Michael Melvin and Stefan C. Norrbin

INTERNATIONAL MONEY AND FINANCE

TENTH EDITION

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Tenth Edition

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Preface

International finance is one of the growth areas of the finance and economics curricula. Today's financial marketplace is truly global. No student of economics or finance can fully understand current developments without some background in international finance. If, after studying this text, a student can pick up *The Wall Street Journal* and understand the international financial news, along with its implications, then we feel that we have succeeded as teachers. To this end, *International Money and Finance Tenth Edition* offers a concise yet comprehensive overview of the subject. The basics of the foreign exchange market and the balance of payments are presented, along with accessible discussions of the most recent research findings related to exchange rate determination. Topics covered range from the nitty-gritty of financing international trade to intuitive discussions of overshooting exchange rates and currency substitution.

The first edition of *International Money and Finance* grew from the lecture notes used to teach undergraduate students at Arizona State University. The notes, as well as the book, summarized the current literature in international finance, with only elementary math as a prerequisite. It was extremely gratifying to find that instructors at other institutions found the earlier editions to be useful texts for undergraduate and MBA students. In fact, the adoption list ranged from the leading MBA schools in the country to small rural 4-year colleges. The fact that the text has proved successful with students of varying abilities and backgrounds is a feature that we have strived to retain in preparing this tenth edition.

Users of the past editions will find the tenth edition updated and revised to keep pace with the rapidly changing world of international finance. The tenth edition has been written in the same spirit as the first nine: to provide a concise survey of international finance suitable for undergraduate and MBA classes.

Acknowledgments

To the Student

Why Study International Finance?

Why study the subject of international money and finance? One reason is that career goals are paramount to many people, and in this regard the topic of the text is related to a growth area in the labor market. This book provides a background in international finance for those who expect to obtain jobs created by international investment, international banking, and multinational business activity. Other readers may have a more scholarly concern with "rounding out" their economic education by studying the international relationships between financial markets and institutions. Although a course in principles of economics is the only prerequisite assumed for this text, many students may have already taken intermediate macroeconomics, money and banking, or essentials of finance courses. But for those interested in international economic relationships, such courses often lack a global orientation. The economic models and discussions of the typical money and banking course focus on the *closed economy*, closed in the sense that the interrelationships with the rest of the world are ignored. Here we study the institutions and analysis of an integrated world financial community, thus giving a better understanding of the world in which we live. We will learn that there are constraints as well as opportunities facing the business firm, government, and individual investor that become apparent only in a worldwide setting.

Finance and the Multinational Firm

A *multinational firm* is a firm with operations that extend beyond its domestic national borders. Such firms have become increasingly sophisticated in international financial dealings because international business poses risk and return opportunities that are not present in purely domestic business operations. A US multinational firm may have accounts payable and receivable that are denominated in US dollars, Japanese yen, British pounds, Mexican pesos, Canadian dollars, and euros. The financial managers of this firm face a different set of problems than the managers of a firm doing business strictly in dollars. It may be true that "a dollar is a dollar," but the dollar value of yen, euros, or pesos can and does change over time. As the

dollar value of the yen changes, the value of yen-denominated contracts will change when evaluated in terms of dollars.

Multinational finance responds to this new set of challenges with a toolkit of techniques and market instruments that are used to maximize the return on the firm's investment, subject to an acceptable level of risk. Once we extend beyond the domestic economy, a wide variety of business opportunities exist that must be utilized with the appropriate financial arrangements. This book intends to cover many aspects of these international financial transactions that the financial manager may encounter. The financial side of international business differs from the study of international trade commonly encountered in international economics courses. Courses in international trade study the determinants of the pattern and volume of world trade, formally referred to as the theory of *comparative advantage*. If country A produces and exports shoes in exchange for country B's food, we say that A has a comparative advantage in shoes and B has a comparative advantage in food. Besides comparative advantage, such courses also examine the movement of factors of production, labor, and capital goods between nations. Obviously, these subjects are important and deserve careful study, but our purpose is to study the monetary consequences of such trade. Although we will not explicitly consider any theories of comparative advantage, as such theories are usually developed without referring to the use of money, we will consider the impact of monetary events on trade in real goods and services. We will find that monetary events have real consequences for the volume and pattern of international trade.

The Actors

This course is not simply a study of abstract theories concerning the international consequences of changes in money supply or demand, prices, interest rates, or exchange rates. We also discuss the role and importance of the institutional and individual participants. Most people tend to think immediately of large commercial banks as holding the starring role in the international monetary scene. Because the foreign exchange market is a market where huge sums of national currencies are bought and sold through commercial banks, any text on international finance will include many examples and instances in which such banks play a major part. In fact, Chapter 1 begins with a discussion of the role of banks in the foreign exchange market.

Besides commercial banks, other business firms play a key part in our discussion, since the goods and services they buy and sell internationally effect a need for financing such trade. The corporate treasurer of any multinational firm is well versed in foreign exchange trading and hedging and international investment opportunities. What is hedging? How are international investment opportunities related to domestic opportunities? These are subjects we address in Chapters 4 and 6. Finally, we examine the role of government. Central banks, such as the Federal Reserve in the United States, are often important actors in our story. Besides their roles of buying, selling, lending, and borrowing internationally, they also act to restrict the freedom of the other actors. The policies of central governments and central banks are crucial to understanding the actual operation of the international monetary system, and each chapter will address the impact of government on the topic being described.

Plan of Attack

This book can be thought of in terms of four main sections. To aid our understanding of the relationships among prices, exchange rates, and interest rates, we will consider existing theories, as well as the current state of research that illuminates their validity. For those students who choose to proceed professionally in the field of international finance, the study of this text should provide both a good reference and a springboard to more advanced work, and ultimately employment. Chapters 1 through 3 identify the key institutions and the historical types of international monetary systems as well as discuss the current system. In Chapters 4 through 7 the expansion of the international monetary system by allowing payments to fall due in a future time period is explained. This results in a need for hedging instruments and expands the interaction between financial variables in different countries.

Chapters 8 through 11 are devoted to applied topics of interest to the international financial manager. Issues range from the "nuts and bolts" of financing imports and exports to the evaluation of risk in international lending to sovereign governments. The topics covered in these chapters are of practical interest to corporate treasurers and international bankers.

Chapters 12 through 15 cover the determinants of balance of payments and exchange rates. Government and industry devote many resources to trying to forecast the balance of payments and exchange rates. The discussion in these chapters includes the most important recent developments.

Although there is some disagreement among economists regarding the relative significance of competing theories, as far as possible in an intermediate-level presentation, the theories are evaluated in light of research evidence. Altogether, these chapters present a detailed summary of the current state of knowledge regarding the determinants of the balance of payments and exchange rates.

At the beginning of this introduction, we asked: Why study international money and finance? We hope that the brief preview provided here will have motivated you to answer this question. International finance is not a dull "ivory tower" subject to be tolerated, or avoided if possible. Instead, it is a subject that involves dynamic real-world events. Since the material covered in this book is emphasized daily in the newspapers and other media, you will soon find that the pages in *International Money and Finance* seem to come to life. To this end, a daily reading of *The Wall Street Journal* or the London *Financial Times* makes an excellent supplement for the text material. As you progress through the book, international financial news will become more and more meaningful and useful. For the many users of this text who do not go on to a career in international finance, the major lasting benefit of the lessons contained here will be the ability to understand international financial news intelligently and effectively.

Michael Melvin and Stefan Norrbin

CHAPTER 1

The Foreign Exchange Market

Foreign exchange trading refers to trading one country's money for that of another country. The need for such trade arises because of tourism, the buying and selling of goods internationally, or investment occurring across international boundaries. The kind of money specifically traded takes the form of bank deposits or bank transfers of deposits denominated in foreign currency. The *foreign exchange market*, as we usually think of it, refers to large commercial banks in financial centers, such as New York or London, that trade foreign currency—denominated deposits with each other. Actual *banknotes* like dollar bills are relatively unimportant insofar as they rarely physically cross international borders. In general, only tourism or illegal activities would lead to the international movement of banknotes.

Foreign Exchange Trading Volume

The foreign exchange market is the largest financial market in the world. Every 3 years the Bank for International Settlements (BIS) conducts a survey of trading volume around the world, and in the 2019 survey the average amount of currency traded *each business day* was $6.6 trillion. Thus the foreign exchange market is an enormous market. Fig. 1.1 shows that the foreign exchange market has grown rapidly over the last decade. In 2001, the trading volume of foreign exchange was $1.5 trillion, by 2007, the foreign exchange market had doubled in volume, and in the last 12 years the foreign exchange market has grown by more than $3 trillion.

The US dollar is by far the most important currency and has remained so, even with the introduction of the euro. The dollar is involved in 88% of all trades. Since foreign exchange trading involves pairs of currencies, it is useful to know which currency pairs dominate the market. Table 1.1 reports the share of market activity taken by different currencies. The largest volume of trading occurs in dollar/euro trading, accounting for slightly more than 24% of the total volume. The next closest currency pair, the dollar/yen, accounts for just over 13%. After these two currency pairs, the volume drops off. For example, the dollar/UK pound pair makes up about
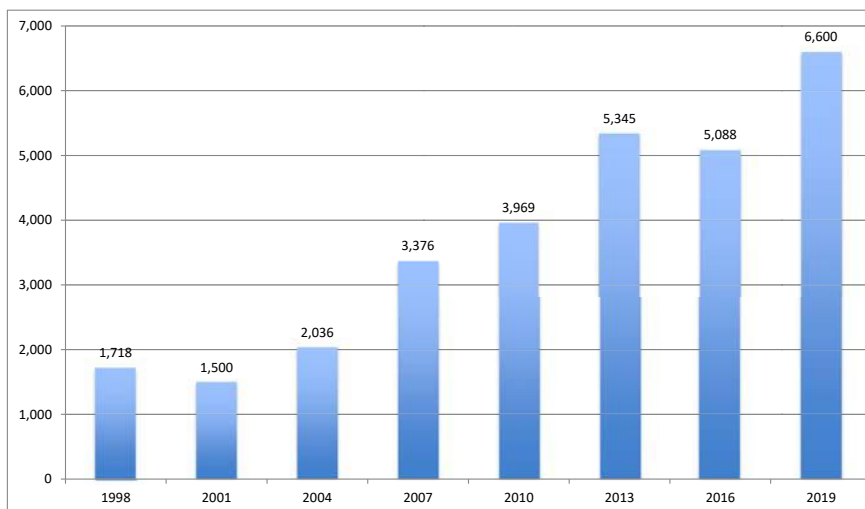
Fig. 1.1

Table 1.1 Top ten currency pairs by share of foreign exchange trading volume

Currency pair	Percent of total
US dollar/euro	23.0
US dollar/Japanese yen	17.7
US dollar/UK pound	9.2
US dollar/Australian dollar	5.2
US dollar/Canadian dollar	4.3
US dollar/China yuan renminbi	3.8
US dollar/Swiss franc	3.5
US dollar/Mexico peso	2.1
Euro/UK pound	2.0
US dollar/Singapore dollar	1.9

Source: Bank for International Settlements, Triennial Central Bank Survey, September 2016.

two-thirds of the trading volume of the dollar/yen pair. The US dollar is represented in 9 of the top 10 currency pairs. Thus the currency markets are dominated by dollar trading.

Geographic Foreign Exchange Rate Activity

The foreign exchange market is a 24-hour market. Currencies are quoted continuously across the world. Fig. 1.2 illustrates the 24-hour dimension of the foreign exchange market. We can determine the local hours of major
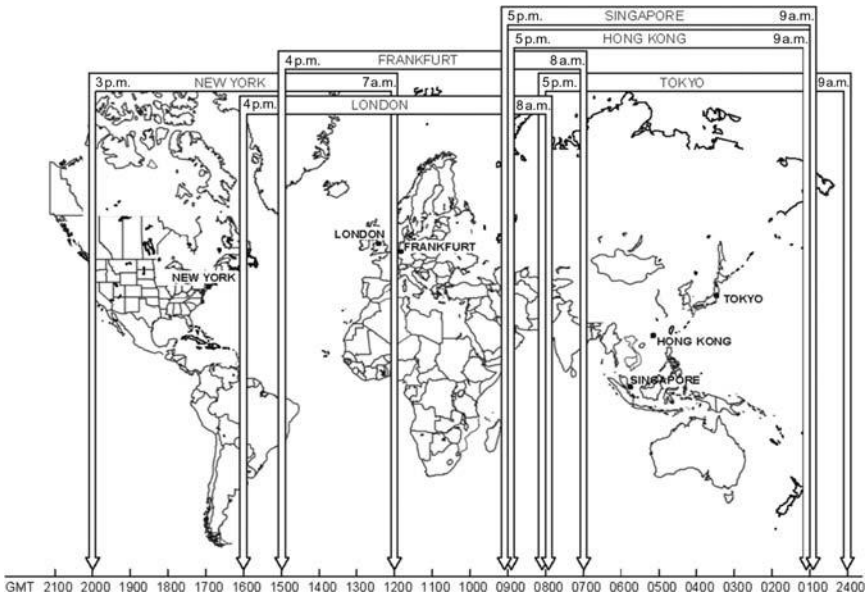
Fig. 1.2

trading activity in each location by the country bars at the top of the figure. Time is measured as Greenwich Mean Time (GMT) at the bottom of the figure. For instance, in New York 0700 is 1200 GMT and 1500 is 2000 GMT. Fig. 1.2 shows that there is a small overlap between European trading and Asian trading, and there is no overlap between New York trading and Asian trading.

Dealers in foreign exchange publicize their willingness to deal at certain prices by posting quotes on electronic networks such as EBS. When a dealer at a bank posts a quote, that quote then appears on computer monitors sitting on the desks of other foreign exchange market participants world-wide. This posted quote is like an advertisement, telling the rest of the market the prices at which the quoting dealer is ready to deal. In addition to the electronic trading venues, there is still bilateral direct-dealing in the market, where one person speaks with a bank dealer to arrange a trade. These bilateral transactions and the quantities and prices that are transacted are proprietary information and are known only by the two participants in a transaction. The quotes on the electronic trading networks are the best *publicly* available information on the current prices in the market.

In terms of the geographic pattern of foreign exchange trading, a small number of locations account for the majority of trading. Table 1.2 reports

Table 1.2 Top ten foreign exchange markets by trading volume

Country	Total volume (billions of dollars)	Percent share
United Kingdom	2426	37.1%
United States	1272	19.4%
Singapore	517	7.9%
Hong Kong	437	6.7%
Japan	399	6.1%
France	181	2.8%
Switzerland	156	2.4%
Australia	135	2.1%
Germany	116	1.8%
Bulgaria	86	1.3%

Source: Bank for International Settlements, Triennial Central Bank Survey, September 2016.

the average daily volume of foreign exchange trading in different countries. The United Kingdom and the United States account for more than half of the total world trading. The United Kingdom has long been the leader in foreign exchange trading. In 2019, it accounted for about 43% of the total world trading volume. While it is true that foreign exchange trading is a round–the–clock business, with trading taking place somewhere in the world at any point in time, the peak activity occurs during business hours in London, New York, and Singapore.

Fig. 1.3 provides another view of the 24–hour nature of the foreign exchange market. This figure shows the average number of quotes on the Japanese yen/US dollar posted to the Reuters foreign exchange network. Fig. 1.3 reports the hourly average number of quotes over the business week. Weekends are excluded, since there is little trading outside of normal business hours. The vertical axis measures the average number of quotes per hour, and the horizontal axis shows the hours of each weekday measured in GMT. A clear pattern emerges in the figure: every business day tends to look the same. Trading in the yen starts each business day in Asian markets, with a little more than 20 quotes per hour being entered. Quoting activity rises and falls through the Asian morning until reaching a daily low at lunchtime in Tokyo (0230 to 0330 GMT).

The lull in trading during the Tokyo lunch hour was initially the result of a Japanese regulation prohibiting trading during this time. Since December 22, 1994, trading has been permitted in Tokyo during lunch–time, but there still is a pronounced drop in activity because many traders
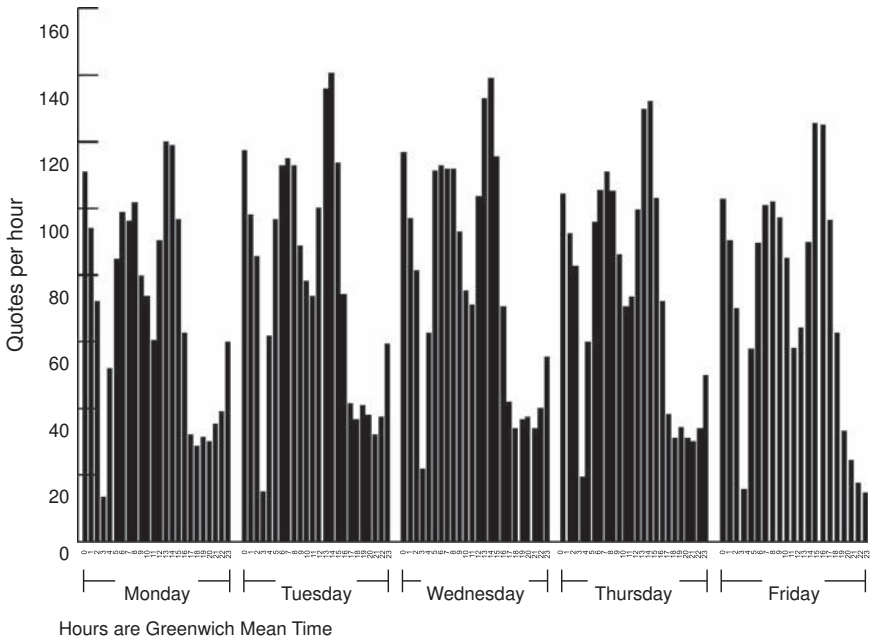
Fig. 1.3

take a lunch break. Following the Tokyo lunch break, market activity picks up in the Asian afternoon and rises substantially as European trading begins around 0700 GMT. There is another decrease in trading activity associated with lunchtime in Europe, 1200 to 1300 GMT. Trading rises again when North American trading begins, around 1300 GMT, and hits a daily peak when London and New York trading overlap. Trading drops substantially with the close of European trading and then rises again with the opening of Asian trading the next day.

Note that every weekday has this same pattern, as the pace of the activity in the foreign exchange market follows the opening and closing of business hours around the world. While it is true that the foreign exchange market is a 24-hour market with continuous trading possible, the amount of trading follows predictable patterns. This is not to say that there are not days that differ substantially from this average daily number of quotes. If some surprising event occurs that stimulates trading, some days may have much different patterns. Later in the text, we consider the determinants of exchange rates and study what sorts of news would be especially relevant to the foreign exchange market.

Spot Exchange Rates

A spot exchange rate is the price of one currency in terms of another that is delivered today. Table 1.3 shows selected spot foreign exchange rate quotations for a particular day. All rates are in foreign currency per dollar terms, except for the euro and UK pound. For example, in the table we see that on May 21, 2021, the US dollar traded for 0.8971 Swiss francs. Note that this exchange rate is quoted at a specific time, since rates will change throughout the day as supply and demand for the currencies change, and involves amounts traded that are greater than $1 million. If the amount were smaller than $1 million, the cost of foreign exchange would be higher. The smaller the quantity of foreign exchange purchased, the higher the price. Therefore if you travel to a foreign country, the exchange rate will be much less favorable for you as a tourist.

While the exchange rate just discussed is the Swiss franc price of the US dollar, we can always convert this into a US dollar price of the Swiss franc by taking the reciprocal of the exchange rate, or 1/exchange rate. For instance, the exchange rate of 0.8971 Swiss francs per dollar is converted into dollars per Swiss franc by calculating the reciprocal: $1/0.8971 = 1.1147$. It will always be true that when we know the Swiss franc price per dollar (SF/$), we can find the dollar price per Swiss franc by taking the reciprocal, i.e., $1/(SF/\$) = (\$/SF)$.

Note that the exchange rate quotes in the first column in Table 1.3 are mid-price rates. For convenience, we often talk about the spot rate as if it is one rate. Often this rate is the mid-price rate. However, the spot rate always involves two rates. Banks *bid* (buy) foreign exchange at lower rates than they *offer* (sell), and the difference between the selling and buying rates is

Table 1.3 Selected spot currency exchange rates

	July 15, 2016		February 15, 2016
Country (currency)	**Mid-price**	**Bid−offer**	**Mid-price**
Canada (dollar)	1.2913	1.2911−914	1.3827
Australian (dollar)	1.3118	1.3116−119	1.4001
Japan (yen)	105.693	105.683−702	114.001
Euro area (euro)	0.9004	0.9003−005	0.8931
Sweden (krona)	8.5156	8.5128−184	8.4565
Switzerland (franc)	0.9812	0.9811−813	0.9826
UK (pound)	0.7450	0.7499−501	0.6903

Source: Oanda.com.

called the *spread*. The *mid-price* is the average of the buying and selling rates. Table 1.3 lists the spreads for the currencies in the second column. The bid/offer prices are quoted so that one can see the *bid* (buy) price, and one can find the *offer* (sell) price by dropping the last three digits of the buy quote and replacing them with the second number. For example, the Swiss franc *bid/offer* price is 0.8970/0.8972. Thus the bank is willing to buy dollars for Swiss francs at 0.8970 and sell dollars at 0.8972 Swiss francs. The spread (the bank's profit) between the buy and sell rates is very small. The spread for the Swiss franc can be measured in percentage terms as (ask − bid)/mid-price. Using the information in Table 1.3, we can compute the spread in percentage terms as (0.8972 − 0.8970)/0.8971 = 0.0002, or 2/100 of 1%. This spread is indicative of how small the normal spread is in the market for major traded currencies. The existing spread in any currency will vary according to the individual currency trader, the currency being traded, and the trading bank's overall view of conditions in the foreign exchange market. The spread quoted will tend to increase for more thinly traded currencies (i.e., currencies that do not generate a large volume of trading) or when the bank perceives that the risks associated with trading in a currency at a particular time are rising.

Let us look at an example of using the buy and sell rates. If you were a US importer buying watches from Switzerland at the dollar price of $10 million, a bank would sell $10 million worth of Swiss francs to you for 0.8971 Swiss francs per dollar. Note that Table 1.3 shows what banks are willing to bid and offer when buying or selling dollars for the Swiss franc. We want to sell our dollars for the Swiss franc, so we need to use the bid rate for the bank in Table 1.3. You would receive SF8,971,000 to settle the account with the Swiss exporter.

$$\$10,000,000 \times 0.8971 \text{ SF}/\$ = \textit{SF}8,971,000$$

Thus far, we have discussed trading Swiss francs using the symbol SF. Table 1.4 lists the commonly used symbols for several currencies along with their international standard (ISO) code. Exchange rate quotations are generally available for all countries where currencies may be freely traded. In the cases where free markets are not permitted, the state typically conducts all foreign exchange trading at an official exchange rate, regardless of current market conditions.

This chapter discusses the buying and selling of foreign exchange to be delivered on the spot (actually, deposits traded in the foreign exchange

Table 1.4 International currency symbols.

Country	Currency	Symbol	ISO code
Australia	Dollar	A$	AUD
Austria	Euro	€	EUR
Belgium	Euro	€	EUR
Canada	Dollar	C$	CAD
Denmark	Krone	DKr	DKK
Finland	Euro	€	EUR
France	Euro	€	EUR
Germany	Euro	€	EUR
Greece	Euro	€	EUR
India	Rupee	₹	INR
Iran	Rial	RI	IRR
Italy	Euro	€	EUR
Japan	Yen	¥	JPY
Kuwait	Dinar	KD	KWD
Mexico	Peso	Ps	MXN
Netherlands	Euro	€	EUR
Norway	Krone	NKr	NOK
Saudi Arabia	Riyal	SR	SAR
Singapore	Dollar	S$	SGD
South Africa	Rand	R	ZAR
Spain	Euro	€	EUR
Sweden	Krona	SKr	SEK
Switzerland	Franc	SF	CHF
United Kingdom	Pound	£	GBP
United States	Dollar	$	USD

market generally take 2 working days to clear); this is called the *spot market*. Comparing the quotes across time, we can see what has happened to the exchange rate. If the exchange rate increases in value, we say that the currency *appreciated*. If the currency falls in value, then the currency is said to have *depreciated*. For example, the yen/dollar rate fell from 109.800 to 108.815 from 2019 to 2021. The dollar depreciated against the yen because the value of a dollar decreased in terms of the yen. Because of the reciprocal nature of exchange rates, a depreciating dollar means that the yen appreciated against the dollar.

In Chapter 4, we will consider the important issues that arise when the trade contract involves payment at a future date. First, however, we should consider in more detail the nature of the foreign exchange market.

Currency Arbitrage

The foreign exchange market is a market where price information is readily available by telephone or computer network. Since currencies are homogeneous goods (a dollar is a dollar regardless of where it is traded), it is very easy to compare prices in different markets. Exchange rates tend to be equal worldwide. If this were not so, there would be profit opportunities for simultaneously buying a currency in one market while selling it in another. This activity, known as *arbitrage*, would raise the exchange rate in the market where it is too low, because this is the market in which you would buy, and the increased demand for the currency would result in a higher price. The market where the exchange rate is too high is one in which you sell, and this increased selling activity would result in a lower price. Arbitrage would continue until the exchange rates in different locales are so close that it is not worth the costs incurred to do any further buying and selling. When this situation occurs, we say that the rates are "transaction costs close." Any remaining deviation between exchange rates will not cover the costs of additional arbitrage transactions, so the arbitrage activity ends.

For instance, suppose the following quotes were available for the Swiss franc/US dollar rate:

- Citibank is quoting 0.8745/0.8755
- Deutsche Bank is quoting 0.8725/0.8735

This means that Citibank will buy dollars for 0.8745 francs and will sell dollars for 0.8755 francs and Deutsche Bank will buy dollars for 0.8725 francs and will sell dollars for 0.8735 francs. This presents an arbitrage opportunity. We call this a *two-point arbitrage*, as it involves two currencies. We could buy $10 million at Deutsche Bank's offer price of 0.8735 and simultaneously sell $10 million to Citibank at their bid price of 0.8745 francs. This would earn a profit of SF0.0010 per dollar traded, or SF10,000 would be the total arbitrage profit.

If such a profit opportunity existed, the arbitrage would result in the banks changing the rates as arbitrageurs enter the market. An increase in the demand to buy dollars from Deutsche Bank would cause them to raise their offer price above 0.8735, while the increased willingness to sell dollars to Citibank at their bid price of 0.8745 francs would cause them to lower their bid. In this way, arbitrage activity pushes the prices of different traders to levels where no arbitrage profits can be earned. Suppose the prices moved to where Citibank is quoting the Swiss franc/dollar exchange rate at

0.8740/0.8750 and Deutsche Bank is quoting 0.8730/0.8740. Now there is no arbitrage profit possible. The offer price at Deutsche Bank of 0.8740 is equal to the bid price at Citibank. The difference between the bid and offer prices of each bank is equal to the spreads of SF0.001. In the wholesale banking foreign exchange market, the bid/offer spread is the only trans-action cost. When the quotes of two different banks differ by no more than the spread being quoted in the market by these banks, there is no arbitrage opportunity.

Arbitrage could involve more than two currencies. Since banks quote foreign exchange rates with respect to the dollar, one can use the dollar value of two currencies to calculate the *cross rate* between the two cur-rencies. The *cross rate* is the implied exchange rate from the two actual quotes. For instance, if we know the dollar price of pounds ($/£) and the dollar price of Swiss francs ($/SF), we can infer what the corresponding pound price of francs (£/SF) would be. From now on, we will explicitly write the units of our exchange rates to avoid the confusion that can easily arise. For example, $/£ = $1.76 is the exchange rate in terms of dollars per pound.

Suppose that in London $/£ = $1.76, while in New York $/SF = $1.10. The corresponding *cross rate* is the £/SF rate. Simple algebra shows that if $/£ = $1.76 and $/SF = 1.1, then £/SF = ($/SF)/($/£), or 1.10/1.76 = 0.625. If we observe a market where one of the three exchange rates, namely $/£, $/SF, and £/SF, is out of line with the other two, there is an arbitrage opportunity, in this case a *triangular arbitrage*. Triangular arbi-trage, or *three-point arbitrage*, involves three currencies.

To simplify the analysis of arbitrage involving three currencies, let us ignore the bid/offer spread and assume that we can either buy or sell at one price. Suppose that in Geneva, Switzerland, the exchange rate is £/SF = 0.625, while in New York $/SF = 1.100, and in London $/£ = $1.600, as shown in Table 1.5. Examining Table 1.5, it appears to have no possible

Table 1.5 Triangular arbitrage.

Location	$/SF	$/£	£/SF
New York	1.100	1.600	—
London	—	1.600	0.625
Geneva	1.100	—	0.625

Source: Data from Loretan, M Winter 2005, "Indexes of the Foreign Exchange Value of the dollar," *Federal Reserve Bulletin*, pp. 1–8. Note that column may not total 100 due to rounding.

arbitrage opportunity, but astute traders in the foreign exchange market would observe a discrepancy when they check the cross rates. Computing the implicit cross rate for New York, the arbitrageur finds the implicit cross rate to be £/SF = ($/SF)/($/£), or 1.100/1.600 = 0.6875. Thus the cost of SF is high in New York and the cost of £ is low.

Assume that a trader starts in New York with $1 million. The trader should buy £ in New York. Selling $1 million in New York (or London), the trader receives £625,000 ($1 million divided by $/£ = $1.60). The pounds then are used to buy Swiss francs at £/SF = 0.625 (in either London or Geneva), so £625,000 = SF1 million. The SF1 million would be used in New York to buy dollars at $/SF = $1.10, so SF1 million = $1,100,000. Thus the initial $1 million could be turned into $1,100,000 with the *triangular arbitrage* action earning the trader $100,000 (costs associated with the transaction should be deducted to arrive at the true arbitrage profit).

As in the case of the two-currency arbitrage covered earlier, a valuable product of this arbitrage activity is the return of the exchange rates to internationally consistent levels. If the initial discrepancy was that the dollar price of pounds was too low in London, the selling of dollars for pounds in London by the arbitrageurs would make pounds more expensive, raising the price from $/£ = $1.60. Note that if the pound cost increases to $/£ = $1.76, then there is no arbitrage possible. However, the pound exchange rate is unlikely to increase that much because the activity in the other markets would tend to raise the pound price of francs and lower the dollar price of francs so that a dollar price of pounds somewhere between $1.60 and $1.76 would be the new equilibrium among the three currencies.

Since there is active trading between the dollar and other currencies, we can look to any two exchange rates involving dollars to infer the cross rates. So even if there is limited direct trading between, for instance, Mexican pesos and yen, by using pesos/$ and $/¥, we can find the implied pesos/¥ rate. Since transaction costs are higher for lightly traded currencies, the depth of foreign exchange trading that involves dollars often makes it cheaper to go through dollars to get from some currency X to another currency Y when X and Y are not widely traded. Thus if a business firm in small country X wants to buy currency Y to pay for merchandise imports from small country Y, it may well be cheaper to sell X for dollars and then use dollars to buy Y rather than try to trade currency X for currency Y directly.

Short-Term Foreign Exchange Rate Movements

Understanding the "market microstructure" allows us to explain the evolution of the foreign exchange market in an intraday sense, in which foreign exchange traders adjust their bid and offer quotes throughout the business day.

A foreign exchange trader may be motivated to alter their exchange rate quotes in response to changes in their position with respect to orders to buy and sell a currency. For instance, suppose Helmut Smith is a foreign exchange trader at Deutsche Bank, who specializes in the dollar/euro market. The bank management controls risks associated with foreign currency trading by limiting the extent to which traders can take a position that would expose the bank to potential loss from unexpected changes in exchange rates. If Smith has agreed to buy more euros than he has agreed to sell, he has a *long position* in the euro and will profit from euro appreciation and lose from euro depreciation. If Smith has agreed to sell more euros than he has agreed to buy, he has a *short position* in the euro and will profit from euro depreciation and lose from euro appreciation. His position at any point in time may be called his *inventory*. One reason traders adjust their quotes is in response to inventory changes. At the end of the day, most traders balance their position and are said to *go home "flat."* This means that their orders to buy a currency are just equal to their orders to sell. Thus the profit the bank receives is from trading activity, not from speculative activity.

FAQ: What Is a Rogue Trader?

Many bank traders are required to balance their positions daily. This is done to eliminate the risk that the overnight position changes in value dramatically. Note that in the arbitrage case the buying and selling is almost instantaneous. Therefore there is practically no risk. The longer one has to wait for an offsetting position, the more risk there is. Thus there is a speculative risk when a bank adopts a one-sided bet. An overnight position would be too much risk for most banks to accept, as this is a high-risk speculation.

However, banks have been subject to fraud at times where they seem to be unable to control what traders do. If traders take on their own bets with exception to the bank's risk controls, then they become "rogue traders." In September 2011, UBS discovered that one of their traders, Kweku Adoboli, had entered into upward of $10 billion in trades with fictitious offset trades. Effectively, this created risky positions that lost UBS as much as $2.3 billion.

FAQ: What Is a Rogue Trader?—cont'd

The most famous "rogue trader" is Nick Leeson, who lost $1.3 billion while working for Barings Investment Bank in the early 1990s. He bought futures contracts without any offsetting transactions, claiming that they were purchase orders on behalf of a client. The loss to Barings Investment Bank was so high that the well-respected bank that had existed for over 200 years had to declare bankruptcy. Nick received a prison sentence in a Singapore jail for 6.5 years. For more on the life of Nick Leeson, see Leeson or watch Ewan McGregor playing Nick Leeson in the movie *Rogue Trader*.

Let us look at an example. Suppose Helmut Smith has been buying and selling euros for dollars throughout the day. By early afternoon, his position is as follows:

dollar purchases: $100,000,000

dollar sales: $80,000,000.

In order to balance his position, Smith will adjust his quotes to encourage fewer dollar purchases and more dollar sales. For instance, if the euro is currently trading at $1.4650/1.4660, then Helmut could raise the bid and offer quotes to encourage others to sell him euros in exchange for his dollars while deterring others from buying more euros from him. For instance, if he changes the quote to 1.4655/1.4665, then someone could sell him euros (or buy his dollars) for $1.4655 per euro. Since he has raised the dollar price of a euro, he will receive more interest from people wanting to sell him euros in exchange for his dollars. When Helmut buys euros from other traders, he is selling them dollars, and this helps to balance his inventory and reduce his long position in the dollar. At the same time, Helmut has raised the sell rate of euros to $1.4665. This discourages other traders from buying more euros from Helmut (giving him dollars as payments).

This *inventory control* effect on exchange rates can explain why traders may alter their quotes in the absence of any news about exchange rate fundamentals.

In addition to the inventory control effect, there is also an *asymmetric information* effect, which causes exchange rates to change due to traders' fears that they are quoting prices to someone who knows more about current market conditions than they do. Even without news regarding the fundamentals, information is being transmitted from one trader to another

through the act of trading. If Helmut posts a quote of 1.0250/1.0260 and is called by Ingrid Schultz at Citibank asking to buy $5 million of euros at Helmut's offer price of 1.0260, Helmut then must wonder whether Ingrid knows something he doesn't. Should Ingrid's order to trade at Helmut's price be considered a signal that Helmut's price is too low? What superior information could Ingrid have? Every bank receives orders from nonbank customers to buy and sell currency. Perhaps Ingrid knows that her bank has just received a large order from Daimler to sell dollars, and she is selling dollars (and buying euros) in advance of the price increase that will be caused by this nonbank order being filled by purchasing euros from other traders.

Helmut does not know why Ingrid is buying euros at his offer price, but he protects himself from further euro sales to someone who may be better informed than he is by raising his offer price. The bid price may be left unchanged because the order was to buy his euros; in such a case the spread increases, with the higher offer price due to the possibility of trading with a better-informed counterparty who wants him to sell euros.

The inventory control and asymmetric information effects can help explain why exchange rates change throughout the day, even in the absence of news regarding the fundamental determinants of exchange rates. The act of trading generates price changes among risk–averse traders who seek to manage their inventory positions to limit their exposure to surprising exchange rate changes and limit the potential loss from trading with better-informed individuals.

Long-Term Foreign Exchange Movements

Thus far, we have examined short-run movements in exchange rates. For the most part, we are interested in long-term movements in this book. Since the exchange rate is the price of one money in terms of another, changes in exchange rates affect the prices of goods and services traded internationally. Therefore most of this book is concerned with why exchange rates move and how we can avoid these effects. In this section we will introduce a simple but powerful tool, called the *trade flow model*. The trade flow model argues that the exchange rate responds to the demand for traded goods by countries.

We can use a familiar diagram from principles of economics courses: the supply and demand diagram. Fig. 1.4 illustrates the market for the yen/ dollar exchange rate. Think of the demand for dollars as coming from the
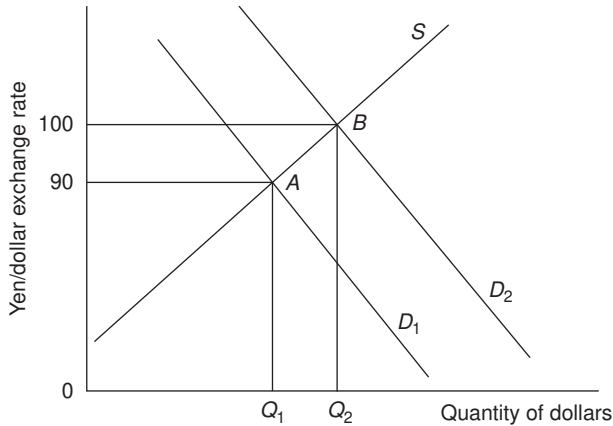
Fig. 1.4

Japanese demand for US goods (they must buy dollars in order to purchase US goods). The downward–sloping demand curve illustrates that the higher the yen price of the dollar, the more expensive US goods are to Japanese buyers, so the smaller the quantity of dollars demanded. The supply curve is the supply of dollars to the yen/dollar market and comes from US buyers of Japanese goods (in order to obtain Japanese products, US importers have to supply dollars to obtain yen). The upward-sloping supply curve indicates that as US residents receive more yen per dollar, they will buy more from Japan and will supply a larger quantity of dollars to the market.

The initial equilibrium exchange rate is at point A, where the exchange rate is 90 yen per dollar. Now suppose there is an increase in Japanese demand for US products. This increases the demand for dollars, so the demand curve shifts from D_1 to D_2. The equilibrium exchange rate will now change to 100 yen per dollar at point B as the dollar appreciates in value against the yen. This dollar appreciation makes Japanese goods cheaper to US buyers.

In the above example the demand for US dollars changed. The supply may also change. Such an example is illustrated in Fig. 1.5. Assume that the US dollar starts at point B with a 100 yen/dollar exchange rate. If US consumers start liking Japanese products more than before, this will result in a supply curve shift. US importers will be more eager to give up their dollars in exchange for yen. This shifts the supply curve out to the right, from S_1 to S_2, and lowers the value of the dollar. The new equilibrium is at point C, where the yen/dollar rate is at 85.
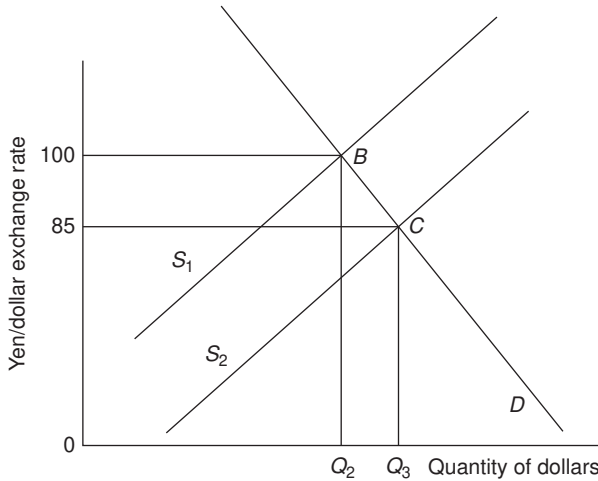
Fig. 1.5

The examples above illustrate that the trade flow model can be a useful model to show the exchange rate changes in response to changes in demand for products in two countries. In the next chapter, we will expand the trade flow model by adding central bank intervention. Later in the text, we will examine other models that can explain exchange rate movements.

Summary

1. The foreign exchange market is a global market where foreign currency deposits are traded. Trading in actual currency notes is generally limited to tourism or illegal activities.
2. The dollar/euro currency pair dominates foreign exchange trading volume, and the United Kingdom is the largest trading location.
3. A spot exchange rate is the price of a currency in terms of another currency for current delivery. Banks buy (bid) foreign exchange at a lower rate than they sell (offer), and the difference between the selling and buying rates is called the spread.
4. Arbitrage realizes riskless profits from market disequilibrium by buying a currency in one market and selling it in another. Arbitrage ensures that exchange rates are transaction costs close in all markets.
5. The factors that explain why exchange rates vary so much in the short run are inventory control and asymmetric information.

6. In the long run, economic factors (e.g., demand/supply of foreign and domestic goods) affect the exchange rate movements. The trade flow model is useful for discussing fundamental changes in the foreign exchange rate.

Exercises

1. Suppose Nomura Bank quotes the ¥/$ exchange rate as 110.30/110.40. Assume you need ¥100,000. How many dollars do you need to pay Nomura Bank to buy ¥100,000? Explain.

2. Compute the cross rate for the following quotes.

   a. Compute the C$/€ using the following: C$/$ = 1.5613, $/€ = 1.0008.

   b. Compute the £/¥ using the following: ¥/$ = 124.84, $/£ = 1.5720.

   c. Compute the SF/C$ using the following: SF/$ = 1.4706, C$/$ = 1.5613.

3. Suppose Citibank quotes the ¥/$ exchange rate as 110.30/110.40 and Nomura Bank quotes 110.40/110.50. Is there an arbitrage opportunity? If so, explain how you would profit from these quotes. If not, explain why not.

4. Suppose that the spot rates of the US dollar, British pound, and Swedish kronor are quoted in three locations as the following:

	$/£	$/SKr	SKr/£
New York	2.00	0.25	—
London	2.00	—	10.00
Stockholm	—	0.25	10.00

Is there an arbitrage opportunity? If so, explain how you, as a trader who has $1,000,000, would profit from these quotes. If not, explain why not.

5. Consider the market for the Japanese yen using the trade flow model. What would happen to the value of the Japanese yen (dollar per yen) if Japanese people like American automobiles more than before? Explain graphically.

Further Reading

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1A The Top Foreign Exchange Dealers

Foreign exchange trading is dominated by large commercial banks with worldwide operations. The market is very competitive, since each bank tries to maintain its share of the corporate business. *Euromoney* magazine provides some interesting insights into this market by publishing periodic surveys of information supplied by the treasurers of the major multinational firms.

When asked to rank the factors that determined who got their foreign exchange business, the treasurers responded that the following factors were the most important. The speed with which a bank makes foreign exchange quotes was ranked third. A second-place ranking was given to the competitiveness of quotes. The most important factor was the firm's relationship with the bank. A bank that handles the other banking needs of a firm is also likely to receive its foreign exchange business.

The significance of competitive quotes is indicated by the fact that treasurers often contact more than one bank to get several quotes before placing a deal. Another implication is that the foreign exchange market will be dominated by big banks, because only the giants have the global activity to allow competitive quotes on a large number of currencies. *Euromoney* conducts an annual survey of major financial market participants to create a view of who does the most business. Table 1A.1 gives the rankings of the *Euromoney* survey. According to the rankings, JPMorgan receives more business than any other bank. The top 10 banks are responsible for over two-thirds of all foreign exchange trade in the world.

What makes JPMorgan the world's best foreign exchange dealer? Many factors have kept them on top of the heap. An important factor is simply their sheer size. JPMorgan holds the bank accounts for many corporations,

Table 1A.1 Percentage weights used in 2016 for the major and broad exchange rate indexes

Country	Exchange rate index	
	Major	**Broad**
Euro area	38.9	16.6
Canada	29.7	12.7
Japan	15.2	6.5
United Kingdom	7.7	3.3
Switzerland	4.0	1.7
Australia	2.8	1.2
Sweden	1.6	0.7
Mexico		12.1
China		21.6
Taiwan		2.4
Korea		3.9
Singapore		1.7
Hong Kong		1.3
Malaysia		1.5
Brazil		2.1
Thailand		1.4
Philippines		0.6
Indonesia		1.0
India		2.0
Israel		1.0
Saudi Arabia		1.0
Russia		1.4
Argentina		0.6
Venezuela		0.3
Chile		0.8
Colombia		0.7
Total	100.0	100.0

Source: Board of Governors of the Federal Reserve System, Table H.10; Authors' calculation.

giving them a natural advantage in foreign exchange trading. Foreign exchange trading has emerged as an important center for bank profitability. Since each trade generates revenue for the bank, the volatile foreign exchange markets of recent years have often led to frenetic activity in the market with a commensurate revenue increase for the banks.

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CHAPTER 2

International Monetary Arrangements

Like most areas of public policy, international monetary relations are subject to frequent proposals for change. Fixed exchange rates, floating exchange rates, and commodity-backed currency all have their advocates. Before considering the merits of alternative international monetary systems, we should understand the background of the international monetary system. Although an international monetary system has existed since monies have been traded, it is common for most modern discussions of international monetary history to start in the late 19th century. It was during this period that the gold standard began.

The Gold Standard: 1880 to 1914

Although an exact date for the beginning of the gold standard cannot be pinpointed, we know that it started during the period from 1880 to 1890. Under a *gold standard*, currencies are valued in terms of their gold equivalent (an ounce of gold was worth $20.67 in terms of the US dollar over the gold standard period). The gold standard is an important beginning for a discussion of international monetary systems because when each currency is defined in terms of its gold value, all currencies are linked in a system of fixed exchange rates. For instance, if currency A is worth 0.10 ounces of gold, whereas currency B is worth 0.20 ounces of gold, then 1 unit of currency B is worth twice as much as 1 unit of A, and thus the exchange rate of 1 currency $B = 2$ currency A is established.

Maintaining a gold standard requires a commitment from participating countries to be willing to buy and sell gold to anyone at a fixed price. To maintain a price of $20.67 per ounce, the United States had to buy and sell gold at that price. Gold was used as the monetary standard because it is a homogeneous commodity (could you have a fish standard?) worldwide that is easily storable, portable, and divisible into standardized units like ounces. Since gold is costly to produce, it possesses another important

attribute: governments cannot easily increase its supply. A gold standard is a *commodity money standard*. Money has a value that is fixed in terms of the commodity gold.

One aspect of a money standard that is based on a commodity with a relatively fixed supply is long–run price stability. Since governments must maintain a fixed value of their money relative to gold, the supply of money is restricted by the supply of gold. Prices may still rise and fall with swings in gold output and economic growth, but the tendency is to return to a long–run stable level. Fig. 2.1 illustrates the relative stability of US and UK prices graphically over the gold standard period as compared to later years. However, note also that prices fluctuated up and down in the short run during the gold standard. Thus frequent small bursts of inflation and deflation occurred in the short run, but in the long run the price level remained unaffected. Since currencies were convertible into gold, national money supplies were constrained by the growth of the stock of gold. As long as the gold stock grew at a steady rate, prices would also follow a steady path. New discoveries of gold would generate discontinuous jumps in the price level, but the period of the gold standard was marked by a fairly stable stock of gold.
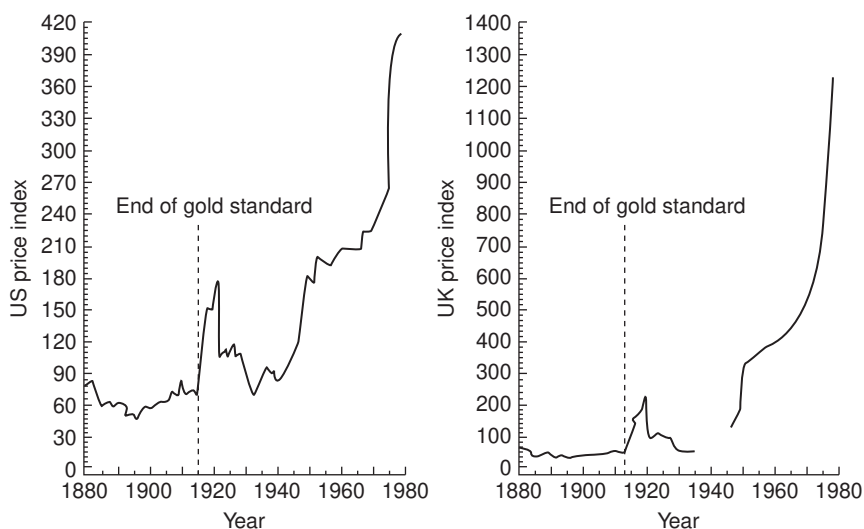
Fig. 2.1 US and UK wholesale price indices from 1880 to 1976. Data are missing for World War II years in the UK. *(Data from Roy WJ 1977,* The Golden Constant, *Wiley, New York.)*

People today often look back on the gold standard as a "golden era" of economic progress. It is common to hear arguments supporting a return to the gold standard. Such arguments usually cite the stable prices, economic growth, and development of world trade during this period as evidence of the benefits provided by such an orderly international monetary system. Others have suggested that the economic development and stability of the world economy in those years did not necessarily reflect the existence of the gold standard but, instead, the absence of any significant real shocks such as war. Although we may disagree on the merits of returning to a gold standard, it seems fair to say that the development of world trade was encouraged by the systematic linking of national currencies and the price stability of the system. Since gold is like a world money when following a gold standard, we can easily understand how a balance of payments disequilibrium may be remedied. A country running a balance of payments (official settlements) deficit would find itself with net outflows of gold, which would reduce its money supply and, in turn, its prices. A surplus country would find gold flowing in and expanding its money supply, so prices rose. The fall in price in the deficit country would lead to greater net exports (exports minus imports), and the rise in price in the surplus country would reduce its net exports so that balance of payments equilibrium would be restored.

In practice, actual flows of gold were not the only, or even necessarily the most important, means of settling international debts during this period. Since London was the financial center of the world, and England the world's leading trader and source of financial capital, the pound also served as a world money. International trade was commonly priced in pounds, and trade that never passed through England was often paid for with pounds.

The Interwar Period: 1918 to 1939

World War I ended the gold standard. International financial relations are greatly strained by war because merchants and bankers must be concerned about the probability of countries suspending international capital flows. At the beginning of the war, both the patriotic response of each nation's citizens and legal restrictions stopped private gold flows. Since wartime financing required the hostile nations to manage international reserves very carefully, private gold exports were considered unpatriotic. Central governments encouraged (and sometimes mandated) that private holders of gold and foreign exchange sell these holdings to the government.

Because much of Europe experienced rapid inflation during the war and in the period immediately following it, it was not possible to restore the gold standard at the old exchange values. However, the United States had experienced little inflation and thus returned to a gold standard by June 1919. The war ended Britain's financial preeminence, since the United States had risen to the status of the world's dominant banker country. In the immediate postwar years the pound fluctuated freely against the dollar in line with changes in the price level of each country.

In 1925, England returned to a gold standard at the old prewar pound per gold exchange rate, even though prices had risen since the prewar period. As John Maynard Keynes had correctly warned, the overvalued pound hurt UK exports and led to a deflation of British wages and prices. By 1931 the pound was declared inconvertible because of a run on British gold reserves (a large demand to convert pounds into gold), and so ended the brief UK return to a gold standard. Once the pound was no longer convertible into gold, attention centered on the US dollar. A run on US gold at the end of 1931 led to a 15 percent drop in US gold holdings. Although this did not lead to an immediate change in US policy, by 1933 the United States abandoned the gold standard.

The depression years were characterized by international monetary warfare. In trying to stimulate domestic economies by increasing exports, country after country devalued, so the early to mid-1930s may be characterized as a period of *competitive devaluations*. Governments also resorted to foreign exchange controls in an attempt to manipulate net exports in a manner that would increase GDP (gross domestic product). Of course, with the onslaught of World War II, the hostile countries utilized foreign exchange controls to aid the war-financing effort.

The Bretton Woods Agreement: 1944 to 1973

Memories of the economic warfare of the interwar years led to an international conference at Bretton Woods, New Hampshire, in 1944. At the close of World War II, there was a desire to reform the international monetary system to one based on mutual cooperation and freely convertible currencies.

There was a need for a system that fixed currencies relative to each other but did not fix each currency in terms of gold. The Bretton Woods Agreement solved this problem by requiring that each country fix the value of its currency in terms of an anchor currency, namely the dollar (this

established the "par" value of each currency and was to ensure parity across currencies). The US dollar was the key currency in the system, and *$1 was defined as being equal in value to 1/35 ounce of gold*. Since every currency had an implicitly defined gold value, through the link to the dollar, all currencies were linked in a system of fixed exchange rates.

Nations were committed to maintaining the parity value of their currencies within 1 percent of parity. The various central banks were to achieve this goal by buying and selling their currencies (usually against the dollar) on the foreign exchange market. When a country was experiencing difficulty maintaining its parity value because of the balance of payments disequilibrium, it could turn to a new institution created at the Bretton Woods Conference: the *International Monetary Fund* (*IMF*). The IMF was created to monitor the operation of the system and provide short–term loans to countries experiencing temporary balance of payments difficulties. Such loans are subject to IMF conditions regarding changes in domestic economic policy aimed at restoring the balance of payments equilibrium.

In the case of a fundamental disequilibrium, when the balance of payments problems are not of a temporary nature, a country could apply for permission from the IMF to devalue or revalue its currency. Such a permanent change in the parity rate of exchange was rare. Table 2.1 summarizes the history of exchange rate adjustments over the Bretton Woods period for the major industrial countries. The Bretton Woods system, although essentially a fixed, or pegged, exchange rate system, allowed for changes in exchange rates when economic circumstances warranted such changes. In actuality, the system is best described as an *adjustable peg*. The system may also be described as a gold exchange standard because the key currency, the dollar, was convertible into gold for official holders of dollars (such as central banks and treasuries).

Central Bank Intervention During Bretton Woods

By signing the Bretton Woods Agreement, countries agreed to protect their exchange rate from moving up or down from the agreed–upon rate. This agreement implied that central banks had to take on a more active role in making sure that market pressure did not change the exchange rate. The various central banks achieved this goal by buying and selling their domestic currencies on the foreign exchange market. The central bank intervention can be illustrated using the trade flow model developed in

Table 2.1 Exchange rates of the major industrial countries over the period of the Bretton Woods Agreement.

Country	Exchange rates[a]
Canada	Floated until May 2, 1962, then pegged at C$1.081 = $1. Floated again on June 1, 1970.
France	No official IMF parity value after 1948 (although the actual rate hovered at around FF350 = $1) until December 29, 1958, when rate fixed at FF493.7 = $1 (old francs). One year later, the rate was FF4.937 = $1 when new franc (one new franc was equal to 100 old francs) was created. Devaluation to FF5.554 = $1 on August 10, 1969.
Germany	Revalued on March 6, 1961, from DM4.20 = $1 to DM4.0 = $1. Revalued to DM3.66 = $1 on October 26, 1969.
Italy	Pegged at Lit625 = $1 from March 30, 1960, until August 1971.
Japan	Pegged at ¥360 = $1 until 1971.
Netherlands	Pegged at F13.80 = $1 until March 7, 1961, when revalued at F13.62 = $1.
UK	Devalued from $2.80 = £1 to $2.40 = £1 on November 11, 1967.

[a]Relative to the US dollar.

Chapter 1. Assume that the US and the UK are trading with each other and that the UK residents start demanding more Ford vehicles (a US good). In Chapter 1 you learned that this would imply a shift in the supply curve for pounds. UK traders would be more willing to supply their pounds to banks in exchange for dollars because the traders want to buy US goods. Banks see more customers supplying pounds and demanding dollars, causing banks to want to depreciate the pound. Fig. 2.2 illustrates the shift in the supply curve causing the banks to want to depreciate the pound from a starting dollar/pound exchange rate of 2.00 to a new equilibrium exchange rate of 1.80.

To prevent the pound from depreciating, the Bank of England (the central bank of the UK) has to intervene in the foreign exchange market. The Bank of England must intervene by buying up pounds and selling dollars that they have already stored in their bank vaults. Fig. 2.2 shows that the Bank of England has to buy a quantity of pounds equivalent to the distance from Q_1 to Q_3 and sell a quantity of dollars equal to the quantity of pounds multiplied by the 2.00 exchange rate. This action would supply

The Market for British Pounds
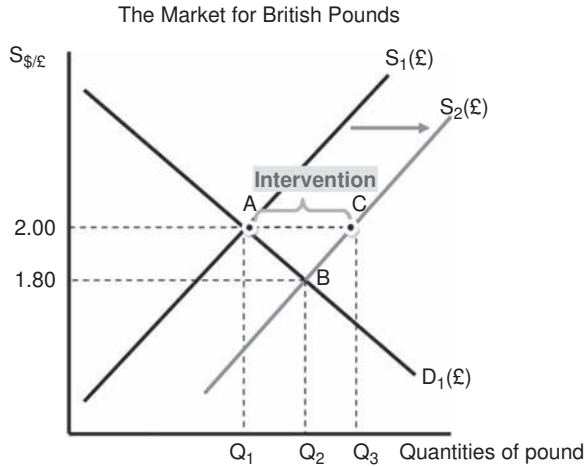
Fig. 2.2 Intervention in a fixed exchange rate system.

enough dollars to prevent private banks and traders from changing the exchange rate.

FAQ: What Are Special Drawing Rights?

There is one odd currency that is priced in any currency table but does not physically exist, namely the SDR (Special Drawing Right). This "currency" was issued by the IMF but never existed in physical form. In contrast, it has been used as a unit of account for a long time. For example, all of IMF's own accounts are quoted in SDRs.

The SDR first appeared in 1969. It was used to support the Bretton Woods fixed exchange rate system. Participating countries in the Bretton Woods Agreement needed more official reserves to support the domestic exchange rate. However, at that time, the supply of gold and US dollars was insufficient for the rapid growth of world trade. The SDR provided more liquidity to the world markets and allowed countries to continue to expand trade. The SDR does not exist as notes and coins but has value because all member countries of the IMF have agreed to accept it.

Allocations of SDRs are rare and have only happened four times in history. The first allocation was in 1970 to 1972 (SDR9.3 billion) at the very end of the Bretton Woods system. The next one was in 1979–1981 (SDR12.1 billion). After that, no more SDRs were allocated until the Great Recession. On August 28, 2009, SDR161.2 billion were allocated and

SDR21.5 billion were allocated shortly thereafter on September 9, 2009. Further information about the SDRs can be obtained from http://www. imf.org/external/np/exr/facts/sdr.htm.

The table below shows the value of an SDR. On May 21, 2021, one SDR was worth $1.44498. The value is computed by the weighted value of the euro, the Japanese yen, the pound sterling, and the US dollar. In 2015 the IMF announced that the Chinese yuan currency would be added to the SDR. In October 2016, the yuan was added and the weights in the SDR are currently:

Valuing the SDR currency

Currency	Currency amount under Rule O-1	Exchange rate	U.S. Dollar equivalent
Chinese yuan	1.0174	6.42945	0.158241
Euro	0.38671	1.22195	0.47254
Japanese yen	11.9	108.685	0.109491
U.K. pound	0.085946	1.42165	0.122185
U.S. dollar	0.58252	1	0.58252
			1.444977
		U.S.$1.00 = SDR	0.692053
		SDR1 = US$	1.44498

Source: IMF.org

Note that the model used to illustrate the intervention is a flow model. This means that each period the situation will occur. For example, if the period is a year, then the excess supply of pounds will exist every year, as long as the new demand for Fords exists. Thus the Bank of England has to intervene each year and buy pounds and sell dollars. If the excess supply persists for too long, the Bank of England may run out of dollars in their vaults and would be forced to apply for permission from the IMF to devalue their currency to be in line with the new market exchange rate (in this example 1.80).

The Breakdown of the Bretton Woods System

The Bretton Woods system worked well through the 1950s and part of the 1960s. In 1960, there was a dollar crisis because the United States had run large balance of payments deficits in the late 1950s. Concern over large

foreign holdings of dollars led to an increased demand for gold. Central bank cooperation in an international gold pool managed to stabilize gold prices at the official rate, but still, the pressures mounted. Although the problem of chronic US deficits and Japanese and European surpluses could have been remedied by revaluing the undervalued yen, mark, and franc, the surplus countries argued that it was the responsibility of the United States to restore the balance of payments equilibrium.

The failure to realign currency values in the face of fundamental economic change spelled the beginning of the end for the gold exchange standard of the Bretton Woods Agreement. By the late 1960s the foreign dollar liabilities of the United States were much larger than the US gold stock. The pressures of this "dollar glut" finally culminated in August 1971, when President Nixon declared the dollar to be inconvertible and provided a close to the Bretton Woods era of fixed exchange rates and convertible currencies.

The Transition Years: 1971 to 1973

In December 1971, an international monetary conference was held to realign the foreign exchange values of the major currencies. The *Smithsonian Agreement* provided for a change in the dollar per gold exchange value from $35 to $38.02 per ounce of gold. At the same time that the dollar was being devalued by about 8 percent, the surplus countries saw their currencies revalued upward. After the change in official currency values the system was to operate with fixed exchange rates under which the central banks would buy and sell their currencies to maintain the exchange rate within 2.25 percent of the stated parity. Although the realignment of currency values provided by the Smithsonian Agreement allowed a temporary respite from foreign exchange crises, the calm was short lived. Speculative flows of capital began to put downward pressure on the pound and lira. In June 1972, the pound began to float according to supply and demand conditions. The countries experiencing large inflows of speculative capital, such as Germany and Switzerland, applied legal controls to slow further movements of money into their countries.

Although the gold value of the dollar had been officially changed, the dollar was still inconvertible into gold, and thus the major significance of the dollar devaluation was with respect to the foreign exchange value of the dollar, not to official gold movements. The speculative capital flows of 1972 and early 1973 led to a further devaluation of the dollar in February 1973, when the official price of an ounce of gold rose from $38 to $42.22. Still, the speculative capital flows persisted from the weak to the strong currencies. Finally, in March 1973, the major currencies began to float.

International Reserve Currencies

International reserves are the means of settling international debts. Under the gold standard, gold was the major component of international reserves. Following World War II, we had a gold exchange standard in which international reserves included both gold and a reserve currency, the US dollar. The reserve currency country was to hold gold as backing for the outstanding balances of the currency held by foreigners. These foreign holders of the currency were then free to convert the currency into gold if they wished. However, as we observed with the dollar, once the convertibility of the currency becomes suspect, or once large amounts of the currency are presented for gold, the system tends to fall apart.

At the end of World War II, and throughout the 1950s, the world demanded dollars for use as an international reserve. During this time, US balance of payments deficits provided the world with a much-needed source of growth for international reserves. As the rest of the world developed and matured, over time, US liabilities to foreigners greatly exceeded the gold reserve backing these liabilities. Yet as long as the increase in demand for these dollar reserves equaled the supply, the lack of gold backing was irrelevant. Through the late 1960s, US political and economic events began to cause problems for the dollar's international standing, and the continuing US deficits were not matched by a growing demand, so the pressure to convert dollars into gold resulted in the dollar being declared officially no longer exchangeable for gold in August 1971.

Table 2.2 illustrates the diversification of the currency composition of foreign exchange reserves since the mid–1970s. The table shows a falling share of international reserves devoted to dollars until the beginning of the

Table 2.2 Share of National Currencies in Total Identified Official Holdings of Foreign Exchange (in Percentages)

	1977	1985	1993	2001	2006	2011	2015	2020
Countries								
U.S. dollar	80.3	65.1	55.6	68.3	65.5	62.2	64.1	59.0
U.K. pounds	1.8	3.2	2.9	4.0	4.4	3.8	3.9	4.7
German mark	9.3	15.5	14.0	–	–	–	–	–
French franc	1.3	1.2	2.2	–	–	–	–	–
Swiss franc	2.3	2.4	1.1	0.7	0.1	0.1	0.3	0.2
Japanese yen	2.5	7.6	7.7	4.9	3.1	3.5	4.2	6.0
Other currencies	1.6	3.9	7.3	9.0	1.8	5.3	6.8	5.0
ECU's	–	–	8.6	–	–	–	–	–
Euro	–	–	–	13.0	25.1	25.0	20.7	21.2

Source: IMF, Currency Compilation of Official Foreign Reserves (COFER), Data for 2020 is fourth quarter data.

1990s. The mark and yen gained larger shares of the international reserve portfolio from the mid-1970s to the mid-1990s. In the 2000s, the dollar share once again increased. Although the share of the dollar in 2020 is not as high as in the mid-1970s, it still is almost 60 percent of the international reserves. Furthermore, the euro has a substantial share of reserves, at 21.2 percent, but it has not threatened the dominance of the dollar.

At first glance, it may appear very desirable to be the reserve currency and have other countries accept your balance of payments deficits as a necessary means of financing world trade. The difference between the cost of creating new balances and the real resources acquired with the new balances is called *seigniorage*. Seigniorage is a financial reward accruing to the issuer of currency. The central bank's seigniorage is the difference between the cost of money creation and the return to the assets it acquires. In addition to such central bank seigniorage, a reserve currency country also receives additional seigniorage when foreign countries demand the currency issued and put those in its vaults, as this reduces the inflationary pressure that money creation causes.

Table 2.2 indicates that the dollar is still, by far, the dominant reserve currency. Since the United States' international position has been somewhat eroded in the past few decades, the question arises as to why we did not see the Japanese yen or Swiss franc emerge as the dominant reserve currency. Although the yen and Swiss franc have been popular currencies, the respective governments in each country have resisted a greater international role for their monies. Besides the apparently low additional seigniorage return to the dominant international money, there is another reason for these countries to resist. The dominant money producer (country) finds that international shifts in the demand for its money may have repercussions on domestic operations. For a country the size of the United States, domestic economic activity is large relative to international activity, so international capital flows of any given magnitude have a much smaller potential to disrupt US markets than would be the case for Japanese, or Swiss markets, where foreign operations are much more important. In this sense, it is clear why these countries have withstood the movement of the yen and franc to reserve currency status. Over time, we may find that the euro emerges as a dominant reserve currency as the combined economies of the euro-area countries provide a very large base of economic activity. However, Table 2.2 shows that the euro still only accounts for 21.2 percent of total international reserves, so it is not close to the 59 percent share taken by the dollar. In addition, the euro share seems to have stabilized at around 21 to 22 percent of the reserve holdings. Most of the growth in the euro reserve holdings has come at the expense of other currencies

than the dollar, effectively creating a dual currency reserve system with the dollar and the euro dominating the international reserves.

FAQ: How Big Is the Foreign Reserve Buildup in China?

The Chinese central bank, the People's Bank of China, has been adding foreign exchange reserves at a very rapid pace in the 2000s. The growth in reserves has been so large that China is by far the largest foreign reserve holder. The following chart shows the rapid addition of reserves in China.

Note in the chart that Chinese reserve holdings were small in the late 1990s but have since grown to a tremendous amount of foreign exchange reserves. The reserve peaked in 2014 at nearly 4 trillion dollars and then fell to slightly over 3.1 trillion dollars. Most of those assets are US dollar assets, implying that the central bank of China holds a tremendous amount of dollar assets.

Foreign exchange reserves (billions of dollars)
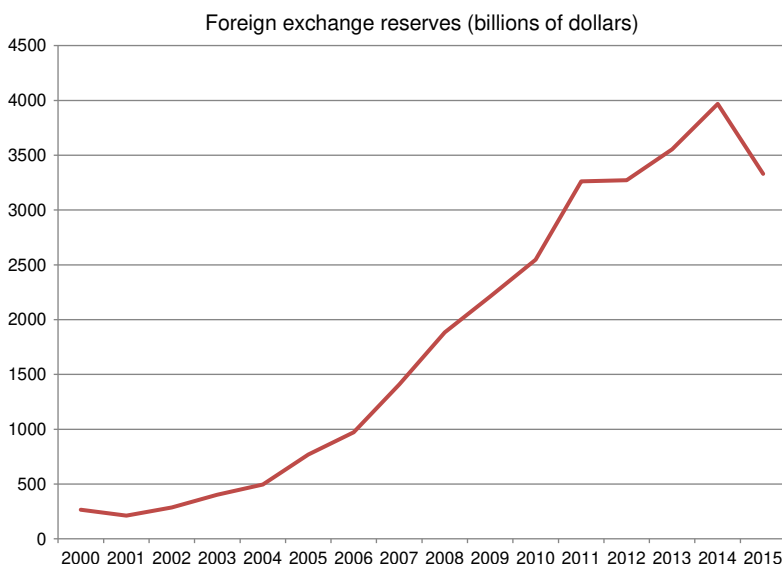
In domestic monetary theory, economists often identify three roles of money. Money is said to serve as (1) a unit of account, (2) a medium of exchange, and (3) a store of value. Likewise, in an international context we can explain the choice of a reserve currency according to criteria relevant for each role. Table 2.3 summarizes the roles of a reserve currency. First, the role of the international unit of account results from information costs. We

Table 2.3 Roles of a reserve currency.

	Function	Resulting from private role	Official role
1. International unit of account	Information costs	Invoicing currency	Pegging currency
2. International medium of exchange	Transaction costs	Vehicle currency	Intervention currency
3. International store of value	Stable value	Banking currency	Reserve currency

find that primary goods like coffee, tin, or rubber are quoted in terms of dollars worldwide. Since these goods are homogeneous, at least relative to manufactured goods, information regarding their value is conveyed more quickly when prices are quoted in terms of one currency worldwide. The private use as an invoicing currency in international trade contracts arises from the reserve currency's informational advantage over other currencies. Besides being a unit of account for private contracts, the reserve currency also serves as a base currency to which other currencies peg exchange rates.

A currency's role as an international medium of exchange is the result of transaction costs. In the case of the US dollar, the dollar is so widely traded that it is often cheaper to go from currency A to dollars to currency B than directly from currency A to currency B. Thus it is efficient to use the dollar as an international medium of exchange, and the dollar serves as the vehicle for buying and selling nondollar currencies. The private (mainly interbank) role as a vehicle currency means that the dollar (or the dominant reserve currency) will also be used by central banks in foreign exchange market intervention aimed at achieving target levels for exchange rates.

Finally, a currency's role as an international store of value results from the stability of its value. In other words, the certainty of future value enhances a currency's role as a store of purchasing power. The US dollar's role in this area was diminished in the 1970s, and it seems likely that further instability in US monetary policy would contribute to a further fall. The private market use of the dollar for denominating international loans and deposits indicates the role of the dominant reserve currency in banking. In addition, countries will choose to hold their official reserves largely in the dominant reserve currency.

Fig. 2.3 shows the sharp growth in foreign reserves that has occurred in the last decade. During the Bretton Woods period the size of the foreign reserves was a topic of interest but became less important in the 1970s and 1980s. This

Fig. 2.3 Foreign exchange reserves.

topic has rebounded again as foreign reserve holdings have grown enormously in the 2000s. In particular, emerging economies, dominated by China, have added tremendous amounts of foreign exchange reserves. This sharp growth has been accompanied by sharp imbalances in trade balances, which will be a topic in the next chapter. However, before we can address the question of trade imbalances, we need to explore how exchange rate systems changed once the Bretton Woods Agreement collapsed.

Post Bretton Woods: 1973 to the Present

Although we refer to the exchange rate system in existence since 1973 as a floating rate system, few countries completely allow the market to define the exchange rate. In such a case, we would call the exchange rate system a "purely floating" one. Instead, a multitude of methods to partly or completely control the exchange rate has emerged. This choice of exchange rate system also dictates limitations on the ability of the central bank to conduct its monetary policy. Fig. 2.4 illustrates the major categories of exchange rate arrangements and the effect that such arrangements have on the monetary policy independence of a country. The types of exchange rate systems, in Fig. 2.4, range from (1), "dollarization" where the central bank of the country completely gives up control of the money supply to adopt some other country's currency, to the other extreme of (6), purely floating,
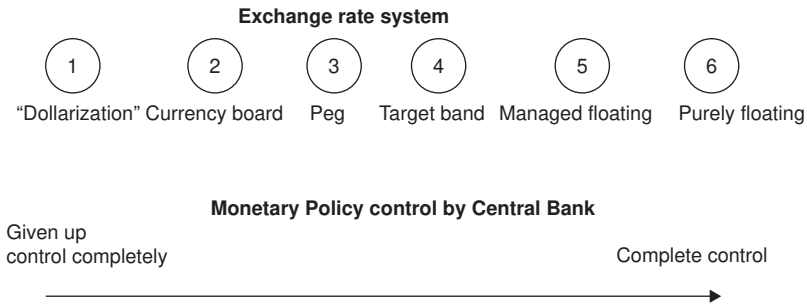
Exchange rate system

①	②	③	④	⑤	⑥
"Dollarization"	Currency board	Peg	Target band	Managed floating	Purely floating

Monetary Policy control by Central Bank

Given up
control completely   Complete control

⟶

Fig. 2.4 Types of foreign exchange arrangements.

where the central bank retains domestic control over the currency in the country. In between, the central bank has some degree of control over the money supply.

The above categories can be summarized under three headings: peg, mixed, and floating, as shown in Fig. 2.5. All pegs involve a fixed rate that is selected by the government, whereas all the floating rates are to some degree market determined. The target bands and crawling pegs are exchange rate systems, somewhere in between the peg and floating, sharing some features of each. For example, the target bands allow the exchange rate to be market determined within some range, but the rate is not allowed to go outside a range that is predetermined by the government.

We provide a brief description of each of the types of foreign exchange arrangements, starting with the exchange rate system with the most independent monetary policy to the one with the least independent monetary policy:

Free floating: The exchange rate is market determined, and any intervention is aimed at moderating fluctuations rather than determining the level of the exchange rate.

Managed floating: The monetary authority (usually the central bank) influences the exchange rate periodically through active foreign exchange market intervention with no preannounced path for the exchange rate.

Peg   **Mixed arrangement;**   **Floating**
                          target band
                          crawling peg

"Dollarization" Currency   Standard   Managed   Free floating
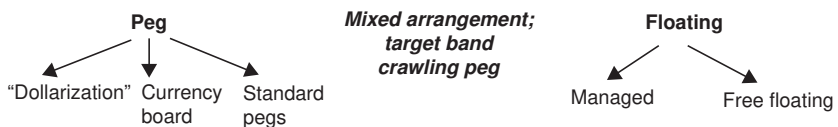   board   pegs

Fig. 2.5 Broad categories of exchange rate arrangements.

Horizontal bands or *Target bands*: The exchange rate fluctuates within an upper and lower band around a fixed central target rate. Such target bands allow for a moderate amount of exchange rate fluctuation while tying the currency to the target central rate.

Crawling pegs: The exchange rate is adjusted periodically in small amounts at a fixed, preannounced rate or in response to certain indicators (such as inflation differentials against major trading partners).

Crawling bands: The exchange rate is maintained within certain fluctuation margins around a central rate that is periodically adjusted at a fixed, preannounced rate or in response to certain indicators.

Fixed peg or *Conventional peg*: The exchange rate is fixed against a major currency or some basket of currencies. Active intervention may be required to maintain the target pegged rate.

Currency board: A fixed exchange rate is established by a legislative commitment to exchange domestic currency for a specified foreign currency at a fixed exchange rate. New issues of domestic currency are typically backed in some fixed ratio (like one-to-one) by additional holdings of the key foreign currency.

"Dollarization" or *No separate legal tender*: Another country's currency is unilaterally adopted as the legal tender.

In Appendix 2A specific country examples of each of the above currency arrangements are provided.

The Choice of an Exchange Rate System

Perfectly fixed or pegged exchange rates would work much as a gold standard does. All currencies would fix their exchange rate in terms of another currency, say, the dollar, and thereby would fix their rate relative to every other currency. Under such an arrangement, each country would have to follow the monetary policy of the key currency in order to experience the same inflation rate and keep the exchange rate fixed.

Flexible or floating exchange rates occur when the exchange rate is determined by the market forces of supply and demand. As the demand for a currency increases relative to supply, that currency will appreciate, whereas currencies in which the quantity supplied exceeds the quantity demanded will depreciate.

Economists do not all agree on the advantages and disadvantages of a floating as opposed to a pegged exchange rate system. For instance, some would argue that a major advantage of flexible rates is that each country can

follow domestic macroeconomic policies independent of the policies of other countries. To maintain fixed exchange rates, countries have to share a common inflation experience, which was often a source of problems under the post–World War II system of fixed exchange rates. If the dollar, which was the key currency for the system, was inflating at a rate faster than, say, Japan desired, then the lower inflation rate followed by the Japanese led to pressure for an appreciation of the yen relative to the dollar. Thus the existing pegged rate could not be maintained. Yet with flexible rates, each country can choose a desired rate of inflation and the exchange rate will adjust accordingly. Thus if the United States chooses 8 percent inflation and Japan chooses 3 percent, there will be a steady depreciation of the dollar relative to the yen (absent any relative price movements). Given the different political environment and cultural heritage existing in each country, it is reasonable to expect different countries to follow different monetary policies. Floating exchange rates allow for an orderly adjustment to these differing inflation rates.

Still there are those economists who argue that the ability of each country to choose an inflation rate is an undesirable aspect of floating exchange rates. These proponents of fixed rates indicate that fixed rates are useful in providing an international discipline on the inflationary policies of countries. Fixed rates provide an anchor for countries with inflationary tendencies. By maintaining a fixed rate of exchange to the dollar (or some other currency), each country's inflation rate is "anchored" to the dollar and thus will follow the policy established for the dollar.

Critics of flexible exchange rates have also argued that flexible exchange rates would be subject to destabilizing speculation. By *destabilizing speculation*, we mean that speculators in the foreign exchange market will cause exchange rate fluctuations to be wider than they would be in the absence of such speculation. The logic suggests that if speculators expect a currency to depreciate, they will take positions in the foreign exchange market that will cause the depreciation as a sort of self-fulfilling prophecy. But speculators should lose money when they guess wrong so that only successful speculators will remain in the market, and the successful players serve a useful role by "evening out" swings in the exchange rate. For instance, if we expect a currency to depreciate or decrease in value next month, we could sell the currency now, which would result in a current depreciation. This will lead to a smaller future depreciation than would occur otherwise. The speculator then spreads the exchange rate change more evenly through time and tends to even out big jumps in the exchange rate. If the speculator had bet on the future depreciation by selling the currency now and the currency

appreciates instead of depreciating, then the speculator loses and will eventually be eliminated from the market if such mistakes are repeated.

Research has shown that there are systematic differences between countries choosing to peg their exchange rates and those choosing floating rates. One very important characteristic is country size in terms of economic activity or GDP. Large countries tend to be more independent and less willing to subjugate domestic policies with a view toward maintaining a fixed rate of exchange with foreign currencies. Since foreign trade tends to constitute a smaller fraction of GDP the larger the country is, it is perhaps understandable that larger countries are less attuned to foreign exchange rate concerns than are smaller countries.

The openness of the economy is another important factor. By openness we mean the degree to which the country depends on international trade. The greater the fraction of tradable (i.e., internationally tradable) goods in GDP, the more open the economy will be. A country with little or no international trade is referred to as a *closed economy*. As previously mentioned, openness is related to size. The more open the economy, the greater the weight of tradable goods prices in the overall national price level is, and therefore the greater the impact of exchange rate changes on the national price level. To minimize such foreign-related shocks to the domestic price level, the more open economy tends to follow a pegged exchange rate.

Countries that choose higher rates of inflation than their trading partners will have difficulty maintaining an exchange rate peg. We find, in fact, that countries whose inflation experiences are different from the average follow floating rates, or a crawling peg—type system, in which the exchange rate is adjusted at short intervals to compensate for the inflation differentials.

Countries that trade largely with a single foreign country tend to peg their exchange rate to that country's currency. For instance, since the United States accounts for the majority of Barbados trade, by pegging to the US dollar, Barbados imparts to its exports and imports a degree of stability that would otherwise be missing. By maintaining a pegged rate between the Barbados dollar and the US dollar, Barbados is not unlike another state of the United States as far as pricing goods and services in the United States—Barbados trade. Countries with diversified trading patterns will not find exchange rate pegging so desirable.

The evidence from previous studies indicates quite convincingly the systematic differences between peggers and floaters, which is summarized in Table 2.4. But there are exceptions to these generalities because neither all