Reducing customs duty payments and overcoming quota restrictions on imports.
4. "Window dressing" operations to improve the apparent, i.e. reported financial position of an affiliate so that its credit rating may be enhanced.

Many giant MNCs have employed the device of re-invoicing centres located in tax havens such as Bahamas, Cayman islands, etc., to co-ordinate transfer pricing around the world. Intra-corporate transactions, e.g. between two affiliates of the same parent or between the parent and an affiliate, are routed through the re-invoicing centre. The latter takes title to the goods sold by the selling unit and resells them to the receiving unit. The prices received by the seller and the prices charged to the buyer are determined so as to achieve one or more of the above objectives. There is no interference with the actual flow of goods which are shipped from the seller to the buyer, but with the documentation showing the two-stage transfer. The purpose is to siphon profits away from a high-tax parent or affiliate to low-tax affiliates and position funds in locations with strong currencies and virtually no exchange controls.

The main constraint on the ability of an MNC to employ transfer pricing arises from the provisions in the tax codes of most countries which enable the tax authorities to reallocate and recompute corporate income. These provisions attempt to establish "correct prices" for intra-corporate transactions in line with arms length prices whenever the latter are available. In addition, the law may also provide for other penalties if a case is established against the management. Another factor is the involvement of local interests in a joint venture. Siphoning profits away from an affiliate will hurt the interests of the local partners in the venture and they will resist such policies.

Some of the objectives stated above may be mutually contradictory. In order to overcome a quota set in value terms by the government of a developing country, if the parent charges low transfer prices to the affiliate in that country, it will conflict with the objective of siphoning profit away from a "soft" currency and (most likely) a high tax country. Very often, transfer pricing may be primarily motivated by exchange control and restrictions on profit repatriation. Overall tax minimisation may be a secondary objective.

A.20.2 AN EXAMPLE OF THE OPTIONS APPROACH TO PROJECTS

We will illustrate the limitations of the traditional NPV analysis by considering a highly simplified situation wherein there is an option to abandon the project at some point during its life. We will use the technique of decision trees to incorporate this possibility in the evaluation of the project.

ABC Ltd., an Indian firm long active in the wines and spirits business, has an opportunity to acquire a brewery in New Zealand for a price of 15 million New Zealand dollars (NZD). The output of the brewery will be sold in the local market and sales will depend upon the state of the New Zealand economy. The brewery will be in a working order for two years after which it will have to be scrapped. Apart from the state of the New Zealand economy, the exchange rate between the Indian rupee and New Zealand dollar is also a source of uncertainty. The company has examined alternative scenarios and come up with the possibilities shown in Exhibit A.20.1. The firm can liquidate the plant at the end of year 1 for a salvage value of NZD 12 million.

Exhibit A.20.1 Exchange Rate and Net Cash Flow Scenarios

Year 1	*Year 2*
(27.5, 20.0)	→ (31.8125, 30.0)
	→ (24.0625, 25.0)
(17.5, 10.0)	→ (24.0625, 10.0)
	→ (15.3125, 7.0)

In each pair of numbers in the parentheses, the first number corresponds to the NZD/INR exchange rate and the second to the net cash flow from the plant in millions of NZD. The current spot rate is INR 20.0 per NZD. Thus, in year 1, the exchange rate may go up to 27.5 with the net cash flow being 20.0 million NZD or, the exchange rate may plunge to 17.5 and then the cash flow will be 10.0 million NZD. Both outcomes are equally likely with 50% probability of occurrence. Given the outcome in year 1, in year 2 again, there are two equally likely possibilities; thus if in year 1, boom conditions prevail, the exchange rate may further rise to 31.8125 with the net cash flow rising to 30.0 million or the economy may slow down with the exchange rate falling to 24.0625 and the net cash flow to 25.0 million. If the economy is depressed in year 1, the year 2 outcome may be (24.0625, 10.0) or (15.3125, 7.0), each with probability 50%.

We will first determine the expected net present value of acquiring the brewery without considering the abandonment option.

The four possible scenarios, the rupee net cash flows under each and the NPV of these cash flows are shown in Exhibit A.20.2.

Exhibit A.20.2 Project NPV without Abandonment Option

Scenario	*Year 0*	*Net Cash Flows (₹ in million) Year 1*	*Year 2*	*Total NPV (₹ in million)*	*Probability*
I	–300	550	954.38	899.93	0.25
II	–300	550	601.56	633.15	0.25
III	–300	175	240.63	34.13	0.25
IV	–300	175	107.19	–66.77	0.25

To obtain the expected NPV of the acquisition, multiply the total NPV under each scenatio by the probability of that scenario and sum across all the scenarios:

$$(899.93 \times 0.25) + (633.15 \times 0.25) + (34.13 \times 0.25) - (66.77 \times 0.25) = 375.12$$

Now let us incorporate the abandonment option. If the economy is depressed in year 1 with the exchange rate at 17.5, the firm can sell off the plant at a net salvage value of NZD 12 million, thus sacrificing the cash flow of the second year. The NPV calculations are now as shown in Exhibit A.20.3.

Exhibit A.20.3 Project NPV with Abandonment Option

Scenario	*Year 0*	*Net Cash Flows (₹ in million) Year 1*	*Year 2*	*Total NPV (₹ in million)*	*Probability*
I	–300	550	954.38	899.93	0.25
II	–300	550	601.56	633.15	0.25
III	–300	385	—	34.78	0.50

If the economic conditions in year 1 are depressed, the firm gets a net cash flow of ₹175 million from operations and ₹210 million from sale of the assets for a total net cash flow of ₹385 million in year 1. The expected NPV of the project is now

$$(899.93 \times 0.25) + (633.15 \times 0.25) + (34.78 \times 0.50) = 400.66$$

Thus, the possibility of abandoning the project after one year increases the expected NPV by over ₹2.5 crores making the project more attractive.

This highly simplified example serves to illustrate the importance of incorporating such built-in operational flexibility in the appraisal process. In most real life situations, many more options may be available – timing of investment, expanding or contracting the scale, temporary closure or abandonment and so forth – and some of them are inter-related in complex ways. The option pricing approach can be fruitfully employed in some of these cases.

Case Study

You are back to your office after a long holiday in Caribbean Islands with your family members. This was a gift for your outstanding performance last year. Your predictions about exchange rate and interest rates were bang on target. This forecast helped your company to save over a hundred million dollars. Your CEO wants you to replicate this performance this fiscal. You have promised your daughter and your spouse that you will be taking them to Amazon forests for white water rafting next year.

Business Situation

Your company is the largest cloth manufacturer in the world in your segment. You are planning forays into the branded garments segment. Since you want to keep transportation costs at their minimum, you are planning to set up manufacturing bases in all the major markets. 'Think Global—Act Local' is your mantra, as well.

Plant and Machinery

It is expected that your three plants will be set up in Mexico, Brazil, and Australia. These plants will have about the same capacity and are likely to cost about USD 10 million each. The construction period could be anywhere from two to five years, depending on the support received from local government officials. This investment could easily make your company the second largest manufacturer of cloth in that segment.

Ownership

Your company has a choice of either setting up a 100% subsidiary or a joint venture with one of the local companies.

Local Issues

There are local political parties who can make life difficult in Brazil. However, in Mexico and Australia you are likely to sail smoothly.

Cash Flow

There are no credible estimates for cash flow because the local markets are an uncharted territory for you. All you know is: your goods will be priced in local currency.

Capital

On this front, you have multiple choices: (i) raising domestic equity in rupee terms, (ii) mix of debt and equity in rupee terms, (iii) USD denominated bond issue, (iv) raising local currency debt.

Question: Should your company make this investment? If yes, then which will be the best route to (a) maximization of profits, (b) minimizing risk, (c) finding the optimal mix of profits and risk.

What all information do you need to arrive at these answers? How will you structure your analysis?

Chapter 21

Accounting Implications of International Activities*

We are in an era of global compulsiveness. Business enterprises are quickly recognising the need to view the world as a single market, as the dividing line between the domestic and overseas market has started blurring with the increase in the level of interdependency. Indian business enterprises are spreading their activities across the national frontiers as part of this globalisation process. Being a part of the world market is not going to be easy: cultural, linguistic, currency and control issues have to be confronted and dealt with. At the micro level, business strategies for marking investment and financing decisions have to reckon with the risks arising from changes in exchange rate of currencies.

With the fall of the Bretton Woods System of fixed exchange rates in 1973, the International Monetary Fund permitted member countries to select and maintain an exchange arrangement of their choice which was communicated by the Fund. This imparted a lot of flexibility to the exchange rate mechanism and consequently exposed the nations more acutely to the risk of exchange rate fluctuations. Exchange rates in India were controlled by the Reserve Bank of India and at the end of February 1992, a dual exchange rate system was introduced and a year later, India moved to a unified market determined exchange rate. In terms of fiscal control, we are in the process of moving towards full convertibility from the present regime of partial convertibility. These changes will force Indian enterprises to face the full impact of exchange risk. This chapter deals with the accounting issues that arise due to exchange rate fluctuations and their impact on the reported earnings and the status of business enterprises.

For the purposes of accounting, foreign activities of an Indian enterprise are divided into two categories. It may enter into transactions which are denominated in foreign currency like import or export of goods or services, borrowing or lending of money, acquisition and sale of securities outside India and subscription by foreign firms to shares issued by Indian companies. It may have foreign operations conducted through branches, subsidiaries, associates, etc. The feature of a foreign

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*This chapter has been contributed by Prof. S. Sundararajan, formerly a professor at Indian Institute of Management, Bangalore.

operation is that it maintains its own accounting records and prepares financial statements in the local currency. An Indian entity, having either or both the types of foreign activities, has to express the foreign currency financial transaction and financial statements in Indian rupees for inclusion in its financial statements. The two principal accounting issues common to both the types of activities relate to the choice of the rate of exchange to be used and the manner of dealing with the loss or gain arising from the differences in the exchange rates. These and the other related matters are dealt with in two parts.

- Accounting for foreign currency transactions
- Accounting for foreign operations

Wherever applicable, the accounting treatments suggested are based on the pronouncements contained in the revised international accounting standard 'The Effects of Changes in Foreign Exchange Rates' (IAS-21) issued and revised till 2003 and its Indian counterpart AS-11 issued and revised by the Institute of Chartered Accountants of India (ICAI) till 2003.

21.1 ACCOUNTING FOR FOREIGN CURRENCY TRANSACTION

A transaction that requires settlement in a foreign currency is called a *foreign currency transaction.* Accounting issues like choice of exchange rate and manner of treatment of exchange difference arise when a foreign currency-denominated transaction is not settled on the date of the transaction, but is carried forward as in the case of credit purchase, credit sale, lending, borrowing, etc. For the purposes of our discussion, by the term foreign transaction, we mean those that are not settled as stated above. There can also be foreign currency forward contracts or other forms of hedges of any exposed foreign currency item. We will first develop a conceptual framework for accounting foreign currency transaction and then consider the accounting implication of forward contracts.

21.1.1 A Conceptual Framework for Accounting Foreign Currency Transactions

We can view a foreign currency transaction as comprising two components, viz. monetary and non-monetary. That part of the transaction which will entail inflow or outflow of foreign currency for settlement in the ordinary course of business is called monetary and the other part which does not involve such settlement is called non-monetary. For example, if an Indian company imports goods for DM 10,000 on credit, there are two components to this transaction: one is the liability to the supplier to be settled in foreign currency and the other is the aspect of acquisition of goods. The trade liability is called a *monetary item* and the inventory is called a *non-monetary item.*

The initial step in accounting is to distinguish between items which are monetary and others which are not. It may be noted that not all foreign currency transactions have both monetary and non-monetary components. For example, if an Indian company raises a loan in French francs which is credited to the account of the company in a French bank, then both components of this transaction namely, the loan and the balance in bank constitute monetary items. Examples of monetary items are trade receivables, trade payables, foreign currency balances on hand and with bank, amounts borrowed or lent in foreign currency, etc.

When a foreign currency transaction takes place, it has to be accounted by using a rate of exchange. If the transaction is not settled then and there, we have a monetary item arising in respect of this transaction. Suppose this monetary item is settled partly on some other date during the same financial year in which the transaction took place and the exchange rate on this date is different from the rate on the transaction date, we have a gain or loss due to exchange difference. Further on the balance sheet date, if we express the outstanding monetary item denominated in foreign currency in Indian rupees by using the rate of exchange prevailing on this date, we will again have an exchange gain or loss. This process will continue till this transaction is settled. The issues that arise in accounting for foreign currency transactions are:

- Fixing the rate to be used for initially accounting for the transaction when it takes place;
- Dealing with the exchange gain or loss arising on partial or full settlement during the same financial year, i.e. conversion; and
- Dealing with the exchange gain or loss on translation of the foreign currency monetary item on the date of balance sheet.

These issues are addressed hereunder.

Initial Accounting

A foreign currency transaction is required to be accounted by an Indian enterprise as at the date on which the transaction occurs by translating the foreign currency into Indian rupees by using the spot rate at that date. A spot rate is a quotation for delivery of foreign currency within two business days. When buying and selling rates are quoted separately, the corresponding rate should be used. It is also permissible to use a rate which approximates the actual rate. For example, when there are several transactions in a given foreign currency, an average rate based on the transactions relating to a week or a month can be used. If there are wide fluctuations in exchange rates, then care has to be taken to ensure that the single rate used is an appropriate substitute for the host of actual rates which it is supposed to represent. When the government decides to regulate the flow of foreign exchange and accordingly announces an official rate, like the situations in India during the regimes of full/partial control, such rate applicable to the transaction has to be used.

Normally, exchange rates are quoted as the number of units of reporting currency per unit of foreign currency. This is called the direct rate. When this relationship is reversed, i.e. the number of units of foreign currency per unit of reporting currency, it is called indirect rate. In this chapter, we will use the expression, ‘exchange rate’ to mean ‘direct rate’.

Conversion on Settlement

A transaction in foreign currency may be settled either partly or fully, on a date later than the date of the transaction, by converting rupees into foreign currency or vice versa, at a rate different from the historic (transaction) rate. This will result in exchange difference. Such difference, either gain or loss, is recognised in the profit and loss account of the financial year/s in which the settlement takes place.

Translation at each Balance Sheet Date

All foreign currency monetary items are retranslated into rupees at each balance sheet date by using the closing rate and the resultant exchange difference is recognised in the profit and loss account. In respect of non-monetary items which are carried at historical cost, no subsequent translation is made. Non-monetary items, carried at fair value denominated in a foreign currency, are translated by using the exchange rates that existed when the fair values were determined.

The aspects relating to initial accounting, conversion and translation at the balance sheet date are illustrated in the following example.

A trading company in India imported on credit from a Canadian firm, 50 computer printers at CAN$300 each (landed price) on January 31, 2006. The terms are that the amount should be settled by payment of US $7500 each on February 28, 2006 and April 30, 2006. The financial year of the Indian company ends on March 31. The stock of these computers held as on March 31, 2006 is 30 numbers. The spot exchange rates on various dates are as follows.

Jan. 31	₹36.04;	Feb. 28	₹36.09
Mar. 31	₹36.06;	Apr. 30	₹35.96

The following entries (in Indian rupees) will be passed by the Indian company to account for the above transactions:

2006		*Dr.*	*Cr.*
Jan. 31	Purchases	5,40,600	
	Accounts Payable		
	[15000 × 36.04]		5,40,600
Feb. 28	Accounts Payable	2,70,300	
	Exchange Loss	375	
	{7,500 × (36.04 – 36.09)}		
	Bank		2,70,675
Mar. 31	Exchange Loss	150	
	{7,500 × (36.04 – 36.06)}		
	Accounts Payable		150
Apr. 30	Accounts Payable	2,70,450	
	Exchange Gain		750
	{7,500 × (36.06 – 35.96)}		Bank
		2,69,700	

Differing Approaches to Accounting Transactions

There are various alternative approaches available for accounting foreign currency transactions. A few of these are:

- Two transaction—recognise
- Two transaction—defer
- One transaction—recognise

The accounting entries proposed in the above example are based on the first approach. Under this approach the transaction is divided into two parts: the purchase aspect and the settlement aspect. The latter is treated as a method of financing and hence, the gain or loss on account of exchange difference on this monetary component of the transaction is recognised in the income statement in the manner similar to treatment of interest. The non-monetary component of the transaction, namely, the inventory is not disturbed for the change in exchange rates. Further, the notional exchange gain or loss arising on restating the monetary item at the rate prevailing on balance sheet date is also recognised in the income statement.

The second method is different from the first in this respect that the gain/loss on translation on balance sheet date is deferred and recognised on the date of settlement. Put differently, only realised exchange gain or loss is recognised under the second method. Accordingly, only the net loss of ₹600 [7,500 × (36.04 – 35.96)] occurring on the date of settlement, namely April 30, will be recognised in the income statement instead of the translation loss of ₹150 on March 31, 2006 and conversion gain of ₹750 on April 30, 2006.

Under the third method all events subsequent to the initial transaction are treated as part of such initial transaction. Hence, the loss on February 28 and March 31 would be adjusted to inventory/cost of goods sold. The gain on April 30 would also be adjusted as above. If the goods are not in stock, the adjustment will be to retained earnings.

For financial accounting purposes the first treatment is widely used and is also recommended by IAS-21 and AS-11. The second approach is generally used for tax accounting.

The rules of accounting as indicated in the illustration holds good for lending/borrowing transactions as well as subscriptions to the securities issued by an Indian company. We will deal with the accounting aspects of investment denominated in foreign currency in the next part.

21.1.2 Accounting Implications of Foreign Exchange Forward Contracts

Engaging in international activities exposes enterprises to the risk arising from exchange fluctuations. In a free market, the spot exchange rate for a given currency is dependent on the supply and demand for that currency which, in turn, is influenced by international movements involving goods, services and investments and in some measure currency speculation. With a view to eliminate or reduce substantially the risk of loss from changes in exchange rates on positions held, enterprises enter into foreign currency transactions which serve as hedges. Since these hedging transactions have a cost, either explicit or implicit, the enterprise has to evaluate the hedge by comparing the hedging cost with the estimated gain or loss that may arise from unhedged open positions.

A foreign currency hedge may be in the form of a foreign currency transaction involving acquisition of foreign currency asset like making foreign currency deposit or incurring foreign currency liability by taking foreign currency loan. The hedging cost incurred is normally recognised in the income statement. But when a foreign currency liability is accounted for as a hedge of a net investment in an independent foreign operation, the exchange difference on the hedge item is adjusted to the retained earrings of the parent and is recognised in the income statement only on the sale of the investment which is hedged.

Forward exchange contracts, options, futures, etc., are other ways of hedging open positions. We will discuss here the accounting implications of forward exchange contracts. Financial instruments such as options, currency swaps and futures contracts involve special accounting treatments by themselves and hence, these are not discussed in this chapter.[1]

A forward exchange contract is a contract to deliver or receive at a specified forward rate and on a stipulated future date, certain quantum of a foreign currency. The forward rate usually differs from the spot rate because of different economic factors. By and large, this difference is attributable to the difference between the interest rates obtaining in the countries of the currencies under consideration. If the forward rate is more than the spot rate, the difference is called a ***premium***; if the forward rate is less than the spot rate, the difference is called a ***discount***, i.e. the foreign currency is being sold at a discount. The premium or discount is treated in the same way as interest income or expense. Forward contracts are generally for short periods. Though RBI permits without prior approval forward contracts beyond 180 pays, there is not much of liquidity for such instruments.

Forward contracts can be used for hedging or speculative purposes. Presently, speculation in foreign currency is not allowed in India. Authorised dealers like banks are permitted to trade in

[1]Those interested in understanding more about these aspects may refer to ***IAS-32 and 39*** issued by the International Accounting Standard Committee on financial instruments.

foreign currency and enter into forward contracts for this purpose and they can use this facility to put through transactions which are in effect speculative transactions. As a hedging device, forward contracts cover an exposed net asset or liability position, or a net investment in a foreign operation, or an identifiable foreign currency commitment. In forward contracts, the accounting issues relate to the treatment of premium and discount. Let us discuss the accounting treatments in the following three cases where the forward contracts are used as a device to:

1. Hedge an exposed foreign currency net asset or liability position;
2. Hedge an identifiable foreign currency commitment;
3. Speculate in foreign currency markets.

Case 1: Hedging an Exposed Foreign Currency Net Asset or Liability Position
A company that has accounts receivable or other monetary assets denominated in a foreign currency greater than its monetary liabilities denominated in that currency, faces a foreign currency risk from its exposed net assets position. Alternatively, it may have an exposed net liability position when monetary liabilities denominated in a foreign currency exceed monetary assets denominated in that currency. A company may enter into a forward contract to hedge an exposed net asset or net liability position as stated above or a net investment in a foreign entity.

Let us illustrate the accounting aspects of hedging an exposed net asset or liability position with the help of the following example dealing with a simple situation of a receivable.

On February 1, 2006, an Indian company sold goods to a company in Canada for an invoice price of CAN dollar 10,000, when the spot rate was ₹35.70 per CAN dollar. Payment was to be received in three months on May 1, 2006. To avoid the risk of loss from decline in exchange rate on the date of receipt, the Indian exporter acquired a forward contract to sell CAN dollar 10,000 @ ₹35.20 per dollar on May 1, 2006. The company's accounting year ends on March 31, 2006 and the spot rate on this date was ₹34.70 per US dollar. The spot rate on May 1, 2006, the date of receipt of money by the Indian exporter was ₹34.20 per CAN dollar.

Accounting entries in rupees for giving effect to the aforesaid transactions in the books of the Indian exporter are as follows:

			Dr.	Cr.
(a)	Feb. 1			
	(i)	Sundry Debtors	3,57,000	
		Sales (To record sales transaction at spot rate)		3,57,000
	(ii)	Forward (₹) Contract Receivable	3,52,000	
		Deferred Discount	5,000	
		Forward (CAN $) Contract Payable (To record agreement to exchange in three months CAN $10000 for ₹3,52,000)		3,57,000
		This entry represents the exporter's obligation to exchange CAN $10,000 for ₹3,52,000 on May 1, 2006.		
		There is certainty about the sum of ₹3,52,000 receivable. Obligation to pay CAN $10,000 is accounted at the spot rate and like any other receivable or payable, this will be restated again at the spot rate on the balance sheet date.		
		Suppose on May 1, 2006 the exporter does not receive the dues from the importer, then he has to buy CAN $ 10,000 at the spot rate prevailing on this date and meet the obligation. Hence, the need to reflect this part of the obligation at the spot rate.		

(Contd.)

(b)	Mar. 31			
	(i)	Exchange Loss	10,000	
		Sundry Debtors		10,000
		(To record the translation loss on the moneys receivable on account of a drop in the spot rate as at the date of balance sheet compared to transaction date)		
	(ii)	Forward (CAN $) Contract Payable	10,000	
		Exchange Gain		10,000
		(To record the reduction in rupees payable to the exchange dealer at spot rate on March 31, 2006)		
	(iii)	Discount Expense	3,334	
		Deferred Discount		3,334
		(To record the amortisation of proportionate discount for two months)		
Next Financial Year				
(c)	May 1			
	(i)	Cash	3,42,000	
		Exchange Loss	5,000	
		Sundry Debtors		3,47,000
		(To record receipt of CAN $ 10000 from the importer at the spot rate on May 1, 2006)		
	(ii)	Forward ($) Contract Payable	3,47,000	
		Exchange Gain		5,000
		Cash		3,42,000
		(To record delivery of CAN $10000 against forward contract at spot rate on May 1, 2006)		
	(iii)	Cash	3,52,000	
		Forward (₹) Contract		3,52,000
		Receivable (To record receipt of rupees as per forward contract)		
	(iv)	Discount Expenses	1,666	
		Deferred Discount		1,666
		(To record amortisation of proportionate deferred discount for one month)		

In the final analysis, the company recorded an exchange loss of ₹15,000 on account of sale of CAN dollar received from the importer, offset by the gain of ₹15,000 on account of the reduction in the forward CAN dollar contract payable in terms of rupees. In the process, the Indian company incurred a discount expense of ₹5,000 amortised at ₹3,334 and ₹1,666 over two accounting periods. What is the benefit to the company from this forward contract? On account of this forward contract, the company realised ₹3,52,000 from the sale of CAN dollar 10,000. Had the company sold this CAN dollar on the date of its receipt in the open market at spot rate, it would have got ₹3,42,000, a sum of ₹10,000 less than what it realised from the forward contract. To effectuate this, the company incurred a discount (hedging) expense of ₹5,000.

Case 2: Hedging an Identifiable Foreign Currency Commitment
An Indian company can enter into a contract for import/export of goods with delivery to be made on an agreed future date. The payment for the goods may be made on the date of delivery or any other future date beyond the delivery date. On the date of the contract, there is no transaction but there is a commitment to buy or sell on a stipulated future date. A forward exchange contract can be entered into as a hedge of any such identifiable foreign currency commitment. In such an event, any gains or losses on the forward contract will be deferred until the transaction is put through and adjusted against the cost of purchase or sales revenue as the case may be. To understand the accounting implications more clearly, let us continue with the previous illustration considered under Case 1. Suppose in the foregoing illustration, the Indian exporter entered into a sale agreement on February 1, 2006 for delivery of goods and receipt of money on May 1, 2006 and other things remained the same, then the transaction gain or loss and the premium or discount on forward contract would have been deferred and included in the measurement of the related foreign currency transaction. The entries would have then been as stated below.

(a)	Feb. 1			
		Forward (₹) Contract Receivable	3,52,000	
		Deferred Discount	5,000	
		Forward (CAN $) Contract Payable		3,57,000
(b)	Mar. 31			
	(i)	Forward (CAN $) Contract Payable	10,000	
		Deferred Gains		10,000
	(ii)	Deferred Sales Adjustment	3,334	
		Deferred Discount		3,334
Next Financial Year				
(c)	May 1			
	(i)	Sundry Debtors	3,42,000	
		Sales		3,42,000
	(ii)	Cash	3,42,000	
		Sundry Debtors		3,42,000
	(iii)	Forward (CAN $) Contract Payable	3,47,000	
		Deferred Gains		5,000
		Cash		3,42,000
	(iv)	Cash	3,52,000	
		Forward (₹) Contract Receivable		3,52,000
	(v)	Deferred Gains	15,000	
		Deferred Sales Adjustment		3,334
		Deferred Discount		1,666
		Sales		10,000

It may be seen that under the forward contract as a hedge of a commitment, sales were recorded at ₹3,42,000 and the net exchange gain of ₹10,000 (overall exchange gains of ₹15,000 less discount of ₹5,000) was added to sales. When the forward contract was a hedge of an exposed asset or liability position as in the main illustration, sales was recorded at ₹3,57,000 and discount expense was accounted at ₹5,000 with the exchange gain of ₹15,000 on forward contract offset by the exchange loss of ₹15,000 on sale of dollars received from sundry debtors. Under both types of contracts, the forward contracts relating to foreign currency payable component were valued on the balance sheet date at the spot rate as on that date. The difference is that under the hedge of an exposed position, the transaction gain/loss was recognised in the profit and loss account and the premium or discount was amortised whereas under the hedge of an identifiable foreign currency commitment, both the transaction gain or loss and the forward contract premium or discount were included in the measurement of the related foreign currency transaction.

Case 3: Speculation in Foreign Currency Markets

A forward exchange contract may be for speculative purposes. In such a case both receivable and payable forward contract accounts are recorded at forward rate and hence there will be no premium or discount to be accounted. On the balance sheet date, the contracts are valued at the forward rate available as on that date for the remaining life of the forward contract and the gain or loss is reported in the profit and loss account.

Let us consider the following illustration.

On March 1, 2006 an Indian company expecting the exchange rate for euro to increase from the current level of ₹58.70 per euro, contracted to buy euro 10,000 in 60 days at a forward rate of ₹59.40 per euro. As at March 31, 2006, the balance sheet date, the forward contract rate for 30 days was ₹59.30 per euro. The spot rate on April 30, 2006, the date of settlement of the contract was ₹60.30 per euro. The following entries will be passed in the books of the Indian company in rupees.

(a)		Mar. 1		
		Forward (euro) Contract Receivable	5,94,000	
		Forward (euro) Contract Receivable		5,94,000
		(To record agreement to exchange in 60 days ₹5,94,000 for receipt of euro 10,000)		
(b)		Mar. 31		
		Exchange Loss	1,000	
		Forward (euro) Contract Receivable		1,000
		(To record the translation loss on the rupee equivalent of euro receivable valued at the forward rate for the remaining 30 days period of the contract) – [10000 × (59.40 – 59.30)]		
(c)		Apr. 30		
	(i)	Forward (euro) Contract Receivable	10,000	
		Exchange Gains		10,000
		(To record the exchange gain on account of increase in the rate of euro on the date of settlement of the contract)—[10000 × (60.30 – 59.30)]		
	(ii)	Forward (₹) Contract payable	5,94,000	
		Cash		5,94,000
		(To record payment of rupees as per forward contract)		
	(iii)	Investment in Foreign Currency	6,03,000	
		Forward (euro) Contract Receivable (To record receipt of euro 10000 as per forward contract at spot rate)		6,03,000
	(iv)	Cash	6,03,000	
		Investment in Foreign Currency		6,03,000
		(To record sale of euros and receipt of cash in rupees at spot rate)		

This speculation in foreign currency enabled the Indian company to earn a net profit of ₹9,000, accounted as loss of ₹1,000 in the year of the forward contract and gain of ₹10,000 in the following year.

21.2 ACCOUNTING FOR FOREIGN OPERATIONS

Many a time it happens that an entity which begins its foreign activities by entering into transactions in foreign currency gradually extends its operations outside the home country by opening overseas branches, investing in foreign subsidiaries or forming any other types of strategic alliance. Such a set-up abroad is called a 'foreign operation' and the enterprise in the home country is called a 'parent' or the 'reporting enterprise'. The main feature of the foreign operation which is relevant for our purposes is that it maintains its books of account in its local currency and prepares its financial statement in that currency. This necessitates translation of such financial statements denominated in a foreign currency into the currency of the parent called the 'reporting currency'. The method to be used to translate the financial statements of a foreign operation depends on the way in which it is financed and operates in relation to the parent.

In this part, we will first deal with the accounting implications of investment in shares of companies, especially those denominated in foreign currency. Then we will take up the aspect of classification of foreign operations into two types for determining the method to be used for translation of financial statements denominated in a foreign currency. This will be followed by a discussion on the translation methodologies. We will conclude by considering two examples which will illustrate the translation of foreign currency financial statements relating to the two categories of foreign operations.

21.2.1 Accounting for Investments in Shares of Foreign Companies

When a company invests in the shares of another company, the investing company has to deal with two accounting issues, namely determination of the amount at which the investment is to be carried on the balance sheet date and the treatment of the consequent gain or loss. When the investment is denominated in a foreign currency, the aspects of accounting for a foreign currency transaction and dealing with the gain or loss arising due to changes in exchange rates between the date of transaction and the balance sheet date also need to be considered.

An investment denominated in a foreign currency is treated as a foreign currency transaction and as discussed in an earlier section of this chapter, is accounted for by translating the foreign currency value into rupees by applying the exchange rate prevailing on the date of the transaction. Valuation of the investment on the balance sheet is dependent upon the nature of the investment—current or long-term. A current investment is an investment that is by its nature readily realisable and is intended to be held for not more than one year. Any investment other than a current investment is a long-term investment. A current investment is generally carried in the balance sheet at lower of cost and fair value. A long-term investment is carried at cost. When there is a decline, other than temporary, in the value of a long-term investment, the carrying amount is reduced to recognise the decline. The reduction in carrying amount is reversed when there is a rise in the value of the investment or if the reasons for reduction no longer exist.

When an investment denominated in a foreign currency is carried in accordance with the above rule, the exchange rate to be adopted for translation is the rate obtained on date with reference to which the fair value or cost, as the case may be, was determined. This method of valuation, in the case of an investment denominated in a foreign currency, will result in two kinds of gains or losses arising. One is the gain or loss on account of the change in the carrying value of the investment itself and another is due to gain or loss on account of change in the exchange rates between the date on which the investment was accounted and the balance sheet date. Let us consider the following example relating to a current investment to illustrate this point. It may be noted that in the case of a long-term investment, once it becomes evident that the investment has to be carried at a value other than the historical cost or vice versa, then the accounting treatment will be the same for both current as well as long-term investments.

AB Ltd., a company in India bought as current investment 1000 equity shares of XY PLC, a London based company for euro 14,500 on January 05, 2006 when the exchange rate was ₹58.50 per euro. The rate on March 31, 2006, the balance sheet date, was ₹59.00 per euro and the value of the shares as on this date was euro 14,300. The Indian company closed the accounts for the next financial year on June 30, 2006, when the exchange rate was ₹58.00 per euro and the market value was euro 14,700.

The necessary journal entries for both financial years are as follows:

Financial year ending March 31, 2006			
		Dr.	***Cr.***
		₹	₹
(a)	Jan. 5.		
	Investments	8,48,250	
	Bank		8,48,250
	(To record purchase of 1000 Equity Shares of XY PLC for euro 14,500, converted at the exchange rate of ₹58.50 per euro)		
(b)	March 31.		
	Loss on Investments	11,700	
	Exchange Gain		7,150
	Investments		4,550
	(To record the effect of carrying the investment at the market value as on March 31, 2006 of euro 14,300—since it is lower than the cost of Euro 14,500 and translating the same at the exchange rate prevailing on this date) [(14300 × 59.00) – (14500 × 58.50)].		

The decrease in the carrying amount of the investment by ₹4,550 consists of a loss in the value of the investment of ₹11,700 [(14,500 × 14,300) × 58.50] and an exchange gain of ₹7,150 [14,300 (59.00 – 58.50)]. For computing the gain or loss on investment, we proceed as if there is no change in exchange rates but there is a change only in the value of the investments. The exchange gain or loss is obtained by multiplying the change in the exchange rate and the new carrying amount of the investment expressed in foreign currency. It may be noted that the above entry would be passed only if the overall carrying value of the investment is lower than that at which it was accounted. For instance, if the exchange rate as on March 31, 2006 was ₹59.50 per euro, the situation would be an overall gain of ₹2,600 being the difference between loss in the value of investment of ₹11,700 and exchange gain of ₹14,300 [14,300 (59.50 – 58.50)]. No entry will be passed to record this change since the overall carrying value of the investment would then be higher than the cost.

Financial year ending June 30, 2006.			
		Dr.	***Cr.***
		4,550[2]	
June 30	Investments		
	Exchange Loss	7,150[3]	
	Gain on Investments		11,700[4]

[2]Represents the increase in the carrying value of investments from ₹8,43,700, being the fair value on the last balance sheet date to ₹8,48,250, being the historical cost which is lower than the fair value on this balance sheet of ₹8,52,600. (euro 14,700 ₹58.00).

[3]Represents the decrease in the exchange rate from ₹59.00 per euro as on the last balance sheet date to ₹58.50 per euro being the rate on the transaction date with reference to which the investment is to be carried now, applied on the carrying value of the investment as on the last balance sheet date. [euro 14,300 (58.50 – 59.00)].

[4]Represents the increase in carrying value of the investment from euro 14,300 being the fair value on the last balance sheet date to the historical cost of euro 14,500, translated at the rate prevailing on the transaction date, that is [(euro 14,500 – euro 14,300) 58.50].

21.2.2 Classification of Foreign Operations

The method to be used for translation of foreign currency financial statements depends on the relationship between the parent and the foreign operation in terms of the extent to which the power for making investment and financial decisions are delegated to the foreign operation. From the point of view of this relationship, foreign operations are classified into two categories—***foreign operations that are integral to the operations of the reporting enterprise*** **and** ***independent foreign operations*** **also referred to as** ***foreign entities*****.**

A foreign operation that is integral to the operations of the parent carries on business as if it is an extension of the operations of its parent. For example, such foreign operation might only sell goods imported from the parent and remit proceeds to its parent. In such cases, a change in the exchange rate between the reporting currency and the currency of the country of operation has an almost immediate effect on the parent's cash flow from operations. Put differently, the activities of the foreign operation virtually become foreign transactions of the parent. Therefore, the change in the exchange rate affects the individual monetary items held by the foreign operation rather than the parent's net investment in that operation.

In contrast, a foreign entity operates independently as if it were a separate enterprise. Such a foreign operation accumulates cash and other monetary items, incurs expenses, realises revenues and perhaps arranges borrowing, all substantially in its local currency. It may also enter into transactions in foreign currency, including transactions in the country of the parent. When there is a change in the exchange rate between the currencies of the foreign entity and that of its parent, there is little or no direct effect on the present and future cash flows from operations of either the foreign entity or the reporting enterprise. The change in the exchange rate affects the parent's net investment in the foreign entity rather than individual monetary and non-monetary items held by the foreign entity.

Some of the factors that are considered for classifying the foreign operation are:

1. The extent to which the cash flows of the foreign operation affect that of the parent.
2. The degree to which the parent is required to meet the financing needs of its foreign operation.
3. The frequency of transactions between the parent and the foreign operation.
4. The level of dependency of the foreign operation for productive factors on the import from the parent.

Translation Methodologies

Exchange loss or gain arises to the parent in respect of a foreign operation depending upon the assets and liabilities of the foreign operation which are considered as exposed to exchange rate changes. We had seen that classification of foreign operations into those that are integral to the operations of the parent and independent foreign entities helps in identifying the parent's exposure to the risk arising from changes in exchange rates in respect of its foreign operation. The exchange rates used for translation of financial statements of foreign operations should mirror this risk exposure of the parent to the activities of the foreign operation and its implications to the cash flows of the parent. Before we discuss the accepted methods for translation of foreign currency financial statements, it may be useful to develop an understanding of the implications of translation methods used. For this purpose, let us consider four possible methods of translation and work through an illustration using these four methods.

1. **Current-Non-current Method:** Under this method, current assets and current liabilities of the foreign operation are translated at the current exchange rates. Other assets and liabilities and share capital are translated at the historical exchange rates. Depreciation and other amortisation charges are translated by using the rates at which the related assets and other items were accounted. Other profit and loss account items are translated at the average rates. This method presumes that the risk exposure is related to the timing of cash flows and hence, converts assets and liabilities based on maturity rather than the nature of the item.
2. **Monetary-Non-monetary Method:** This method substitutes nature of the balance sheet item for maturity. Under this method, monetary assets and monetary liabilities are translated at the current rates and non-monetary assets and liabilities and share capital are translated at historical rate. Profit and loss account items are translated as in the current-non-current method. This method is based on the premise that when there is a change in the exchange rates, the monetary and non-monetary items respond to such changes in the same way.
3. **Temporal Method:** Though this method is a variation of the monetary-non-monetary method, it is not based on strict balance sheet classification. According to this method, cash, receivables and payables (both current and non-current items) are translated at the current rate. Further, other assets and liabilities which are carried at current value are also translated at current rates. For example, inventory carried at not realisable value will be translated at current rate though this is not a monetary item. All other assets and liabilities which are carried at past transaction prices are translated at historical rates. Revenue and expense items are translated at rates that prevailed when the underlying transactions took place. Use of average rate is also permitted when revenue and expense items are numerous. It may be seen that use of this translation method will amount to treating the foreign operation's transactions as foreign transactions of the parent.
4. **Current Rate Method:** This method requires translation of all assets, liabilities and profit and loss account items using the current rate. This is similar to translation of a book from one language to another. Use of this method will result in preservation of the inter-relationships among various elements in the financial statements. For example, a relationship like fixed assets turnover ratio will remain the same in the currency of the parent as it was in the foreign currency financial statement.

Let us now consider an example to illustrate the effects of translation methods used on the exposure of the balance sheet amounts to exchange risks and the gains or losses due to changes in exchange rates.

Illustration An Indian company acquired 100% shares in an existing foreign company on March 30, 2006, when the exchange rate was ₹1 = 1 F.C. (F.C. is the currency of the foreign operation). The balance sheet of the foreign company as on March 30, 2006 in its currency F.C. is given below. Assuming that there was no transaction on March 31, 1997 and that the currency F.C. was devalued on March 31, 2006 such that F.C. 2.00 was equal to ₹1.00, we can translate the financial statement of the foreign operation as on March 31, 2006 into Indian rupees using each of the four methods stated above and indicate the amount in F.C. that is exposed to exchange risk and the exchange gain/loss in Indian rupees on translation.

The balance sheet in F.C. as on March 31, 2006 (which is the same as the position on March 30, 2006) and the translated statement under each of the methods as on March 31, 2006 along with the exposure position and exchange gain/loss is given in Table 21.1.

Table 21.1 Effects of using Different Exchange Rates on Currency Exposure Translation Gains and Losses Balance Sheet as on March 31, 2006 of Foreign Operations

	FC	*Rupees before Devaluation (1 INR = 1 FC)*	*Rupees after Devaluation of FC ₹1 = 2 FC*			
			Current	*Current Non-Current*	*Monetary Non-Monetary*	*Temporal*
Assets		₹	₹	₹	₹	₹
Fixed Assets	5000	5000	2500	5000	5000	5000
Cash	2000	2000	1000	1000	1000	1000
Sundry Debtors	3000	3000	1500	1500	1500	1500
Inventories	4000	4000	2000	2000	4000	2000[1]
Total	14000	14000	7000	9500	11500	9500
Liabilities						
Long-Term Loan	3000	3000	1500	3000	1500	1500
Sundry						
Creditors	4000	4000	2000	2000	2000	2000
Net Worth	7000	7000	3500	4500	8000	6000
Accounting Exposure[2]	7000	5000	(2000)	(2000)		
Translation Gain/(Loss) (₹)	(3500)	(2500)	1000	1000		

[1]Assume that inventories are carried at market value.
[2]Amount of foreign currency exposed to risk of exchange fluctuation based on the translation method used.

Translation Rules and Consolidation

Having understood the inter-relationship between the translation method chosen on the one hand and the amount which is considered exposed to the risk of exchange rate fluctuation and the consequent gains or losses due to changes in the exchange rates on the other, let us now develop a framework for determining the method to be used for translation based on the characteristics of foreign operations.

In the case of an integral operation, the exposure of the parent to the risk of exchange fluctuations is similar to the situation that will arise had the parent company itself put through the transactions of the foreign operation as its foreign transactions. Hence, the method of translation of foreign currency financial statement should, as nearly as possible, produce the same effect as that would ensure by treating the transactions of the foreign operation as that of the parent. The temporal method of translation is found to meet this criterion admirably and is hence an accepted method of translation for integral operations.

We can now turn to foreign operations which are independent entities. Such an entity operates on its own, has its own market, incurs expenses and finances operations without leaning on the support of the parent. Exchange rate fluctuations between the reporting currency and the foreign entity's currency do not directly affect the cash flows of the parent. The stake of the parent is its net investment in the foreign entity. Translation of the financial statements of such entities by using the closing rate method and the subsequent consolidation with the parent (irrespective of whether the foreign entity is a branch or a subsidiary) will reflect the correct position of the inter-relationships between the parent and the foreign entity.

This amount is equal to the net of assets and liabilities items translated by using different rates.

Having said that, the financial statements of an integral foreign operation should be translated by using temporal method and that of independent foreign operation (referred to as 'foreign entity') by using closing rate method, let us proceed to deal with an issue relating to translation: what do we do with the exchange gain or loss arising on translation? The answer is self-evident. In the case of an integral operation, the gain or loss should be dealt with in the same way as applicable to transition gain or loss, i.e. recognised in the profit and loss account. In the case of foreign entity, the stake of the parent is its net investment and hence, till the investment is disposed the gain or loss on translation is deferred and shown under reserves and surplus of the parent as part of its equity.

Let us work through an illustration to understand the mechanics of translation of financial statements denominated in foreign currency of an independent foreign entity. Though under the Indian company law, the financial statements of a subsidiary company are not required to be consolidated with that of its holding company, with a view of explaining the concept of consolidation and the manner of dealing with the long-term investment and the gains or losses arising from exchange rates in the financial statements of the parent, we attempt translation and consolidation in this illustration.

Illustration: Translation of Financial Statement of a Foreign Entity and Consolidation

We are going to consider the case of a foreign entity which is a subsidiary company wherein the issue of the exchange rate to be adopted for translating the net worth would arise. With a view to facilitate a better understanding of this issue and the treatment, the illustration is worked through in two phases. Phase I deals with the position as on the date of acquisition of the foreign entity and Phase II goes further into the position as at the end of the immediately succeeding year.

Phase I—Date of Acquisition

H. Ltd., an Indian Company acquired the entire shares of an established Netherlands company, S. Ltd., for ₹1,80,000 on April 1, 2005. On this date, the exchange rate was ₹18.00 per Dutch Guilder (DG). The balance sheets of H. Ltd., and S. Ltd., as on this date are given below. The balance sheet of S. Ltd., is translated into Indian rupees by using the exchange rate on April 1, 2005.

Balance Sheet as on April 1, 2006		
	H. Ltd. ₹	*S. Ltd. DG*
Fixed assets (net)	5,00,000	8,000
Investments in subsidiary	1,80,000	—
Net current assets	1,20,000	7,000
Long-term loans	—	5,000
	8,00,000	10,000
Owners Funds:		
Share capital	5,00,000	6,000
Profit and loss account	3,00,000	4,000
	8,00,000	10,000

Required: To translate the balance sheet of S. Ltd. into rupees as on April 1, 2006 and to prepare the consolidated balance sheet of H. Ltd., as on this date.

S. Ltd. Balance Sheet as on April 1, 2006			
	DG	***Translation***	₹
Fixed assets (net)	8,000	C.R. = 18	1,44,000
Net current assets	7,000	C.R. = 18	1,26,000
	15,000		2,70,000
Long-term loan	5,000	C.R. = 18	90,000
	10,000		1,80,000
Owners funds: Shares capital	6,000	C.R. = 18	1,08,000
Profit and loss account	4,000	C.R. = 18	72,000
	10,000		1,80,000
C.R. stands for closing rate.			

The consolidated balance sheet of H. Ltd. will be as follows:

H. Ltd. Consolidated Balance Sheet as on April 1, 2006	
	₹
Fixed assets	6,44,000
Net current assets	2,46,000
	8,90,000
Long-term loan	90,000
	8,00,000
Owners funds:	
Share capital	5,00,000
Profit and loss account	3,00,000
	8,00,000

Phase II—End of One Year After Acquisition

Suppose these companies operate for a year and their financial statements at the end of this year are as follows:

Summarised Profit and Loss Account for the year ended March 31, 2006		
	H. Ltd. ₹	***S. Ltd.*** ***DG***
Profit before taxation	1,60,000	4,000
Income tax	80,000	2,000
Profit after tax—retained earnings	80,000	2,000

Balance Sheets as on March 31, 2006.		
	H. Ltd. ₹	S. Ltd. DG
Fixed assets (net)	5,10,000	9,000
Investments in subsidiary	1,80,000	—
Net current assets	1,90,000	8,000
	8,80,000	17,000
Long-term loan	—	5,000
	8,80,000	12,000
Owners funds:		
Share capital	5,00,000	6,000
Profit and loss account	3,80,000	6,000
	8,80,000	12,000

The relevant exchange rates are as follows:
April 1, 2005 ₹18.00 Average rate ₹18.50
March 31, 2006 ₹19.00

Required: To prepare the consolidated financial statements of H. Ltd., for the year ended March 31, 2006.

First let us translate the financial statements of S. Ltd., using the closing rate, i.e. ₹19.00.

Fixed assets (net)	9,000	C.R. = 19.00	1,71,000
Net current assets	8,000	C.R. = 19.00	1,52,000
	17,000		3,23,000
Term loan	5,000	C.R. = 19.00	95,000
	12,000		2,28,000
Owners Funds: Share capital	6,000	C.R. = 19.00	1,14,000
Profit and loss account	6,000	C.R. = 19.00	1,14,000
	12,000		2,28,000

The profit and loss account balance as on March 31, 2006 shows a figure of DG 6,000. Stated in rupees, this is equal to ₹1,14,000. The opening balance in profit and loss account was DG 4,000 equivalent to ₹72,000 (see the translated opening financial statement). Retained earning for the year is DG 2,000 or ₹38,000 (translated at the closing rate of ₹19.00). Thus, the balance in the profit and loss account should be ₹1,10,000 and not ₹1,14,000. The difference of ₹3,000 may seem to arise on account of translation difference. There is a fallacy in this computation.

We know the general relationship that:

Closing net worth = Opening net worth + Additions – Deductions

In the context of foreign operations, if there is no change in the exchange rates, then the closing net worth when translated into the reporting currency should obey this rule.

If there is a change in the exchange rate, then there will be a mismatch in this equation. Let us set up this relationship for S. Ltd., and determine the exchange difference.

Closing net worth as at March 31, 06		=	Opening net worth as at April 1, 05		+	Retained earnings for the year	
DG	₹		DG	₹		DG	₹
12,000	2,28,000	=	10,000	1,80,000	+	2,000	38,000

i.e. ₹2,28,000 = ₹1,80,000 + ₹38,000 = ₹2,18,000

There is a mismatch of ₹10,000 which is the actual exchange difference. This exchange gain is not to be recognised in the profit and loss account, but is to be treated as part of the Reserves and Surplus of the parent in the consolidated balance sheet. In this context, the following points deserve to be noted:

1. The general equation can be stated as:
   Closing net worth = Opening net worth + Additions – Deductions + or – exchange difference
2. The exchange difference can also be determined as opening net worth ₹ (closing rate – opening rate), i.e. 10,000 × (19.00 – 18.00) = ₹10,000
3. In the foregoing discussion, we have presumed that the revenue and expense items and the resultant retained earnings will be translated at the closing rate. Actually we will be using the average rate for converting the figure of retained earnings in foreign currency. Then, the general equation will be

   ₹2,28,000 = ₹1,80,000 + ₹37,000 + E.D.

   Therefore, E.D. (exchange difference) = ₹11,000
   This can be independently confirmed as:
   Exchange difference = Effect of change in the exchange rate on opening net worth + Effect of change in the exchange rate on retained earnings.

   = 10000 (19 – 18) + 2000 (19 – 18.50)
   = 10,000 + 1,000 = 11,000

4. When H. Ltd. invested in the shares in S. Ltd., it was based on the value of the net worth of S. Ltd., expressed in the reporting currency by translating the amount in foreign currency at the rate prevailing on the date of acquisition of these shares. This amount of net worth consisting of pre-acquisition share capital and pre-acquisition reserve will, in the future, continue to be translated at historic rate, i.e. the rate that prevailed on the date of acquisition.

   Expressing the net worth of S. Ltd in DG and rupees in keeping with the points made above will help in grasping the idea.

Owners funds:	***DG***	***Rate***	₹
Share capital	6,000	H.R. = 18.00	1,08,000
Pre-acquisition reserve	4,000	H.R. = 18.00	72,000
Post acquisition reserve:			
Profit and loss a/c	2,000	A.R. = 18.50	37,000
Exchange difference	—	—	11,000
	12,000		2,28,000

Having understood the mechanics relating to translation, let us prepare the translation work sheet of S. Ltd and the consolidated financial statements of H. Ltd.

S. Ltd. Profit and Loss Account for the year ended March 31, 2006

	DG	*Rate*	₹
Profit before taxation	4,000	A.R. = 18.50	74,000
Income tax	2,000	A.R. = 18.50	37,000
Profit after tax	2,000		37,000
Balance Sheet as on March 31, 2006			
Fixed assets (net)	9,000	C.R. = 19.00	1,71,000
Net current assets	8,000	C.R. = 19.00	1,52,000
	17,000		3,23,000
Term loan	5,000	C.R. = 19.00	95,000
	12,000		**2,28,000**
Owners Funds:			
Share capital	6,000	H.R. = 18.00	1,08,000
Pre-acquisition reserve	4,000	H.R. = 18.00	72,000
Post-acquisition reserve:			
Profit & loss account	2,000	A.R. = 18.50	37,000
Exchange difference	—	—	11,000
	12,000		**2,28,000**

H. Ltd. Consolidated Profit and Loss Account for the year ended March 31, 2006

	₹
Profit before taxation	2,34,000
Income tax	1,17,000
Profit after tax	1,17,000
Consolidated Balance Sheet as on March 31, 2006	
Fixed assets (net)	6,81,000
Net current assets	3,42,000
	10,23,000
Term loan	95,000
	9,28,000
Net Worth:	
Share capital	5,00,000
Reserves and surplus:	
Profit and loss account	4,17,000
Exchange difference	11,000
	9,28,000

The accounting treatment for consolidation can become quite complex by itself. The amount paid for the investment in subsidiary need not be equal to the net worth of the subsidiary. Also, the quantum of interest acquired in the subsidiary can be less than 100%, resulting in a need to account for minority interest. Add to this the possibilities of several integral and independent foreign operations with varying degree of exposures to inflationary pressures, being translated and consolidated. The final picture that emerges could be daunting in terms of accounting exercise. The purpose here is to broadly introduce the implications of foreign currency activities on the performance and status of an enterprise due to changes in exchange rates.

Chapter 22

Tax Implications of International Activities*

"Taxes are what we pay for a civilized society. I like to pay taxes. With them I buy civilization"—**Justice Holmes**. When the burden of tax is perceived to be high, the entities to be taxed make all sorts of efforts to reduce this burden by means of tax planning and tax avoidance and in certain instances, they resort to the risky venture of tax evasion. In response, the tax gatherer comes out with measures to check the efforts of the taxpayer to mitigate the tax burden and the cycle goes on. This process makes the tax law very complicated, placing it beyond the reach of a lay person. In this complex setting, which is best handled by experts, the purpose of this chapter is to sensitise the reader to and help him in developing an appreciation for the tax issues involved in the foreign activities undertaken by Indian enterprises and the operations of foreign enterprises in India. The references to section numbers and discussions are based on the provisions of the Income Tax Act, 1961 as amended by the Finance Act, 2010 (referred to hereinafter as the "Act").

As a first step, we will understand the framework for taxing income based on the twin factors of residential status of the entity earning income and the country in which the source of income is situated. The two sections following this will deal with the tax aspects of foreign activities undertaken by an Indian enterprise and activities of foreign enterprises in India in that order. Lastly comes the topic of double taxation relief.

22.1 SCOPE OF TAX CHARGE: STATUS-SITUS NEXUS (SECTIONS 5 AND 6)

22.1.1 Residential Status

Every country develops its own rules to determine the scope of income that it can tax. These rules create liability to tax each year by linking the residential status of the income earning entity and the place where the income is earned. In terms of residential status, the Act stipulates that in respect of

*This chapter has been contributed by Prof Padmini Srinivasan, from Indian Institute of Management, Bangalore.

each previous year[1], any person (individual, firm, company, etc.) is treated as either "resident" or "non-resident" in India. An individual who is a resident can, once again, be considered as either "ordinarily resident" or a "not ordinarily resident". In the case of an individual, the residential status depends upon the duration of his stay[2] in India during the previous year under consideration. A firm or a company is treated as resident or non-resident depending on whether the control and management of its affairs is situated wholly in India or outside India, respectively during the previous year. An Indian company is always treated as a resident. It may be noted that the definition of residential status under the Act is not entirely in agreement with the definition given under the Foreign Exchange Management Act.

22.1.2 Place of Earning Income and Tax Liability

Any person who is a resident and an ordinarily resident during a previous year is liable to tax in India on the world income:

- which is received or deemed to be received in India; or
- which accrues or arises or deemed to accrue or arise in India; or
- which accrues or arises outside India.

Non-residents are liable to tax only in respect of the first two categories of income. An individual who is a resident, but not an ordinarily resident is taxed on the first two categories of income plus the income that accrues or arises outside India which is derived from a business controlled in or a profession set up in India.

We can dwell a little on the ideas of receipt and accrual of income. An income accrues or arises in the place of its source. For example, income from business accrues in the country where the business is carried and rental income is earned in the place where the property is located. Though an income accrues or arises outside India, it is taxable in India if it is received in India. Suppose a non-resident who owns a house in London, which is let out, receives from the tenant the rent in India, such rent will be taxed in India as income received in India under item (1) above. On the contrary, if the tenant pays the rent to the account of the landlord in a London bank and the banker sends the same to the non-resident in India, the same is not taxed in India for the reason that the rent was received first as income by the bank in London and thereafter it passes as money and not as income to India! The idea of deemed receipt in India under the first item refers to certain categories of employees' provident fund transactions in India. The implications of deeming accrual will be discussed separately later. It may be noted that the double taxation avoidance treaties entered into by India with various countries normally provide for the scope of taxability based on the place of earning income and the residential status.

22.2 TAX IMPLICATIONS OF FOREIGN ACTIVITIES OF AN INDIAN ENTERPRISE

22.2.1 Taxation of Exchange Gains or losses

Before we discuss the aspect of treatment of exchange gains or losses for purposes of taxation, let us consider certain basic concepts relating to taxability of incomes/expenditures and gains/losses. For the purposes of taxation receipts, expenditures and losses are divided into capital and revenue

[1]For the purposes of income tax, a uniform financial year ending on 3lst March every year called the "previous year" is adopted for computing the taxable income and determining residential status.

[2]For knowing the tests for residential status, one can refer to Section 6 of the Act.

in nature. A capital receipt is not taxed as income unless otherwise stated. For example, if a person (who is not a detective) receives a reward for restoring a lost property to its owner, it is not treated as income receipt and hence, not taxed. Similarly, capital expenditure is not allowed as a deduction in computing the taxable income. For example, if a company incurs expenditure for laying internal roads within its factory, such outlay is treated as a capital expenditure and hence, not allowed as a one-time deduction in computing the taxable income. On the same token, a loss on capital account is not allowed as a deduction in computing the income, while the loss, which is not on capital account, is allowed as a deduction.

For example, if certain advance is given for purchase of fixed assets and due to some reason, the purchase does not go through and the advance is forfeited, the loss will not be allowed as a deduction on the ground that this is on capital account. If there are certain trading inventory that are destroyed by fire and these assets were not insured, the loss of inventory will be deducted in computing the income of the firm as it is revenue in nature.

The aforesaid general rules are applied in dealing with the exchange gains and losses also. The principle of law in this regard is stated by the Supreme Court in the case of Sutlej Cotton Mills Limited vs CIT [1979] 116 ITR in page number 13, thus:

"The law may, therefore, now be taken to be well settled that where profit or loss arises to an assessee on account of appreciation or depreciation in the value of foreign currency held by it, on conversion into another currency, such profit or loss would ordinarily be trading profit or loss if the foreign currency is held by the assessee on revenue account or as a trading asset or as part of circulating capital embarked in the business. But if on the other hand, the foreign currency is held as a capital, such profit or loss would be of capital nature".

Some of the decided case laws relating to treatment of exchange gain[3] which are in conformity with the rule stated by the Supreme Court as above are mentioned below by way of amplification.

1. In the case of EID Parry Limited [174 ITR 11], the promoters of the company made contribution towards share capital in pound sterling and this amount was kept in a bank in the UK. After a few months, this was repatriated into India and there was an exchange gain on conversion. It was held that this was capital in nature and hence, not taxable.
2. In the case of Triveni Engineering Works [156 ITR 202], the company converted a loan of pound sterling 50,000 into equity capital and this resulted in translation gain. It was held that this gain was on capital account and hence, not taxable.
3. In the case of TELCO [60 ITR 405], the company accumulated certain incomes earned and loan repayments in the US with an agent in the US for buying equipment. The equipment could not be acquired and hence, the money was repatriated resulting in exchange gain. This was held to be not taxable being capital in nature.
4. In the case of Hindustan-Aircraft Limited [49 ITR 471], the company was doing assembling and servicing of aircraft in the US. There was appreciation in rupee value of the balance held in US dollars. It was held taxable being on revenue account.
5. Imperial Tobacco Company bought US dollars for buying tobacco in the US. Due to war, the Indian government did not permit this import and the company surrendered the US dollars and made a gain in the process. It was held that this gain is taxable being on revenue account.

[3] Most of the case laws decided in this country on exchange differences relate to exchange gains on foreign currency assets or exchange losses on foreign currency liabilities-may be because the rupee has been depreciating consistently against major currencies of the world. These case laws deal with exchange differences arising on conversion thereby implying that for the purposes of tax accounting, only realised exchange gains or losses are reckoned and not translation gains or losses. It is to be seen whether this general trend may undergo a change with increasing foreign currency transactions and foreign operations.

After the devaluation of rupee on June 6, 1966, a provision [Section 43A] was introduced in the Income Tax Act, 1961 with effect from April 1, 1967 to deal with certain types of exchange gains and losses relating to acquisition of fixed assets outside India incurring liability in foreign currency. According to this provision, where an assessee acquires any fixed asset from a country outside India and incurs any liability in foreign currency (including interest) in connection with such acquisition and there is increase or decrease in such liability expressed in rupees during any previous year due to change in the rate of exchange, then such gain or loss shall be adjusted to the historical cost of the asset concerned for the purposes of claiming deduction towards depreciation or claiming 100% deduction as capital expenditure on scientific research or for computing capital gains on sale of such asset. It may be noted that but for this provision all exchange losses and gains of the nature specified above would have been treated as arising on capital account. Consequently, the losses would not have been allowed as a deduction in arriving at the taxable income and the gains would not form part of taxable income and hence, not taxed. As a result of introduction of this section, such exchange losses and gains enter the computation of taxable income by way of either increased depreciation (when exchange losses are added to the cost of asset) or reduced depreciation (when exchange gains go to reduce the cost of the asset).

22.3 TAX INCENTIVES FOR EARNINGS IN FOREIGN CURRENCY

Taxation has been used by governments of the world including India as a tool for bringing about social and economic change. Provisions have been introduced in the Indian tax law for encouraging varied activities ranging from promoting family planning amongst employees of a concern to setting up new industrial undertakings. Though the nominal rates of income tax in the Indian context appear to be high, such incentives reduce the tax burden resulting in lower effective rates of income tax. Among other things, such incentives have increased the scope for manipulation by assessees and led to interpretational problems and complexity in the administration of tax laws. The Indian government, having realised the negative implications of tax incentives, has been progressively dismantling these incentive provisions and correspondingly reducing the nominal rates of taxes. In a setting like this, an earning in foreign currency by an Indian enterprise is one area where more and more tax incentives are being introduced—obviously with a view to tackle the problem of balance of payments deficits. We will briefly deal with such incentives here.

1. **Newly Established Industrial Undertakings in Free Trade Zones [Section I0A]** Newly established industrial undertakings in free trade zones, electronic hardware technology parks or software technology parks can claim exemption of 100% of their profits and gains derived from such exports for a period of ten years beginning with the assessment year relevant to the previous year in which the industrial undertaking begins to manufacture or produce articles or things. This section applies to Kandla Free Trade Zone, Santacruz Electronics Export Processing Zone or any other free trade zone as prescribed by the Central Government by notification in the Official Gazette or the technology parks set up under a scheme notified by the Central Government, for the purposes of this section. The deduction under this section is not available from the assessment year 2012-13.
2. **Newly Established Hundred Per Cent Export Oriented Undertakings [Section 10B]** This provision extends the same type of benefit as allowed for the industrial undertakings set up in a free trade zone or technology park, to newly established undertakings recognised as 100% Export Oriented Undertaking. For the purposes of this section, "hundred per cent export oriented undertakings" means an undertaking which has been approved as a hundred per cent export oriented undertaking by the Central Government.

3. **Export of certain articles or things [Section 10 BA]**
   This provision provides a deductions of such profits and gains of an undertaking derived from export of hand-made articles or things which are of artistic value and which require the use of wood as the main raw material. The deduction is available, if the undertaking satisfies certain conditions.
4. **Newly established units in special economic zones [Section 10 AA]**
   Newly established units of the assessee being an entrepreneur as referred to in Clause j of Section 2 of the Special Economic Zone Act, 2005, that begins to manufacture or produce articles or things or provide any services after 1st April 2006, can claim a deduction of hundred per cent of profits and gains derived from the units for a period of five consecutive years and further fifty per cent for the next five years. A further deduction of fifty per cent is eligible for deduction for another five years, if the amount is credited to a Special Economic Zone Reinvestment Reserve Account.

22.4 TAX IMPLICATIONS OF ACTIVITIES OF FOREIGN ENTERPRISES IN INDIA

Foreign non-resident business entities may have business activities in India in a variety of ways. In its simplest form this can take the form of individual transactions in the nature of export or import of goods, lending or borrowing of money, sale of technical know-how to an Indian enterprise, a foreign air-liner touching an Indian airport and booking cargo or passengers, etc. On the other hand, the activities may vary in intensity ranging from a simple agency office to that of an independent subsidiary company. Various tax issues arise on account of such activities. The first is the determination of income, if any, earned by the foreign entity from those transactions and operations. This will call for a definition of income that is considered to have been earned in India and a methodology for quantification of the same. Foreign enterprises having business transactions in India may not be accessible to Indian tax authorities. This raises the next issue of the mechanism to collect taxes from foreign enterprises. The government wants to encourage foreign enterprises to engage in certain types of business activities in India, which in its opinion is desirable for achieving a balanced economic growth. This takes us to the topic of tax incentives. Increasing presence of multinational companies in India creates issues relating to transfer pricing, which is dealt with in the last section. These and other related issues relating to taxation of foreign enterprises in India are discussed in this section under the following heads:

- Taxation of transactions and operations of foreign enterprises in India
- Representative assessees
- Tax incentives
- Advance ruling
- Transfer pricing

22.4.1 Taxation of Transactions and Operations of Foreign Enterprises in India

This topic is discussed under the following three heads:

- Definition of income that is taxable in India
- Quantification of taxable income
- Tax rates

Definition of Income that is Taxable in India

Section 9 of the Act stipulates the items of income which are treated as accruing or arising in India from activities of foreign enterprises in India. These are as follows:

1. All income accruing or arising, whether directly or indirectly, through or from any business connection in India. The term "business connection" is not defined exhaustively in the Act and is to be determined based on the facts of each case. However, the explanation provides that the business connection will include any business activity carried out through a person acting on behalf of the non-resident, who:
   (a) has and habitually exercises in India, an authority to conclude contracts on behalf of the non-resident, unless his activities are limited to the purchase of goods or merchandise for the non-resident; or
   (b) has no such authority, but habitually maintains in India a stock of goods or merchandise from which he regularly delivers goods or merchandise on behalf of the non-resident; or
   (c) habitually secures orders in India, mainly or wholly, for the non-resident or for that non-resident and other non-residents controlling, controlled by, or subject to the same common control, as that non-resident.

   For example, appointing an agent in India for the systematic and regular purchase of raw materials or other commodities or for the sale of the non-resident's goods, or having financial association between a resident and non-resident company could be considered as business connection, if the above conditions are satisfied.

   The above provisions are not applicable to broker, general commission agent or any other agent having an independent status and are acting in the ordinary course of his business. A broker, general commission agent or any other agent are not considered of independent status, if one or more non-resident has a controlling interest in the principal non-resident or are subject to the same common control as the principal non-resident and the Indian agent.

   Only so much of income as is attributable to the operations carried out in India shall be deemed to accrue or arise in India.

   Generally when a transaction takes place between a foreign entity and an Indian enterprise, (including a subsidiary of the foreign enterprise) on a principal-to-principal basis and at arms length, no business connection is attributed to such transactions [Section 9(1)(i)].
2. Salary is deemed to be earned in India if it is either payable for services rendered in India or payable by Indian Government to a citizen of India for services rendered outside India [Section 9(i) (ii) and (iii)].
3. Dividend paid by Indian Company outside India [Section 9 (i) (iv)].
4. Income by way of interest payable by –
   (i) Indian Government; or
   (ii) a person who is a resident, except where the interest is payable in respect of any debt incurred, or moneys borrowed and used, for the purposes of a business or profession carried on by such person outside India or for the purposes of making or earning any income from any source outside India; or
   (iii) a person who is a non-resident, where the interest is payable in respect of any debt incurred, or moneys borrowed and used, for the purposes of a business or profession carried on by such person in India [Section 9 (i) (v)].
5. Income by way of royalty including lump sum consideration payable by-
   (i) Indian Government; or
   (ii) a person who is a resident, except where the royalty is payable in respect of any right, property or information used or services utilised for the purposes of a business carried on

by such person outside India or for the purposes of making or earning any income from any source outside India; or

(iii) a person who is a non-resident, where the royalty is payable in respect of any right, property or information used or services utilised for the purposes of a business or profession carried on by such person in India or for the purposes of making or earning any income from any source in India [Section 9 (i) (iv)].

For the purposes of the above "royalty" means consideration (including any lump sum consideration, but excluding any consideration which would be the income of the recipient chargeable under the head "Capital gains") for: (i) the transfer of all or any rights (including the granting of a licence) in respect of a patent, invention, model, design, secret formula or process or trademark or similar property; (ii) the imparting of any information concerning the working of, or the use of, a patent, invention, model, design, secret formula or process or trademark or similar property; (iii) the use of any patent, invention, model, design, secret formula or process or trademark or similar property; (iv) the imparting of any information concerning technical, industrial, commercial or scientific knowledge, experience or skill; (v) the use or right to use, any industrial, commercial or scientific equipment but not including the amounts referred to in Section 44BB; (v) the transfer of all or any rights (including the granting of a licence) in respect of any copyright, literary, artistic or scientific work including films or video tapes for use in connection with television or tapes for use in connection with radio broadcasting, but not including consideration for the sale, distribution or exhibition of cinematographic films; or (vi) the rendering of any services in connection with the above activities. [Explanation 2]

6. Income by way of fees for technical services, including lump sum consideration payable by
   (i) Indian Government; or
   (ii) a person who is a resident, except where the fees are payable in respect of services utilised in a business or profession carried on by such person outside India or for purposes of making or earning any income from any source outside India; or
   (iii) a person who is a non-resident, where the fees are payable in respect of services utilised in a business or profession carried on by such person in India or for the purposes of making or earning any income from any source in India [Section 9(i) (vii)].

   For the purposes of this clause, fees for technical services means any consideration (including any lump sum consideration) for the rendering of any managerial, technical or consultancy services (including the provision of services of technical or other personnel), but does not include consideration for any construction, assembly, mining or like project undertaken by the recipient or consideration which would be income of the recipient chargeable under the head Salaries.
7. Income embedded in the transaction of supply of machinery or plant to an Indian company located in India for which the consideration is to be discharged by allotment of shares of the Indian company will be taxed in India as income received in India though the income may accrue or arise outside India [CBDT Circular No. 382, dated 4th May, 1984].

Qualification of Taxable Income

Various provisions dealing with the qualification of income are stated hereunder:

1. In the case of a business of which all the operations are not carried out in India, only that part of the income as is reasonably attributable to the operations carried out in India can be treated as income accruing or arising in India. When the operations of a non-resident are confined to purchase of goods in India for purposes of export, no income is deemed to accrue or arise in India [Section 9(1)(i)].

2. In computing the income of an Indian operation, the deduction in respect of expenses incurred by a head office outside India is allowed to the following extent, namely,
   (i) an amount equal to 5% of the adjusted total income of the branch; or
   (ii) the amount of so much of the expenditure in the nature of head office expenditure incurred by the assessee as is attributable to the business or profession of the assessee in India; whichever is less.

   The adjusted total income is the amount of total income of the assessee for the previous year computed before deducting any carried forward business loss or unabsorbed depreciation of earlier years and the amount allowable under this section. If the adjusted total income as aforesaid is a loss, then the average of the income assessable in respect of immediately preceding years, not exceeding three previous years is treated as the adjusted total income (Section 44C).
3. In respect of royalty or fees for technical services, received from Government or an Indian concern by a non-resident (not a company) or a by foreign company which is carrying business in India through a permanent establishment* or performs professional services from a fixed place of profession situated therein and the royalty and fees for technical services paid is effectively connected with such permanent establishment, then the income will be computed under the head 'Profits and Gains of business or profession' [Section 44DA].
   (i) No deduction will be allowed in respect of any expenditure, which is not wholly or exclusively incurred for the business of such permanent establishment.
   (ii) No deduction will be allowed in respect of any expenses paid by the permanent establishment of its head office or to any of its office, other than reimbursement of actual expenses paid.
4. In respect of a non-resident assessee engaged in the business of operation of ships, a sum equal to 7.5% of the aggregate of the following sums shall be treated as business income and taxed accordingly in India:
   (i) The amount paid or payable (whether in or out of India) to the assessee or to any person on his behalf on account of the carriage of passengers, mail, goods or livestock shipped at any port in India; and
   (ii) The amount received or deemed to be received in India by or on behalf of the assessee on account of the carriage of passengers, mail, goods or livestock shipped at any port outside India (Section 44B).
5. When the non-resident assessee is engaged in the business operation of aircraft then, in respect of aggregate of receipts of the nature mentioned above, a sum equal to 5% of such aggregate is treated as business income and taxed accordingly in India [Section 44 BBA].
6. Any non-resident assessee engaged in the business of providing services or facilities in connection with, or supply of plant and machinery on hire used or to be used, in the prospecting for, or extraction or production of, mineral oils will be deemed to have earned a profit equal to 10% of the following sums:

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*Please note the term "Permanent Establishment" has been defined in a very broad way in Section 92 F (*iiia*) to include a fixed place of business through which the business of the enterprise is wholly or partly carried on. The detailed definition of this term is found in the Double Taxation Avoidance Agreements between countries. Normally, a place would be regarded as Permanent Establishment, if the enterprise in the other country has control over the operations. Apart from this, certain specific locations like, branch office, factory, workshop, warehouse, etc., are also considered Permanent Establishment. An exclusive agent or dependent employees and even an installation can be treated as Permanent Establishment in the Double Avoidance Taxation Agreements. Several tribunal cases and advanced rulings have dealt in detail the concept of permanent establishment.

(i) The amount paid or payable (whether in or out of India) to the assessee or to any person on his behalf on account of the provision of services and facilities in connection with or supply of plant and machinery on hire used or to be used, in the prospecting for, or extraction or production of, mineral oils in India; and

(ii) The amount received or deemed to be received in India by or on behalf of the assessee on account of the provision of services and facilities in connection with or supply of plant and machinery on hire used or to be used, in the prospecting for, or extraction or production of, mineral oils outside India [Section 44BB].

7. In the case of an assessee, being a foreign company, engaged in the business of civil construction or the business of erection of plant or machinery or testing or commissioning thereof, in connection with a turnkey power project approved by the Central Government in this behalf, a sum equal to ten per cent of the amount paid or payable (whether in or out of India) to the said assessee or to any person on his behalf on account of such civil construction, erection, testing or commissioning shall be deemed to be the profit and gains of such business chargeable to tax [Section 44BBB].

Tax Rates Various types of incomes accruing or arising in India in respect of various categories of non-resident assessees are taxed at different rates as mentioned below:

1. Income by way of interest on money borrowed or debt incurred in foreign currency and income from units of approved mutual funds under Section 10 (23D) purchased in foreign currency of any foreign company is taxed at 20% [Section 115 A(1)].
2. Royalty and fees for technical services received by a foreign company against agreement which is approved by government or is relating to a matter included in the industrial policy for the time being in force is taxed at 10%, if paid after 1st June 2005. If the royalty is in respect of copyright in any book to an Indian concern or in respect of any computer software to a person resident in India, then the requirement to have the agreement approved by government will not apply. [Section 115(1) AA & 115(1) (BB)]
4. Income received in respect of Unit Trusts of India or any other approved mutual fund purchased in foreign currency as well as capital gains arising on the sale of such unit accruing to a overseas financial organisation is taxed at 10% of such income. For the purpose of this provision, an "overseas financial organisation" means any fund, institution, association or body, whether incorporated or not, established under the laws of a country outside India, which has entered into an arrangement for investment in India with any public sector bank or public financial institution or a mutual fund specified under clause (23D) of section 10 and such arrangement is approved by the Central Government, for this purpose [Section 115AB].
5. Income by way of interest on bonds of an Indian company, issued in accordance with such scheme as the Central Government may, by notification in the Official Gazette, specify in this behalf, and purchased in foreign currency as well as long-term capital gains arising from the transfer of such bonds accruing to any non-resident assessee is taxed at the rate of 10% of such income [Section 115AC].
6. Income accruing to a foreign institutional investor from securities listed in a recognised stock exchange in India is taxed at 20% of such income. Long-term capital gains arising from the transfer of such securities is taxed at 10% of such income. Short-term capital gains arising on the transfer of such securities is taxed at 30% of such income. However, a short-term capital gain referred in Sec 111A is taxed at 15%. For the purpose of this provision, "foreign institutional investor" means such investor as the Central Government may, by notification in the Official Gazette, specify in this behalf. [Section 115 AD].

22.4.2 Representative Assessees [Sections 159 to 167]

For the purpose of effectuating the provisions of the Income Tax Act in respect of a non-resident assessee, Income Tax Act treats the agent of such assessee as a representative assessee. For this purpose, an agent in relation to a non-resident includes any person in India

- who is employed by or on behalf of the non-resident; or
- who has any business connection with the non-resident; or
- from or through whom the non-resident is in receipt of any income, whether directly or indirectly; or
- who is a trustee of the non-resident; and also includes
- any other person who, whether a resident or non-resident, has acquired by means of a transfer, a capital asset in India.

No person shall be treated as the agent of a non-resident unless he had an opportunity of being heard by the Assessing Officer as to his liability to be treated as such.

Every representative assessee, as regards the income in respect of which he is a representative assessee, shall be subject to the same duties, responsibilities and liabilities as if the income were income received by or accruing to or in favour of him beneficially, and shall be liable to assessment in his own name in respect of that income; but any such assessment shall be deemed to be made upon him in his representative capacity only, and the tax shall be levied upon and recovered from him in like manner and to the same extent as it would be leviable upon and recoverable from the person represented by him. Such a representative assessee who pays any sum under this provision is entitled to recover the sum so paid from the person on whose behalf it is paid.

22.4.3 Tax Incentives

The following amounts shall not be treated as a part of the taxable income of a non-resident assessee:

1. Income by way of interest on such securities or bonds including premium on redemption of such bonds as the Central Government may specify in the Official Gazette. [Section 10(4)]
2. Any income arising to a foreign company, as the Central Government may, by notification in the Official Gazette, specify in this behalf by way of royalty or fees for technical services received in pursuance of an agreement entered into with that Government for providing services in or outside India in projects connected with security of India. [Section 10(6C)]
3. Interest payable: [Section 10(15)]
   (i) to any bank incorporated in a country outside India and authorised to perform central banking functions in that country on any deposits made by it, with the approval of the Reserve Bank of India, with any scheduled bank;
   (ii) to Nordic Investment Bank being a multilateral financial institution constituted by the Governments of Denmark, Finland, Iceland, Norway and Sweden on a loan advanced by it to a project approved by the Central Government;
   (iii) to European Investment Bank on a loan granted by it in pursuance of the framework agreement for financial cooperation;
   (iv) by Government or a local authority on money borrowed by it from (or debts owed by it to) sources outside India;
   (v) by an industrial undertaking in India on money borrowed by it under a loan agreement entered into with any such financial institution in a foreign country as may be approved in this behalf by the Central Government by general or special order;

(vi) by an industrial undertaking in India on any money borrowed or debt incurred by it in a foreign country in respect of the purchase outside India of raw materials (or components) or capital plant and machinery, to the extent to which such interest does not exceed the amount of interest calculated at the rate approved by the Central Government in this behalf, having regard to the terms of the loan or debt and its repayment;

(vii) by public financial institutions like Industrial Financial Corporation of India, Industrial Development Bank of India and Export Import Bank of India as well as banking company established under Banking Regulation Act, 1949 on any money borrowed by it from sources outside India to the extent such interest does not exceed the amount of interest calculated at the rate approved by the Central Government in this behalf, having regard to the terms of loan and its repayment.

(viii) by an industrial undertaking in India on any money borrowed by it in foreign currency from sources outside India under a loan agreement approved by the Central Government having regard to the need for industrial development in India, to the extent to which such interest does not exceed the amount of interest calculated at the rate approved by the Central Government in this behalf, having regard to the terms of the loan and its repayment; and

(ix) by a scheduled bank to a non-resident or to a person who is not ordinarily resident, on deposits in foreign currency where the acceptance of such deposits by the bank is approved by the Reserve Bank of India.

(x) Any income by way of interest received by a non-resident or a person who is not ordinarily resident in India on a deposit made in an Off Shore Banking Unit referred to in Section 2 clause (u) of the Special Economic Zone Act, 2005.

22.4.4 Advance Ruling [Sections 245 N to 245 V]

One major disadvantage faced by the tax payers with the tax administration is the uncertainty about the way how the assessing authorities will interpret any tax provision while computing the taxable income or tax payable. There is no mechanism provided in the Act to obtain in advance the opinion of the assessing authorities on the treatment of any receipt, expenditure or loss. In a liberalised economy wherein participation from foreign enterprises is being sought by the government, the above uncertainty about interpretation proved to be a bottleneck. In order to obviate this problem, the Act has been amended to provide for the facility of advance ruling exclusively for non-residents.

Under this scheme, any non-resident can make an application in the prescribed form to the Authority for Advance Ruling, a committee located at Delhi comprising of a Chairman, who is a retired Judge of the Supreme Court, an officer of Indian Revenue Service who is qualified to be a member of Central Board of Direct Taxes and an Officer of the Indian Legal Service who is qualified to be an Additional Secretary to Government of India.

The applicant has to state the question on which the advance ruling is sought. The authority can either allow or reject the application after examining the application and other relevant records. The authority shall give an opportunity to the applicant to be heard before rejecting the application and should give the reasons for rejection in the order. The authority shall not allow a question, which

- is pending for disposal with any authority in the applicant's case; or
- involve determination of fair market value of any property; or
- relates to a transaction, which is designed on the face of it for the avoidance of income tax.

The ruling given by the authority will be binding

- on the applicant who sought it;
- in respect of the transaction in relation to which the ruling has been sought; and
- on the commissioner and his subordinates in respect of the applicant and the said transaction.

22.5 DOUBLE TAXATION RELIEFS

One of the risks associated with doing business outside the home country is the possibility of double taxation. Business transactions may be subject to tax both in the country of their origin and of their completion. As seen in the preceding section, tax charge is determined by taking the residential status in conjunction with the situs of accrual, arisal or receipt of the item of income. Accordingly, an item of income may be taxed in one country based on residential status and in another country on account of the fact that the income was earned in that country. For example, an Indian company having a foreign branch in France will pay income tax in respect of the income of the foreign branch in India based on its status as "Resident" and in France because the income was earned there. Since such a state of affairs will impede international business, each country tries to avoid such double taxation by either entering into an agreement with the other country to provide relief or by incorporating provisions in their own tax statutes for avoiding such double taxation. The first scheme is called "Bilateral Relief" and the second "Unilateral Relief". The features of both kinds of reliefs are discussed hereunder.

22.5.1 Bilateral Relief

Relief against the burden of double taxation can be worked out on the basis of mutual agreement between the two sovereign States concerned. Such agreements may be of two kinds. In one kind of agreement, the two countries concerned agree that certain incomes, which are likely to be taxed in both countries, shall be taxed only in one of them or that each of the two countries should tax only a specified portion of the income. Such arrangements will avoid double taxation of the same income. In the other agreement, the income is subjected to tax in both the countries, but the assessee is given a deduction from the tax payable by him in the other country, usually the lower of the two taxes paid. Double taxation relief treaties entered into between two countries can be comprehensive covering a host of transactions and activities or restricted to air, shipping or both kinds of trade. India has entered into treaties of both kinds with several countries. Also, there are many countries with which no double taxation relief agreements exist.

Section 90 of the Income Tax Act empowers the Central Government to enter into an agreement with the Government of any country outside India for granting relief when income tax is paid on the same income in both the countries and for avoidance of double taxation of income. This section also empowers the Central Government to enter into agreements for enabling the tax authorities to exchange information for the prevention of evasion or avoidance of taxes on income or for investigation of cases involving tax evasion or avoidance or for recovery of taxes in foreign countries on a reciprocal basis. This section provides that between the clauses of the double taxation relief agreement and the general provisions of the Income Tax Act, the provisions of the Act shall apply only to the extent they are beneficial to the assessee. Where a double taxation relief agreement provides for a particular mode of computation of income, the same is to be followed irrespective of the provisions in the Income Tax Act. Where there is no specific provision in the agreement, it is the basic law, i.e. the Income Tax Act that will govern the taxation of income.

The treaties entered into with certain countries contain a provision that while giving credit for the tax liability in India on the doubly taxed income, 'Indian tax payable' shall be deemed to include any amount spared under the provisions of the Indian Income Tax Act. The effect of this provision is that tax exempted on various types of interest income as discussed under the preceding section would be deemed to have been already paid and given credit in the home state. This will result in the lender saving taxes in his home country. Since this saving is relatable to the transaction with the business enterprise in India, the Indian enterprise can seek a reduction in the rate of interest charged on the loan. Suppose an interest income of ₹100 is earned by a British bank on the money lent to an Indian company, the British rate of tax on this income is 35% and the Indian withholding tax is 15%, and this income is exempted from tax under Section 10(6)(iv), the British bank will save ₹I5 on this transaction by way of tax in British as indicated below:

Gross Interest Income	₹100.00
Less: Indian withholding tax	—
	₹100.00
Less: British tax @ 35% on gross interest income	₹35.00
Income after tax	₹65.00
Add: Credit for Indian spared tax	₹15.00
Net income after tax	₹80.00

Had the interest not been exempted in India, the British bank would have paid a withholding tax in India, but would have claimed an abatement from the British tax payable of ₹35 towards this tax and paid ₹20 in Britain. Thus, the total tax liability would have been ₹35. Since the interest on this loan is a tax spared, the British bank has saved ₹25 or its post-tax income has gone up by over 20%. The Indian borrower will be justified in striking a bargain with the British bank for reduction in the rate of interest levied.

22.5.2 Unilateral Relief

Section 91 of the Income Tax Act provides for unilateral relief in cases where no agreement exists. Under this section, if any person who is resident in India in any previous year proves that, in respect of his income which accrued or arose during that previous year outside India (and which is not deemed to accrue or arise in India), he has paid in any country with which there is no agreement under Section 90 for the relief or avoidance of double taxation, income tax, by deduction or otherwise, under the law in force in that country, he shall be entitled to the deduction from the Indian income tax payable by him of a sum calculated on such doubly taxed income at the Indian rate of tax or the rate of tax of the said country, whichever is the lower, or at the Indian rate of tax if both the rates are equal. For the purposes of this provision,

1. The expression "Indian income tax" means income tax charged in accordance with the provisions of the Act;
2. The expression "Indian rate of tax" means the rate determined by dividing the amount of Indian income tax after deduction of any relief due under the provisions of the Act, but before deduction of any relief due under this provision, by the total income;
3. The expression "rate of tax of the said country" means income tax and super-tax actually paid in the said country in accordance with the corresponding laws in force in the said country after deduction of all relief due, but before deduction of any relief due in the said country in respect of double taxation, divided by the whole amount of the income as assessed in the said country;

4. The expression "income-tax" in relation to any country includes any excess profits tax or business profits tax charged on the profits by the Government of any part of that country or a local authority in that country.

22.6 TRANSFER PRICING

There is an increasing participation of multinational companies in the economic activities of a country. The profits derived by such enterprises carrying business in any country can be controlled by the multinational group. Taxation issue relating to international trade has become important as business transactions have become very complicated. Transfer pricing is one such area which has come under scrutiny of tax authorities all over the world. Transfer pricing has been of great concern to the government as it has cost governments huge tax revenues.

Transfer prices are the prices charged by an entity for supplies of goods, services or finance to another to which it is related or associated. When there are dealings with unrelated parties, the prices can be presumed to be determined by market forces. However, when it comes to related parties, the terms tend to be different and many a time may not be related to the fair value presumptions based upon **"arms length principle."**

The Transfer pricing system works as follows: Price charged by one company in Country *A* to another company in Country *B* is reflected in the profit and loss account of both companies, either as an income or an expenditure. By resorting to transfer pricing, related entities can reduce the global incidence of tax by transferring higher income to low-tax jurisdictions or greater expenditure to those jurisdictions where the tax rate is very high. Thus, the global group as a whole will benefit from tax savings.

Some of the important areas where transfer pricing has been prevalent are: Import of raw material, semi-finished goods for assembling and most important of all, intellectual property such as know-how and technology areas.

Till recently, the important sections relating to transfer pricing in the Income Tax Act 1961 were section 40A(2), section 80 1A(9) and section 80 IA (10). The first enables tax authorities to disallow any payment made to a related party, which they feel is excessive. Tax benefits are available under section **80 IA** in the form of tax holiday for certain number of years. If misuse of transfer pricing is suspected, then the tax authorities can reduce or deny such benefits.

The Finance Act, 2001 made amendments of far reaching nature in respect of transfer pricing by inserting Sections 92A to 92F in the Income Tax Act, 1961. This is applicable from the financial year 2001.

The provisions of transfer pricing is applicable when there are two or more enterprises which are associated enterprises and they enter into transactions which are international in nature. In such cases, income arising from an international transaction shall be computed having regard to the "arms lengths price". Every person/entity who enter into an international transaction should maintain all information and documents which are specified in the Income Tax Rules and furnish the same to the appropriate authorities as and when required (Section 92 D). They also have to obtain a report in the specified format from an accountant.

If there is non-compliance of procedural requirement or understatement of profits, or non-maintenance of documents and information, then the Income Tax Authorities have the right to levy penalty.

For the purpose of transfer pricing, the various terms have been defined as follows:

An Enterprise would be regarded as "**Associated Enterprise**" of another, if it directly or indirectly or through intermediaries or through one or more persons or entities, participate in the management, control or capital of the other enterprises. [Section 92A(1)]

Two entities are also treated as associated enterprises based on the Voting Power, Value of Loan Advanced, Value of the Guarantees Given, Power to Appoint Directors, Commercial Rights for Manufacturing Process Given, etc. [See Section 92A(2)]

An international transaction would mean transactions like, purchase, sale or lease of tangible or intangible property, providing services, lending and borrowing of money, and agreements for sharing cost or expenses for mutual benefit. (Section 92B)

There are different ways of determining an arm's length price. In relation to an international transaction, this price can be calculated using one of the following methods given in Section 92C:

(a) comparable uncontrolled price method
(b) resale price method
(c) cost plus method
(d) profit split method
(e) transactional net margin method
(f) or any other method determined by the Central Board of Direct Taxes

Summary

- The scope of income that can be taxed in India is determined on the basis of the residential status of the person earning income and the place (country) where the income is earned.
- Indian enterprises having foreign activities either in the form of foreign transactions or in the form of foreign operations will have to be aware of the following tax implications:
  1. Exchange gains and losses are divided into those arising on capital account and others. Gains or losses attributable to capital transactions are not reckoned with in computing the taxable income.
  2. Only the exchange gains or losses arising on account of conversion, i.e. exchange of Indian and foreign currency are considered for determining the taxable income.
  3. Exchange gains or losses attributable to increase or decrease in rupee, terms of liabilities incurred directly or indirectly in foreign currency for acquiring a fixed asset outside India is adjusted to the cost of the asset.
  4. The Government is providing several incentives for encouraging earnings in foreign currency.
- Foreign enterprises operating in India have to bear in mind the following tax implications:
  1. Section 9 of the Act stipulates the items of income, which will be deemed to have been earned in India for the purposes of chargeability to tax in India.
  2. There are provisions in the Income Tax Act, which seek to quantify in standard terms the income that is deemed to be earned from various activities of foreign enterprises in India.
  3. For the purposes of collecting taxes, certain persons are treated as agents of foreign enterprises having transactions in India and such agents are made liable to pay taxes in respect of incomes that are treated as accruing from such transactions. Such agents are referred to as representative assessees.
  4. With a view to encourage certain types of financial transactions and technology transfers, the Act provides for tax incentives in respect of these chosen activities of foreign enterprises in India.

5. Non-residents have the facility of obtaining advanced ruling on the taxability of any anticipated transaction in India.

- In respect of international transactions with associated parties, Transfer Pricing regulations have to be adhered to.
- In respect of incomes which get charged to income tax simultaneously in India and in some other country, such burden is sought to be alleviated by providing for double taxation reliefs. Such reliefs are provided either through bilateral agreements with other countries or unilaterally through provisions in the Income Tax Act.

Appendix A

Interest Rate Mathematics

I INTRODUCTION

Rational pricing of debt instruments and management of interest rate risk requires a throughout understanding of the basic mathematics of the various yield concepts, bond pricing, the impact of changes in interest rates on bond prices and the term structure of interest rate. We have used some of these concepts in our discussion of interest rate futures, options, caps and floors and interest rate swaps. This appendix provides a self-contained exposition of the basic interest rate mathematics.

II DAY COUNT FRACTIONS

Each market has evolved its own conventions for computing the time period in terms of years between two calendar dates for the purpose of calculating interest payments on debt instruments. Following are some standard conventions:

1. Actual/360 Basis

   Here we divide the actual number of calendar days between any two dates and assume that one year consists of 360 days. Thus, consider a 3-month deposit starting May 1 and maturing on August 1 at an interest rate of 6% p.a. The interest payment per dollar of deposit would be (92/360) (0.06) since there are 92 days between May 1 and August 1. This convention is used in the US money market and for most currencies in the euromarket.
2. Actual/365 Basis

   The difference here is that one year is deemed to have 365 days. This convention is used in US treasury bond market and the sterling money market. This is a sterling deposit from May 1 to August 1 to 8% would pay an interest of (92/365) (0.08) per pound of deposit.
3. 30/360 Basis

In this convention the number of days between any two calendar dates is calculated by assuming that all the intervening calendar months have 30 days and a year consists of 360 days. This convention is used for instance in the generic US dollar coupon swaps for calculating the fixed payments. Thus, consider the period September 15 to January 15. The number of days is calculated as: 15 + 30 + 30 + 30 + 14 = 119 even though two of the intervening months, October and December have 31 days.

In addition to these, the "Actual/Actual" convention also exists. Hence, the number of days in a year may be 365 or 366 in a leap year.

III YIELD CONCEPTS AND THE BOND PRICING EQUATION

We have come across two types of debt instruments:

(1) Coupon instruments and (2) Pure-discount or zero coupon instruments. The former make periodic coupon payments which are a fixed fraction of the face value and redeem the face value at maturity. The latter are purchased at a discount to face value and redeem the face value at maturity with no intervening payments. Examples of the former are coupon bonds while examples of the latter are T-bills, commercial paper and zero-coupon bonds.

Consider first a pure-discount instrument such as a T-bill. *Discount Yield* on such an instrument is defined by:

$$\text{Discount Yield} = \frac{(\text{Face Value} - \text{Price})}{\text{Face Value}} \times \frac{360}{N}$$

where N is the number of days to maturity. This can be rewritten as:

$$\text{Price} = \text{Face Value } - \frac{\text{Face Value} \times \text{Discount Yield} \times N}{360}$$

(If the number of days in a year is 365, use 365 in place of 360 in the above formulas)

The *Bond Equivalent Yield* (BEY) on a treasury bill is defined by (bond equivalent yield is calculated with 365 day year):

$$\text{Bond Equivalent Yield} = \frac{(\text{Face Value} - \text{Price})}{\text{Price}} \times \frac{365}{N}$$

The main difference is the use of price rather than face value in the denominator. Since price is always less than the face value for a pure discount instrument, bond equivalent yield is higher than the discount yield.

Thus suppose USD T-bill with a face value of $1 million and 79 days to maturity is purchased for a price of $9,87,780. The discount yield is

$$[(1000000 - 987780)/1000000]\ (360/79) = 5.5686\%$$

and the bond equivalent yield is

$$[(1000000 - 987780)/987780]\ (365/79) = 5.7158\%$$

Conversely, suppose an investor buys a CP with face value of $100,000 and 142 days to maturity at a discount yield of 8%, the purchase price would be

$$\$100000\ [1 - (0.08 \times 142/360)] = \$96844.44$$

Bond Pricing Equation

Consider a coupon bond. Start with the simplest case: The bond makes annual coupon payments at a rate c, face value if F and it is bought on the day the dirts coupon starts accruing. It matures M years later. How do we value such a bond? The present value of the cash flows from the bond is given by the *Bond Pricing Equation:*

$$P_0 = \sum_{i=1}^{i=M} \frac{C(t)}{(1+r_t)^t} + \frac{F}{(1+r_M)^M} \tag{1}$$

where $C(t) = cF$ is the coupon payment at the end of year t and P_0 is the current bond price. Notice that each cash flow $C(t)$ is being discounted at a different discount rate r_t; the redemption payment F is being discounted at a rate r_M. These are known as the "spot rates". The rate r_t is the appropriate rate to discount a cash flow which occurs at time t. Consider a zero-coupon bond which matures after t years and pays the face value FV on maturity. Its present value is given by

$$FV/[(1 + r_t)^t]$$

Define the discount function $\delta(t) = 1/[1 + r_t]^t$. The bond pricing Equation (1) can be written as

$$P_0 = \left[\sum_{i=1}^{i=M} C(t)\,\delta\,(t)\right] + F\delta\,(M) \tag{2}$$

In Equation (1), each coupon payment $C(t)$ is being treated as redemption value of a zero-coupon bond maturing at time t and the face value F as another zero-coupon bond maturing at M.

The *Yield to Maturity* (YTM) of a coupon bond is a return measure which ignores the fact that discount rates applicable to different points in time are different. In Equation (1) we put $r_t = r_M = r$ for all t and find the value of r such that the PV of all cash flows from the bond equals the current market price P_0 of the bond. In other words, we solve the following equation for r[1]:

$$P_0 = \sum_{i=1}^{i=M} \frac{C(t)}{(1+r)^t} + \frac{F}{(1+r)^M} \tag{3}$$

The resulting value of r is the *Yield to Maturity* of the given coupon bond. This assumes that each coupon payment is being re-invested at a rate r from the time it is received to maturity of the bond[2,3].

- A \$1000 face value bond with coupon rate of 12%, semiannual coupon payments, matures two years from now. The current market price of the bond is \$900. The value of r which satisfies the equation:

  $$900 = 60\ (1 + r) + 60/(1 + r)^2 + 60/(1 + r)^3 + 1060/(1 + r)^4$$

  is $r = 0.0912$ or 9.12%. This is the yield to maturity on a six-monthly basis. The corresponding annual yield is 18.24%.[4]

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[1]The equation has to be solved iteratively.

[2]In other words, we assume that one-year rate 1, 2, 3,.. years from today will be the same as the one-year rate today. As we will see below, this is equivalent to assuming a flat yield curve.

[3]In addition to the YTM, practitioners also use two other yield concepts. The "current yield" is just the amount of coupon stated as percentage of the current market price of the bond. The "coupon yield" is just the coupon as percentage of face value or the coupon rate.

[4]Strictly speaking, the annual yield is $[(1.0912)^2 - 1] \times 100$ per cent.

Now consider a more realistic case. Suppose the coupon payments are made m times per year. Thus, US treasury bonds pay semiannual coupons each of size $cF/2$ (recall that c is the coupon rate stated as a fraction and F is the face value of the bond) so that $m = 2$. The bond is purchased between two coupon payment dates. The number of days to the next coupon payment is tc and the number of days between the most recent coupon and the next coupon is B. Conventionally, the YTM of this bond is the value of r which satisfies:

$$P_t = \left[\sum_{k=1}^{k=N} \frac{CF/m}{(1+r/m)^{(k-1)+(tc/B)}}\right] + \left[\frac{F}{(1+r/m)^{(N-1)+(tc/B)}}\right] \tag{4}$$

Hence, N is the number of coupon payments yet to be received. However, now there is the small complication of accrued interest. The price of the bond P_t consists of two components. The "clean price" P_{ct} and the accrued interest AI:

$$P_t = P_{ct} + AI$$

Bond dealers quote the "clean price". The bond buyer must pay to the seller the accrued interest AI in addition to the clean price. Accrued interest is calculated as

$$AI = [(B - tc)/B]\ (cF/m)$$

The price P_t, including the accrued interest is called the 'dirty price'.

How do we modify Equation (1) to take account of multiple coupon payments and the fact that bond is bought between two coupon payments? The basic approach remains the same: each remaining cash flow from the bond is discounted at the spot rate appropriate for the time when the cash flow occurs and the present values of all cash flows are added up to give the present value of the bond. Let us use the following notation:

t_k : time (measured in years) at which k^{th} coupon payment occurs.
$r(t_k)$: spot rate applicable to t_k
m : number of coupon payments per year.
N : number of coupon payments left.

The bond pricing equation becomes

$$P_t = \left[\sum_{k=1}^{k=N} \frac{CF/m}{(1+r\,(t_k)^{t_k}}\right] + \left[\frac{F}{(1+r\,(t_N)^{t_N}}\right] \tag{5}$$

It is easily seen that t_1 is the time to the first coupon payment and $t_k = t_1 + (k - 1)/m$ for $k = 1$ ... N. Keep in mind that the spot rates $r(t_k)$ are all annualised rates. P_t as before is the "dirty" price.

IV COMPOUNDING FREQUENCIES AND CONTINUOUS COMPOUNDING

In many debt contracts, interest is compounded more than once a year. Consider a two-year deposit at an interest rate of 10% p.a. compounded once a year. A ₹100 deposit compounds to 100 $(1.10)^2$ = 121 at the end of two years. Now suppose interest is compounded twice a year. The compounded value at the end of two years will be 100 $(1.05)^4$ = 121.5506. This is identical to the compounded value at a rate of 10.25% p.a. compounded once a year. Thus, In general, if R_m is the (annual) rate compounded m times a year, the equivalent rate R compounded once a year is given by

$$R = [1 + (R_m/m)]^m - 1 \tag{6}$$

More generally, if R_m is the rate compounded m times per year, the equivalent rate R^k compounded k times a year is given by

$$R_k = k\ \{[1 + (R_m/m)]^{(m/k)} - 1\} \tag{7}$$

Thus, if a rate of 10% is compounded quarterly, its semiannual equivalent is found by putting $m = 4$, $k = 2$, $R_m = 10\%$.

$$2[1.025)^2 - 1] = 0.10125 = 10.125\%.$$

Rewrite (6) as

$$(1 + R) = [1 + (R_m/m)]^m \tag{8}$$

Now consider the limiting case as m increases without limit. This lends to continuous compounding, a mathematically convenient way of handling present value and future value algebra. The limiting value of $[1 + (R_m/m)]^m$ as $m \to \infty$ is $(e)^{Rm}$ where e is the base of natural logarithms. Thus, the present value of a cash flow t years from today with a continuously compounded rate of discount R is e^{-Rt}.

With continuous compounding, the bond pricing Equation (5) is simplified because the complication of accrued interest disappears. Coupons instead of being paid at finite intervals are paid continuously and the bond pricing equation becomes

$$P_{ct} = \int_0^M C(\mu)\ \delta(\mu)\ d\mu + F\delta(M) \tag{9}$$

whereas before P_{ct} is the clean price and (μ) is the discount factor for $t = \mu$. While this form of bond pricing equation is used in theoretical work, it must be used with caution for practical computations.

V BOND PRICE-YIELD RELATIONSHIP, DURATION, AND CONVEXITY

Equation (3) above is a relationship between the current price P_0 of a coupon bond and its YTM. As we have seen above, the concept of YTM assumes that spot rates r_t are identical for all t. In this section we investigate the impact of changes in YTM on bond prices.

From Equation (3) it is obvious that P_0 and YTM denoted by r are inversely related. The intuition behind this is easy to see. Suppose a bond issued two years ago at par has a coupon of 10% paid annually. Obviously, at the time of issue its YTM was 10%. Now, bonds in the same risk class are priced to yield 15%. The current market price of the 10% coupon bond must be at a discount to par.

The following five rules govern the price movements of bonds. They were proved by Malkiel (1962). To illustrate the rules, we will assume that coupon payments are annual rather than semiannual.

- *Rule 1*: Bond prices are inversely related to yield.
  This is obvious from the bond pricing equation. Given $C(t)$ and F, as r increases, PV decreased.
- *Rule 2:* For two bonds which are identical in all respects except the coupon size, the bond with a smaller coupon will have a greater proportionate change in price of a given change in yield.

Consider two bonds, both with $1000 face value and three-year maturity. One has coupons of $100 per year (10%) and the other $150 (15%). Their PVs for discount rates of 14% and 16% are as follows:

Coupon	*PV(14%)*	*PV(16%)*	*Change in PV*	*% Change in PV*
10%	907.13	865.25	41.48	4.62
15%	1023.22	977.54	45.68	4.46

The bond with lower coupon shows a larger *percentage decrease* in value when discount rate rises from 14 to 16%.

- *Rule 3:* Between two bonds which are identical in all respects except time to maturity, the proportionate change in price for a given change in discount rate will be larger for the longer maturity bond.

Consider two bonds, face value $1000, 15% coupon, one with 3 years to maturity and the other with 5 years. Their PVs for discount rates of 14 and 16% are as below;

Maturity	*PV (14%)*	*PV(16%)*	*Change*	*% Change*
3	1023.22	977.54	45.68	4.46
5	1034.33	967.26	68.07	6.48

- *Rule 4:* A bond which is currently priced below its par value is called a *discount bond* while one priced above the par value is called *premium bond*. (Do not confuse a discount bond with a pure discount bond described above, though the latter will always sell below its par value and is therefore always a discount bond). For a given change in yield, percentage price change will be larger for a discount bond than for a premium bond.

This is clearly seen in the data given for Rule 2. The 15% bond is at premium when yield is 14% while the 10% bond is at discount. When the yield rises to 16%, the latter's value decreases proportionately more than the former.

- *Rule 5*: For a given bond, an increase in yield will cause a smaller percentage change in price than a decrease in yield of the same magnitude.

Again the reason should be obvious. Percentage changes are calculated as per cent of initial value. When yields rise, values go from high to low while when yields decline, value goes from low to high. Take the 15% 5-year bond under Rule 3 above. The change in its price is 68.07 when yield changes from 14% to 16%. This is 6.48% of its value at 14% while it is 7.04% of its value at 16%.

Figure A1 shows the relationship between the price of a bond and its YTM. The relationship is convex towards the origin implying that a yield falls bond price increases at a faster and faster rate while as yield rises it falls at a slower and slower rate.

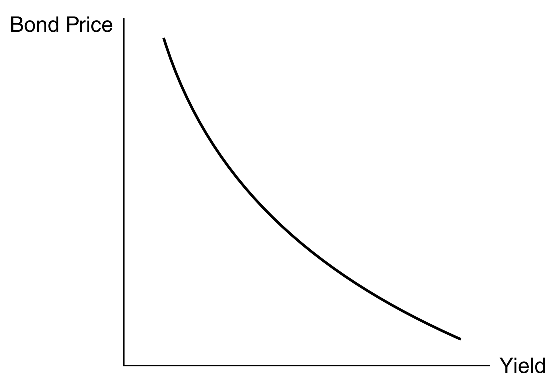

Fig. A1 Bond price-yield relationship

A very useful concept in risk management of fixed income securities is that of *Duration* originally introduced by Macaulay (1938). Informally, it is the weighted average life of all the cash flows from the bond.

Consider a N-period coupon bond. Denote the cash flows this bond by $C_t t = 1 \ldots N$. (Note that the last cash flow C_N includes both the last coupon and the principal). Denote the YTM of a coupon bond by r and let

$$R = (1 + r)$$

Then the bond pricing equation is

$$P = \sum_{i=1}^{i=N} \frac{C_t}{R^t} \tag{10}$$

where P is bond price. For any single payment C_t, we have:

$$\frac{d\left(\frac{C_t}{R^t}\right)}{dR} = -\frac{tC_t}{R^{t+1}}$$

For the bond as a whole, we have:

$$\frac{dP}{dR} = -\sum_{i=1}^{i=N} \frac{tC_t}{R^{t+1}}$$

Multiply both sides by $-(R/P)$

$$-\left(\frac{dP}{dR}\right)\left(\frac{R}{P}\right) = \sum_{i=1}^{i=N} \frac{t\frac{C_t}{R^t}}{P} \tag{11}$$

The expression on the right-hand side of Equation (11) is the *Macaulay Duration* denoted by D. Note how it is computed. (C_t/R^t) is the present value of the cash flow C_t occurring at time t; bond price P is just the PV of all cash flows from the bond discounted at its yield r. Thus, the quantity $[(C_t/R_t)]/P$ is the fraction of the bond's total PV contributed by the cash flow occurring at time t. This fraction of the bond's total PV is captured after t periods. Macaulay duration is thus the weighted sum of the "lives" of the bond's cash flows where the weight attached to the "life" t of cash flow C_t is the fraction of total PV contributed by C_t. Equation (11) tells us that Macaulay duration is the elasticity of the bond price with respect to R $(=1 + r)$.

The following example illustrates computation of a bond's duration.

- Consider a 5-year, 10% coupon bond, face value \$ 1000. The bond is priced to yield 14%.

t	$C(t)$	$\frac{C(t)}{(1.14)^t}$	$t \times \frac{C(t)}{(1.14)^t}$
1	100	87.72	87.72
2	100	76.95	153.90
3	100	67.50	202.50
4	100	59.21	236.84
5	1100	571.31	2856.55
	Sum	**862.69**	**3537.51**

The duration of this bond is therefore:

3537.51/862.69 = 4.10 years

Now suppose the yield changes to 12%. The change in (1 + r) if from 1.14 to 1.12 which represents a 1.75% change {= [(1.14 – 1.12)/1.14] × 100}. The PV of the bond at 12% increases to 927.90 from 862.69 at 14%. This represents a change of 7.55%. The ratio of per cent change in PV to per cent change in (1 + r) is 4.31 which approximately equals the duration computed above. The discrepancy is due to ignoring the face that the bond price-yield relationship is non-linear as seen in Figure A1. Greater precision can be acquired by incorporating this nonlinearity as discussed below.

Practitioners use a slightly different concept of duration known as *Modified Duration*. Modified Duration *MD* is defined by

$$MD = D/R \tag{12}$$

where D is Macaulay duration.
Thus,

$$MD = -\,(dP/dR)/P = -(dP/dr)/P\ \ (dP/dr) = -(MD)P \tag{13}$$

Thus, the proportionate change in bond price corresponding to a small change in yield equals the modified duration of the bond.

However, the relationship between the yield and bond price is not linear. Recall Malkeils' Rule 5 above which tells us that it is a convex relation as shown in Figure A1. Thus, the concept of duration is only 'locally' valid, i.e. for small changes in yield. Look at Figure A2 which plots the price yield relation for two bonds. At point A both have the same modified duration[5]. But as seen from the figure, when yield decreases from A to B, bond 2 gains more in value than bond 1 while if yield increases from A to C, bond 2 loses less in value than bond 1. Bond 1 has more 'convexity'. A better approximation to the change in bond price in response to a change in yield can be obtained by taking account of the curvature in the price-yield relationship. This is done with the concept of convexity.

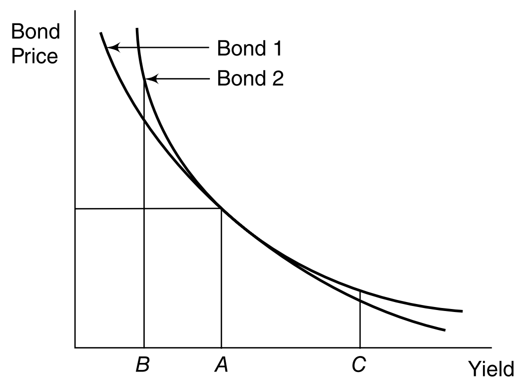

Fig. A2 Bonds with different convexity

Consider the second derivative of bond price with respect to R. For a single payment, we have:

$$\frac{d^2\left(\dfrac{C_t}{R^t}\right)}{dR} = \frac{1}{R^2}\,\frac{\left[t\,(t+1)\,C_t\right]}{R^2} \tag{14}$$

For the bond as a whole

$$\frac{d^2P}{dT^2} = \frac{1}{R^2}\sum_{i=1}^{i=n}\frac{t\,(t+1)\,C_t}{R^2} \tag{15}$$

[5]Modified duration is –(dP/dr)/P. At point A, the slopes of the two curves are same and hence dP/dr is identical for both the bonds. Since both bonds have the same price at the point A, their modified durations are identical.

Convexity is defined by

$$CV = (1/P)\ (d^2P/dR^2)$$

From (15) we have:

$$CV = \frac{1}{PR^2}\sum_{i=1}^{i=N}\frac{t\,(t+1)\,C_t}{R^2} \tag{16}$$

Now expand (dP/dR) around say $R = R_0$ in a Taylor's series expansion and ignore second and higher order terms;

$$\frac{dP}{dR} = \left(\frac{dP}{dR}\right)\Bigg|_{R=R_0} + \frac{1}{2}\left(\frac{d^2P}{dR^2}\right)\Bigg|_{R=R_0}(dR) \tag{17}$$

But from (13) and the definition of convexity

$$(dP/dR) = (dP/dr) = -\ MD(P) \text{ and } (d^2P/dR^2) = CV(P)$$

Hence, a better approximation to the change in bond price for a given change in yield is given by

$$\Delta P = -\ (MD)P\ \Delta R + (1/2)P\ (CV)\ (\Delta R)^2 \tag{18}$$

Now you can understand why bonds with higher convexity are preferred. When interest rates fall, rise in price is higher for bonds with higher convexity and when interest rates rise, fall in price is smaller.

Note however that we are working with the assumption of flat yield curve, i.e. identical spot rates for all maturities. Also, when yields change, it is implicitly assumed that the change is equal at all maturities, i.e. parallel shifts in the yield curve. Both assumptions are not valid in practice. So even with convexity taken into account, we could still be wrong and the inference that more convexity is always to be preferred may not be valid in general. See Grantier (1988), Winkelmann (1989) and Schnabel (1990).

For a pure discount bond with no intervening interest payments, duration equals maturity—the bond returns its entire value in a single payment at maturity. For coupon bonds, duration is less than maturity.

The concept of duration is used by bond portfolio managers to manage interest rate risk. When interest rates are expected to rise, they can minimise the loss by selling high duration securities and buying low duration bonds. One of its most important uses is in *immunization stategies*, i.e. designing a portfolio the value of which is insensitive to interest rate changes.

VI TERM STRUCTURE, YIELD CURVE, AND FORWARD RATES

Yields on debt instruments are affected by a number of factors, viz. maturity, default risk, coupons, tax factors, presence of call features, and so on. The concept of *term structure of interest rates* is an attempt to isolate the effect of maturity on yield holding other factors constant. In practice, all other factor cannot be kept constant. The *yield curve* is the plot of yield against maturity for debt instruments of a particular class which are a close to each other as possible in level of risk, capability, etc. Yield curves are normally plotted for government securities all of which can be deemed to be default free. An upward slopping yield curve such as the one in Panel (a) of Figure A3 implies that interest rates are higher for longer maturities. The curve in Panel (b) indicates the opposite.

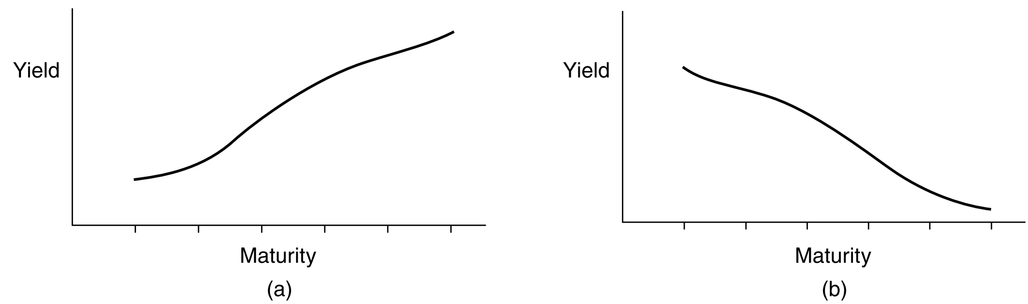

Fig. A3 Yield curves

In practice, one encounters different notions of yield curve. The spot *Yield Curve* or *Zero-Coupon Yield Curve* is a plot of yields on zero-coupon bonds against their maturities. Recall that we has defined r_t[or $r(t)$] as the discount rate appropriate for discounting a cash flow occurring all time t. The spot yield curve is a plot of r_t versus t. For bond pricing Equation (1) and in the zero-coupon method of swap valuation, we need values of r_t for various values of t. Also, as we will see below, the shape of the spot yield curve is interpreted by practitioners as a reflection of market views about movements in future short-term rates.

Another concept of yield curve found in practice is the *Par Yield Curve*. Consider a (possibly hypothetical) M-period coupon bond. Its par yield, denoted y_M is defined by

$$F = y_M \sum_{i=1}^{i=M} \delta(t) + F\delta(M) \tag{19}$$

which gives

$$y_M = \frac{F[1 - \delta(M)]}{\sum_{i=1}^{i=M} \delta(t)} \tag{20}$$

Note that to be able to compute y_M we must already have the discount factors δ_1 ... $\delta(M)$. A plot of y_M against M is the part yield curve.

The *Coupon Yield Curve* is a plot of YTMs of coupon bonds versus their maturities. This curve by itself has little theoretical significance though practitioners often use it as a signal of future movements in rates.

We now introduce the concept of *Forward Interest Rates*. Let us divide time into intervals or 'periods' of equal length (which may be a year, six months or whatever). Index time by $t = 0, 1, 2$ .. T. The Forward Rate F_n is defined as the one-period rate applicable from $t = n - 1$ to $t = n$. Now consider the present value of a single cash flow C_n to be received at $t = n$. We must discount it from n back to $n - 1$ at the rate F_n, from $n - 1$ to $n - 2$ at the rate F_{n-1}, etc. till we finally discount it from $t = 1$ back to $t = 0$ at F_1. Thus, its PV is given by

$$C_n/[1 + F_n)(1 + F_{n-1}) \ldots (1 + F_1)].$$

Thus, the current price of a zero-coupon bond maturing at time n (an n-period 'zero' in the trade jargon) per 1 dollar of face value is

$$Z_n = 1/[1 + F_n)(1 + F_{n-1}) \ldots (1 + F_1)]$$

Similarly,

$$Z_{n-1} = 1/[1 + F_{n-1})(1 + F_{n-2}) \ldots (1 + F_1)]$$

which implies

$$Z_{n-1}/Z_n = (1 + F_n) \tag{21}$$

Thus,

$$(1 + F_n) = \frac{\text{price of zero maturing at } t = n - 1}{\text{price of zero maturing at } t = n} \tag{22}$$

Suppose we have the following three zeros traded in the market all with face values of 100:

Maturity (periods)	Price
1	97.50
2	94.25
3	90.75

Then, since zeros do not pay any coupon, we must have

$$97.50 = (100)/(1 + F_n)$$

which gives $F_1 = 0.025642$ (= 2.5641%).

$$94.25 = (100)/[(1 + F_1)(1 + F_2)]$$

which, along with F_1 determined earlier, gives $F_2 = 3.4484\%$, and finally,

$$90.75 = (100)/[(1 + F_1)(1 + F_2)(1 + F_3)]$$

which gives $F_3 = 3.8567\%$

Recall that the YTM of a n-period zero coupon bond is defined as the value of r_n which satisfies

$$Z_n = 1/[(1 + r_n)^n]$$

which implies

$$(1 + r_n) = [(1 + F_n)(1 + F_{n-1}) \ldots (1 + F_1)]^{1/n}$$

Thus, the discount factor for period n is the geometric average of one-period discount factor $(1 + F_1)$, ... $(1 + F_n)$.

Now let us explore the relationship between the prices of coupon bonds and forward rates.,

Given our definition of forward rates, the price of an N-period coupon bond with coupon rate c and face value FV should satisfy the following equation:

$$P = \frac{cFV}{(1+F_1)} + \frac{cFV}{(1+F_1)(1+F_2)} + \ldots + \frac{cFV + FV}{(1+F_1)(1+F_2)\ldots(1+F_N)} \tag{23}$$

Suppose we observe the following bond prices in the market:

Maturity (periods)	*Coupon Rate*	*Face Value*
1	c_1	FV_1
2	c_2	FV_2
3	c_3	FV_3
4	c_4	FV_4

Then we can write an equation life (23) for each of these four bonds and solve these for the four unknowns F_1 ... F^4. Thus, the currently observed prices of coupon bonds with various maturities imply a set of forward rates.

The plot of F_n versus n is called *The Forward Rate Curve*. The relationship between the forward rate curve and the sport yield curve is similar to that between average and marginal concepts often used in economics (e.g. marginal cost and average cost)[6]. This can be seen from the relationship we developed above between the n-period discount factor $(1 + r_n)$ and the one-period forward discount factors $(1 + F_1) \ldots (1 + F_n)$. As long as the forward interest rate curve is above the spot yield curve, the spot yield curve will continue to rise. However, it is not necessary that forward rates must rise (fall) in order for the yield curve to be upward (downward) sloping[7]. Figure A4 presents a schematic picture of the relationship between the spot yield curve and the forward curve. Notice that the spot curve continues to rise even after the forward curve has turned down.

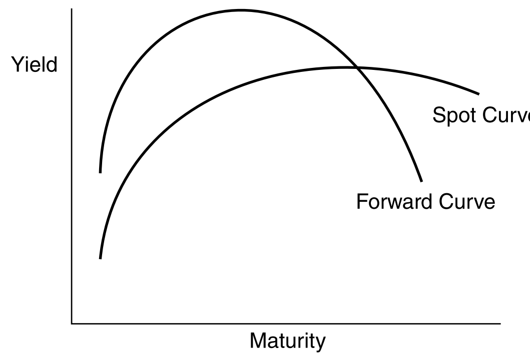

Fig. A4 Spot yield curve and the forward curve

The *Pure Expectations Theory* of term structure holds that forward rates equal expected future spot rates. The reasoning is based on the argument that return on investment over a holding period must be equal whether one invests in a long-period bond or a series of short-period bonds in succession. To understand this, suppose there are two coupon bonds both with face value of 100 and both trading at par. One of them matures in one period and has a coupon of 6% per period while the other matures in two period with a coupon of 8%. An investor with a two-period horizon is considering the following alternatives.

1. Invest in the two-period bond. At the end of the first period, invest the coupon at the then one period rate.
2. Invest in the one-period bond. AT the end of the first period, invest the coupon and principal at the then one-period rate.

The investor's only concern is her expected wealth at the end of her planning horizon. The investor would be indifferent if this is identical for both the choices. For every 100 invested, this requires:

$$8(1 + R^e_{1,2}) + 108 = 106\,(1 + R^e_{1,2})$$

where $R^e_{1,2}$ is the one-period rate the investor expects at the end of period one. Note, however, that from (23) above, for these two bonds

$$100 = \frac{8}{(1+F_t)} + \frac{108}{(1+F_1)\,(1+F_2)}\,\frac{106}{(1+F_1)}$$

---

[6]Whereas the sport rate r_n gives the average return over n periods, the forward rate F_n gives the return over the period $n - 1$ to n. More formally, F_n gives the marginal return from substituting an n-period zero-coupon bond for an $(n - 1)$-period zero-coupon bond in a portfolio.

[7]For instance, consider the values

$F_1 = 0.05,\ F_2 = 0.09,\ F_3 = 0.08$

These will yield

$r_1 = 0.05,\ r_2 = 0.0698,\ r_3 = 0.0732$

Thus, the spot yield curve rises throughout while the forward rate falls after period 2.

which gives

$$8(1 + F_2) + 108 = 106\ (1 + F_2)$$

where F_2, is the forward rate for the second period. Thus, for investor indifference, $R^e_{1,2}$, the investor's expected one-period rate over the second period must equal F_2, the forward rate for the period. Solving the above two equations

$$F^2 = R^e_{1,2} = 10.2041\%$$

With the two bonds priced as above, if the market expects the one-period rate one period from now to be higher than 10.2041%, say 11%, it is easy to see that all investors would prefer the second investment, viz. buy the one-period bond and roll over the investment. This will increase the demand for the one-year bond raising its price and lower the demand for the two-year bond lowering its price till the equality between the forward rate and the expected spot rate is satisfied. Conversely, if the expected one-period rate one period from now is less than the forward rate, say 9%, demand for the short-term bond will decline and for the long-term bond increase. In a similar fashion, it can be shown that if the investors care only about the end of period wealth, expected future one-period rates should equal the forward rates implied by the observed structure of coupon bond prices. However, as asserted above, it would be wrong to conclude from this that when the yield curve of coupon bonds is upward (downward) sloping, one-period rates are expected to rise (fall)[8]. Finally note that the pure expectations hypothesis ignores the possibility that investors may be risk averse since it compares investments based only on their expected returns.

There are competing hypotheses about the term structure which deny that forward rates equal expected future spot rates. One such theory known as the *liquidity premium theory* holds that investors have a preference for short maturity investments. This implies that the expected future sport rates can be lower than the forward rates without necessarily reducing the demand for short-term instruments. The implication is that, short-term rates would be lower than long-term rates and the yield curve would naturally be upward sloping. Still another hypothesis known as the *market segmentation* hypothesis holds that there are segmented markets for short- and long-term securities with different groups of borrowers and investors with distinct maturity preferences in each. Yields in each segment are determined by the relative demand and supply positions in each and need not have any implications for expected future one-period rates.

Apart from these traditional theories of the term structure, modern theories based on general equilibrium concepts or notions of arbitrate-free term structure provide more rigorous explanations of the term structure. As an example of the former, see Cox et al. (1985) and for the latter, see Ho and Lee (1986).

[8]Consider a simple numerical illustration. Suppose the forward rates are $F_1 = 0.06$, $F_2 = 0.09$ and $F_3 = 0.08$. Consider three default-free bonds with maturities of 1,2 and 3 periods respectively and coupons of 6%, 8% and 9% per period. From (21) their prices can be computed. These are 100, 101.0213, and 103.6316 respectively. Using the YTM formula is reverse, we can compute their YTMs. These work out to 6%, 7.43%, and 7.60%. Thus, even though the forward rate falls after the second period, the coupon yield curve rises throughout.

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Appendix B

Selected ISO Currency Codes, by Continent and Country

Country	Currency	Code
AFRICA		
Algeria	Dinar	DZD
Angola	Kwanza	AON
Botswana	Pula	BWP
Central African Republic	Equat. CFA Franc	XAF
Chad	Equat. CFA Franc	XOF
Congo	Equat. CFA Franc	XAF
Egypt	Ound	EGP
Ethiopia	Birr	ETB
Ghana	Cedi	GHC
Kenya	Shilling	KES
Liberia	Dollar	LRD
Libya	Dinar	LYD
Madagascar	Franc	MGF
Mauritiuius	Rupee	MUR
Morocco	Dirham	MAD
Mozambique	Metical	MZM
Namibia	Dollar	NAD
Nigeria	Naira	NDN
Senegal	West. CFA Franc	XOF
Seychelles	Rupee	SCR
Somalia	Shilling	SOS

(Contd.)

Country	Currency	Code
South Africa	Rand (Fin)	ZAL
South Africa	Rand(Com)	ZAR
Sudan	Dinar	SDD
Swaziland	Lilangeni	SZL
Tanzania	Shilling	TZS
Tunisia	Dinar	TND
Uganda	New Shilling	UGX
Zaire	New Zaire	ZRN
Zambia	Kwacha	ZMK
Zimbabwe	Dollar	ZWD
AMERICA		
Argentina	Peso	ARS
Bahamas	Dollar	BSD
Bermuda (UK)	Dollar	BMD
Bolivia	Boliviano	BMD
Brazil	Cruzeiro Real	BRR
Canada	Dollar	CAD
Caymen Islands	Dollar	KYD
Chile	Peso	CLP
Colombia	Peso	COP
Costa Rica	Colon	CRC
Cuba	Peso	CUP
Ecuador	Sucre	ECS
Guatemala	Quetzal	GTQ
Haiti	Gourde	HTG
Jamaica	Dollar	JMD
Mexico	Peso Nuevo	MXN
Nicaragua	Cordoba Oro	NIO
Panama	Balbao	PAB
Paraguay	Guarania	PYG
Peru	Nuevo Sol	PEN
Trinidad & Tobago	Dollar	TTD
United States of America	Dollar	USD
Uruguay	Urug.Peso	UYD
Venezuela	Bolivar	VEB
West-Indies	W-I Dollar	XCD
ASIA and AUSTRALIA		
Afghanistan	Afghani	AFA
Australia	Dollar	AUD
Bahrain	Dinar	BHD

(Contd.)

Country	*Currency*	*Code*
Bangladesh	Taka	BDT
Brunei	Dollar	BND
Bhutan	Ngultrun	BTN
China	Remnimbai Yuan	CNY
Hong Kong	Dollar	HKD
India	Rupee	INR
Indonesia	Rupees	IDR
Iraq	Dinnar	IQD
Iran	Rial	IRR
Israel	Shekel	ILS
Japan	Yen	JPY
Jordan	Dinar	JOD
Kirgistan	Som	KGS
Kuwait	Dinar	KWD
Lais	New Kip	LAK
Lebanon	Pound	LBP
Malaysia	Ringgit	MYR
Mongolia	Tugrik	MNT
Myanmar (Burma)	Kyat	MMK
Nepal	Rupee	NPR
New Zealand	Dollar	NZD
North Korea	Won	KPW
Oman	Rial	OMR
Pakistan	Rupee	PKR
Qatar	Riyal	QAR
Saudi Arabia	Riyal	SAR
South Korea	Won	KPW
Singapore	Dollar	SGD
Sri Lanka	Rupee	LKR
Syria	Pound	SYP
Taiwan	Taiwan Dollar	TWD
Thailand	Baht	THB
United Arab Emirates	Dirham	AED
Vietnam	New Dong	VND
Yemen	Rial	YER
EUROPE		
Austria	Schilling	ATS
Belguim	Franc	BEF
Bulgaria	Lev	BGL
Czeck Republic	Crown	CZK

(Contd.)

Country	***Currency***	***Code***
Cyprus	Pound	CYP
Croatia	Dinar	HRD
Denmark	Crown (Kroner)	DKK
Finland	Markka	FIM
France	Franc	FRF
Germany	Mark	DEM
Great Britain	Pound	GBP
Greece	Drachma	GRD
Hungary	Forint	HUF
Ireland	Pount (Punt)	IEP
Italy	Lira	ITL
Luxembourg	Franc	LUF
Netherlands (The)	Crown (Kroner)	NOK
Poland	Zloty	PLZ
Portugal	Escudo	PTE
Romania	Lei	ROL
Russia	Ruble	RUR
Slovakia	Crown	SKK
Spain	Peseta	ESP
Sweden	Crown (Kroner)	SEK
Turkey	Lira	TRL

Note: In the three letter ISO code, the first two letters refer to the country and the third to the currency.

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