

Chapter

5

Exchange Rate Systems

Currencies such as the euro, the yen, and the dollar trade freely in the world's forex markets, and their values fluctuate from minute to minute. The Hong Kong Monetary Authority, on the other hand, has kept the Hong Kong dollar between $\text{HKD}7.75 = \text{USD}1$ and $\text{HKD}7.85 = \text{USD}1$ since 1983. Between these extremes of freely floating exchange rates and fully fixed exchange rates is a wide variety of exchange rate systems. Understanding how these systems differ is critically important because the differences affect the currency risks international businesses face.

This chapter examines the many different currency arrangements around the world. An important part of this discussion involves understanding the key role central banks and their international reserves play in the exchange rate systems.

This chapter also describes how European countries created the European Monetary Union and came to adopt the euro as a common currency. This discussion is topical for three reasons. First, countries continue to adopt the euro as their currency; second, other groups of countries around the world may someday follow a similar scheme; and third, stresses within the euro zone have caused some European politicians to advocate abandonment of the euro and return to domestic currencies. Understanding the constraints that adopting the euro has placed on different countries clarifies the desirability of such a system.

5.1 ALTERNATIVE EXCHANGE RATE ARRANGEMENTS AND CURRENCY RISK

This section first surveys the spectrum of existing exchange rate arrangements. Then we summarize how different systems impose different currency risks on international businesses. Finally, we reflect on past and future trends in exchange rate arrangements.

Exchange Rate Systems Around the World

Exhibit 5.1 surveys the current arrangements in place across the world, using information from the International Monetary Fund (IMF). Although the IMF distinguishes more categories, the exchange rate systems can be split up into roughly three broad categories: currencies with floating exchange rates, currencies that have fixed or pegged exchange rates, and currencies in which the exchange rate is kept in a target zone or allowed to follow a crawling peg.

Exhibit 5.1 Exchange Rate Systems Around the World

No Separate Legal Tender	
Uses the U.S. Dollar	Ecuador, El Salvador, Marshall Islands, Micronesia, Palau, Panama, Timor-Leste, Zimbabwe
Uses the Euro	Kosovo, Montenegro, San Marino; European Monetary Union – Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovak Republic, Slovenia, Spain
Uses the Australian Dollar	Kiribati
Currency Board	
Fixed to the U.S. Dollar	ECCU – Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines Djibouti, Hong Kong
Fixed to the Euro	Bosnia and Herzegovina, Bulgaria, Lithuania CFA Franc Zone: WAEMU – Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, Togo; CEMAC – Cameroon, Central African Republic, Chad, Republic of Congo, Equatorial Guinea, Gabon
Fixed to the Singapore Dollar	Brunei Darussalam
Conventional Fixed Rate	
Fixed to the U.S. Dollar	Aruba, Bahamas, Bahrain, Barbados, Belize, Eritrea, Jordan, Maldives, Netherlands Antilles, Oman, Qatar, Saudi Arabia, Turkmenistan, United Arab Emirates, Venezuela
Fixed to the Euro	Cape Verde, Comoros, Denmark, Latvia, São Tomé and Príncipe
Fixed to a Composite Currency	Fiji, Kuwait, Libya, Morocco, Samoa
Fixed in Other Way	Bhutan, Lesotho, Namibia, Nepal, Swaziland
Crawling Pegs and Other Stabilization Arrangements Involving Active Intervention	
Versus the Dollar	Angola, Algeria, Azerbaijan, Bangladesh, Bolivia, Cambodia, Costa Rica, China, Ethiopia, Guyana, Honduras, Iraq, Kazakhstan, Lebanon, Liberia, Nicaragua, Suriname, Trinidad and Tobago, Uzbekistan, Vietnam
Versus the Euro	Croatia, Macedonia
Versus Composite	Algeria, Belarus, Botswana, Iran, Russia, Singapore, Solomon Islands, Syria, Tonga, Vanuatu
Other	Burundi, Dominican Republic, Egypt, Georgia, Guinea, Haiti, Kyrgyz Republic, Jamaica, Lao P.D.R., Malawi, Malaysia, Mauritania, Myanmar, Nigeria, Paraguay, Rwanda, Sri Lanka, Tajikistan, Ukraine, Tunisia, Yemen
Floating Rates	
Managed Floating	Afghanistan, Albania, Argentina, Armenia, Brazil, Colombia, Democratic Republic of Congo, Gambia, Ghana, Guatemala, Hungary, Iceland, India, Indonesia, Israel, Kenya, Republic of Korea, Madagascar, Mexico, Moldova, Mongolia, Mozambique, Pakistan, Papua New Guinea, Peru, Philippines, Romania, Serbia, Seychelles, Sierra Leone, South Africa, Switzerland, Sudan, Tanzania, Thailand, Uganda, Uruguay, Zambia
Free Floating	Australia, Canada, Chile, Czech Republic, Japan, Mauritius, New Zealand, Norway, Somalia, Sweden, Turkey, United Kingdom, United States

Note: The information is based on the International Monetary Fund's 2010 Annual Report (Appendix Table II-9).

Floating Currencies

At one extreme, some countries allow the value of their currency to be determined freely in the foreign exchange markets without any government restrictions or interventions in the foreign exchange market. These currencies are said to be **floating currencies**, and major currencies such as the dollar, yen, euro, and pound fall into this category, as do the currencies of other developed countries, such as the Australian dollar and the Swedish krona, and emerging market currencies, such as the Czech koruna and the Turkish lira.

Managed Floating

Although a number of countries can be classified as have floating exchange rates, the monetary authorities in the managed floating countries intervene in the foreign exchange market sufficiently often that IMF does not classify them as freely floating. A number of the prominent emerging market countries, such as Argentina, Brazil, Colombia, Indonesia, Israel, Mexico, and South Africa, fall into this category.

Fixed, or Pegged, Currencies

In exchange rate systems with **fixed rates**, or **pegged currencies**, governments attempt to keep the values of their currencies at particular pegged values in the foreign exchange market, relative to another currency or a basket of currencies. A **basket of currencies** is a composite currency consisting of various units of other currencies. The two most well-known examples of currency baskets are the **special drawing right (SDR)**, which is a unit of account created by the IMF (see Section 5.5), and the historical **European currency unit (ECU)**, which was formerly a unit of account in the European Monetary System (see Section 5.6). The SDR is sometimes used to denominate contracts, as Example 5.1 demonstrates.

Example 5.1 The Thai Baht Value of the SDR

As an exporter of rice from Thailand, ThaiRice contracted to receive the Thai baht (THB) value of SDR 1 million on December 24, 2010, for its rice exports. How many baht did it receive?

The Thai baht value of the SDR is found by multiplying the exchange rates of the baht versus the individual currencies by the given amounts of each currency in the basket. In December 2010, the SDR consisted of the following amounts of four major currencies: €0.41, ¥18.4, £0.0903, and \$0.632. The exchange rates for these currencies on December 24, 2010, were THB40.2821/EUR, THB0.3704/JPY, THB47.3875/GBP, and THB30.6860/USD.

Thus, on December 24, 2010, the Thai baht value of the SDR was

$$\begin{aligned} & \frac{\text{THB}40.2821}{\text{EUR}} \times \text{€}0.41 + \frac{\text{THB}0.3704}{\text{JPY}} \times \text{¥}18.4 + \frac{\text{THB}47.3875}{\text{GBP}} \times \text{£}0.0903 \\ & + \frac{\text{THB}30.6860}{\text{USD}} \times \text{\$}0.632 = \frac{\text{THB}47.0037}{\text{SDR}} \end{aligned}$$

Because ThaiRice received the Thai baht value of SDR 1 million, ThaiRice received

$$\frac{\text{THB}47.0037}{\text{SDR}} \times \text{SDR 1 million} = \text{THB}47,003,700$$

Between July 2005 and July 2008, China pegged the value of the yuan relative to a basket of currencies including the major ones (dollar, euro, and yen) and a number of Asian currencies. Following Singapore's example, China did not disclose the amounts of the currencies in the basket. Other examples of pegged currencies include the Namibian dollar, which is pegged to the South African rand, and the Latvian lat, which is pegged to the euro.

No Separate Legal Tender

Some countries have actually adopted the currency of another country, thereby importing both that country's money and its monetary policy. Ecuador, El Salvador, and Panama have

all adopted the U.S. dollar, whereas Kiribati uses the Australian dollar. Kosovo, Montenegro, and San Marino use the euro, as do the 17 euro-zone countries.

The category also includes arrangements such as the CFA franc zone, where a regional central bank controls the exchange rate system for several countries. The CFA franc zone is a group of 14 African countries with two currencies, the West African CFA franc (with currency symbol XOF), which is used in eight countries in the West African Economic and Monetary Union, and the Central African CFA franc (with currency symbol XAF), which is used in six countries in the Economic and Monetary Community of Central Africa.¹ The values of the two CFA francs are pegged at CFA francs 655.957 = EUR 1. The area is called the *franc zone* because the countries formerly pegged their currencies to the French franc. CFA is an acronym that originally stood for *Colonies Françaises d'Afrique* ("French Colonies of Africa") and now stands either for *Coopération Financière en Afrique Centrale* ("Financial Cooperation in Central Africa") in the Central African countries and *Communauté Financière d'Afrique* ("Financial Community of Africa") in the West African countries.

Currency Boards

A fixed, or pegged, exchange rate fully hinges on the commitment of a country's central bank to defend the currency's value. Some countries have created **currency boards** to accomplish this. A currency board limits the ability of the central bank to create money (see Section 5.4). The most well-known currency board is run by Hong Kong. The countries in the Eastern Caribbean Currency Union (ECCU) also have a currency board.

Target Zones and Crawling Pegs

The IMF also distinguishes some other categories including *target zone systems* and *crawling peg systems*. In such systems, the exchange rate is either kept within a fixed band (the target zone), or exchange rate changes are kept lower than preset limits that are adjusted regularly, typically with inflation (crawling pegs). For example, in 2007, the currency of Cyprus, the Cypriot pound, moved in a 15% band around the value of the euro. The ability of Cyprus to remain in this band was a condition for joining the EMU, and the euro replaced the Cypriot pound in January 2008.

Currency Risks in Alternative Exchange Rate Systems

It may seem that exporters or importers face more uncertainty conducting business in a country with a flexible exchange rate than in a country with a target zone, or even better, a pegged exchange rate system. Unfortunately, things are not that simple.

Quantifying Currency Risks

We know that the transaction exchange risk faced by an importer or exporter depends on the conditional distribution of the future exchange rate. It is easier to assess the conditional distribution of future exchange rates in some regimes than in others.

A critical characteristic of the conditional distribution is its dispersion, typically measured by the standard deviation (also called volatility). Exporters and importers can use this volatility to help quantify a possible range of future exchange rates, and hence quantify their currency risks. Exhibit 5.2 provides a general guide to the currency risks related to various exchange rate regimes.

A second important characteristic of the conditional distribution of future exchange rate changes is its skewness, which tells us whether large exchange rate changes in a particular direction are more likely than in the other direction.

¹The West African countries are Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Sénégal, and Togo. The Central African countries are Cameroon, Central Africa Republic, Chad, Republic of the Congo, Equatorial Guinea, and Gabon.

Exhibit 5.2 Currency Risk in Alternative Exchange Rate Systems

	Central Bank Objective	Exchange-Rate Volatility		Inflation Variability	Countries Adhering to System
		Historical	Latent		
Pure Floating	Domestic	—	—	—	0
Dirty Float	Domestic and Exchange Rate	Large	None	Large	51
Target Zone or Crawling Bands/Pegs	Domestic and Exchange Rate	Small	Large	Small	53
Pegged Exchange Rates	Exchange Rate	None	Large	Small	30
Currency Board	Exchange Rate	None	Small	Small	6
Dollarized	Domestic	None	Small	Small	12
Monetary Union	Domestic	None	Very Small	Small	17

Notes: The first column indicates whether the central bank focuses its policy on exchange rates or domestic objectives, such as inflation targeting. We classified “managed floating systems” under dirty float, but some of these currencies may more appropriately fit into the pegged or target zone categories. We did not classify the currencies in the ECCU and the CFA zones. The two exchange rate volatility columns classify the various currency systems according to the expected magnitude of volatility. The next column does the same with respect to inflation variability. The last column records the number of countries in each currency system, using the information provided in Exhibit 5.1.

Currency Risks in Floating Exchange Rate Systems

A completely pure floating rate system does not really exist. In reality, central banks *intervene* episodically in the foreign exchange market. That is, they buy and sell their own currencies to attempt to affect their values. Whether such a **dirty float currency system** is more or less volatile than a true floating system depends on whether you believe central bank intervention increases or decreases exchange rate volatility. In any case, one advantage of the floating exchange rate system is that history provides data that indicate past currency volatility. Although this volatility varies through time, because most major currencies have been freely floating since 1973, the historical data are useful in pinning down a realistic volatility number for the future. However, if you randomly pick two countries in the world that have substantial trade with one another, chances are their currencies are not floating relative to one another.

The risks of a large movement of the exchange rate in one direction or another in a floating exchange rate system are reasonably symmetric unless a currency has strengthened or weakened systematically for several years, as the dollar did in the early 1980s. Then, the risk of a large reversal in direction typically begins to manifest itself—often while the currency continues to defy this prediction.

Currency Risk in Target Zones

Target zones try to limit exchange rate variability and achieve inflation convergence within the participating countries. As long as the exchange rate remains within the preset band, day-to-day currency fluctuations are bound to be smaller than what is observed for floating currencies. However, when the monetary authorities devalue or revalue a currency (by resetting the bands), the discrete changes in rates are often large. The effect of this behavior for currency risk is well illustrated with an historical example.

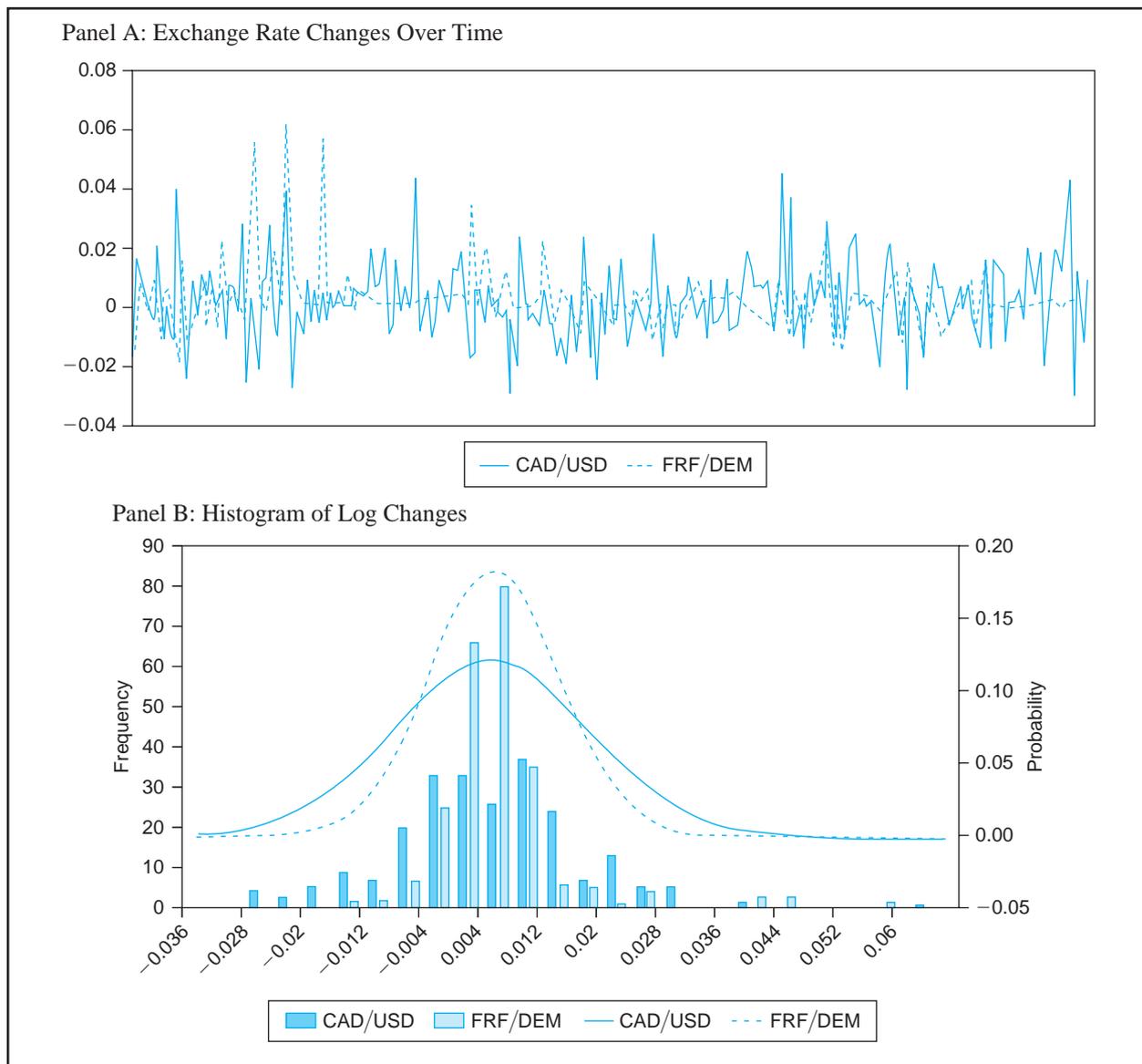
The annualized historical volatility of the rate of change of the French franc–Deutsche mark (FRF/DEM) exchange rate between 1979 and 1999 was 3.01%. This is much lower than the typical volatilities observed for the major floating currencies, such as the \$/£ and ¥/\$, which tend to be around 11% (see Chapter 13). This suggests that the European Monetary System—the target zone system under which the franc and the mark traded at the time—successfully reduced

the volatility of the exchange rate between the two currencies to below what it would have been in a floating currency system. However, the comparison is somewhat strained.

The United States, United Kingdom, and Japan do not have similarly close geographical proximity and trading relationships as do France and Germany. A more comparable country duo, which has not established a formal currency system between them, is Canada and the United States. The volatility of changes in the CAD/USD exchange rate was only 4.53% over the same time period, which is closer to the volatility of the FRF/DEM series than to the volatility of the major currencies.

When we graph the CAD/USD and the FRF/DEM exchange rate changes (see Exhibit 5.3), we see that the volatility of the FRF/DEM exchange rate came in bursts.

Exhibit 5.3 Contrasting the FRF/DEM and CAD/USD Exchange Rates



Notes: In Panel A, we graph monthly exchange rate changes over time (using data from April 1979 to December 1998), whereas in Panel B, we show histograms for logarithmic differences. These logarithmic differences are relatively close to the simple percentage differences computed as $[S(t+1)/S(t)]-1$, with $S(t)$ being the spot rate. For each histogram, we also graph the normal distribution with the same mean and standard deviation as the data.

When there was a speculative crisis and the weak currency was eventually devalued, volatility suddenly and sharply increased.² For example, the exchange rate would abruptly move to the edge of the band. Indeed, the FRF witnessed devaluations of as much as 5.75%. Such large, 1-day movements do not tend to occur with floating exchange rates, where a weak currency may lose ground more gradually. As a result, more extreme observations occurred for changes in the FRF/DEM than for changes in the CAD/USD. If more extreme observations are observed than what we would see in a normal distribution, the distribution is said to exhibit “fat tails,” or leptokurtosis (see Chapter 3). We can see this leptokurtic behavior clearly in the histograms in Panel B of Exhibit 5.3. From the perspective of a multinational business, dealing with such exchange rate behavior is much more difficult than dealing with the smoother changes over time characterizing flexible exchange rate changes. If the possibilities of devaluations or revaluations are not symmetrical, the conditional distribution will also be skewed. This risk also arises in pegged exchange rate systems, as you will see.

Currency Risk in Pegged Exchange Rate Systems

The difficulties in assessing currency risk are amplified in pegged exchange rate systems. If the peg holds for a long time, historical volatility appears to be zero, but this may not accurately reflect underlying tensions that may ultimately result in a devaluation of the currency. Hence, the true currency risk does not show up in day-to-day fluctuations of the exchange rate. Therefore, we say this situation exhibits “latent volatility.”

The key reason we discovered that the behavior of the FRF/DEM exchange rate was not all that different from the behavior of the CAD/USD exchange rate is that we used a long enough historical period, so that a number of devaluations of the FRF were part of the sample. In pegged exchange rate systems, such history is sometimes completely lacking. For example, before the Thai baht succumbed to speculative pressure in the crisis of 1997, it had only been devalued twice in the previous 30 years and not at all in the prior 10 years. From these few observations, it was impossible to determine the true latent volatility of the baht in 1997. What can be done is to look at other countries with similar systems and policies. Economists have built sophisticated models to forecast devaluations and quantify currency risk, which we will discuss in Chapter 10. The great challenge of these models often is to be forward looking without the benefit of a long span of historical data.

Fortunately, it is usually clear in a pegged exchange rate system whether the pegged currency will be devalued or revalued. This one-sided view helps importers and exporters to assess who faces the greater risk. Nevertheless, it is still difficult to know the probabilities associated with devaluations or revaluations and the potential magnitudes of these changes.

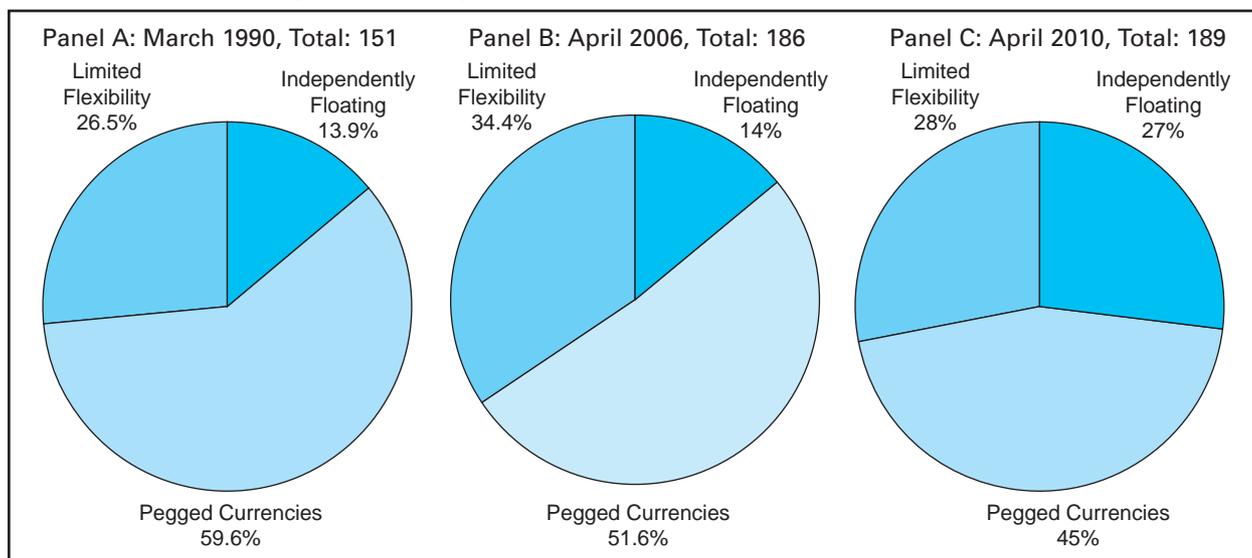
Currency Risk in Currency Boards and Monetary Unions

Currency boards attempt to further limit the risk of devaluation by severely reducing the scope of a country’s monetary policy in exchange rate matters. The problem is that currency boards frequently collapse. For example, the currency boards of all the former British colonies ceased to exist after the colonies became independent, although their demise was not always accompanied by a currency crisis. The Argentine currency board that began in 1991 collapsed in 2002 when the country faced a banking crisis, which plunged the country into a deep recession and a currency crisis.

The only truly credible fixed exchange rate regime may well be a common currency in a monetary union, such as the euro. (We study the European experience with currency arrangements in the final section of this chapter and offer a brief introduction to monetary unions there.) Nevertheless, even a monetary union can be broken apart, so while the probability of devaluation under such a system is quite low, it is not zero.

²See Bekaert and Gray (1998) for a detailed study of the currency volatility around speculative crises in the FRF/DEM market.

Exhibit 5.4 Exchange Rate Arrangements



Note: Data are from various International Monetary Fund Annual Reports.

The lessons from this analysis are clear: For currencies that are not freely floating, the historical volatility of their exchange rates may not be an accurate measure of currency risk. Even though such exchange rate systems might provide short-term exchange rate stability, they do not guarantee the absence of currency risk. Currencies in pegged exchange rate systems can still be devalued, and even currency boards can be, and have been, abandoned.

Trends in Currency Systems

Exhibit 5.4 puts the currencies into the three categories mentioned earlier, comparing the current situation (Panel C) with the situations in 1990 (Panel A) and 2006 (Panel B). Needless to say, there have been many changes in recent years.

First of all, there are now more currencies than there used to be. One main reason is the splitting of the Soviet Union into separate states, each with its own currency. Second, there was an increase in systems with limited flexibility between 1990 and 2006 that has reversed itself. Third, pegged currency systems still dominate, but they are less dominant than they used to be. Fourth, the world has seen a modest increase in floating exchange rate systems.

Exchange rate systems are in constant flux, and international businesses must be watchful for potential dramatic events. One prediction that we venture to make from studying the history of currency systems is that there is now a trend toward the extremes. Countries opt either for a very credible fixed exchange rate system, such as a currency board or monetary union, or a free-float system. The popularity of pegged and target zone systems is declining. When doing business with countries operating such systems, the potential for regime shifts is large.

5.2 CENTRAL BANKS

To understand how the exchange rate systems operate, you must first understand the functioning of central banks.

Exhibit 5.5 Central Bank Balance Sheet

Assets	Liabilities
Official international reserves	Deposits of private financial institutions (Bank reserves)
Domestic credit	Currency in circulation
• Government bonds	Other
• Loans to domestic financial institutions	
Other	

The Central Bank's Balance Sheet

Exhibit 5.5 shows a simplified central bank balance sheet.³

Bank Reserves and Currency in Circulation

The first item on the liabilities side of the balance sheet consists of the reserves that financial institutions have on deposit at the central bank. Countries require their commercial banks to hold a certain percentage of the deposits the banks accept from the public as reserves at the central bank. These reserves are called **required reserves**, and they are often non-interest bearing. Even if the central bank did not force banks to hold reserves, banks would still hold some reserves to facilitate transfers across banks and because they always face withdrawals, many of which have to be met immediately. Currency physically held in banks, called *vault cash*, is also part of reserves.

The other liability of the central bank is currency in circulation, which includes the coins and bills used by the public. Because the central bank operates the only authorized printing press in the country, it can actually print money to pay its bills or to acquire assets.

The sum of the two central bank liabilities is called the **monetary base** of the country, or simply *base money*. If the central bank buys an asset (for example, a government bond) from a financial institution, it credits the financial institution's reserve account at the central bank for the purchase price of the bond. Because this financial institution can now use these funds to lend money to individuals and businesses, the central bank has, essentially, created money. During the financial crisis that began in 2007, many central banks engaged in a policy known as "quantitative easing," which essentially amounts to the purchase of additional assets from commercial banks that expanded the banks' reserves. Although definitions of *money* in a modern economy vary, we define it here as the sum of bills in circulation and demand deposits at commercial banks (a measure called M1).

One dollar of additional base money eventually leads to much more than 1 dollar of actual money. Further money creation happens as financial institutions lend out part of the additional reserve dollar. This money is spent and, in turn, is deposited at some other financial institution, swelling that bank's deposits and its reserves. This bank will not leave that money idle but will lend it out and keep only a fraction as reserves. Consequently, the process of money creation continues in what monetary economists call the money multiplier effect: 1 dollar of additional base money leads to multiple dollars of new money. The money multiplier effect is smaller when financial institutions fail to lend out new deposits or when people hold cash rather than depositing money in the banking system.

Domestic Credit

The asset side of the central bank's balance sheet in Exhibit 5.5 records its investment portfolio. One important category here is domestic government bonds. In the United States and many other countries, these assets are used to influence the money supply through **open market operations**, which are the purchases or sales of government bonds by the central

³See Mishkin (2010) for more details about central banks and monetary policy.

bank. In the United States, the Federal Reserve (the Fed) is the central bank, and if the Fed buys a U.S. Treasury bond, it pays by crediting the account of the bank selling the bond. By doing so, the Fed injects dollars into the financial system. The converse is also true; the Fed can reduce the money supply by selling government bonds to the public. Open market operations are the main channel through which the Fed affects the money supply.

The interest rate at which the Fed’s supply of reserves matches the financial institutions’ demand for reserves is called the federal funds rate. It is also the rate at which banks lend reserves to each other overnight. Using open market operations, the Fed controls the federal funds rate, which in turn affects the interest rates at which banks lend to households and firms.

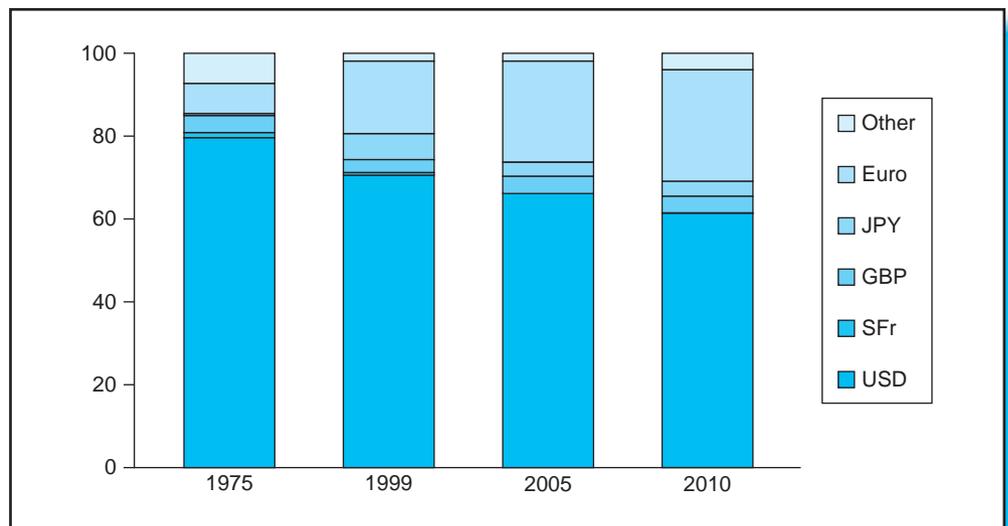
Another category of assets on a central bank’s balance sheet that is often extremely important for developing countries is “credit to the domestic financial sector,” which corresponds to “loans to domestic financial institutions” in Exhibit 5.5. The central bank in most countries is also a lender of last resort—that is, it can and should extend credit to the banking sector to prevent bank runs in times of panic and financial crisis. Inflationary problems often arise, though, when financial institutions become dependent on the central bank for funds.

Official Reserves

The item “official international reserves” on the balance sheet in Exhibit 5.5 is at the core of the role central banks play in the foreign exchange market. **Official reserves** consist of three major components: foreign exchange reserves, gold reserves, and IMF-related reserve assets. (We discuss the last two items in Section 5.4.) Around the world, **foreign exchange reserves** constitute the largest component of official international reserves, accounting for 86% of total reserves at the end of 2009. Gold accounted for 10% and IMF-related reserve assets accounted for 4% of total reserves.

Chapter 4 noted that international reserves are the central bank’s foreign currency–denominated assets (bonds, deposits, and credit lines). In terms of currency denomination, the dollar is the dominant foreign reserve asset held by most central banks around the world. Exhibit 5.6, constructed from IMF Annual Reports, indicates that the dollar’s dominance has waned in recent times, falling from close to 80% in 1975 to about 61% today.

Exhibit 5.6 Foreign Exchange Reserves



Notes: The data are from Table I-2 in the International Monetary Fund Annual Reports, various issues. For 1975, the numbers for the euro reflect the sum of reserve positions in the Deutsche mark and the French franc.

Other important reserve assets are the euro, the pound sterling, and the yen. A much-discussed issue is whether the arrival of the euro will cause the relative importance of the dollar to decrease (see Galati and Wooldridge, 2009; and Papaioannou et al., 2006). Comparing the 1999 and 2010 numbers, it does appear to be the case that the share of the euro has increased relative to that of the dollar, but at times during the 1980s and 1990s, the total share of international reserves of the currencies replaced by the euro (the Deutsche mark, French franc, and ECU) was higher than that of the euro today.

International reserves are depleted or increased when a central bank intervenes in the foreign exchange market. If the central bank buys its currency in the foreign exchange market, it must sell foreign currency assets and its international reserves are depleted. If the central bank sells its currency in the foreign exchange market, it buys foreign currency assets and its international reserves are increased.

Central banks usually limit the risk of their portfolios by not investing in equities. Most official reserves are held as foreign Treasury bills and bonds.

Whereas 10 years ago, the largest stock of official reserves was found in developed countries, at the end of 2009, developing countries held more than 65% of the global stock of reserve assets. After currency crises in Mexico in 1994, Southeast Asia in 1997, and Russia in 1998, many developing countries built up substantial reserves, partially as insurance against future crises. Traditionally, the level of reserves is compared to the amount of imports a country must fund. However, in an increasingly financially globalized world, reserves can also protect against sudden stops in capital flows from abroad (see Jeanne and Ranciere, 2009). China, in particular, has built up substantial reserves, which at the end of September 2010 stood at \$2,987 billion, of which \$2,648 billion was foreign exchange and \$339 billion was gold.

Money Creation and Inflation

The central bank's right to create money is a valuable tool. Central banks finance their physical operations and pay their staff from the interest income on their assets, which are obtained by creating base money. Any residual income is given to the country's treasury. The value of the real resources that the central bank obtains through the creation of base money is called **seigniorage**. By setting the amount of nominal money circulating in the economy at each point in time, the bank establishes the growth rate of the nation's money supply over time. Monetary authorities hope to use their policies to achieve low inflation while promoting growth and lowering unemployment. This is a difficult task because the demand for money ultimately depends on the amount of real transactions in the economy and how much money is needed to facilitate these transactions.

For example, if the authorities double the money supply in the hope of stimulating the economy, they will probably only succeed in doubling the overall level of prices in the economy. The increase in the money supply is unlikely to make people consume more or work harder. But with more money supporting the same number of real transactions, prices will inevitably rise. Whereas economists have formulated theories in which changes in the supply of money do have real effects on the economy in the short run, it is generally believed that the long-run impact of additional money growth on real activity is negligible. This long-run property of the growth in the money supply is called *money neutrality*.

Sometimes, central banks forget that creating money cannot solve real problems. For example, governments may use open market operations to monetize fiscal deficits to help finance a large budget deficit. The deficit arises because government expenditures exceed tax revenues, and the deficit must be financed by the sale of government bonds to the public. If the bonds are bought by the central bank, the central bank's holdings of government bonds increase, and the money supply expands. The deficit is monetized. A government that "runs the printing presses" to finance its deficits undermines its central bank's ability to control the money supply and eventually creates inflation.

Central banks fall into this trap because the open market purchase of bonds does not immediately increase the price level. Prices only rise over time as the banking system's increased reserves finance additional lending to the public, which increases aggregate demand. In 2010, the Fed's policy of quantitative easing essentially monetized a large part of the U.S. budget deficit, but inflation remained low. When questioned by Congress if this policy would eventually create inflation, Chairman Bernanke responded that the Fed had the tools to reverse the policy in the future should inflationary pressures appear.

Deficit finance was an acute problem in many Latin American economies in the 1970s and 1980s. Argentina and Bolivia eventually faced hyperinflation (triple-digit annual inflation or worse) because they created too much money. Similarly, if central banks frivolously extend credit to the banking sector, the money supply will likely expand beyond the amount that individuals and firms need to conduct transactions, and inflation inevitably results.

The Impossible Trinity or Trilemma

Standard open-economy macroeconomic theory holds that there is an intrinsic incompatibility between perfect capital mobility (that is, no capital controls on international financial transactions), a fixed exchange rate, and domestic monetary autonomy (that is, using monetary policy to achieve domestic policy goals). The fact that only two of these three policies are possible is called the **impossible trinity** or **trilemma**.⁴ If a country wants to fix its exchange rate and has perfect capital mobility, capital flows will determine the country's money supply, making it impossible to run an independent monetary policy.

Some economists argue that combining an independent monetary policy and control of the exchange rate with capital controls is the best way to deal with the impossible trinity, but in practice, such policies do not always work. Even when a currency is flexible, problems can arise. For example, in December 2006, Thailand imposed capital controls on foreign capital inflows (essentially slapping a tax on foreign portfolio investment into Thailand) after facing a strong appreciation of the Thai baht that hurt Thai exporters. The Thai authorities did not want to lower local interest rates to lessen the attractiveness of foreign investment in Thailand. Why? Because that would boost local demand and further overheat the economy. As you will see in the next section, any effort by the central bank to intervene to lower the value of the baht would have a similar effect. After the equity market declined by 15% in 1 day in response to the imposition of capital controls, the controls were hastily removed from equity investments and relaxed for debt investments. Yet, in the wake of the 2007 to 2010 global crisis, a number of emerging economies, including Brazil and South Korea, imposed capital controls on short-term or "hot" capital inflows, and capital controls are an integral ingredient of China's monetary policy (see the box titled *The Trilemma in China* later in this chapter).

Foreign Exchange Interventions

Central banks sometimes intervene in foreign exchange markets to affect exchange rates directly. By supplying more of their currency, they weaken it; and by demanding their currency, they strengthen it. Exhibit 5.7 shows the effects of two different types of interventions on a central bank balance sheet.

With either intervention, the central bank ends up buying foreign currency. (In practice, central banks do not just buy foreign currency; they eventually buy foreign currency assets that earn interest, such as foreign bonds.) There are two types of interventions, depending on whether the interventions are "sterilized." We discuss the non-sterilized intervention first and then explain sterilization.

⁴**Capital controls** are the set of regulations and taxes pertaining to flows of capital into and out of the country. See Obstfeld and Shambaugh (2005) for some historical perspectives on the trilemma and Aizenman et al. (2010) for an analysis of the current situation.

Exhibit 5.7 Sterilized and Non-Sterilized Foreign Exchange Intervention

Panel A: A Non-Sterilized Intervention			
Central Bank Balance Sheet		Financial Intermediary Balance Sheet	
Assets		Liabilities	
International reserves	+50	Deposits of financial institutions	+50
Domestic credit	0		
<hr/>			
Panel B: A Sterilized Intervention			
Central Bank Balance Sheet		Financial Intermediary Balance Sheet	
Assets		Liabilities	
International reserves	+50	Deposits of financial institutions	+50
Domestic credit	-50		-50
	0		0
<hr/>			
		Financial Intermediary Balance Sheet	
		Assets	Liabilities
		Reserves at Federal Reserve	+50
		Foreign currency interbank deposits	-50
		Government bonds	+50
			0
		<hr/>	

Notes: The Fed buys USD 50 million worth of yen on the foreign exchange market in Panel A. In Panel B, the bold transaction shows how the Fed sterilizes the original transaction by selling government bonds to financial intermediaries.

Non-Sterilized Interventions

Consider the situation in Exhibit 5.7. Imagine that the Fed wants to depreciate the dollar relative to the yen, to make U.S. products more attractive to potential Japanese buyers. Suppose the exchange rate is ¥100/\$, and the Fed buys ¥5,000 million in the foreign exchange market from a major U.S. commercial bank. How does the Fed pay for the yen? It simply credits the account of the commercial bank at the Fed by \$50 million = (¥5,000 million) / (¥100/\$). The commercial bank in turn wires ¥5,000 million to the Fed. This transaction decreases the assets of the commercial bank by ¥5,000 million, but it increases the assets of the commercial bank by \$50 million. At the central bank, this **non-sterilized intervention** increases foreign assets and increases the U.S. money supply. Essentially, the Fed pays the bank by creating \$50 million of base money. By increasing the demand for yen and increasing the supply of dollars to the foreign exchange market, the Fed hopes to lower the yen price of the dollar.

Sterilized Interventions

An unwelcome side effect of a non-sterilized foreign exchange intervention is its effect on the money supply. A higher money supply eventually leads to higher inflation, and the foreign exchange objective of the central bank's policy may conflict with its domestic goal of price stability. A potential solution is to "sterilize" the foreign exchange intervention—that is, to remove the new money from circulation to remove the inflation threat. **Sterilized interventions** involve conducting an offsetting open market transaction to restore the monetary base to its original size.

Panel B of Exhibit 5.7 presents a sterilized intervention. Here, the Fed uses an open market transaction to offset the effect of the foreign exchange intervention on the domestic money supply. That is, at the same time as the Fed buys ¥5,000 million for \$50 million, it

sells \$50 million worth of domestic government bonds in the bond market. Because a financial institution pays for these bonds using its reserve account at the Fed, money is taken out of circulation at the same time that money is injected into circulation through the foreign exchange intervention. These two transactions cancel each other out, as Exhibit 5.7 shows. The net effect is that the Fed has replaced domestic bonds with foreign assets, but there is no effect on the money supply. The private sector now holds more domestic bonds and fewer foreign currency bonds.

How Do Central Banks Peg a Currency?

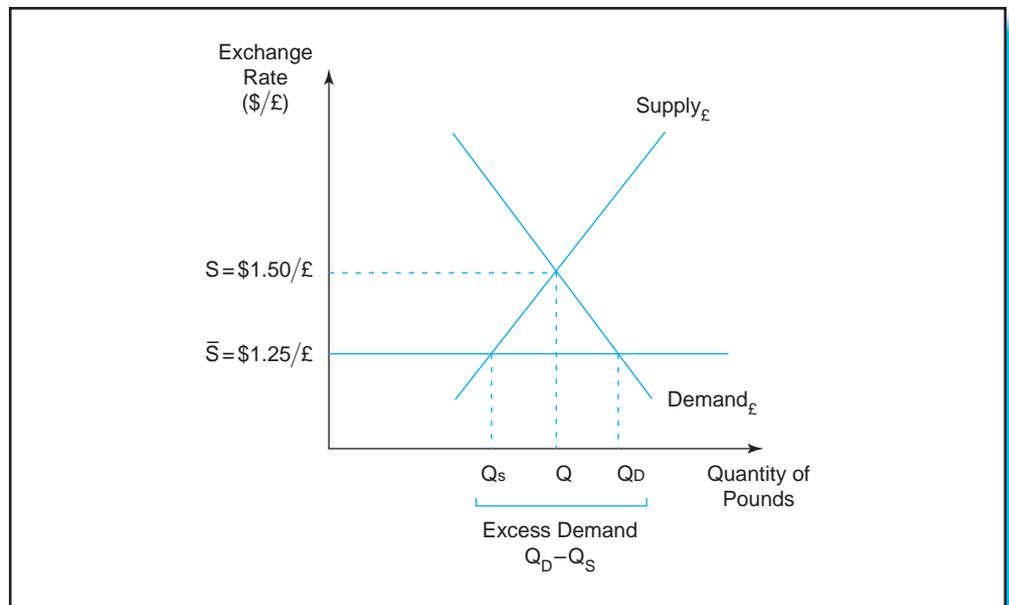
Although most central banks—even those with free-floating currencies—intervene in the foreign exchange market, some central banks go further and attempt to fix the value of their currencies relative to a benchmark currency. How does a central bank peg a currency? To establish and maintain a fixed value when a currency is freely traded, the central bank has to be willing to “make a market” in its currency. The central bank has to be willing and able to supply its currency when there is excess private demand for it (buying the foreign currency), and if there is excess private supply of the domestic currency, the central bank must demand any excess supply that arises (selling its foreign currency reserves). As the central bank buys or sells the foreign currency, its international reserves increase or decrease.

Pegging the Exchange Rate

Suppose that the Bank of England, the U.K. central bank, wants to peg the value of the pound relative to the dollar at $\bar{S} = \$1.25/\text{£}$. Exhibit 5.8 presents the aggregate demand and supply for the pound. The horizontal axis represents quantities of pounds demanded or supplied in the foreign exchange market over some time interval, such as a quarter or a year. The vertical axis represents the price of the pound in terms of the dollar—in other words, the dollar/pound exchange rate, S .

Why is the demand (supply) schedule downward (upward) sloping? Let us assume that the United Kingdom and the United States are the only countries in the world and

Exhibit 5.8 Fixing the \$/£ Exchange Rate



assume for simplicity that the demands to trade currencies arise only from importers and exporters. The quantity of pounds demanded by U.S. importers will go down as the dollar price of the pound increases. If the U.K. product prices remain fixed, a higher dollar/pound exchange rate raises the dollar prices of U.K. goods to U.S. importers. Consequently, the demand schedule for pounds, $Demand_{\pounds}$, is downward sloping. Similarly, the supply of pounds to the foreign exchange market—for example, by U.K. importers needing dollars to import goods or services from the United States—will tend to increase the higher the exchange rate (the more dollars a pound buys) because the price of U.S. goods is going down from the U.K. perspective. The supply schedule, $Supply_{\pounds}$, is therefore upward sloping. The equilibrium exchange rate that equates the private sector's demand and supply schedules is denoted by S and equals $\$1.50/\pounds$. If the exchange rate were freely floating without government intervention, this would be the market exchange rate.

The level at which the government wants to fix the value of the pound, \bar{S} , is represented by a horizontal line. In this case, the value is below the equilibrium exchange rate. At \bar{S} , there is an excess private demand for pounds, and the pound is undervalued relative to its equilibrium value. Hence, if the Bank of England wants to keep the exchange rate at that level, it will have to supply these excess pounds (represented by $Q_D - Q_S$) to the foreign exchange market and obtain foreign currency (dollars) in return. In other words, this situation causes the Bank of England to increase its foreign reserves.

Exhibit 5.8 also summarizes the essence of the economic content of the balance of payments (BOP) statistics we discussed in Chapter 4. The demand for pounds over a certain time interval is every item that gives rise to a credit on the BOP, a source of foreign currency. The supply of pounds over that same time interval is every item that gives rise to a debit item, a use of foreign currency. In a purely floating exchange rate system, the exchange rate is always at its equilibrium value, S ; the private sector's balance of payments is always balanced; and there is no need for central bank intervention. However, if the Bank of England wants to peg the currency at \bar{S} , its foreign exchange reserves will increase when there is excess private-sector demand for pounds, and there will be an official settlements deficit because the Bank of England is building up foreign assets.

The Trilemma in China

Because China pegs the value of the yuan to the dollar, the impossible trinity or trilemma implies that China can only run an independent monetary policy by imposing capital controls. Indeed, China incurs huge costs to control capital flows. The controls are asymmetric: Certain types of inflows are allowed (especially foreign direct investment [FDI] and limited equity flows), but outflows are prohibited. However, with growing international trade, China's current account transactions are now relatively unrestricted, making it more difficult to contain capital flows masked as current account transactions. The fixed exchange rate coupled with large trade surpluses and substantial FDI inflows necessarily imply that China has been building up massive international reserves. To prevent this from affecting the

local money supply, China must sterilize the foreign reserve buildup. Because China does not have well-developed financial and Treasury bond markets, the People's Bank of China, its central bank, has resorted to issuing central bank bills and raising reserve requirements to reduce the money multiplier. As Wang (2010) reports, between July 2006 and September 2008, reserve requirements for the commercial banks were raised 19 times, from 8.0% to 17.5%. Wang also demonstrates that China's ability to fully sterilize the foreign exchange buildup has diminished over time, as has the effectiveness of its capital controls. As China slowly continues on a path toward more financial openness, it may have to give up the exchange rate peg or risk losing monetary independence.

5.3 FLEXIBLE EXCHANGE RATE SYSTEMS

Although the central banks of the major developed countries mostly let competitive market forces determine the values of their exchange rates, they nonetheless have a variety of tools at their disposal to influence the path of exchange rates. For example, they can use domestic monetary policy (by varying the money supply or interest rates under their control); they can attempt to restrict capital movements; or they can tax or subsidize international trade to influence the demand for foreign currency. We will come back to these alternative tools later on in this chapter. Here we focus on direct foreign exchange intervention—that is, the sale or purchase of foreign assets against domestic assets by the central bank.

The Effects of Central Bank Interventions

Despite their prevalence, foreign exchange interventions are a controversial policy option for central banks. In one view, intervention policy is not only ineffective in influencing the level of the exchange rate, but it is viewed as dangerous because it can increase foreign exchange volatility. Others argue that intervention operations can influence the level of the exchange rate and can “calm disorderly markets,” thereby decreasing volatility. Yet others, including Nobel Laureate Milton Friedman (1953), argue that interventions are ineffective and a waste of taxpayers’ money.

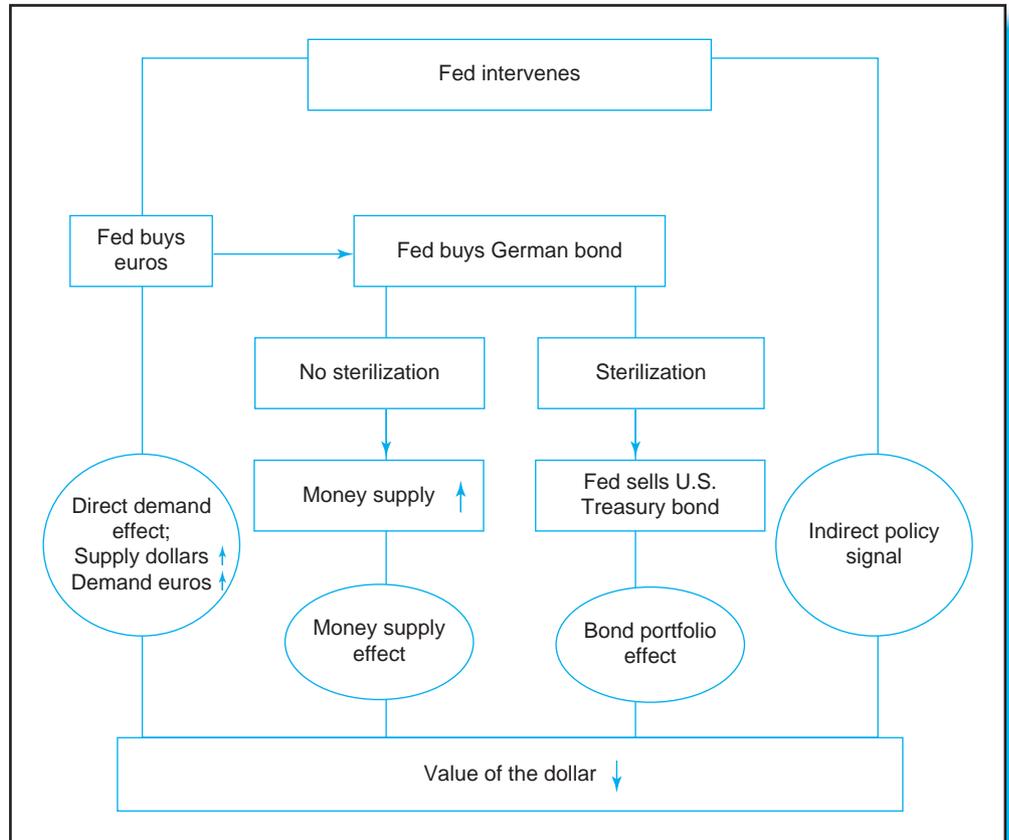
To better understand this debate, let’s consider how interventions can affect exchange rates. We distinguish two main channels: direct and indirect. The direct channel stresses the importance of the volume and the intensity of the intervention operations themselves, whereas the indirect channel stresses the importance of the market response to the intervention and how expectations of private investors and their investment portfolios may be altered as a result. We summarize these channels in Exhibit 5.9, which takes us through the potential effects of the Fed buying euros. In the discussion here, we move from left to right in the diagram.

Direct Effects of Interventions

The direct channel is easiest to understand. The central bank’s action directly affects the supply and demand of foreign currency. In Exhibit 5.9, the supply of dollars to the foreign exchange market increases, and the demand for euros increases. Most economists believe that the direct effects of interventions must be negligible because the magnitude of interventions is typically like a drop in the ocean of overall foreign exchange trading. The daily trading volume in the foreign exchange markets across all currencies is around \$4 trillion per day, whereas interventions rarely exceed \$20 billion at a time. Of course, when the intervention is not sterilized, buying euros has the same effect as an expansion of the U.S. money supply. However, the U.S. money supply also dwarfs the size of a typical intervention so that this money supply effect is likely to be small as well. Moreover, both the Fed and the European Central Bank routinely *sterilize* their interventions, implying that the money supply is typically not affected by direct interventions.

Although sterilized interventions have no effect on the domestic money supply, they do change the composition of the assets held by private investors. For example, a Fed purchase of euros with dollars would increase the U.S. money supply and must be offset with a sale of government bonds, which reduces the U.S. money supply, if the intervention is sterilized. The net effect in private-sector portfolios in Exhibit 5.9 is that dollar bonds replace euro bonds, which we term the *bond portfolio effect*. The central bank forces this change in portfolio composition upon private investors, who may require changes in the prices and expected returns on the bonds before they are willing to buy them. Whether these changes in portfolio composition generate any direct effect on the exchange rate is questionable, given the size of

Exhibit 5.9 The Effects of Foreign Exchange Interventions



Notes: The Federal Reserve buys euros to attempt to reduce the value of the dollar relative to the euro. Because it wants to hold interest-bearing instruments, it uses the euro to buy a 5-year Bund, a German government bond with a maturity of 5 years.

worldwide bond portfolios relative to the typical size of an intervention. The U.S. government bond market alone, for example, has a market capitalization over to \$9 trillion.

Interventions may still be effective in generating short-term effects on the exchange rate through creating inventory imbalances for foreign exchange dealers or by creating order flow that dealers try to exploit (see Pasquariello, 2010). For example, if the Fed intervenes to reduce the value of the dollar by buying euros with dollars from several dealers, the efforts of these dealers to either reduce their inventory imbalances (by re-buying the euros) or to exploit the order flow may well decrease the value of the dollar. In this sense, “smallish” interventions may still have an exchange rate effect by squeezing foreign exchange inventories at dealer banks.

Indirect Effects of Interventions

Even though an intervention may fail to move the exchange rate directly, it can still alter people’s expectations and affect their investments, thus helping to push the exchange rate in the direction the central bank desires. For example, the intervention may be a signal to the public of the central bank’s monetary policy intentions, or it may signal the central bank’s inside information about future market fundamentals, such as future GDP growth.

Alternatively, the central bank may signal to investors that the exchange rate is deviating too far from its long-run equilibrium value. However, the market might not take a mere announcement of a policy change seriously because “talk is cheap,” as the saying goes. By

contrast, an actual intervention makes the signal more credible because the central bank is putting its own resources on the line when it intervenes. When a central bank incorrectly assesses the equilibrium value of the exchange rate, the intervention will result in a loss. For example, if the central bank buys foreign currency when it feels the foreign currency is undervalued and bound to appreciate, but subsequently the foreign currency depreciates, the bank suffers a loss. The marketplace, recognizing these costs, is likely to take the central bank's policy statement more seriously if it is backed up by intervention. This reasoning, though, makes standard secretive interventions of central banks quite mysterious.

Empirical Evidence on the Effectiveness of Interventions

After the advent of floating exchange rates in 1973, policymakers gradually discovered that exchange rates were much more variable than they had envisioned. Several years of undisciplined and uncoordinated national monetary and fiscal policies created huge current account imbalances and a sizable misalignment of the dollar, which had appreciated strongly since the end of 1979. The Plaza Accord of September 1985 ushered in a period of quasi-regular interventions by the major central banks. With the Plaza Accord, the central banks of Germany, Japan, and the United States conducted a coordinated intervention to lower the value of the dollar after its sustained rise during the first half of the 1980s. Since then, there have been other coordinated interventions (for example, the Louvre Accord in 1987) and many unilateral interventions by a single central bank, which provide useful data to examine whether interventions are effective. Surveys of the literature by Neely (2008) and Menkhoff (2010) suggest that interventions are more successful when coordinated among central banks and when they are consistent with market fundamentals.

Dominguez and Frankel (1993) draw an engaging analogy between the foreign exchange market and a cattle drive. In the analogy, the market is the herd of steers, and the central banks are the herd dogs. In any cattle drive, the steers clearly outnumber the herd dogs in both size and number, yet the dogs can still influence the steers' path by barking and nipping at their heels. The steers at the edge of the pack influence the rest of the herd to stay on the right path. In much the same way, central banks, while clearly outnumbered in terms of market participants and the sheer volume of market trading activity, may be able to exert greater influence on exchange rates than their size and number would suggest because they can affect market expectations. But the herd dogs likely have less chance of success when the cattle are going full speed toward a ravine and must be turned around 180 degrees. Interventions that fly in the face of powerful economic fundamentals are unlikely to work. Although the Plaza Accord was deemed successful because the dollar did indeed decline in its wake, the decline in the value of the dollar had already started, and the Plaza Accord may have just endorsed a market movement already under way.

Many studies have tested whether central bank intervention has served to stabilize exchange rates. While the results differ across countries, the empirical evidence so far suggests that central bank interventions have increased or not changed volatility rather than decreased it (see Beine et al., 2007; and Dominguez, 2006).⁵ One problem with assessing the efficacy of interventions to reduce volatility is the possibility that central banks intervene during periods that are relatively more volatile.

A final perspective is to try to assess directly whether central bank interventions indeed waste taxpayers' money by examining the profitability of interventions. One example of a loss was the Swiss National Bank's (SNB) loss on euro intervention in 2010. The Swiss franc is often viewed as a safe haven currency and tends to attract many investors in crisis times. In March 2009, the SNB thought that Swiss franc appreciation had gone too far and intervened

⁵This is true despite central bankers themselves believing that their interventions do not increase volatility. See the survey in Neely (2008).

against the euro to prevent the Swiss franc from appreciating below CHF1.50/EUR. The SNB was successful throughout 2009, but during the first half of 2010, they acquired CHF132 billion of international reserves, mostly euro denominated. This intervention was unsuccessful in preventing appreciation of the Swiss franc as the exchange rate reached CHF1.25/EUR by July 2010, at which time the SNB announced that it had lost CHF14 billion on its intervention. In contrast, Neely (2008) notes that several studies show central bank interventions to be profitable, both in the United States and Australia. Given the inconclusiveness of much of the research in this area, the debate on the usefulness of interventions in otherwise freely floating currencies will probably continue for a long time to come.

5.4 FIXED EXCHANGE RATE SYSTEMS

Until 1971, an essentially fixed exchange rate system based on gold dominated the international monetary system. From then onward, fixed exchange rate systems have been primarily prevalent in developing countries.

The International Monetary System Before 1971: A Brief History

The Gold Standard

At the start of the 18th century, Great Britain made its paper currency notes exchangeable for gold, thereby establishing the first official **gold standard**. By the end of the 19th century, all major industrial countries had adopted the gold standard. Because coins and bills could be converted into gold at fixed rates at central banks, the gold standard essentially resulted in a system of fixed exchange rates among the major countries. Central banks also used gold to pay for balance of payments deficits. That is, gold was sent from the deficit country (which faced an excess demand for the foreign currency) to the surplus country. This transfer helped restore equilibrium on the balance of payments because the loss of international reserves by deficit countries also meant that their money supply decreased, putting downward pressure on prices. Lower prices increased demand for the country's products from foreign residents, which automatically improved the BOP.

Hyperinflation and the Interwar Period

During World War I, the gold standard was suspended as governments printed massive amounts of paper money to finance their war efforts. The result was substantial inflation, with Germany as the most dramatic example. Germany faced hyperinflation between 1919 and 1923, with prices rising by a factor of 481.5 billion in those 4 years alone! People literally had to use wheelbarrows full of money to make their purchases.

The interwar period was an era of international economic disintegration punctuated by the Great Depression starting in 1929.⁶ Some countries allowed their currencies to float in the foreign exchange markets. Others maintained some form of gold standard; for example, the United States and Great Britain restored gold convertibility at prewar parities after the war. That is, the number of dollars or pounds needed to obtain an ounce of gold was kept at the same value as before the war. However, gold standard countries regularly devalued their currencies relative to gold and hence relative to other currencies. These devaluations were intentionally aimed at making locally produced goods more competitive—that is, cheaper for foreign buyers. At the same time, protectionist measures were taken, aimed at keeping out foreign products. International cooperation and coordination of economic policies declined precipitously, and international tensions grew.

⁶Eichengreen (1992) provides an excellent economic history of the interwar period.

The Bretton Woods System

In 1944, the International Monetary Fund (IMF) was created by an international agreement called the **Bretton Woods Agreement** because it was signed at Bretton Woods, New Hampshire. The participating countries agreed to an exchange rate regime that linked their exchange rates to the dollar. The dollar itself had a fixed gold parity (\$35 per ounce).

The Bretton Woods Agreement grew out of a desire to avoid the monetary chaos of the interwar period. Fixed exchange rates were meant to provide stability and discipline, but the Great Depression had convinced the IMF's architects that fixed exchange rates should not come at the price of long-term domestic unemployment. Therefore, the IMF agreement incorporated some flexibility into the application of the fixed exchange rate system. Countries were allowed to devalue their currencies if they experienced "fundamental disequilibrium," a term that was never formally defined. Policymakers in different countries debated who should do the adjustments and who was at fault for protracted balance of payments deficits. In contrast, if a country encountered a temporary balance of payments problem (a current account deficit) that threatened its currency peg, it could draw on the lending facilities of the IMF to help it defend the currency.

Each IMF member contributed both gold and its own national currency to the fund. A member was entitled to use its own currency to temporarily purchase gold or foreign currencies from the fund equal in value to its gold contribution. Further gold or foreign currencies (up to a limit) could be borrowed from the fund, but only under increasingly stringent IMF supervision of the borrower's macroeconomic policies. This *IMF conditionality* (see also Chapter 1) is still applied to countries when they borrow from the IMF. The Bretton Woods Agreement allowed exchange rates to fluctuate in a 1% band around the chosen parity value.

Individual Incentives Versus Aggregate Incentives

Because the United States was required to trade gold for dollars with foreign central banks, it maintained large gold reserves. During the 1950s, the world demand for international reserves grew more rapidly than world gold supplies, and foreign countries happily accumulated interest-earning dollar international reserves without converting them into gold at the Federal Reserve. As these dollar claims became larger and larger relative to the size of the U.S. gold reserves, though, foreign confidence in the dollar–gold parity understandably fell. The market began to predict a devaluation of the dollar in terms of gold, which increased the incentive of individuals and central banks to hold gold, not dollars.

If individual foreign countries exercised their right to convert their dollar claims into gold, the United States would eventually not be able to honor all these requests and would be forced to abolish convertibility at \$35 an ounce. Yet, if the aggregate of all countries did not ask to convert their dollar assets into gold, the system could continue indefinitely, with dollar assets forming the foundation of international reserves. Some countries, such as France, found this politically unacceptable.

Special Drawing Rights

In 1968, the IMF created special drawing rights (SDRs) as an alternative reserve asset with the same gold value as the dollar, in an attempt to provide an internationally acceptable asset other than the dollar. However, the United States kept running BOP deficits, and the pressure on the U.S. gold reserves continued to mount, prompting President Nixon to abolish the convertibility of the dollar into gold in August 1971.

An international agreement reached in December 1971 at the Smithsonian Institution in Washington, DC, devalued the dollar by about 8% relative to most other currencies, but speculation against the dollar continued. By March 19, 1973, the Bretton Woods system collapsed, and the currencies of Japan and most European countries began to float freely relative to the dollar.

The value of the SDR remained expressed in gold until 1976, after which it became a basket currency. Since then, gold has lost its official role in the international monetary system, although most central banks continue to keep part of their official reserves in the form of gold. The price of gold has fluctuated considerably over the years and exceeded \$1,400 per ounce at the end of 2010.

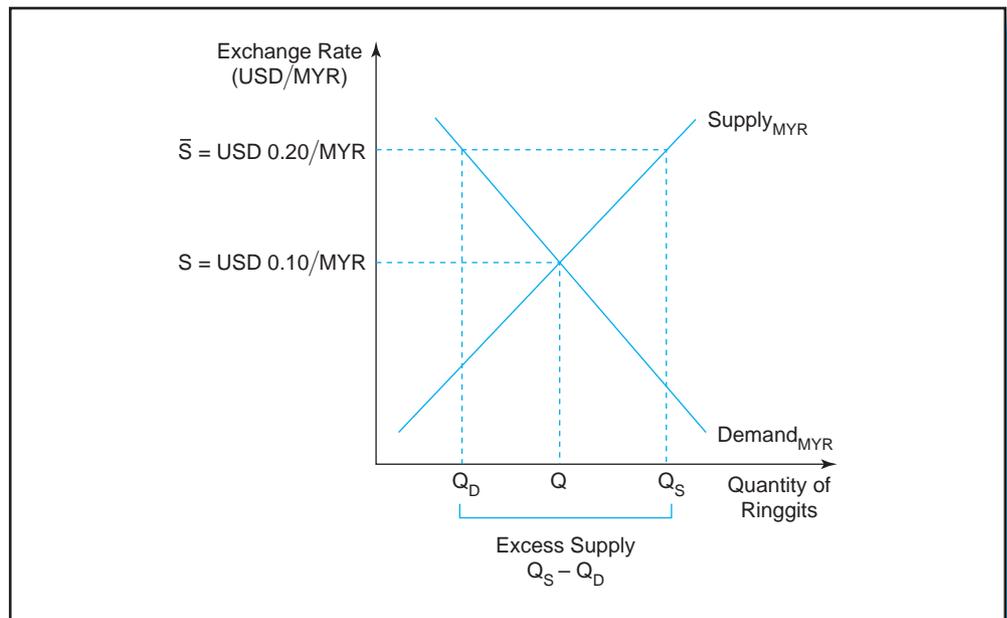
Pegged Exchange Rate Systems in Developing Countries

As we saw in Exhibit 5.1, many developing countries have pegged exchange rate systems. It is often the case that the authorities in these countries set the exchange rate at a level that overvalues the local currency. This situation is opposite that in Exhibit 5.8, in which the equilibrium exchange rate is below the pegged value. Exhibit 5.10 repeats Exhibit 5.8 for the Malaysian ringgit, with S being 0.10 dollars per ringgit (10 ringgits to the dollar) and \bar{S} being equal to 0.20 dollars per ringgit (5 ringgits to the dollar).

At 0.20 dollars per ringgit, there is an excess supply of Malaysian ringgits ($Q_S - Q_D$): Everybody wants to turn in ringgits to the central bank, receive dollars, and buy goods abroad or invest abroad. The fixed exchange rate overvalues the domestic currency (the ringgit) and undervalues the foreign currency (the dollar), thereby subsidizing buyers of foreign currency (such as importers and those investing abroad) and taxing sellers of foreign exchange (such as exporters and foreign buyers of domestic assets). (The *Point-Counterpoint* feature in this chapter further analyzes the ramifications of such an overvalued exchange rate.)

Needless to say, this situation is not tenable indefinitely. Because of the implicit tax on sellers of foreign exchange, exporters would fail to repatriate their foreign currency earnings, and because of the subsidies to buyers of foreign exchange, domestic residents would invest in foreign assets (a phenomenon known as capital flight; see Chapter 4). At the exchange rate the central bank wants to maintain (0.2 dollars per ringgit), the supply of ringgits to the central bank is larger than the demand for ringgits; or, equivalently, the demand for foreign currency from the central bank is larger than the supply of foreign currency to the central bank. The country runs a BOP deficit, and the central bank must artificially restore equilibrium by

Exhibit 5.10 Pegging an Exchange Rate in a Developing Country



using its international reserves to satisfy the excess demand. If this situation persists, the central bank's foreign reserves will dwindle fast.

The only way to sustain such a system indefinitely is to impose exchange controls. The central bank of the developing country must ration the use of foreign exchange, manage who gets access to it, and restrict capital flows; in short, it must strictly control financial transactions involving foreign currencies. More often than not, most frontier and some emerging market country currencies are inconvertible, which makes the use of exchange controls easier.⁷ Inconvertible currencies are primarily traded by the central bank of the country or by financial institutions with strict controls on their use of foreign currency.

Illegal Currency Markets

The private market response to the incorrectly valued exchange rate is often the development of an illegal or parallel currency market where foreign currencies command a higher domestic-currency price than the one offered by the central bank. The differences between official and illegal market rates can often be very large. For example, the Venezuelan government devalued the Bolivar Fuerte to VEF4.3/USD in January 2011, but in the parallel market, U.S. dollars sold for VEF9.25, more than double the official rate. Tourists sometimes take advantage of illegal market rates simply by selling dollars to informal dealers stationed in front of their hotel, but such activity can result in severe penalties.

Although maintaining capital controls may be feasible for inconvertible currencies, it is much harder for countries with freely traded currencies because the government can exert less direct control over the use of its currency. Nevertheless, capital controls were the norm in many European countries during the 1970s and 1980s (see Section 5.6).

POINT-COUNTERPOINT

The Burden of the Baguette

Freedy, Ante, and Suttle are in Paris, where they are visiting their cousin, Jean Patie, who grew up in France, received his MBA at Columbia Business School in May 1993, and then decided to go back to France. Jean suggested that they meet at Chez Jerry, a cozy bar on the Place du Tertre, and over a delightful glass of Sancerre, Ante asks Jean what life was like when Jean took his first job.

“Well,” Jean begins, “I spent half of my time in Africa, as I was working for Painargent, a French company that exported sourdough baguettes to Africa. Their main markets were the 14 French-speaking countries in the Communauté Financière d’Afrique.” “Hey,” Freedy interjects, “we just learned about those countries in the international finance class that Ante and I are taking. Those countries all peg the CFA franc to the euro, right?” Jean responds, “Very good, Freedy. So, if you guys are such international finance hot shots, are you up for a little quiz?” Ante and Freedy respond enthusiastically, with shouts of “Bring it on,” as Suttle just smiles.

Jean begins, “Well, when I left school, the CFA countries had been pegging their exchange rate versus the French franc, without devaluation, for an impressive 45 years. My bosses spoke volumes about how wonderful the stability of the fixed exchange rate was for business. Painargent even accepted CFA francs from the African importers because they were fully convertible into French francs at the fixed exchange rate. Because of the stability of the CFA franc’s value, exchange rate issues really had not played any part in Painargent’s business.”

⁷A convertible currency is one that may be freely used in international transactions by citizens of any country. After World War II, Europe only restored currency convertibility (and then mostly only for current account transactions) in 1958.

Jean continued, “When I was hired, economic growth in the CFA region had recently lagged behind economic growth in other countries. Many in the region blamed an overvalued CFA franc, and some politicians were calling for a devaluation of the CFA franc relative to the French franc. These politicians noted that non-CFA neighbors Nigeria and Ghana had recently devalued their own currencies, which seemed to improve the competitiveness of their exports and provided additional jobs in their export industries. Nevertheless, some of my bosses expressed anger at those CFA *canailles* and said that devaluation would crush Painargent’s profit margin.” Ante and Freedy, remembering their international finance class, nod approvingly. Jean asks Ante, “What would devaluation mean for Painargent?”

Ante quickly responds, “A CFA devaluation would mean that every CFA franc Painargent earns would turn into fewer French francs, resulting in lower French franc revenues.” Freedy, quick to show that he had been paying attention in class, adds, “A CFA devaluation would definitely have cut into Painargent’s profits because its primary cost would be wages paid to French bakers, which would not be affected by the devaluation. Thus, profits would fall.”

Jean then asks, “So, did the CFA countries devalue or not?” Ante agitatedly exhorts, “Surely they did not devalue! The system worked well for over 45 years, it brought stability to the region, and besides, devaluation would have been a disaster for too many people. Think of all the French companies, like Painargent, with assets, real and financial, in the CFA countries. It would have been devastating for them to have to endure devaluation!” Freedy is less sure. “If their currency was really overvalued, this would have put pressure on their foreign reserves because foreign goods would have appeared cheaper than domestic goods. People in the CFA countries would also have sold the overvalued currency and bought foreign exchange if they thought devaluation might occur. The central bank would have to supply that foreign exchange to keep the exchange rate fixed, but their reserves would have been limited. Devaluation was probably inevitable,” he concludes.

While Ante and Freedy continue their heated discussion about the likelihood of devaluation, Jean notices that his other cousin, Suttle, has decided to join in. Suttle interjects, “Let’s list who gains and who loses by the devaluation. Once we figure this out, it should be easy to infer what was likely to happen.” Ante gushes, “Good idea! Here is why they would never devalue: French businesses such as Painargent would never tolerate the loss of stability and monetary discipline that the fixed CFA franc brought. Moreover, these firms would be willing to use a lot of political capital to prevent devaluation because such an event would mean an instant loss of wealth for these companies.” Suttle nods. “You’re right, but I think the decision to devalue was not entirely up to the French businesses. I think it is also important to think about the rich Africans, including the ones wielding political power and the civil servants. Devaluation would reduce their purchasing power abroad as the CFA franc would buy fewer French francs, and hence, fewer bottles of Moët & Chandon and fewer vacations in Saint-Tropez. It would also make French schools more expensive for their kids.” Ante, now ecstatic, shouts, “And import prices would rise, which fuels inflation. It would also be harder for the CFA governments and firms to repay any debt denominated in foreign currency because it would cost more in local currency.”

“Hold it,” cries a surprisingly agitated Freedy. “A government simply cannot keep the exchange rate at what is clearly not its equilibrium value without severe exchange controls that would eventually cripple the country. If the CFA countries had lost their competitiveness relative to the countries with which they trade, a devaluation would make imports more expensive, but exports to the rest of the world would be cheaper, leading to a competitive edge for local businesses.” Suttle notes, “Yes, that is true, too.” Jean adds, “At the time, there were also lots of rumors of rich Africans spotted arriving in Marseilles with suitcases stuffed full of CFA francs that they immediately converted to French francs while the rate was good.”

Freedy interjects, “Right, we learned that such capital flight removes critical capital, which could be used to finance development. Moreover, it is likely that the IMF and the World Bank probably were insisting on devaluation before they would lend more money to those countries.”

“Hmmm, this is a hard one,” Suttle admits. “I am not convinced that devaluation helps in the long run. After all, import prices will likely rise, and that in turn may put upward pressure on other prices and wages. If that is true, the competitive advantage for local firms gets squandered pretty quickly. In the short run, however, appropriate government policies can make sure the higher import prices do not filter through immediately into higher wage demands. I’m not sure I know how this one turned out,” he muses.

Finally, Jean decides it is time to explain what happened. “Well, the devaluation happened shortly after I started working. In January 1994, the exchange rate was changed from 50 CFA francs per French franc to 100 CFA francs per French franc, a 100% increase in the value of the French franc relative to the CFA franc. The results of the devaluation were decidedly mixed. After years of dismal growth, the Ivory Coast, for example, started growing again, but in Cameroon, problems persisted, and inflation was rife.⁸ The profitability of Painargent was definitely affected for a few years, but we persisted as best we could. We raised our baguette prices as much as we could, and we had to fire some of our bakers. We also started selling more in Nigeria.”

Why Not Simply Float?

Why do countries go through the trouble of trying to keep the exchange rate fixed at a particular value instead of letting market forces determine the equilibrium value of their currency? As in the *Point–Counterpoint* feature, the political elite may prefer a strong exchange rate for their own private benefit, potentially to the detriment of the country’s citizens. However, the economics profession has most definitely not reached a consensus about the choice of the exchange rate regime. The most-often-quoted advantages ascribed to fixed exchange rates can be summarized with two words: discipline and stability.

Discipline refers to the “straitjacket” that a fixed-rate regime imposes on fiscal and monetary policies. If a country with a fixed exchange rate runs higher inflation than its trading partners, it loses competitiveness (see Chapters 8 and 9). The fear of this occurring should discourage over-expansionary fiscal or monetary policies, which in turn, should keep inflation down. According to fixed-rate proponents, the currency volatility that characterizes floating exchange rates can hardly be beneficial for international trade. Fluctuating currencies make importers more uncertain about the prices they will have to pay for goods in the future and exporters more uncertain about the prices they will receive. Of course, this argument can be easily countered by noting that this risk can be rather cheaply hedged (for example, using forward contracts) and by noting that the stability offered by pegged exchange rate systems appears more illusory than real. In fact, the 1990s witnessed a number of important currency crises where speculators successfully attacked pegged currencies.

These currency crises are not isolated phenomena. Klein and Shambaugh (2008) examine the dynamics of exchange rate regimes in 125 countries over a 35-year period. The average duration of a fixed-rate regime is 4.67 years, and the median is only 2 years. Most fixed-rate periods end with a devaluation of the currency and a continuation of the pegged system, but often a new exchange rate regime is adopted. The risk that the currency will devalue plagues any system in which exchange rates are not allowed to trade at market values.

⁸See “After a Devaluation, Two African Countries Fare Very Differently,” 1995; and Amegbeto and Winter-Nelson, 1998.

If pegged systems have such short durations and devaluations occur frequently, can they really be expected to yield the benefits of inflation credibility and exchange rate stability the authorities expect? Although Klein and Shambaugh argue that fixed-rate regimes effectively lower exchange rate volatility, many believe that such systems are doomed to fail. In recent times, a number of governments have resorted to an alternative monetary system, the currency board, which enhances the credibility of the peg. In their quest for exchange rate stability, the European Union (EU) countries went one step further and established a monetary union, where one central bank issues one currency for all the participating countries. Other countries have adopted the currency of a larger country, a phenomenon known as *dollarization*. We discuss currency boards and dollarization next but defer the discussion of monetary unions to Section 5.6, where we survey Europe’s experimentation with different currency arrangements.

Currency Boards

A currency board is a type of fixed exchange rate system, a monetary institution that issues base money (notes and coins and required reserves of financial institutions) that is fully backed by a foreign reserve currency and fully convertible into the reserve currency at a fixed rate and on demand. Hence, the domestic currency monetary base is 100% backed by assets payable in the reserve currency. In practical terms, this requirement bars the currency board from extending credit to either the government or the banking sector. Exhibit 5.11 shows the balance sheet of a currency board.

In the past, currency boards have existed in more than 70 countries. The first currency board was established in the British Indian Ocean colony of Mauritius in 1848, and currency boards were subsequently adopted in many British colonies and a few other countries. However, when those countries became independent after World War II, most of them decided to replace their currency boards with central banks. More recently, currency boards have been adopted by Hong Kong (since 1983), Argentina (1991 to 2001), and Estonia (1992 to 2010).

In recent policy debates, currency boards are often mentioned as a miracle cure for cutting inflation without high costs to the economy. The main success story is Hong Kong (see Kwan and Liu, 2005). The Hong Kong Monetary Authority has kept the Hong Kong dollar at HKD7.8/USD since 1983, and it successfully weathered the Southeast Asian currency crisis of 1997. Argentina’s experience offers a cautionary tale. Argentina’s Convertibility Law of April 1991 instituted a currency board. In the 1980s, inflation in Argentina averaged 750.4% per year; in the 1990s, inflation averaged 2.4% per year. The reason some believe a currency board imparts more monetary credibility than a conventional exchange rate peg is that a currency board has no discretionary powers. Its operations are completely passive and automatic. It cannot lend to the government and hence cannot monetize fiscal deficits. This also means that a currency board cannot rescue banks when they get into trouble. In other words, a currency board cannot function as a lender of last resort.

It has to be said that the practical implementations of currency boards are not always this strict. For example, the reserve requirements for Argentine banks were quite high; hence, the central bank could inject liquidity into the banking system by lowering reserve requirements, and it did so following the Mexican crisis in 1994.

Exhibit 5.11 The Balance Sheet of a Currency Board

Assets	Liabilities
International reserves	Currency in circulation
	Required reserves of financial institutions

Whether a currency board is more credible than a standard pegged exchange rate system is hard to determine from the limited historical experiences we have. Speculators attacked the Argentine peso in the wake of the Mexican currency crisis, and they attacked the Hong Kong dollar in the wake of the Southeast Asian currency crisis, but the currency boards survived. As always in speculative crises, interest rates did increase, and the economies suffered. Whether other systems would have generated smaller economic costs is difficult to guess.

Argentina's good luck did not last. While Argentina enjoyed the success of a seemingly well-functioning currency board, its government was able to borrow at competitive rates, and the country's public debt grew substantially. In addition, a crisis in Brazil in 1999 led to a large devaluation of the Brazilian real, making Argentine exports less competitive. Also, the dollar was strong relative to the euro, which undermined the competitiveness of Argentine exports to Europe. The Argentine economy began to sputter, with economic growth becoming negative, making the public debt burden suddenly seem much less sustainable. In mid-2001, the government started to tinker with the currency board (introducing a special exchange rate for international trade transactions, for example) in the hope of improving Argentina's international competitiveness. But the policy changes only managed to further undermine the confidence of investors in the sustainability of the currency board.

Argentina had trouble meeting interest payments on its international bonds, and in November 2001, the country effectively defaulted on its international debt. This led to a bank run by Argentine citizens, who dumped their pesos in favor of dollars. The government responded by restricting bank deposit withdrawals. Soon the country was engulfed in a deep economic crisis, with looting and rioting accompanying close to 20% unemployment rates.

In January 2002, the new interim president of Argentina, Eduardo Duhalde, abandoned the currency board and devalued the peso to 1.4 pesos per dollar for most transactions, while allowing all other transactions to be made at market rates. Other ill-devised temporary measures to deal with the crisis (converting debts denominated in dollars to debts denominated into pesos, for example) only further deepened the economic crisis. The year 2002 was disastrous for Argentina: Output collapsed, and inflation increased to double-digit levels. The idea that a currency board entailed no currency risk was buried with it. The peso was eventually allowed to float, and it depreciated to over 3.5 pesos per dollar.⁹

Dollarization

Interestingly, Argentina's Minister of Finance, Domingo Cavallo, who was the architect of the Convertibility Plan, ascribed Argentina's initial success in controlling inflation and maintaining the exchange rate peg not as much to the currency board as to the dual-currency feature of the system. During the hyperinflation of the 1970s, Argentina's money was superseded by the U.S. dollar. The phenomenon of foreign currencies (often the dollar) driving out local currencies as a means of payment (at least for big transactions) and a savings vehicle is known as **dollarization**.¹⁰

"Unofficial" dollarization occurs when residents of a country extensively use foreign currency alongside or instead of the domestic currency. The foreign currency often is the U.S. dollar, as is the case in much of Latin America, but it can also be another currency, such as the euro, as is often true in southeastern Europe. Researchers at the Federal Reserve gauge the extent of unofficial dollarization by estimating the use of dollars by nonresidents. They estimate that foreigners hold 55% to 70% of U.S. dollar notes.

"Official" dollarization occurs when foreign currency has exclusive or predominant status as full legal tender. In Andorra, a small country in the Pyrenees, the euro is legal tender.

⁹See Dornbusch (2001) for more detail about the pros and cons of currency boards.

¹⁰Kurt Schuler maintains a Web site with information on dollarization and currency boards (<http://users.erols.com/kurrency>). Edwards and Magendzo (2003) provide a rather skeptical view of the economic benefits of dollarization.

Unofficial Dollarization Turns Official: The Disappearance of the Zimbabwe Dollar

Before January 2009, the Zimbabwe dollar was nominally pegged relative to the U.S. dollar, but it was devalued regularly. Mugabe's regime not only mismanaged the economy, causing a decline in GDP per capita of over 75% in the course of a decade, but it also made ample use of the printing press, generating inflation. At the end of 2001, inflation in Zimbabwe reached over 100% per month; by the end of 2008, it reached astronomical levels, over 450 billion percent per month! The hyperinflation not only sent the exchange rate of Zimbabwe dollars per dollar to astronomical levels in the parallel market, but people also simply stopped

using the worthless Zimbabwe dollar bills, resorting to several international currencies instead. In January 2009, the Zimbabwe government made dollarization official by abolishing the Zimbabwe dollar and rendering the U.S. dollar, the British pound, the euro, the South African rand, and the Botswanan pula legal tender. What made the introduction of the multicurrency system inevitable was that the payment systems of the banking sector and the central bank could no longer cope with the increased volumes and multiple digits in the transaction values that had to be handled.

Similarly, the 1991 Convertibility Law in Argentina officially condoned the use of the dollar, allowing Argentines to open checking and savings accounts and to conduct most transactions in the currency of their choice.

Most officially dollarized countries, however, are tiny, using the currency of the "mother" country from colonial times or from a large neighboring country. Kiribati, a Polynesian island, for example, uses the Australian dollar, but it issues its own coins. The largest and most well-known dollarized country is Panama, where dollarization has existed since 1904. Ecuador (in 2000) and El Salvador (in 2001) have also officially adopted the U.S. dollar as their currency. In contrast to a currency board, a dollarized system can no longer collect seigniorage. This may discourage larger countries such as Mexico and Argentina from adopting such a system.

5.5 LIMITED-FLEXIBILITY SYSTEMS: TARGET ZONES AND CRAWLING PEGS

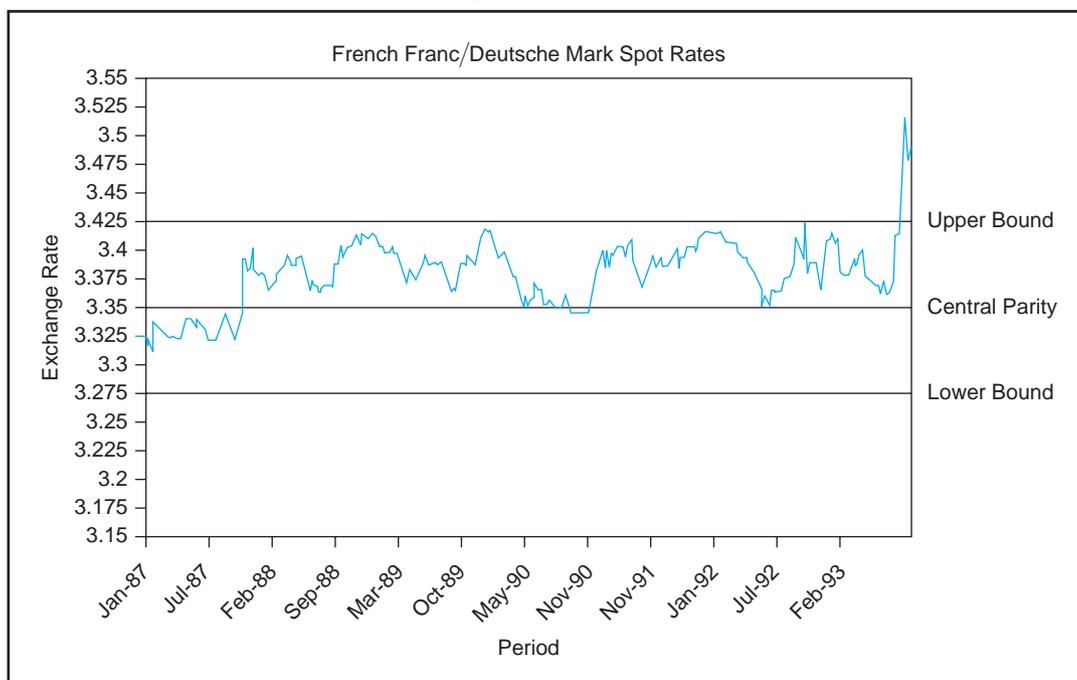
In between fixed and floating exchange rate systems are systems where exchange rate fluctuations are kept within a certain range.

Target Zones

The Bretton Woods system in effect between 1944 and 1971 is an example of a **target zone system**. Whereas the dollar was fixed relative to gold (at \$35 per ounce), all other currencies had particular dollar par values (a specified exchange rate versus the dollar), but the actual exchange rates were allowed to move within a range of 1% on either side of these par values. The most famous target zone system in recent times is the European Monetary System (EMS), and, given its historical importance, we discuss it in greater detail later.

To see how a target zone operates, consider Exhibit 5.12, which once again looks at the French franc–Deutsche mark (FRF/DEM) exchange rate between early 1987 and August 1993. Although the exchange rate shows substantial variability, it fluctuates within a band until the very end of that period. The EMS specified a central parity of FRF3.3539/DEM, but the exchange rate was allowed to fluctuate in a 2.25% band around this value.

Exhibit 5.12 An Example of a Target Zone



Example 5.2 Determining the Intervention Exchange Rates

Let's use the FRF/DEM information to determine the intervention exchange rates. With a central parity of FRF3.3539/DEM, the monetary authorities need to determine the exchange rates for the upper and lower intervention limits such that the band is a 2.25% band around the central parity. The computation also must guarantee that the width of the band is the same, no matter how the exchange rates were expressed (in FRF/DEM or DEM/FRF).

Let S be the central parity in FRF/DEM, let the upper intervention limit be $(1 + y)S$, and let the lower intervention limit be $S/(1 + y)$. Clearly, expressing exchange rates in DEM/FRF by taking reciprocals results in the same intervention points. Then, because the width of the band is 4.5% of the central parity, we can solve the following equation for y :

$$(1 + y)S - S/(1 + y) = 0.045S$$

The solution is $y = 0.022753$. Thus, the upper value of the band is $1.022753 \times (\text{FRF}3.3539/\text{DEM}) = \text{FRF}3.4302/\text{DEM}$, and the lower value of the band is $(\text{FRF}3.3539/\text{DEM})/1.022753 = \text{FRF}3.2793/\text{DEM}$.

During this period, francs and marks were freely traded in the forex market. What keeps the actual exchange rate in the prespecified band? As long as private market participants deem the central rate reasonable and recognize a credible commitment by the monetary authorities to defend the rate, market participants will not expect the currency value to go outside the bands, and no currency crisis will occur. A previously announced strategy of

monetary policy is *credible* if it remains an optimal strategy for the central bank over time. A strategy will continue to be optimal if it is more costly for policymakers to abandon their commitment to the strategy rather than to honor it. Unless a strategy is credible, the private sector's expectations and consequent behavior will not support the strategy's goal, and it will not be achieved.

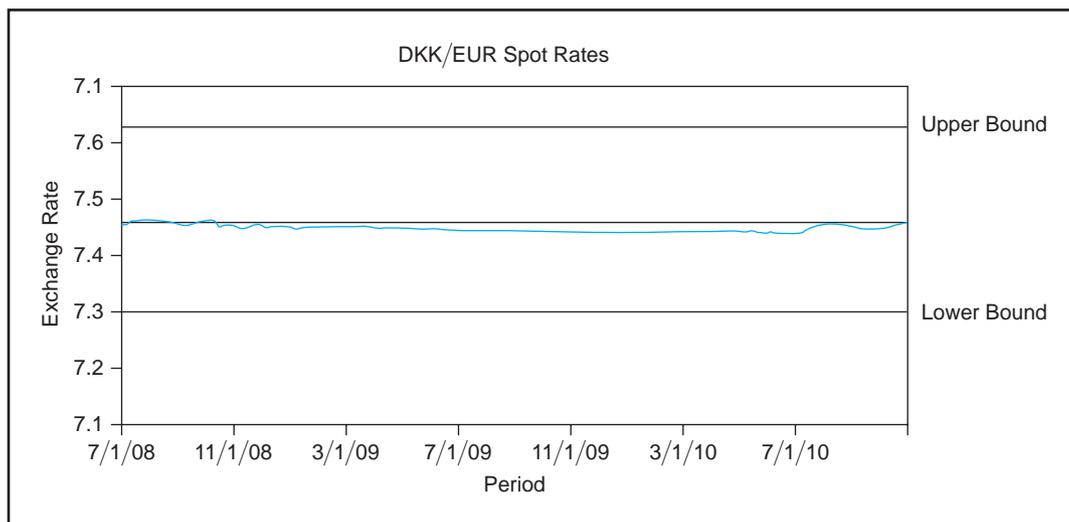
Hence, a crucial element for the stability of a target zone system is the perception on the part of investors and speculators that the authorities are committed to defend their exchange rate. This holds all the more for a pegged exchange rate system, which can be thought of as a target zone with a very thin band. From our description of how a central bank functions, we know that such an exchange rate target necessarily means that the authorities will not be able to use monetary policy to reach other goals, such as pushing the economy toward full employment. When the commitment of the authorities becomes less certain—for example, because of unfavorable domestic economic conditions—a currency can come under pressure and move toward the edge of the band. In Exhibit 5.12, the franc is the weak currency when the exchange rate approaches the higher edge of the band.

Although Denmark is a member of the EU, the Danes did not vote to adopt the euro. Policymakers have chosen, though, to remain in the Exchange Rate Mechanism II that requires specification of a central parity and allows for deviations of $\pm 2.25\%$. Exhibit 5.13 shows that in recent years the Danish National Bank has actually kept the spot rate very close to the central parity of DKK7.46038/EUR. The maximum deviation is only 0.30%, which has prompted the IMF to classify the Danish krone as a pegged currency.

Speculative Attacks

Policymakers invariably blame downward pressure on the foreign exchange value of their currency on nasty speculators. We will discuss speculation explicitly in Chapter 7, so here we just give a verbal description. During a speculative attack, speculators hope to profit from a devaluation of the currency or a resetting of the bands of a target zone by massively borrowing the weak currency and investing the proceeds in assets (typically short-term money market instruments) denominated in the strong currency. If the amount of the devaluation exceeds any differential between the interest they pay and the interest they receive, speculators win.

Exhibit 5.13 A Tight Target Zone



Defending the Target Zone

To defend their currency, the monetary authorities in the countries with weaker currencies have three basic mechanisms available. First, they can simply intervene in the currency markets. When a central bank intervenes to support its currency, it buys its own currency with official reserves. An intervention by the central bank of the weak currency country, if not sterilized, reduces the money supply. The reduced liquidity in the money market tends to put upward pressure on interest rates. This raises the costs of speculators (which include financial institutions), who try to borrow the money to invest abroad.

The second defense mechanism of the central bank is to raise the interest rates they control (typically, the rate at which banks can borrow at the central bank), both to make currency speculations more costly and to signal commitment to the central rate.¹¹ The behavior of central banks and private market participants results in higher short-term interest rates, which drive up the cost of speculation. The magnitude of the interest rate hike needed to stave off a speculative attack depends on the probability that the currency will devalue and hence on the credibility of the authorities.

Although a policy of high interest rates discourages speculation, it also increases the short-term funding costs for businesses borrowing money, which is a drag on the economy. Not surprisingly, many countries resort to a third line of defense: limiting foreign exchange transactions through capital controls. At the simplest level, the authorities may tax or simply prohibit the purchase of most foreign securities by the country's residents. At one time, Italy and Spain, countries that had participated in the EMS, forced purchasers of foreign currency or foreign assets to make a non-interest-bearing deposit at their central banks equal to 50% of the value of the foreign investment. Such rules considerably increase the cost of speculation but at a loss of freedom for the citizens of the country.

Lead-Lag Operations

Most countries with capital controls also impose restrictions on trade financing. Whereas currency speculation may conjure up images of wicked financiers plotting the fall of a currency behind a computer screen, often a more serious problem arises from the financing practices of exporters and importers. In international business, it is customary for exporters to allow their customers to pay some time after the goods have been shipped or even after they have arrived. When devaluation is expected, exporters from the country tend to extend the maturity of these "trade credits" (because they hope to exchange currency they receive for a greater amount of local currency than they could have before the devaluation). This is called a **lag operation** because it postpones the inflow of foreign currency. Conversely, domestic importers prepay for goods that they plan to purchase from abroad in order to beat the increase in costs the devaluation will impose on them. This effectively grants a credit to foreign exporters and is therefore called a **lead operation**. Lead and lag operations often put pressure on the foreign reserves of the central bank because the volume of foreign trade is large relative to the reserves of the central bank for small open economies.

Crawling Pegs

In many developing countries, where inflation is especially a problem, the bands have been allowed to move ("crawl") over time. Such mini-devaluations or resets of the bands take place quite frequently, sometimes even daily, and are mostly preannounced.

To understand the logic behind this system, you must understand the effects of inflation on a quasi-fixed exchange rate system. (These issues are addressed in more detail in Chapters 8 and 9.) Consider the example of Mexico and the United States. Suppose the Mexican

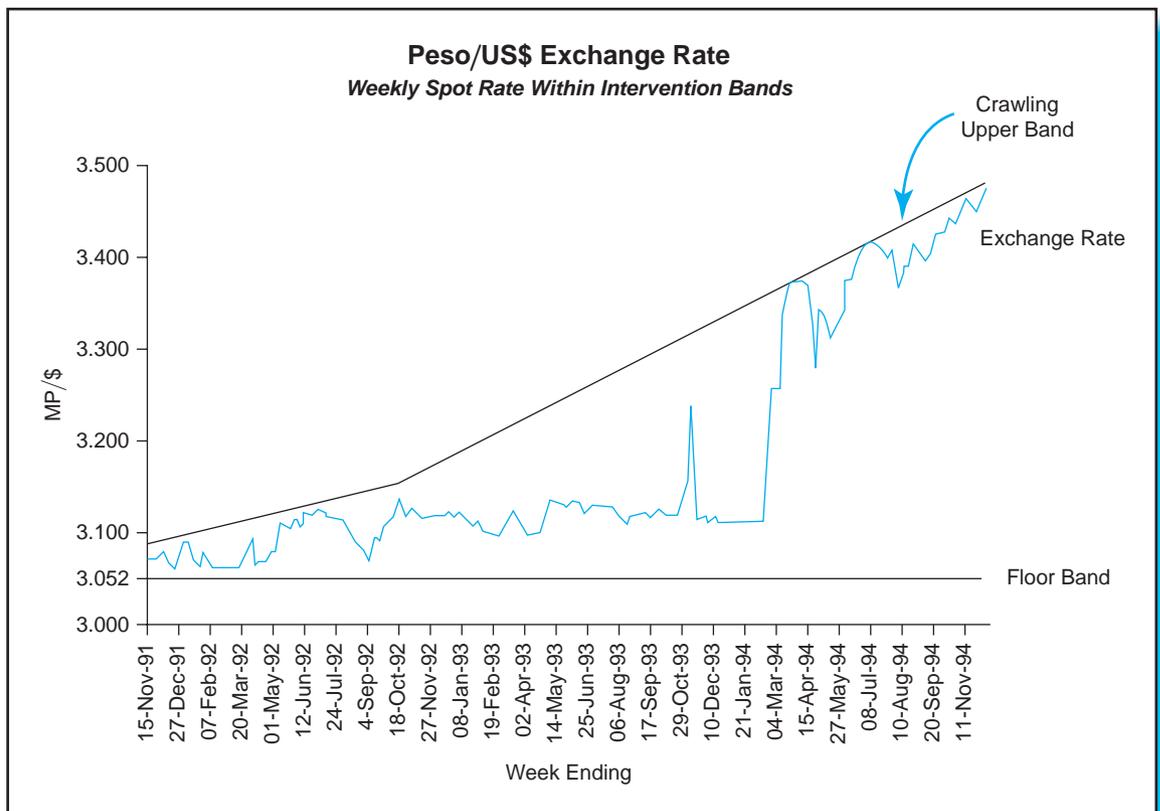
¹¹Earlier, we argued that monetary authorities can set the rate of money growth, unless they focus on another policy goal, in which case money growth becomes endogenous (see Section 5.2).

central bank wants to fix the Mexican peso's value relative to the dollar, as it has tried to do many times in the past. If the exchange rate remains fixed, and Mexico experiences higher inflation than the United States, it loses competitiveness because the prices of Mexican goods increase relative to the prices of U.S. goods. The resulting reduction in Mexican exports to the United States is likely to hurt Mexico's economy severely because the United States is its largest trading partner.

Knowing the perverse effects of the loss of competitiveness that high inflation entails, governments should be motivated to follow non-inflationary policies. Hence, the fixed exchange rate can potentially buy inflation credibility, and Mexico can "import" low inflation from the United States by pegging its currency to the U.S. dollar. Again, credibility is important, and in developing countries, maintaining the same level of inflation as in developed countries is a tall order. Also, the consequences of the loss of competitiveness are particularly dire. Anticipating a gradual loss of competitiveness, a **crawling peg** system adjusts the fixed rate or band over time, where the adjustment is often a function of the inflation differential between the developing country and the country to which its currency is pegged.

Exhibit 5.14 illustrates such a policy. From November 1, 1991, to December 21, 1994, the Mexican peso traded within a formal intervention band set by the Bank of Mexico relative to the dollar. The floor of the band remained fixed at MXP3.052/USD, while the upper band rose (allowing for peso depreciation) at a predetermined rate: increasing at MXP0.0002/USD per day from November 11, 1991, to October 20, 1992, and MXP0.0004/USD per day from October 21, 1992, to December 21, 1994. The history of the crawling peg in Mexico ended with the famous currency crisis in December 1994 and early 1995.

Exhibit 5.14 An Example of a Crawling Peg



It turns out that the changes in the band did not fully correct for the inflation difference between the United States and Mexico, and Mexican firms gradually lost competitiveness. With a large current account deficit and insufficient capital inflows, Bank of Mexico intervention in the foreign exchange market was necessary. By December 1994, international reserves had dwindled until they were almost depleted. An attempt to devalue the peso by 15% in December only caused a run on the currency, and Mexico was forced to float the peso. Currently, the Mexican peso floats freely. Costa Rica has successfully run a crawling band system (relative to the USD) since 2006, but the currency did come under pressure in 2010, causing the central bank to intervene. The problem was not that the colón was too weak but too strong, as the dollar depreciated substantially against many emerging currencies during 2010.

5.6 HOW TO SEE AN EMU FLY: THE ROAD TO MONETARY INTEGRATION IN EUROPE

One of the most important financial developments in recent years is the emergence of the economic and monetary union (EMU), with the euro as a common currency, first for 11 countries and now for 17 countries. All 27 countries in the EU are eligible to join the monetary union if they comply with certain monetary requirements. Although the United Kingdom and Denmark participated in the Maastricht Treaty (discussed later) and the European Monetary System (EMS), they negotiated exemptions from the requirement that they adopt the euro as their currency. Any country joining the EU since the 1993 implementation of the Maastricht Treaty has had to pledge to adopt the euro in due course.

Because the euro did not arrive overnight, this section chronicles the history of currency systems in Europe, starting with the EMS and leading to the introduction of the euro. We also discuss the economic issues related to whether countries should use a common currency—what economists term the “optimum currency area” issue. When the euro was initially proposed, some economists voiced concern that Europe was not an optimal currency area. The problems that were predicted took 10 years to manifest themselves, but the sovereign debt crisis of 2010 has led some economists to predict the eventual dismantling of the euro. The history of the euro may hold important lessons for other regions of the world that may set up similar currency systems. In particular, regional associations of countries promoting free trade and other forms of economic and political cooperation in Latin America (Mercosur), Asia (the ASEAN countries), and Africa (the East African Community [EAC] countries) are prime candidates for a similar currency arrangement sometime in the foreseeable future.¹²

The European Monetary System (EMS)

The desire for currency stability in Europe dates back many decades. It was actively pursued in the context of the European Community (EC). One reason these countries desired monetary stability is that most western European countries are not only quite open to foreign trade but their main trading partners are also their neighboring countries, making costs of exchange rate variability particularly acute within Europe. Another reason the EC countries wanted to limit exchange rate fluctuations was to facilitate the operation of a common market for agricultural products. Finally, the desire for stable exchange rates in Europe should also be

¹²The Mercosur countries are Argentina, Brazil, Paraguay, and Uruguay, whereas Bolivia, Chile, Colombia, Ecuador, and Peru have associate member status. The ASEAN countries are Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. The EAC countries are Burundi, Kenya, Rwanda, Tanzania, and Uganda.

viewed as an integral part of the wider drive toward economic, monetary, and political union between European countries in the EC.

From 1944 to 1973, stability was supplied by the Bretton Woods system of fixed exchange rates. Although old plans to establish a monetary union got bogged down during the breakup of the Bretton Woods system, the EC countries kept their currencies in a target zone system and eventually established the **European Monetary System (EMS)** in 1979. All EC countries joined, although Britain, characteristically, did not fully participate until 1990. The EMS had three components: the Exchange Rate Mechanism (ERM), a set of intervention rules and intervention financing mechanisms, and a set of rules for realignments. We discuss each in turn.

The ERM

The ERM was a grid of bilateral fixed central parities, from which exchange rates could deviate by 2.25% on each side, with the exception of the Italian lira, which was allowed a margin of 6%.

Intervention Rules

Interventions by both central banks were compulsory whenever either bilateral margin was reached. The central bank of the strong currency was required to grant the central bank of the weak currency an unlimited credit line to assist in the defense of its currency. Of course, a central bank could intervene to support its currency before the outer limits were reached, which happened quite frequently.

Realignment Rules

When the bilateral central parity could not be sustained at reasonable cost, the finance ministers of the EMS countries gathered secretly to establish new central parities, devaluing the weaker currencies and revaluing the stronger currencies.

ECUs, Euros, and Franken

The central parities were expressed in terms of the **European Currency Unit (ECU)**, which was a currency basket, consisting of specified amounts of each member currency. Exhibit 5.15 presents the last composition of the ECU basket, which was fixed in 1989, after which the Maastricht Treaty prevented any changes. Consequently, the currencies of countries joining the EC later were never part of the ECU basket. The amounts of the different currencies were revised every 5 years to reflect the economic importance of each country.

Exhibit 5.15 also reports the central parities expressed in terms of the ECU. Using the ECU as the numeraire obviates the need for a complex bilateral grid of central rates. For example, knowing the exchange rates of FRF/ECU and DEM/ECU provides the FRF/DEM central parity:

$$(\text{FRF}6.63186/\text{ECU}) / (\text{DEM}1.97738/\text{ECU}) = \text{FRF}3.35386/\text{DEM}$$

However, the actual exchange rates differed from the central parities because exchange rates only needed to stay within a 2.25% band around the central rates. This also meant that the market weights in the ECU basket could differ from the official weights. In fact, with the basket amounts fixed, stronger currencies slowly gained weight in the basket.

Apart from its role as a numeraire, the ECU was the unit of account for all interventions and thus came to serve as a reserve asset for transactions among the EC's central banks. In addition, some companies used the ECU for invoicing and in their financial statements, and contracts denominated in ECUs became important in financial markets. Banks offered ECU-denominated deposits and loans, bonds were issued in ECU, and derivative contracts traded on exchanges allowed traders to bet on the direction of ECU interest rates. As a consequence,

Exhibit 5.15 Composition of the ECU Basket

Currency	Amounts of Currencies Included in the ECU Basket ^a	ECU Central Rates ^b	Relative Weight of Each Currency in the ECU Basket (in %)	
			9-21-89	10-22-98
Deutsche mark	0.6242	1.97738	30.09	31.57
French franc	1.332	6.63186	19.00	20.08
British pound	0.08784	0.653644	13.00	13.44
Italian lira	151.8	1957.61	10.16	7.75
Dutch guilder	0.2198	2.22799	9.40	9.87
Belgian and Luxembourg franc	3.431	40.7844	7.89	8.41
Spanish peseta	6.885	168.22	5.31	4.09
Danish krone	0.1976	7.54257	2.45	2.62
Irish punt	0.008552	0.796244	1.10	1.07
Portuguese escudo	1.393	202.692	0.80	0.69
Greek drachma	1.44	357	0.80	0.41

^aAs of September 21, 1989.

^bAs of October 23, 1998.

Note: Data are from the Bank for International Settlements.

banks started to quote ECU-denominated exchange rates without strict reference to its synthetic value—that is, the value of the ECU in terms of the market value of the constituent currencies. Soon, this “private” ECU no longer necessarily had a 1 to 1 value with the market-determined value of the basket of currencies.

The Treaty of Maastricht in 1991, which mapped out the road to monetary integration, named the ECU as the single European currency, and when the single currency came into existence, on January 1, 1999, its external value was set equal to the theoretical value of one ECU. However, the new currency was not called the ECU, but the euro. This is somewhat surprising because the name “euro” confusingly added to a list of existing but quite different “Euro-financial assets” such as Eurobonds and Eurocurrencies (see Chapter 11).

The Politics of Naming the Euro

The seemingly insignificant issue of the single currency’s name is a nice illustration of the amazing development in Europe that brings together very different cultures in one monetary arrangement. Despite the familiarity of Europeans with the ECU and its use in scores of financial contracts, the Germans, who were very attached to their beloved Deutsche mark, felt that the name “ECU” sounded too French. The name of an old French coin also was the *écu*. Rumor has it that to ensure that the name “euro” would replace the name “ECU,” the Germans pushed for an alternative name, the “Franken.” Appalled, the French agreed to a compromise.

Was the EMS Successful?

The main goal of the EMS was to reduce exchange rate volatility and consequently to narrow inflation and interest differentials between countries. Was it successful?

Day-to-Day Variability Was Down

Overall, the EMS record was mixed. First, although the day-to-day variability of European exchange rates decreased beginning in 1979, large currency movements still occurred because of realignments and the currency crises of 1992 to 1993. The realignments were frequent at first, but they became less frequent over the years. Interestingly, the Deutsche mark never devalued during the history of the EMS. With the exception of the Dutch guilder, the currencies of other countries in the EMS fell by more than 20% relative to the Deutsche mark through seven realignments in the early 1980s.

Inflation and Interest Differentials Narrowed

Although inflation and interest rate differentials narrowed during the EMS period, the EMS might not have been the main cause of the narrowing. For instance, inflation cooled down in most countries around the world during the 1980s. After the currency realignments mentioned earlier, two traditionally weak currencies, the Belgian franc and the Danish krone, actually became “hard” currencies.

A country’s monetary and fiscal authorities practice a hard currency policy when they try to prevent their currency from depreciating by maintaining staunch anti-inflationary monetary and fiscal policies. The benefit of such a policy in the context of the EMS was lower interest rates, which meant important interest rate savings for a high public debt country such as Belgium. Unfortunately, the Maastricht Treaty started a period of currency turmoil that peaked in September 1992, when the pound and the lira were forced to leave the system. This currency turmoil led to a widening of the bands to 15% on each side of the central parities in August 1993.

Asymmetric Adjustments

The original plans for the EMS envisioned a symmetric system with the ECU as the center of the EMS and the adjustment burden in times of crises shared across countries. An anatomy of the realignment episodes and the turbulent events in the 1990s strongly indicates an asymmetric system with an anchor role for the Deutsche mark. That is, the Bundesbank, the German central bank, maintained the purchasing power of the Deutsche mark, and the other countries adopted monetary and financial market policies that were consistent with maintaining a stable exchange rate vis-à-vis the Deutsche mark. In tense and speculative times, countries with weak currencies intervened in the currency markets and increased their interest rates.

Some claim the system proved beneficial to inflation-prone countries, such as Italy and France, by improving the credibility of authorities in pursuing non-inflationary policies. The EMS made it costly for an economy to experience inflation because it led to an erosion of the competitiveness of the country’s currency between realignments. It could also lead to a permanent erosion of competitiveness if the realignment didn’t compensate fully for the inflation that had occurred, which was often the case. Others admit that the Bundesbank played a central and at times disciplinary role in the EMS, but they believe that in times of crises, the Bundesbank stubbornly stuck to its policies, even if that put the entire adjustment burden on the other countries. For example, the Bundesbank only intervened when it was required to do so according to the EMS rules.

The Maastricht Treaty and the Euro

In 1991, the European heads of state met in Maastricht in the Netherlands to map out the road to economic and monetary union, including a single EC currency, to be reached by 1999. When a number of countries establish a **monetary union**, they fix their exchange rates relative to one another, possibly by introducing a single currency, and they establish a single central bank to conduct a single monetary and exchange rate policy across the region. The Maastricht Treaty specified a number of criteria that member countries had to satisfy in order to be able to join the monetary union. These “convergence criteria” were to be measured 1 year before the start of the EMU and were as follows:

1. Inflation within 1.5% of that of the three best-performing states.
2. Interest rate on long-term government bonds within 2% of the long-term interest rates of the three best-performing countries in terms of inflation.
3. A budget deficit of less than 3% of gross domestic product.
4. Government debt less than 60% of gross domestic product.
5. No devaluation within the exchange rate mechanism within the past 2 years.

The convergence criteria garnered a lot of controversy, and the fiscal criteria almost became a stumbling block for the EMU. At one point, only one country readily qualified for EMU entry—tiny Luxembourg—and even Germany barely made it.

The road to EMU was completed in three stages. In Phase I, all remaining restrictions on the movement of capital and payments between member states and between member states and third countries were removed. This phase was completed by January 1, 1994.

In Phase II, a new European Monetary Institute (EMI) was created, with headquarters in Frankfurt, Germany, to administer the EMS and prepare the ground for the European Central Bank to be established in Phase III by strengthening the coordination of monetary policies of the member states. Phase II also introduced EC supervision of fiscal policy of the member states and forbade monetary financing of budget deficits. Central banks of the member countries were also made politically independent.

In Phase III, the European Central Bank (ECB) replaced the EMI. The European System of Central Banks (ESCB), composed of the ECB and the national central banks, conducts monetary and exchange rate policy for the whole of the single-currency area. Its primary objective, as specified in the Maastricht Treaty, is to maintain price stability. This phase started on January 1, 1999, at which time the conversion rates into the euro were fixed. The first 11 countries were Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain. The United Kingdom and Denmark opted out. To join, a country must satisfy the convergence criteria, and the following countries have joined: Greece (2001), Slovenia (2007), Cyprus and Malta (2008), Slovakia (2009), and Estonia (2011).

ERM II

When a country joins the EU, it negotiates a time at which it joins the ERM II, which requires that the country establish a central parity for its currency versus the euro and pledge to remain within a $\pm 15\%$ band. In practice, countries keep their currencies in a much tighter band, as Exhibit 15.13 demonstrates.

If a country successfully keeps its currency within the ERM II band for 2 years and satisfies the other Maastricht criteria, it is eligible to adopt the euro as its currency and become a member of the **eurozone**. The EMU may eventually include most countries in Europe and may inspire other regions to form monetary unions, but are they really a good idea?

Pros and Cons of a Monetary Union

Since the signing of the Maastricht Treaty, economists have heatedly debated whether monetary union in Europe makes economic sense. The debate typically centers on the question of whether Europe is, or is not, an optimum currency area.

Optimum Currency Areas

In 1961, Robert Mundell, a Nobel Laureate, published a theory of **optimum currency areas**. Mundell defines an optimum currency area as one that balances the microeconomic benefits of perfect exchange rate certainty against the costs of macroeconomic adjustment problems.

Sharing a currency across a border enhances price transparency (prices are easier to understand and compare across countries), lowers transactions costs, removes exchange rate uncertainty for investors and firms, and enhances competition. A currency union may therefore promote trade and economic growth.

The potential cost of a single currency is the loss of independent monetary policies for the participating countries. Losing this monetary independence is especially grave if a region is likely to suffer from *asymmetric economic shocks*. Asymmetric shocks can include a sudden fall in demand for a country's main export product or sudden increases in the prices of the main inputs for a country's manufacturing sector, where the shocks affect that country differently from the other countries in the single-currency area. In a monetary union, the affected country no longer has the ability to respond to economic shocks by relaxing its monetary policy.

The country also cannot devalue its currency. The inability to react with monetary policy is thought to deepen recessions and exacerbate unemployment. Rockoff (2003) notes that such problems plagued different regions of the United States especially in the 19th century.

These problems became apparent in 2010 when the financial markets realized that Greece, Ireland, Portugal, and Spain were experiencing much deeper recessions than Germany. The Organization for Economic Cooperation and Development (OECD) reports that unemployment in Germany in 2010 was 6.9%, compared to Portugal's 10.7%, Greece's 12.2%, Ireland's 13.6%, and Spain's 19.8%. The fall in income during a recession also manifests itself in government budget deficits. In 2010, Germany's budget deficit as a percentage of GDP was 4%, compared to Portugal's 7.3%, Greece's 8.3%, Spain's 9.2%, and Ireland's 32.3%. The optimum currency area theory concludes that for a currency area to have the best chance of success, asymmetric shocks should be rare. This is likely to be the case when the economies involved face similar business cycles and have similar industrial structures. Failing that, other mechanisms must absorb the shocks. This requires mobility of labor and capital or a central fiscal authority that has the power to make transfers across regions.

An analogy to the United States is useful. For example, if California experiences lower demand from Asia, which increases unemployment in California, while Texas booms due to high oil prices, workers moving from California to Texas can restore unemployment rates back to normal. Labor mobility is enhanced if wages are flexible because wages would be increasing in Texas and decreasing in California. Moreover, federal fiscal transfers to California may help it get out of the economic doldrums.

Is Europe an Optimum Currency Area?

Many prominent U.S. economists conclude that Europe is not particularly well suited to be a monetary union: The shocks hitting European countries are quite asymmetric; labor mobility is very limited due to cultural, linguistic, and legal barriers between countries; and the EC budget is too small to transfer huge resources into recessionary areas. An adjustment to a bad shock requires a relative price change, which could be more quickly accomplished, if countries had separate currencies, by an exchange rate change.

Nevertheless, substantial academic research documents sizable economic benefits following the introduction of the euro in terms of price convergence, lower costs of capital, and increased trade.¹³ None of the articles have incorporated the very recent data though. The severity of the recessions following the 2007 to 2010 global financial crisis and the lack of an overall European fiscal authority led to the sovereign debt crisis of 2010. Greece was the first to encounter problems funding its budget deficit when the new government announced in late 2009 that the previous government had understated the magnitude of the deficit by 50%. Confronted with a possible Greek default, European finance ministers and the IMF cobbled together a €110 billion package of loans for Greece on May 2, 2010, forcing Greece to announce cutbacks in government services and increases in taxes. On May 4, riots erupted throughout Athens. Problems came to a head later in 2010 for Ireland as the ramifications of Ireland's bailout of its banking system during the financial crisis led to its massive budget deficit and the prospect of an Irish default. While Irish politicians initially fought a bailout from the EU, they eventually agreed on November 28 to a €67.5 billion rescue deal.

Proponents of the EMU argue that the skeptics have too much confidence in the real effects of monetary or exchange rate policy. They argue that devaluing a currency may only cause local inflation, and the competitive advantage gained may be very temporary. Furthermore, the proponents question the effectiveness of labor mobility as a shock absorber, even in the United States. The theory talks about temporary business cycle shocks that would require

¹³The literature is reviewed in Baldwin (2006) and Bekaert et al. (2010). One concern with much of the literature is that the benefits ascribed to the single currency may simply reflect the benefits of economic (not monetary) integration. See Silva and Tenreiro (2010) for a skeptical view on the economic benefits of the euro.

a temporary movement into regions where work is abundant and productivity high, and vice versa. But even in the United States, such a temporary migration of workers across states is unlikely to occur on a large scale because moving is so costly.

The ability of a central fiscal authority to make transfers across regions in the United States has also come into question. By the end of 2010, many U.S. states including California, Illinois, New Jersey, and New York faced large fiscal deficits that were leading some economists to forecast that there would be defaults on state and municipal debt. The presence of a federal fiscal authority with its 2009 stimulus package had allowed these states to put off the hard issues of how they were going to balance their budgets, but in 2011, it seemed unlikely that Congress would agree on further bailouts.

On the other hand, the leaders of the EU realized that a sovereign default would possibly wreak havoc in European government debt markets and engulf the region in an even worse recession. To avoid this fate, the 27 members of the EU agreed to the creation of the European Financial Stability Facility, which has the ability to borrow up to €440 billion with the backing of all EU governments in order to lend to a country in financial difficulty. These funds can be combined with €60 billion of funds from the EU budget and €250 billion from the IMF for a total of €750 billion.

The backing of these loans is proportional to the capital contributed by each country to the ECB. Thus, Germany's share is 27.13%. Should some of these loans end up in default, German tax payers would be shouldering a burden that they might not enjoy. Of course, the German banking system also holds substantial amounts of the debts of the troubled countries, so the German tax payers may be forced to do a bank bailout if they abandon the euro. It is this tension that has economists discussing situations in which the euro unravels. Others argue that Europe's troubles will only force the countries into greater cooperation and integration.

5.7 SUMMARY

This chapter has analyzed the large variety of currency arrangements around the world. The main points in the chapter are the following:

1. There are three main exchange rate systems: floating exchange rates, target zones, and pegged or fixed exchange rate systems. Different systems entail different currency risks.
2. Currency risk can be summarized by a forward-looking conditional distribution of exchange rate changes and the distribution's volatility (dispersion) and skewness. This distribution depends on the exchange rate system and is more difficult to estimate when currencies are not freely floating.
3. The government, through its central bank, controls the money supply. When too much money is issued relative to the demand for money, inflation results.
4. The central bank's balance sheet contains currency in circulation and reserves held by financial institutions as its main liabilities. Together, these are called base money. The assets of the central banks are foreign currency-dominated securities (official international reserves), domestic government bonds, and loans to the domestic financial sector.
5. When a currency is freely floating, no official reserves are needed, but in reality, pure freely floating exchange rate systems do not exist. Instead, governments either intervene to influence a currency's value (dirty float) or formally try to peg the exchange rate (fixed exchange rate system) or limit its variability within certain bands around a central value (target zone or crawling peg when the bands are automatically reset over time).
6. In dirty float systems, forex interventions are often sterilized; that is, the central bank performs an open market operation that counteracts the effect of the original intervention on the money supply. There is no consensus on whether central banks can really affect the level and volatility of exchange rates through their interventions.
7. To peg a currency, the government must make a market in foreign currencies buying any private excess supply of foreign currency and delivering additional foreign currency if there is excess private demand for it.
8. The impossible trinity or trilemma holds that there is an intrinsic incompatibility between perfect capital mobility, fixed exchange rates, and domestic monetary autonomy.
9. After World War II, countries adopted the Bretton Woods system of fixed exchange rates, based on gold and the dollar. This system lasted until 1971.

10. Currently, many developing countries peg their exchange rates, often at unrealistically high values. Devaluations and currency crises resulting in changes in the exchange rate regime occur regularly. To increase credibility, a number of governments have introduced currency boards, where base money is backed 100% by foreign currency-denominated assets.
11. The most important historical example of a target zone is the European Monetary System, which operated between 1979 and 1999. Exchange rates were maintained between bands of 2.25% around central parities.
12. The EU experimented with various exchange rate systems in an attempt to limit exchange rate variability. Since 1999, 17 countries in Europe are now joined in a monetary union with a single currency, the euro, and a single monetary policy.

QUESTIONS

1. How can you quantify currency risk in a floating exchange rate system?
2. Why might it be hard to quantify currency risk in a target zone system or a pegged exchange rate system?
3. What is likely to be the most credible exchange rate system?
4. How can a central bank create money?
5. What are official international reserves of the central bank?
6. What is likely to happen if a central bank suddenly prints a large amount of new money?
7. What is the effect of a foreign exchange intervention on the money supply? How can a central bank offset this effect and still hope to influence the exchange rate?
8. How can a central bank peg the value of its currency relative to another currency?
9. Describe two channels through which foreign exchange interventions may affect the value of the exchange rate.
10. What was the Bretton Woods currency system?
11. How do developing countries typically manage to keep currencies pegged at values that are too high? Who benefits from such an overvalued currency? Who is hurt by an overvalued currency?
12. What are the potential benefits of a pegged currency system?
13. Describe two different currency systems that have been introduced in countries such as Hong Kong and Ecuador to improve the credibility of pegged exchange rate systems.
14. What is the difference between a target zone and a crawling peg?
15. How can central banks defend their currency—for example, if the currency is within a target zone or pegged at a particular value?
16. What was the EMS?
17. What is a basket currency?
18. What did the Maastricht Treaty try to accomplish?
19. What is an optimum currency area?
20. Do you believe its monetary union will be beneficial for Europe?
21. Do you think the euro will survive?

PROBLEMS

1. Toward the end of 1999, the central bank (Reserve Bank) in Zimbabwe stabilized the Zimbabwe dollar, the Zim for short, at Z\$38/USD and privately instructed the banks to maintain that rate. In response, at the end of 1999, an illegal market developed wherein the Zim traded at Z\$44/USD. Are you surprised at rumors that claim corporations in Zimbabwe were “hoarding” USD200 million? Explain.
2. In Chapter 3, we described how exchange rate risk could be hedged using forward contracts. In pegged or limited-flexibility exchange rate systems, countries imposing capital controls sometimes force their importers and exporters to hedge. First, assuming that forward contracts are to be used, and an exporter has future foreign currency receivables, what will the government force him to do? Second, how does this help the government in defending their exchange rate peg?
3. In years past, Belgium and South Africa operated a two-tier, or dual, exchange rate market. The two-tier market was abolished in March 1990 in Belgium and in March 1995 in South Africa. Import and export transactions were handled on the official market, and capital transactions were handled on the financial market, where the “financial” exchange rate was freely floating. Discuss why such a system may prevent speculators from profiting when betting on a devaluation.
4. The kuna is the currency of Croatia. Find the Web site of Croatia’s central bank and determine the exchange

rate system Croatia runs. Suppose the kuna weakens substantially relative to the euro. Which action can the central bank take to keep its currency system functioning properly?

5. Type “People’s Bank of China” into your favorite search engine and go to the English versions of the

Web site. Under “Statistics,” find the Balance Sheet of the Monetary Authority. Calculate the growth rate of base money and the growth rate of international assets for the past few years. How much foreign exchange intervention is China doing? Are they sterilizing it?

BIBLIOGRAPHY

- “After a Devaluation, Two African Countries Fare Very Differently,” May 10, 1995, *Wall Street Journal*.
- Aizenman, Joshua, Menzie D. Chinn, and Hiro Ito, 2010, “The Emerging Financial Architecture: Tracing and Evaluating the New Patterns of the Trilemma’s Configurations,” *Journal of International Money and Finance* 29, pp. 614–641.
- Amegbeto, Koffi, and Alex Winter-Nelson, 1998, “Currency Devaluation and Resource Mobilization. A Computable General Equilibrium Analysis of Adjustment in Cameroon,” *Review of Development Economics* 2, pp. 94–105.
- Baldwin, Richard E., 2006, “The Euro’s Trade Effects,” ECB Working Paper.
- Beine, Michel, Jerome Lahaye, Sebastien Laurent, Christopher J. Neely, and Franz C. Palm, 2007, “Central Bank Intervention and Exchange Rate Volatility, Its Continuous and Jump Components,” *International Journal of Finance and Economics* 12, pp. 201–224.
- Bekaert, Geert, and Stephen Gray, 1998, “Target Zones and Exchange Rates: An Empirical Investigation,” *Journal of International Economics* 45, pp. 1–45.
- Bekaert, Geert, Campbell Harvey, Christian Lundblad, and Stephan Siegel, 2010, “The European Union, the Euro and Equity Market Integration,” working paper.
- Dominguez, Kathryn M. E., 2006, “Why Do Central Bank Interventions Influence Intra-Daily and Longer-Term Exchange Rate Movements,” *Journal of International Money and Finance* 25, pp. 1051–1071.
- Dominguez, Kathryn, and Jeffrey Frankel, 1993, “Does Foreign Exchange Intervention Matter? The Portfolio Effect,” *American Economic Review* 83, pp. 1356–1369.
- Dornbusch, Rudiger, 2001, “Fewer Monies, Better Monies,” *American Economic Review* 91, pp. 238–242.
- Edwards, Sebastian, and I. Igal Magendzo, 2003, “Dollarization and Economic Performance: What Do We Really Know?” *International Journal of Finance and Economics* 8, pp. 351–363.
- Eichengreen, Barry, 1992, *Golden Fetters: The Gold Standard and the Great Depression, 1919-1939*, Oxford, U.K.: Oxford University Press.
- Friedman, Milton, 1953, “The Case for Flexible Exchange Rates,” *Essays in Positive Economics*, Chicago: University of Chicago Press, pp. 157–203.
- Galati, Gabriele, and Philip Wooldridge, 2009, “The Euro as a Reserve Currency: A Challenge to the Pre-Eminence of the Dollar,” *International Journal of Finance & Economics* 14, pp. 1–23.
- Jeanne, Olivier, and Romain Ranciere, 2009, “The Optimal Level of International Reserves for Emerging Market Countries: A New Formula and Some Applications,” Johns Hopkins Working Paper.
- Klein, Michael W., and Jay C. Shambaugh, 2008, “The Dynamics of Exchange Rate Regimes: Fixes, Floats and Flips,” *Journal of International Economics* 92, pp. 70–92.
- Kwan, Yum K., and Francis T. Liu, 2005, “How Well Has the Currency Board Performed? Evidence from Hong Kong,” Chapter 10, in Y. K. Kwan and Eden S. M. Yu, eds., *Critical Issues in China’s Growth and Development*, Aldershot, U.K.: Ashgate Press.
- Menkhoff, Lukas, 2010, “High Frequency Analysis of Foreign Exchange Interventions: What Do We Learn?” *Journal of Economic Surveys* 24, pp. 85–112.
- Mishkin, Frederic S., 2010, *The Economics of Money, Banking, and Financial Markets*, 9th ed., Boston: Addison-Wesley.
- Mundell, Robert, 1961, “A Theory of Optimum Currency Areas,” *The American Economic Review*, LI, No. 4, pp. 509–517.
- Neely, Christopher J., 2008, “Central Bank Authorities’ Beliefs About Foreign Exchange Intervention,” *Journal of International Money and Finance* 27, pp. 1–25.
- Obstfeld, Maurice, and Jay C. Shambaugh, 2005, “The Trilemma in History: Tradeoffs Among Exchange Rates, Monetary Policies, and Capital Mobility,” *Review of Economics and Statistics* 87, pp. 423–438.
- Papaioannou, Elias, Richard Portes, and Gregorios Siourounis, 2006, “Optimal Currency Shares in International Reserves: The Impact of the Euro and the Prospects for the Dollar,” *Journal of the Japanese and International Economics* 20, pp. 508–547.
- Pasquariello, Paolo, 2010, “Central Bank Intervention and the Intraday Process of Price Information in the Currency Markets,” *Journal of International Money and Finance* 29, pp. 1045–1061.
- Rockoff, Hugh, 2003, “How Long Did It Take the United States to Become an Optimal Currency Area,” in Forrest H. Capie and Geoffrey E. Wood, eds., *Monetary Unions: Theory, History, Public Choice*, London: Routledge.
- Silva, João, M.C. Santos, and Silvana Tenreiro, 2010, “Currency Unions in Prospect and Retrospect,” *Annual Review of Economics* 2, pp. 51–74.
- Wang, Yongzhong, 2010, “Effectiveness of Capital Controls and Sterilizations in China,” *China and the World Economy* 18, pp. 106–124.