CHAPTER 1
Why Do We Study Exchange Rates?

1.1. Introduction

This book is about the theory of, and empirical evidence on, exchange rates. We are living in the era of globalization in which governments, firms, and individuals deal with each other across borders, which makes them exposed to the foreign exchange risk resulting from fluctuations in exchange rates. Even if a firm does not deal with the rest of the world, it is exposed to foreign exchange risk because these changes affect its share in the domestic market. For example, domestic currency appreciation induces foreign firms to enter the domestic market, thereby threatening the market shares of purely domestic firms. This is an example of the microeconomic effects of changes in exchange rates. From a macroeconomic perspective, exchange rate fluctuations affect output, employment, inflation, the external balance, interest rates, and monetary and fiscal policies (macroeconomic policy in general).

Some cynics make the observation that the shift from fixed to flexible exchange rates following the collapse of the Bretton Woods system in the early 1970s resulted in the promotion of telex operators to foreign exchange dealers. Beyond the humor in this statement, the effects of this shift have been profound in terms of the (increased) uncertainty surrounding the outcome of financial and commercial cross-border transactions. The shift has led to the emergence of two thriving and interrelated industries: exchange rate forecasting and foreign exchange risk management.

An important aspect of globalization that has brought exchange rates to the forefront (in terms of importance as a macroeconomic variable) is the internationalization (or globalization) of finance. This process has been driven by advances in information and computer technologies, globalization of national economies, liberalization and deregulation of national financial and capital markets, and competition among the providers of financial

intermediary services. Several factors indicate an ever-increasing degree of the internationalization of finance, including (i) the volume of international bank lending (including cross-border lending and domestic lending denominated in foreign currencies); (ii) the value of securities transactions with foreigners; (iii) the flows of portfolio investment and foreign direct investment; (iv) the value of daily turnover (trading volume) in the global foreign exchange market and (v) the percentage of foreign exchange trading conducted with crossborder counterparties.

Given that this book is about the exchange rate, the price of foreign exchange that is determined in the foreign exchange market, it is perhaps of most interest for us here to talk about the volume of trading in the foreign exchange market. Measuring the volume of trading in this market is not straightforward because, unlike the stock market (which is an organized exchange), it is a global over-the-counter (OTC) market, a huge network of telecommunication linking market participants, the buyers, and sellers of currencies. Arriving at an exact figure for the volume of trading in the global foreign exchange market is almost impossible. Instead, the size of the market is measured through surveys conducted by the central banks of individual countries and coordinated by the Basel-based Bank for International Settlements.

This exercise, called the triennial central bank survey, is conducted once every 3 years, the last of which was in April 2007. The survey's results (reported in Bank for International Settlements, 2007) revealed that the average daily turnover in the global foreign exchange market was $3.2 trillion, up by 63% on the previous survey of April 2004.[1] In the 1992 survey, this figure was $880 billion (Figure 1.1). The reason why growth of the volume of trading in the foreign exchange market is considered as an indicator for the internationalization of finance is that most of this amount is used to finance capital account transactions (involving the buying and selling of securities denominated in various currencies) or the trading of currencies (as financial assets) in their own right. Some 62% of total trading is carried out with cross-border counterparties. This rapid growth of the foreign exchange market is a reflection of the growth of other indicators of the internationalization of finance, including the volume of international bank lending, the value of securities transactions with foreigners, and the flows of portfolio investment and foreign direct investment. Foreign exchange transactions are associated with cross-border current account and

[1] Out of the $3210 billion dollars of daily trading, spot transactions accounted for $1005 billion, whereas outright forward and swaps accounted for the rest.

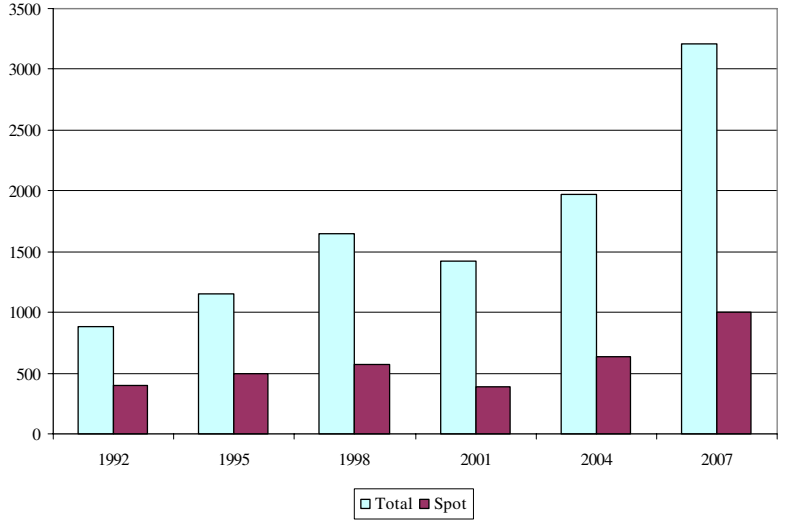

Figure 1.1. Daily turnover in the foreign exchange market ($ million).

capital account transactions, as well as transactions with local counterparties involving foreign currencies (for example, foreign currency deposits held by locals with domestic banks).

1.2. The Importance of Exchange Rates

It is not an exaggeration to say that the exchange rate is the single most important macroeconomic variable in an open economy. This is so much the case in the present environment of financial deregulation and globalization of financial markets. In this section, we elaborate on some of the points that were raised briefly in the previous section.

1.2.1. *The Exchange Rate and Business Operations*

The exchange rate is very important for businesses, particularly under the present international environment. Business firms indulge in international operations to reap the benefits arising from the globalization of trade and finance. One obvious benefit of international trade is the extension of the market for the firm's products beyond the national frontiers. The advantage of the globalization of finance is to enhance the ability of business firms to diversify their financing and investment portfolios. However, there is

no "free lunch": these opportunities bring with them exposure to foreign exchange risk, which results from (unanticipated) fluctuations in exchange rates.

Foreign exchange risk is typically classified into transaction risk, economic risk, and translation risk. Transaction risk results from the effect of fluctuations in exchange rates on the contractual cash flows associated with existing trade contracts, as well as foreign assets and liabilities. Economic risk, on the other hand, results from the effect of changes in the (real) exchange rate on cash flows that are not contractual as well as market share. Translation risk (also called accounting risk) results from the effect of exchange rate fluctuations on the domestic currency values of foreign currency assets and liabilities. It arises mainly in the process of constructing consolidated financial statements for a firm with foreign subsidiaries. History is full of examples of companies that have disappeared because of adverse movements in exchange rates, and there are even more examples of companies that were affected profoundly in terms of shrinking profit and market shares.[2]

The outcome of business operations involving exposure to foreign exchange risk is contingent upon the movement of the underlying exchange rate between the time at which a decision to enter an operation (or take a position) is taken and the materialization of the outcome. The generation of exchange rate forecasts is therefore necessary for taking decisions pertaining to these operations. The following are some examples:[3]

- In uncovered interest arbitrage (also known as carry trade), a short position is taken on a low-interest currency while a long position is taken on a high-interest currency if it is expected that the high-interest currency will not depreciate against the low-interest currency by more than the interest rate differential.
- In spot-forward speculation, a currency is bought forward and sold spot if the spot exchange rate on the maturity of the forward contract is higher than the forward rate (and vice versa).
- In speculation by using options, a long call or a short put is taken if the underlying currency is expected to appreciate (and vice versa).

[2]For an illustration of how foreign exchange risk arises and its classification, see Moosa (2003). For details on how exchange rate affects the prices, costs, revenues, and profits of an exporting firm, see Moosa (2005).

[3]A detailed description of financial decisions involving exchange rate forecasting can be found in Moosa (2000b).

These are but a few examples of business decisions that require exchange rate forecasting. Unless business firms decide to go technical and use "black boxes" to forecast exchange rates, some understanding of the exchange rate determination process may prove to be useful.

1.2.2. *The Exchange Rate and Macroeconomic Policy*

Under a system of flexible exchange rates, central banks intervene in the market on a regular basis to "smooth" and "iron out" fluctuations in exchange rates. Sometimes, they even intervene to accomplish the nearly-impossible objective of reversing an established market trend, only to fail spectacularly in this endeavor (recall the bitter experiences of the Bank of England in September 1992 and the Thai monetary authorities in July 1997).

The argument for central bank intervention is based on the propositions that (i) exchange rate fluctuations can be excessive and (ii) exchange rate fluctuations have adverse effects on economic activity. The first proposition actually implies the importance of understanding the behavior of exchange rates. The second proposition is that exchange rates create uncertainty that adversely affects the value of international trade and investment. Fluctuations in exchange rates can affect international trade in a number of ways. The first is that agents respond to uncertainty by reducing the volume of international transactions. The response may also involve a change in the composition of output and investment to reduce risk. Moreover, fluctuations in exchange rates may affect macroeconomic policy formation by changing policy trade-offs (see, for example, International Monetary Fund, 1984). There is also some evidence that exchange rate uncertainty has a negative effect on exports and the allocation of resources (see, for example, Arize, 1995).

1.2.3. *Macroeconomic Linkages Through Exchange Rates*

The exchange rate provides a key macroeconomic linkage between the domestic economy and the rest of the world that takes place through goods and asset markets. In the goods market, the exchange rate establishes linkages between domestic and foreign prices, as domestic prices are some sort of exchange rate-adjusted foreign prices (not exactly but close enough). Some of the effect of foreign prices on domestic prices is transmitted through the labor market, as workers may demand wage increases when higher import prices raise the cost of living (and higher import prices

may result purely from foreign currency appreciation). In general, changes in exchange rates may produce imported inflation and loss of competitiveness. Asset markets also have exchange rate linkages. The choice among assets depends on the trade-off between risk and return, a linkage that can be expressed in terms of uncovered interest parity (UIP).

Microeconomic linkages through the exchange rate involve resource allocation. When the real exchange rate makes the economy highly competitive, resources are drawn into the traded goods sector, which is mirrored in the factor market by a new allocation of resources. The economy becomes trade-oriented, with rising employment of capital and labor in the export- and import-competing sectors. The distribution of income is also affected. If the country has a traditional export sector (for example, agriculture or mining), then a very competitive exchange rate (undervalued domestic currency) will make traditional exports profitable. There are also implications for asset markets. When domestic returns are below foreign returns, capital flight will occur, leaving a smaller amount of resources available for domestic investment. When capital controls are imposed, those who indulge in (illegal) capital flight (for example, those who fake trade invoices) often do so at the expense of those who do not (perhaps because they cannot).

Exchange rate policies/regimes affect the external balance and the internal balance through their effects on total spending (via the demand for money) and on the competitiveness of traded goods. According to Collier and Joshi (1989), the external balance should be interpreted as the achievement of a sustainable current account deficit (a deficit that is consistent with a realistic medium-run projection of foreign capital inflow). The internal balance is a more complex target as it has employment (or output) and inflation as its components. Policymakers would like to have high employment and output and low inflation, but complications are introduced by the fact that there may be a trade-off between these subtargets (as implied by the Phillips curve). Exchange rate regimes/policies affect the internal balance because the price of a currency has an important direct effect on the general price level (through goods market linkages), and an important indirect influence on the level of aggregate economic activity. Microeconomic efficiency, or the efficiency of resource allocation, is important for the objective of maximizing real income. Exchange rate regimes/policies affect efficiency in two ways: (i) by affecting the uncertainty surrounding the outcome of economic transactions (particularly foreign-trade transactions) and (ii) by making the imposition of trade restrictions more or less likely.

1.3. Stylized Facts and Figures

Some stylized facts have been observed about the actual behavior of exchange rates and their relation with other macroeconomic variables. We start with the stylized facts on the behavior of exchange rates without reference to possible determining variables. Then, we examine the stylized facts pertaining to the behavior of exchange rates relative to that of macroeconomic factors that are supposed to be the determining factors.

1.3.1. *Stylized Facts: Exchange Rates Only*

Four stylized facts can be observed about the behavior of exchange rates. These stylized facts, which are derived from a visual inspection of historical data, are the following: (i) exchange rates appear to follow a random walk with little or no drift; (ii) they move predominantly in cycles, but it is not obvious whether they are procyclical or countercyclical with respect to economic activity; (iii) the behavior of exchange rate can be described as a combination of bubbles and crashes and (iv) they exhibit volatility clustering.

Stylized facts (i) and (ii) are related. Little or no drift actually means the dominance of cycles (and of course random variation). This can be seen in Figure 1.2, which depicts the time paths of the U.S. dollar exchange rates against the Japanese yen (JPY), British pound (GBP), Australian dollar (AUD), and special drawing rights (SDR). Apart from the period of fixed exchange rates, when the exchange rates were stable, subsequent behavior is characterized by significant cyclical and random variation with little trend (no strong sustained trends). The cyclical behavior is clearer in Figure 1.3, which exhibits the smoothed time paths of the four exchange rates.[4] The dominance of cycles over trends is a characteristic that distinguishes exchange rates from stock prices. However, it is not clear whether exchange rates are procyclical or countercyclical (Lenten, 2006). In Chapter 14, we will show that the various exchange rate models described in this book, and other macroeconomic models, have different predictions of the cyclical behavior of exchange rates.

The second stylized fact is that exchange rates typically exhibit movements that can be described as "bubbles followed by crashes." This simply

[4]The smoothed time paths are derived by applying the HP filter to the exchange rate data.

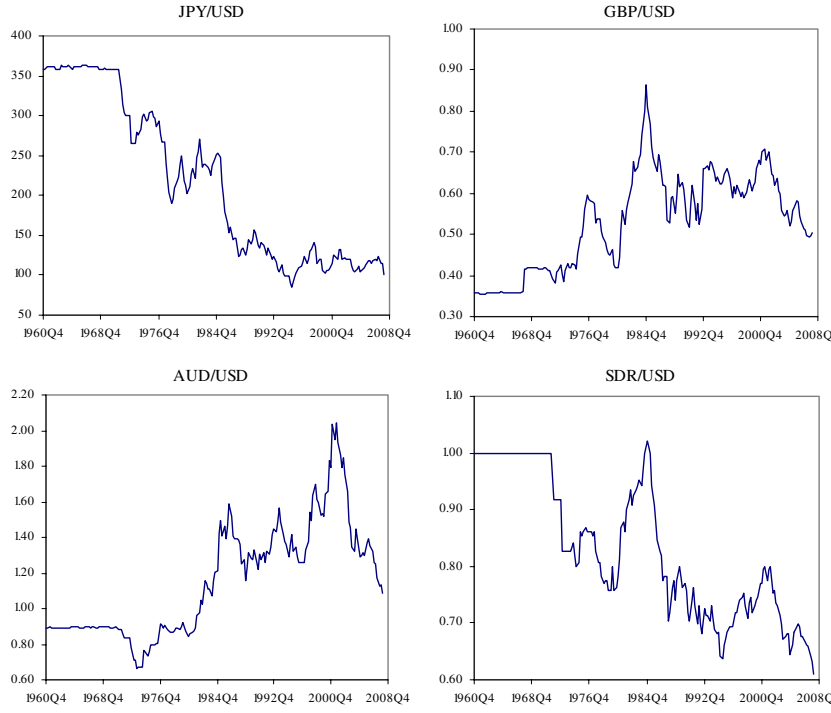

Figure 1.2. Time paths of exchange rates versus the U.S. dollar.

means that exchange rates exhibit sustained upward movements for a long period in a bubble-like movement, then they crash by losing all of the previous gains over a short (or shorter) period. Take, for example, the exchange rate of the SDR versus the U.S. dollar. We can observe two episodes of bubbles and crashes, which are magnified in Figure 1.4. Table 1.1 reports the magnitude of the rise and fall of the dollar in the two episodes. In the first episode (1979:Q4–1987:Q4), it took the dollar 21 quarters to rise by 34.7% and 12 quarters to fall by 31%. In the second episode (1995:Q2–2004:Q4), it took the dollar 30 quarters to rise by 25.6% and 11 quarters to fall by 19.4%.

But there is no bubble and crash like that of the Australian dollar versus the U.S. dollar, which materialized very recently. Figure 1.5 illustrates the episode with a plot of daily data over the period 4 January 2005–10 October 2008. It took the Australian dollar the time between 4 January 2005 and 15 July 2008 to rise from 0.7668 to its peak of 0.9802. By 10 October 2008,

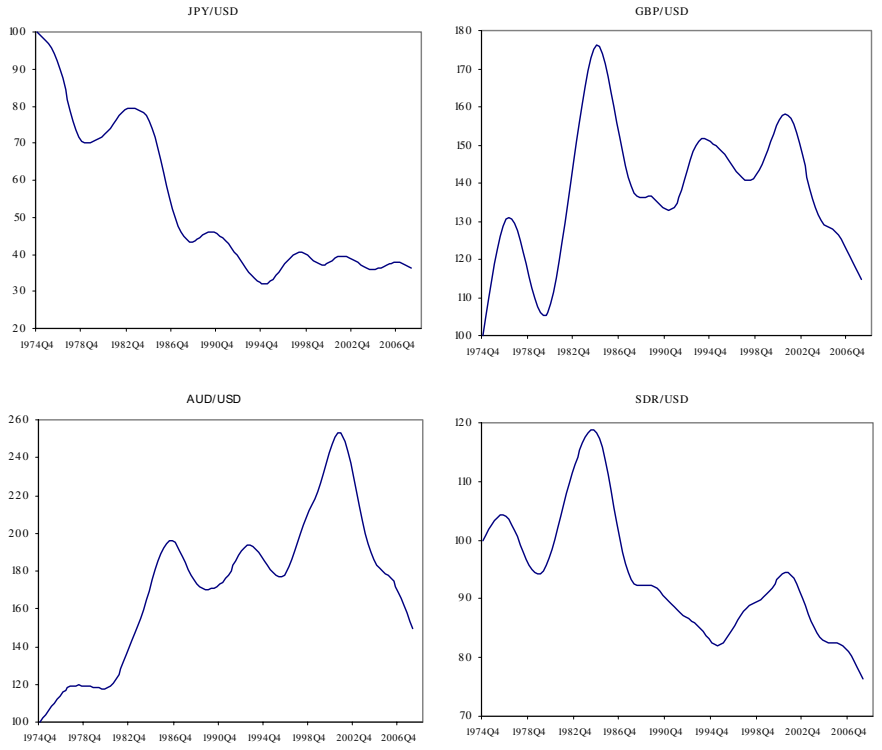

Figure 1.3. Smoothed time paths of exchange rates versus the U.S. dollar.

the Australian dollar had fallen to 0.6529. This is a spectacular crash that no model and no forecaster could have predicted.[5]

The last stylized fact when we examine the behavior of exchange rates on their own is volatility clustering. This means that periods of calm are followed by periods of calm (clustering of small changes in the exchange rate); then periods of turbulence are followed by periods of turbulence (clustering of big changes in the exchange rate). This behavior can be seen clearly in Figure 1.6, which also provides some indication that the percentage changes in exchange rates are not normally distributed. Table 1.2 reports some

[5]Following a short-lived recovery from this level, the Australian currency plunged to just over 0.60 by the end of October 2008. Some explanations for this depreciation are presented in Chapter 14.

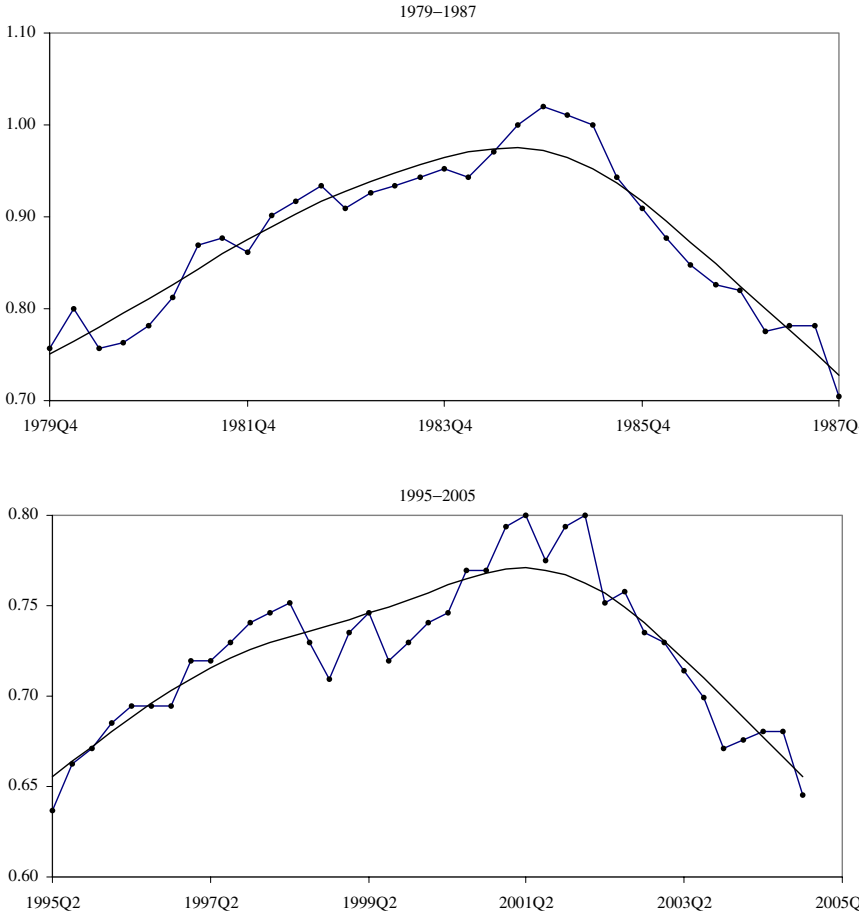

Figure 1.4. Bubbles and crashes of the dollar (SDR/USD).

indicators based on the data used to plot Figure 1.6. We can see, for example, that 32 observations on the JPY/USD rate fall above the 99th percentile and 10 observations fall above the threshold of three standard deviations above the mean (a 3-sigma event). It can also be seen from the table that the largest percentage change in the EUR/USD is 4.29 standard deviations above the mean. The probability of a 4-sigma (or, to be precise, a 4.29-sigma) event is extremely low, and it is certainly not compatible with a normal probability distribution. But this is nothing compared to what happened to the USD/AUD rate during the first 10 days of October 2008, as it registered

Table 1.1. Bubbles and crashes (SDR/USD).

Quarter	Exchange rate	% Change	Time in quarters
1979:Q4	0.7567		
1984:Q4	1.0204	+34.7	21
1987:Q4	0.7040	−31.0	12
1995:Q2	0.6369		
2002:Q1	0.8000	+25.6	30
2004:Q4	0.6452	−19.4	11

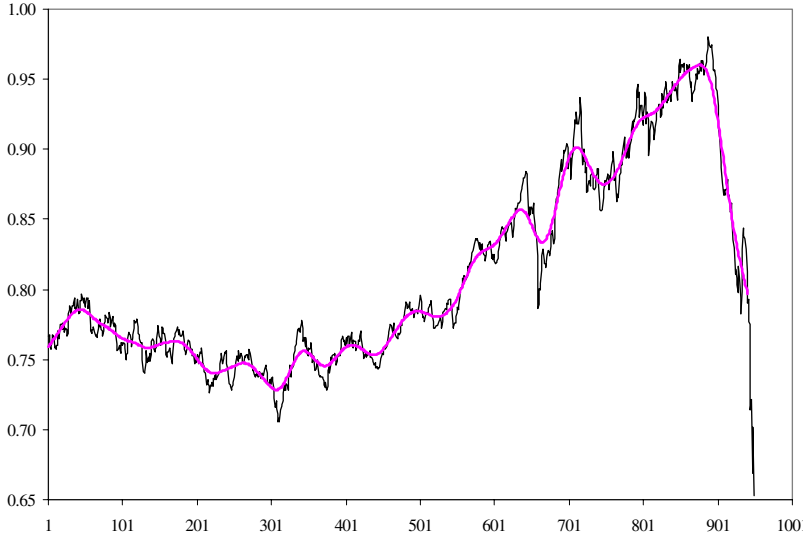

Figure 1.5. The great bubble and crash of the Australian dollar (USD/AUD, 4 January 2005–10 October 2008).

8- and 9-sigma events, as can be seen in Figure 1.7. The distribution of the percentage change in exchange rates contains too many extreme values to be normally distributed.[6]

[6]The probability of a 4-sigma event on any 1 day is 0.00317%, which means that a 4-sigma event is expected to occur once every 31,560 days. A 10-sigma event occurs with a probability of 7.62×10^{-22}%, or that it is expected to occur once every 5.2×10^{20} years. Dowd *et al.* (2008) calculate the probabilities of up to 25-sigma events, showing that this event should be expected to occur once every 1.309×10^{135} years.

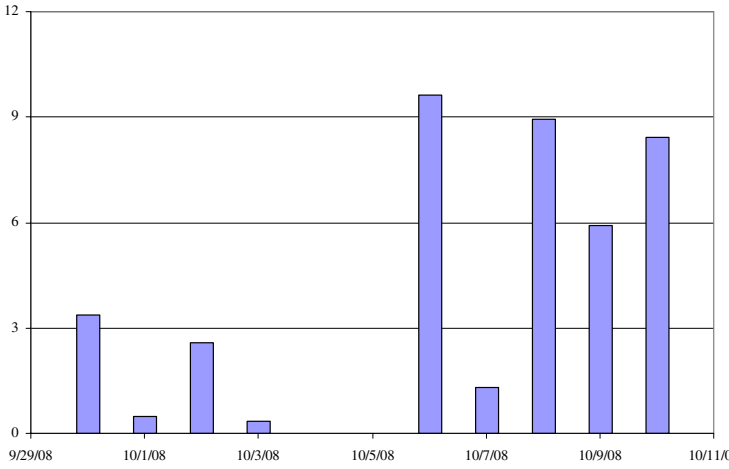

Figure 1.6. Standard deviations above or below the mean daily percentage change (USD/AUD, 30 September–10 October 2008).

Table 1.2. Some statistics of daily percentage changes in exchange rates (4 January 2005–10 October 2008).

Statistic	EUR/USD	GBP/USD	JPY/USD
1	1.41	1.37	1.32
2	1.59	1.58	1.88
3	16	14	32
4	9	10	10
5	4.29	4.00	3.63

1. 99th percentile.
2. The value falling three standard deviations above or below the mean.
3. Number of observations above or below the 99th percentile.
4. Number of observations above or below the mean plus (minus) three standard deviations.
5. Number of standard deviations above or below the mean where the highest or lowest values fall.

1.3.2. *Stylized Facts: Spot Rates, Forward Rates, and Macroeconomic Variables*

The first stylized fact is that the spot and forward rates tend to move in the same direction and by approximately the same amount, particularly if the

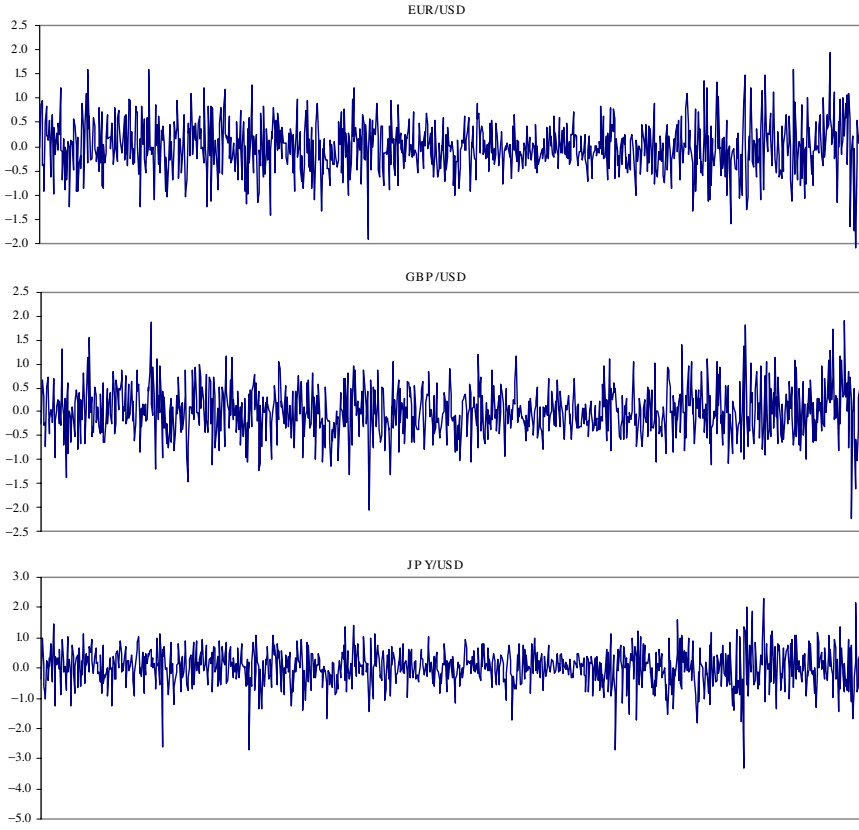

Figure 1.7. Volatility clustering in exchange rates (percentage changes: 4 January 2005–10 October 2008).

movements are large. The implication of this observation is that it is not advisable to use the forward rate to predict the spot rate expected to prevail in the future. The spot and forward rates are related contemporaneously, as implied by covered interest parity, and not what is implied by the unbiased efficiency hypothesis. This issue will be discussed in Chapter 9.

Exchange rates are more volatile than macroeconomic variables. Table 1.3 reports the standard deviations of quarterly percentage changes in four exchange rates and three macroeconomic variables covering the U.S. and three other countries: industrial production, the general price level (measured by the consumer price index, CPI) and the money supply. It is obvious that exchange rates are more volatile than the macroeconomic variables

Table 1.3. Standard deviations of quarterly percentage rates of change.

	1985–89	1990–94	1995–99	2000–2007	1985–2007
Exchange rates					
SDR/USD	3.78	3.36	2.54	2.34	3.01
JPY/USD	6.65	5.43	7.44	4.40	5.99
GBP/USD	6.36	6.72	3.00	3.47	4.98
AUD/USD	6.32	4.06	4.88	5.49	5.29
Industrial production					
U.S.	1.04	1.19	0.83	1.15	1.09
Japan	1.26	1.74	1.89	2.09	1.85
U.K.	1.67	1.26	0.86	1.25	1.31
Australia	1.85	1.07	1.18	1.25	1.34
Prices					
U.S.	0.52	0.50	0.36	0.36	0.63
Japan	0.66	0.47	0.63	0.63	0.54
U.K.	0.68	1.13	0.34	0.34	0.76
Australia	0.44	0.72	0.51	0.51	0.81
Money supply					
U.S.	1.71	1.23	0.90	1.60	1.62
Japan	1.94	1.65	1.11	2.40	1.93
U.K.	0.77	1.07	0.50	0.41	0.84
Australia	2.15	2.74	1.41	3.24	2.63

that are supposed to determine them. This observation raises the following question: how can a highly volatile variable be determined by variables that move relatively smoothly over time? Among the exchange rates, the least volatile is, as expected, the SDR/USD rate because the SDR is a basket of currencies (hence, the SDR/USD rate is a multilateral rather than a bilateral rate). Out of the three bilateral rates, the AUD/USD rate seems to be the most volatile.

The other stylized facts describe the possible relations between the exchange rate and individual macroeconomic variables. The following can be stated:

- There is no close correspondence between movements in exchange rates and movements in domestic and foreign price levels. This proposition, which casts doubt on the theory of purchasing power parity (PPP), is more

valid over a short rather than a long period. The problem (for exchange rate modeling) is that PPP is a cornerstone of the monetary model of exchange rates.

- There is a weak general tendency for countries experiencing sharp deterioration in the current account to experience subsequent and consequent depreciation of their currencies. For example, the U.S. dollar appreciated considerably during the period 1981–85 while the current account was dipping further into the red. The current account plays a key role in the Hooper–Morton model and all versions of the portfolio balance model.
- Countries that experience rapid expansion of their money supplies also experience rapid depreciation of their currencies. The word "rapid" must be emphasized here because this proposition seems to be valid for hyperinflation countries only (for example, Germany in the 1920s). This proposition is a prediction of the monetary model of exchange rates.[7]

Figure 1.8 shows the behavior of the actual exchange rates of the yen and pound against the U.S. dollar and the corresponding PPP rates. The latter are calculated by adjusting the actual exchange rates at the base period (1988:Q4) for prices (by multiplying the base period rates by the price ratios prevailing in subsequent periods). We can see the contrast between the actual behavior of the exchange rates and the behavior predicted by PPP. The PPP rates are calculated under the assumption that prices are the only determining factor of exchange rates. Notice that if the exchange rate is determined by prices only (which is what PPP tells us), the time path of the exchange rate would be rather smooth and it would be significantly less volatile than the actual rate. This provides support for the stylized fact that there is no close correspondence between movements in exchange rates and movements in domestic and foreign price levels. But one could argue that we cannot expect the exchange rate to be determined by one or two price indices, and that other variables should be brought into play. However, we will find out throughout this book that no matter what combination of variables we bring in, the behavior of exchange rates is difficult to explain and predict. This observation, however, does not mean that macroeconomic fundamentals do not matter. The importance, or otherwise, of fundamentals is an issue that will be revisited in Chapter 14.

[7]For a detailed account of five major hyperinflation episodes and the performance of the monetary model and purchasing power parity under hyperinflation, see Gazos (2008).

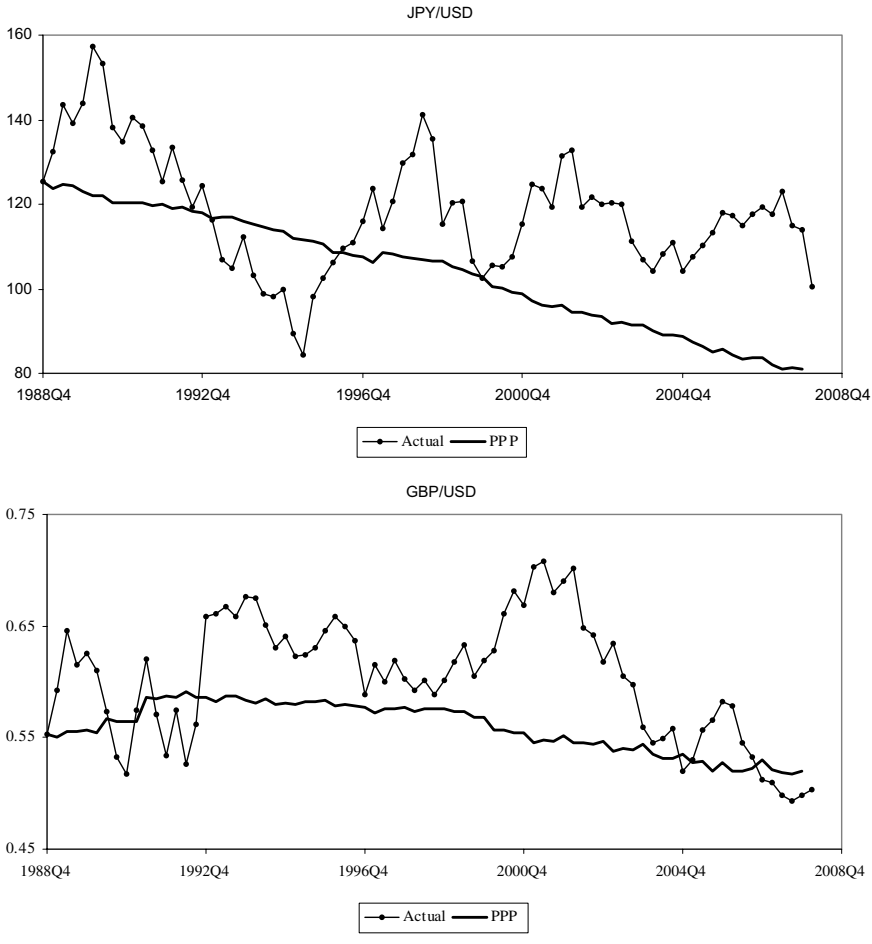

Figure 1.8. Exchange rates and prices: deviations from PPP.

1.4. Exchange Rates and Other Financial Prices: The Subprime Crisis as an Example

The relation between exchange rates and other financial prices is not clear. Take, for example, the relation between exchange rates and stock prices. On a firm level, we should expect domestic currency depreciation to be beneficial for the stocks of exporting firms and harmful for the stocks of importing firms. But in aggregate, the relation is not clear. On the capital account side, stock prices should be boosted by expectation of domestic

currency appreciation, but the econometric extraction of expected values may not reflect the actual expectation formation mechanism, thus producing misleading results.

Perhaps it is insightful in this respect to observe what happened in the foreign exchange market during the subprime crisis that surfaced in mid-2007 and affected all financial markets (see, for example, Moosa, 2008a,b). During the crisis, the foreign exchange market witnessed increasing volatility and (initially) further depreciation of the U.S. dollar. Higher volatility resulted from rapid unwinding of carry trade positions as a result of lower appetite for financial risk. Carry trade involves taking a short position on a low-interest currency and a corresponding long position on a high-interest currency.[8] The risk involved in this operation is the potential loss resulting from the possibility of the appreciation of the low-interest currency against the high-interest currency by more than the interest rate differential, which means that exchange rate volatility discourages the conduct of carry trade. Furthermore, the hedge funds affected by the subprime crisis started to unwind carry trade positions to meet margin calls following losses in their credit portfolios. Thus, the unwinding of carry trade positions led to exchange rate volatility, which in turn led to more unwinding of these positions.

Moreover, viewing the U.S. economy as being more vulnerable to the subprime crisis than the economies of Europe and Australasia brought with it further depreciation of the U.S. currency. By the end of October 2007, the U.S. dollar was at a record low against the euro, the lowest level against the Australian dollar since 1984, and the lowest level against the pound in 26 years. But then, the Australian currency lost 20 cents of its value against the U.S. dollar in less than 2 months, and as the ramifications of the subprime crisis became clearer and as it was "upgraded" to a full-blown credit and financial crisis. In the first half of October 2008, the Australian dollar crashed against the U.S. dollar, as we have seen.[9]

Figure 1.9 shows the behavior of the Dow Jones Industrial Average and three dollar exchange rates (EUR/USD, JPY/USD, and GBP/USD) using daily data over the period 10 February 2006–10 September 2008 (note that the subprime crisis surfaced in June 2007). There is simply no obvious

[8]On carry trade, see Moosa (2008c).

[9]One plausible explanation is that U.S. dollar-based investors were liquidating their Australian assets and converting them into U.S. dollars because they were in need for U.S. dollar funds.

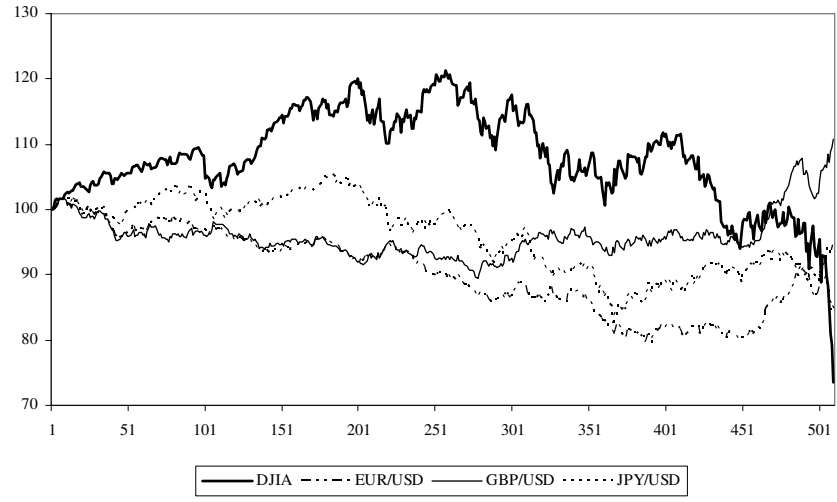

Figure 1.9. Exchange rates and stock prices (10 February 2006–10 September 2008).

relation between stock prices and exchange rates. The relation between the two variables seems to depend on time and the particular exchange rate. For the whole period shown in the graph, the correlation coefficient between the DJIA and the three exchange rates was as follows: 0.14 for the EUR/USD rate, −0.75 for the GBP/USD rate, and 0.48 for the JPY/USD rate. At one time, correlation was generally positive, but toward the end of the period covered by the graph, the dollar strengthened significantly against the pound as the U.S. stock market collapsed. It is true that the British stock market was also collapsing at the same time and that the U.K. was affected by the credit crisis. But the crisis was American by birth, and it seems implausible to think that the U.K. was affected by an American crisis more than America itself. What then explains the rapid appreciation of the dollar against the pound as the ramifications of the crisis were becoming more and more conspicuous? The problem is that even if one or more plausible explanations can be found, these explanations (individually or collectively) cannot be captured by an exchange rate determination model.[10]

[10]Apart from the reason pointed out in the previous footnote, one could think of other plausible reasons for the strength of the U.S. currency in the midst of the credit crisis. The sheer size and diversity of U.S. financial markets may still be appealing to investors, particularly that the U.S. government has the power to issue the dollar, which is the world's

1.5. Exchange Rate Regimes

This book presents a description of models designed for various exchange rate regimes. Most of these models deal with the determination of flexible exchange rates. The balance of payments models presented in Chapter 4 deals with the effect of macroeconomic changes on the balance of paymets under fixed exchange rates. In between, the Girton–Roper model presented in Chapter 7 is designed to deal with the joint determination of the exchange rate and international reserves under a system of managed floating. For this reason, it may be worthwhile to go through a brief classification of exchange rate regimes in theory and practice. For a detailed discussion of exchange rate regimes and their implications, see Moosa (2005).

1.5.1. *Exchange Rate Regime Classification*

From a theoretical perspective, exchange rate regimes can be classified (according to the flexibility of exchange rates) into perfectly fixed exchange rates, fixed but adjustable exchange rates, and perfectly flexible exchange rates. The movements in flexible exchange rates are small and continuous, resulting from changes in market forces (shifts in the supply and demand curves). Changes in fixed (but adjustable) exchange rates are large and discrete, resulting from deliberate policy actions (changing the par value of the domestic currency). While a change in a fixed exchange rate is called "devaluation" (downward) and "revaluation" (upward), the corresponding changes in a flexible exchange rate are called "depreciation" and "appreciation," respectively. It is often the case (particularly in the media, but also in academic work) that the words "depreciation" and "devaluation" are (mistakenly) used interchangeably as if they meant the same thing.

Other regimes include fixed but flexible within a band, fixed but adjustable and flexible within a band, and flexible exchange rates with

main reserve currency. Foreign direct investment flows would be another reason, given that the crisis has left numerous undervalued companies and assets in the U.S. Furthermore, other countries started cutting their interest rates vigorously when the dollar interest rates were low, thus reducing the interest rate differential against the dollar. Finally, a reason for the renewed strength of the dollar that has nothing to do with the crisis is the cyclical behavior of exchange rates. The dollar, it seems, had reached its trough in July 2008, and it was about time it would appreciate. On the other hand, the depreciation of the dollar against the yen was caused by the reversal of carry trade operations.

market intervention. Managed floating (also called dirty floating), independent floating, and target zones are regimes that fall under the heading "flexible rates with market intervention." The main difference lies in the degree and frequency of market intervention, and hence the flexibility of the exchange rate. Exchange rate flexibility is lower under managed floating than under independent floating. But under both of these systems, intervention is mainly directed at combating speculative pressure and reducing exchange rate volatility (this is at least what is normally claimed, although there is the view that managed floating has the objective of influencing the market trend of the exchange rate). Indeed, the difference between managed floating and independent floating is typically blurred.

A system of target zone differs from managed floating and independent floating in at least two respects: (i) establishing a range for the exchange rate for a future period and (ii) observing closely the exchange rate in the conduct of monetary policy to keep it within the target range. But unlike the adjustable peg system, a target zone system does not imply a formal commitment to intervene in the foreign exchange market to keep the exchange rate within the target range. The target range is reviewed and changed if necessary.

In practice, and following the classification system of the International Monetary Fund, exchange rate regimes are classified according to the degree of exchange rate flexibility into (i) fixed exchange rates, (ii) flexible exchange rates, and (iii) intermediate regimes. The so-called clean floating or perfectly flexible exchange rates hardly exist these days, and not even the free-market champions of the IMF advocate a system like this. Under these three broad categories, there are specific regimes, including the following:

Dollarization

The term "dollarization" is generic, implying the use of the currency of one country as the legal tender of another country. As the U.S. dollar is the most commonly used currency for this purpose, we use the term "dollarization" and not "euroization" or "poundization." Further discussion of dollarization can be found in Chapter 9.

Currency Unions

A currency union is another hard-peg system where a group of countries use a common currency, which means that these countries have fixed exchange rates among them. The obvious example is the European Monetary Union.

Currency Boards

A currency board is a system of fixed exchange rates that was common in colonial territories during the first half of the twentieth century. Under this system, the currency board is obliged to supply, on demand and without limit, the foreign currency to which the domestic currency is pegged.

Single-Currency Pegs

Pegging to a single currency amounts to fixing the bilateral exchange rate against another currency (the anchor currency). The anchor currency is, or should be, that of the major trading partner.

Multicurrency Pegs

Unlike single-currency pegs, multicurrency pegs (or basket pegs) do not give rise to a form of currency area. Rather than reflecting acceptance of optimum currency area arguments in favor of a link to a single currency, the choice of a basket peg may be interpreted as a rejection of these arguments. Again, it is possible that the pegged exchange rate is allowed to move within a band, giving rise to what Frankel *et al.* (2001) call a "band around a basket peg."

Adjustable Pegs

Under adjustable pegs (fixed but adjustable exchange rates), the country undertakes an obligation to defend the peg, but reserves the right to alter the exchange rate to correct a fundamental disequilibrium. The Bretton Woods system (1944–71) was a system of adjustable pegs.

Crawling Pegs

One variation on fixed exchange rates that is common among high-inflation developing countries is the crawling peg, whereby the government announces a schedule of small, discrete devaluations. A country adopting a crawling peg undertakes an obligation to defend the peg but either commits itself to moving the peg in small steps in accordance with a preannounced rule or reserves the right to change the peg in small steps that are discretionary in size and timing. This is called a discretionary crawling peg. Like the adjustable peg, a crawling peg involves a choice between pegging to

a single currency and pegging to a basket of currencies. Again, the presumption is that pegging to a basket is superior.

1.5.2. *Exchange Rate Regime Verification*

It has become an undisputed fact of life that, with respect to exchange rate regime choice, countries do not necessarily practise what they declare. This phenomenon has led to the emergence of a new strand of research in international finance, appearing under the headings "exchange rate regime verification," "*de facto* versus *de jure* regimes," and "fear of floating" (also fear of fixing or fear of pegging).[11] Countries do not adhere to the declared regime for a number of reasons.

China provides the most recent example of adopting a regime (crawling peg) and declaring another one (basket peg). Moosa *et al.* (2008) attempt to verify the exchange rate regime that China has been following since 21 July 2005 when a policy shift was implemented, presumably taking China from a dollar peg to a basket peg. The results show that while the previous regime of simple and strict dollar peg has indeed been abandoned, the evidence does not support the proposition that the current exchange rate regime is a basket peg. It is suggested, based on the empirical results, that the current Chinese regime is some sort of a discretionary crawling peg against the U.S. dollar. It is argued that this regime is consistent with the Chinese objectives of maintaining a competitive advantage while avoiding a trade war with the U.S. Moosa (2008d) reaches the same conclusion by demonstrating that a crawling peg model is more powerful in forecasting the yuan/dollar exchange rate than a basket peg model.

1.6. What Is to Come

As stated earlier, this book deals mainly with flexible exchange rates, but we also consider fixed exchange rates and managed floating. In Chapter 2, we study the Mundell–Fleming model under both fixed and flexible exchange rates. We will see how the model can be viewed as an exchange rate determination model and how it can be used to assess the effectiveness of monetary and fiscal policies under fixed and flexible exchange rates. Chapter 3 covers

[11] For a detailed discussion of these issues, see Moosa (2005).

the determination of (flexible) exchange rates under monetarist conditions, including perfect price flexibility. The flexible-price monetary model, which came as a challenge to the Mundell–Fleming model, is simply an extension of the quantity theory of money to the case of open economy. One problem with this model is the very assumption of perfect price flexibility, which leads to the proposition that purchasing power parity is valid not only in the long run but also in the short run.

Just like the flexible price monetary model has been suggested as a replacement for the Mundell–Fleming flow model, the monetary approach to the balance of payment has been suggested as a replacement for the elasticities, Keynesian and income absorption approaches. This topic is covered in Chapter 4, which is concerned with the balance of payment adjustment mechanism under fixed exchange rates. It will be shown, however, that it is possible to come up with a synthesis of the monetary and Keynesian approaches.

In Chapter 5, we study the Dornbusch sticky-price model, which is a representation of long-run equilibrium toward which the economy tends to adjust, while in the short run it is possible that the exchange rate may overshoot its long-run value (hence, the model is also called the "overshooting model"). This model explains the paradox that countries with high interest rates tend to have currencies that are expected to appreciate. The initial rise in domestic interest rates leads to steep appreciation of the domestic currency, which is expected to be followed by slow depreciation to satisfy uncovered interest parity. Thus, this model plugs loopholes in the Mundell–Fleming model and the flexible-price monetary model. Other sticky-price models were developed subsequently, including the real interest differential model, Driskell's generalized stock-flow sticky-price model, the equilibrium real exchange rate model of Hooper and Morton, the Buiter–Miller model with a core inflation rate, and Frankel's sticky-price model with a wealth effect. These models are described in Chapter 6.

While Chapters 2–6 deal with either fixed or flexible exchange rates, Chapter 7 provides an exposition of a model that is designed for an intermediate arrangement, whereby both the exchange rate and the level of international reserves change. This is the monetary model of exchange market pressure developed by Girton and Roper, who suggest that the monetary model is valid for either a pure float or a pure peg (the monetary approach to the balance of payment). This makes a lot of sense because in practice there is no pure float and hardly a pure peg, unless we are talking about currency unions or currency boards.

All monetary models are asset market models that are restrictive in the sense that they only allow for one asset: money. The portfolio balance model described in Chapter 8 allows for the holding of bonds. This model postulates that a deficit or surplus in the current account gives rise to a portfolio balance effect on the exchange rate. The role of the current account is prominent in this model because the accumulation or otherwise of assets (wealth) is supposed to take place via the current account. A synthesis of the monetary and portfolio balance models is also presented in Chapter 8. Furthermore, it is shown that the portfolio balance model can be modified by introducing a role for the banking sector and the effect of bank lending.

The exchange rate models described in Chapters 2, 3, and 5–8 do not allow individuals and firms to hold foreign currencies. This is a restriction that is not consistent with reality where diversified currency portfolios are held for transaction, precautionary, and speculative motives. The tendency to hold foreign currencies in addition to, or instead of, the domestic currency is called "currency substitution." In the currency substitution model, which is described in Chapter 9, the demand for money functions is modified by introducing the expected change in the exchange rate as an additional explanatory variable. The model shows that allowing for currency substitution makes exchange rates volatile and even indeterminate in extreme cases.

In Chapter 10, we move from macroeconomic models to the microstructure model of exchange rates. The unsatisfactory performance of macroeconomic models has led some economists to rethink the exchange rate determination process by introducing an explicit role for the process of trading in the foreign exchange market. One of the major contributors to the field, Richard Lyons, tells an interesting story to explain why he developed interest in the microstructure approach to exchange rates after he spent a day in a dealing room where he watched dealers in action. When he visited the dealing room, he writes "At that time, I considered myself an expert, having written my thesis on exchange rates. I thought I had a handle on how it worked. I thought wrong" (Lyons, 2001a, p. xiii). No wonder that Lyons's name will be mentioned quite frequently in Chapter 10 (and in Chapter 13).

While the microstructure approach has been suggested to explain the empirical failure of macroeconomic models, an earlier attempt was made without departing from the macroeconomic framework. Instead of relating changes in exchange rates to total changes in economic fundamentals, the news approach relates changes in exchange rates to unanticipated changes in the fundamentals or news about fundamentals. This approach is considered

in Chapter 11. The main problem with this approach is the task of extracting of the news components of total changes in macroeconomic fundamentals, which makes the econometric testing of the news model rather difficult. In particular, the representation of the news components by the residual of a univariate model of the underlying macroeconomic variable may introduce errors in variables and generated regressors problems.

Chapters 12 and 13 present the empirical evidence on the macroeconomic and microstructure models of exchange rates, respectively. Evidence on the macroeconomic models described in earlier chapters is based on conventional econometric methods, out-of-sample forecasting, cointegration-based dynamic models, and simultaneous equation models. In general, the evidence on macroeconomic models is dismal. The evidence on the microstructure models shows that order flow, which is the most important microstructure variable, has some explanatory power that far exceeds that of macroeconomic variables such as interest rates. However, one has to bear in mind that order flow is a "proximate cause," and that it is not "the underlying cause of exchange rate movements" because "the underlying cause is information" (Lyons, 2001a, p. 17). While the microstructure approach provides an explanation for the failure of macroeconomic models, hence providing an alternative approach, other alternative approaches are discussed in Chapter 14, where we also conclude.