

Chapter

19

The Foreign Exchange Market

PREVIEW

In the mid-1980s, American businesses became less competitive with their foreign counterparts; subsequently, in the 1990s and 2000s, their competitiveness increased. Did this swing in competitiveness occur primarily because American management fell down on the job in the 1980s and then got its act together afterwards? Not really. American business became less competitive in the 1980s because American dollars became worth more in terms of foreign currencies, making American goods more expensive relative to foreign goods. By the 1990s and 2000s, the value of the U.S. dollar had fallen appreciably from its highs in the mid-1980s, making American goods cheaper and American businesses more competitive.

The price of one currency in terms of another is called the **exchange rate**. It affects the economy and our daily lives, because when the U.S. dollar becomes more valuable relative to foreign currencies, foreign goods become cheaper for Americans and American goods become more expensive for foreigners. When the U.S. dollar falls in value, foreign goods become more expensive for Americans and American goods become cheaper for foreigners. We begin our study of international finance by examining the **foreign exchange market**, the financial market where exchange rates are determined.

As you can see in Figure 1, exchange rates are highly volatile. What factors explain the rise and fall of exchange rates? Why are exchange rates so volatile from day to day?

To answer these questions, we develop a modern view of exchange rate determination that explains recent behavior in the foreign exchange market.

Foreign Exchange Market

www.ny.frb.org/Pihome/addpub/usfxm

Get detailed information about the foreign exchange market in the United States.

Most countries of the world have their own currencies: The United States has its dollar; the European Monetary Union, the euro; Brazil, its real; and India, its rupee. Trade between countries involves the mutual exchange of different currencies (or, more usually, bank deposits denominated in different currencies). When an American firm buys foreign goods, services, or financial assets, for example, U.S. dollars (typically, bank deposits denominated in U.S. dollars) must be exchanged for foreign currency (bank deposits denominated in the foreign currency).

The trading of currency and bank deposits denominated in particular currencies takes place in the foreign exchange market. Transactions conducted in the foreign

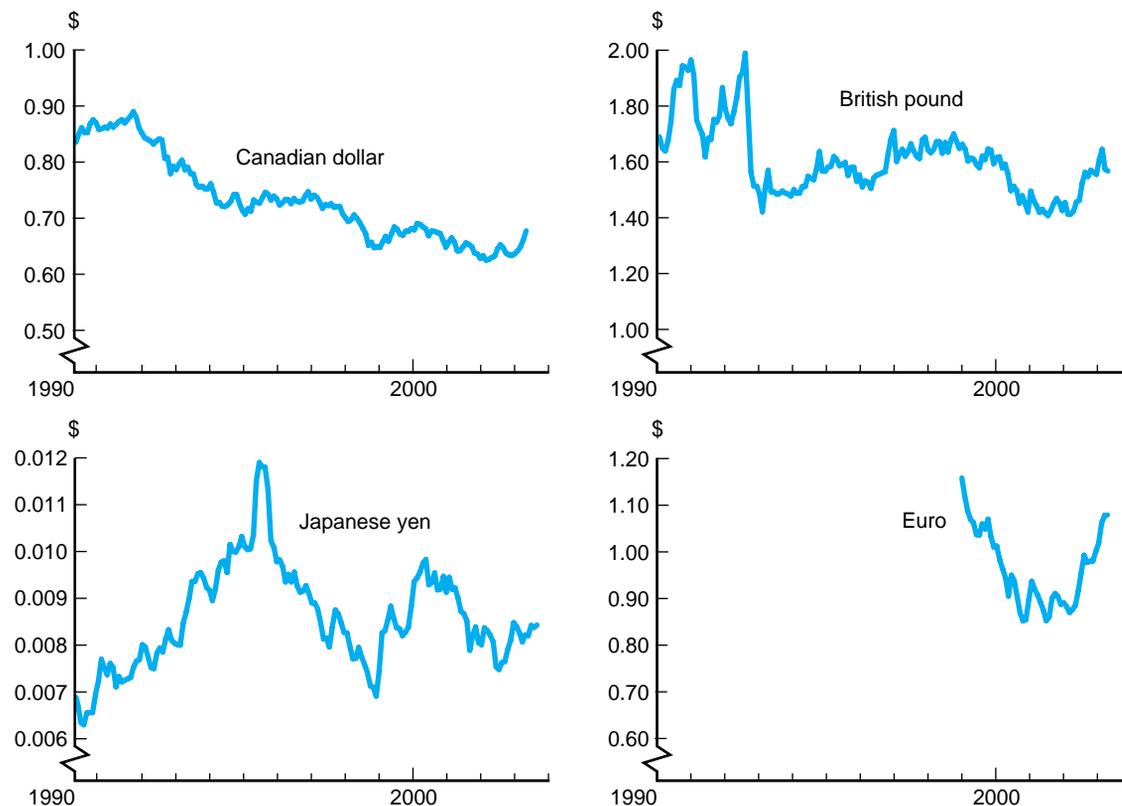


FIGURE 1 Exchange Rates, 1990-2002

Dollar prices of selected currencies. Note that a rise in these plots indicates a strengthening of the currency (weakening of the dollar).

Source: Federal Reserve: www.federalreserve.gov/releases/h10/hist.

exchange market determine the rates at which currencies are exchanged, which in turn determine the cost of purchasing foreign goods and financial assets.

What Are Foreign Exchange Rates?

<http://quotes.ino.com/chart/>
Go to this web site and click on “Foreign Exchange” to get market rates and time charts for the exchange rate of the U.S. dollar to major world currencies.

There are two kinds of exchange rate transactions. The predominant ones, called **spot transactions**, involve the immediate (two-day) exchange of bank deposits. **Forward transactions** involve the exchange of bank deposits at some specified future date. The **spot exchange rate** is the exchange rate for the spot transaction, and the **forward exchange rate** is the exchange rate for the forward transaction.

When a currency increases in value, it experiences **appreciation**; when it falls in value and is worth fewer U.S. dollars, it undergoes **depreciation**. At the beginning of 1999, for example, the euro was valued at 1.18 dollars, and as indicated in the “Following the Financial News” box, on February 5, 2003, it was valued at 1.08 dollars. The euro *depreciated* by 8%: $(1.08 - 1.18)/1.18 = -0.08 = -8\%$. Equivalently, we could say that the U.S. dollar, which went from a value of 0.85 euros per dollar at the

Following the Financial News

Foreign Exchange Rates

Foreign exchange rates are published daily and appear in the "Currency Trading" column of the *Wall Street Journal*. The entries from one such column, shown here, are explained in the text.

The first entry for the euro lists the exchange rate for the spot transaction (the spot exchange rate) on February 5, 2003, and is quoted in two ways: \$1.0795 per euro and 0.9264 euros per dollar. Americans gen-

erally regard the exchange rate with the euro as \$1.0795 per euro, while Europeans think of it as 0.9264 euros per dollar. The three entries immediately below the spot exchange rates for some currencies give the rates for forward transactions (the forward exchange rates) that will take place one month, three months, and six months in the future.

CURRENCY TRADING

Wednesday, February 5, 2003

EXCHANGE RATES

The foreign exchange mid-range rates below apply to trading among banks in amounts of \$1 million and more, as quoted at 4 p.m. Eastern time by Reuters and other sources. Retail transactions provide fewer units of foreign currency per dollar.

Country	U.S. \$ Equivalent		Currency per U.S. \$		Country	U.S. \$ Equivalent		Currency per U.S. \$	
	Wed	Tue	Wed	Tue		Wed	Tue	Wed	Tue
Argentina (Peso)-y	.3160	.3160	3.1646	3.1646	Pakistan (Rupee)	.01719	.01723	58.173	58.038
Australia (Dollar)	.5901	.5915	1.6946	1.6906	Peru (new Sol)	.2866	.2863	3.4892	3.4928
Bahrain (Dinar)	2.6522	2.6523	.3770	.3770	Philippines (Peso)	.01852	.01853	53.996	53.967
Brazil (Real)	.2784	.2798	3.5920	3.5740	Poland (Zloty)	.2606	.2622	3.8373	3.8139
Canada (Dollar)	.6574	.6602	1.5211	1.5147	Russia (Ruble)-a	0.3142	0.3142	31.827	31.827
1-month forward	.6566	.6595	1.5230	1.5163	Saudi Arabia	.2667	.2667	3.7495	3.7495
3-months forward	.6548	.6576	1.5272	1.5207	Singapore (Dollar)	.5742	.5755	1.7416	1.7376
6-months forward	.6517	.6544	1.5344	1.5281	Slovak Rep. (Koruna)	.02579	.02607	38.775	38.358
Chile (Peso)	.001348	.001346	741.84	742.94	South Africa (Rand)	.1192	.1202	8.3893	8.3195
China (Renminbi)	.1208	.1208	8.2781	8.2781	South Korea (Won)	.0008516	.0008529	1174.26	1172.47
Colombia (Peso)	.0003372	.0003378	2965.60	2960.33	Sweden (Krona)	.1169	.1177	8.5543	8.4962
Czech Rep. (Koruna)					Switzerland (Franc)	.7358	.7424	1.3591	1.3470
Commercial rate	.03398	.03438	29.429	29.087	1-month forward	.7362	.7428	1.3583	1.3463
Denmark (Krone)	.1453	.1463	6.8823	6.8353	3-months forward	.7371	.7437	1.3567	1.3446
Ecuador (US Dollar)	1.0000	1.0000	1.0000	1.0000	6-months forward	.7386	.7451	1.3539	1.3421
Hong Kong (Dollar)	.1282	.1282	7.8003	7.8003	Taiwan (Dollar)	.02881	.02881	34.710	34.710
Hungary (Forint)	.004406	.004454	226.96	224.52	Thailand (Baht)	.02338	.02342	42.772	42.699
India (Rupee)	.02099	.02094	47.642	47.756	Turkey (Lira)	.00000061	.00000061	1639344	1639344
Indonesia (Rupiah)	.0001128	.0001127	8865	8873	U.K. (Pound)	1.6423	1.6485	.6089	.6066
Israel (Shekel)	.2050	.2049	4.8780	4.8804	1-month forward	1.6391	1.6452	.6101	.6078
Japan (Yen)	.008336	.008353	119.96	119.72	3-months forward	1.6322	1.6382	.6127	.6104
1-month forward	.008344	.008362	119.85	119.59	6-months forward	1.6221	1.6283	.6165	.6141
3-months forward	.008363	.008381	119.57	119.32	United Arab (Dirham)	.2723	.2723	3.6724	3.6724
6-months forward	.008391	.008408	119.18	118.93	Uruguay (Peso)				
Jordan (Dinar)	1.4094	1.4085	.7095	.7100	Financial	.03500	.03550	28.571	28.169
Kuwait (Dinar)	3.3479	3.3523	.2987	.2983	Venezuela (Bolívar)	.000520	.000520	1923.08	1923.08
Lebanon (Pound)	.0006634	.0006634	1507.39	1507.39	SDR	1.3741	1.3697	.7277	.7301
Malaysia (Ringgit)-b	.2632	.2632	3.7994	3.7994	Euro	1.0795	1.0883	.9264	.9189
Malta (Lira)	2.5690	2.5861	.3893	.3867					
Mexico (Peso)									
Floating rate	.0920	.0913	10.8648	10.9481					
New Zealand (Dollar)	.5494	.5496	1.8202	1.8195					
Norway (Krone)	.1434	.1448	6.9735	6.9061					

Special Drawing Rights (SDR) are based on exchange rates for the U.S., British, and Japanese currencies. Source: International Monetary Fund.
a-Russian Central Bank rate. b-Government rate. y-Floating rate.

Source: *Wall Street Journal*, Thursday, February 6, 2003, p. C12.

beginning of 1999 to a value of 0.93 euros per dollar on February 5, 2003, *appreciated* by 9%: $(0.93 - 0.85)/0.85 = 0.09 = 9\%$.

Why Are Exchange Rates Important?

Exchange rates are important because they affect the relative price of domestic and foreign goods. The dollar price of French goods to an American is determined by the interaction of two factors: the price of French goods in euros and the euro/dollar exchange rate.

Suppose that Wanda the Winetaster, an American, decides to buy a bottle of 1961 (a very good year) Château Lafite Rothschild to complete her wine cellar. If the price of the wine in France is 1,000 euros and the exchange rate is \$1.08 to the euro, the wine will cost Wanda \$1,080 (= 1,000 euros \times \$1.08/euro). Now suppose that Wanda delays her purchase by two months, at which time the euro has appreciated to \$1.20 per euro. If the domestic price of the bottle of Lafite Rothschild remains 1,000 euros, its dollar cost will have risen from \$1,080 to \$1,200.

The same currency appreciation, however, makes the price of foreign goods in that country less expensive. At an exchange rate of \$1.08 per euro, a Compaq computer priced at \$2,000 costs Pierre the Programmer 1,852 euros; if the exchange rate increases to \$1.20 per euro, the computer will cost only 1,667 euros.

A depreciation of the euro lowers the cost of French goods in America but raises the cost of American goods in France. If the euro drops in value to \$0.90, Wanda's bottle of Lafite Rothschild will cost her only \$900 instead of \$1,080, and the Compaq computer will cost Pierre 2,222 euros rather than 1,852.

Such reasoning leads to the following conclusion: ***When a country's currency appreciates (rises in value relative to other currencies), the country's goods abroad become more expensive and foreign goods in that country become cheaper (holding domestic prices constant in the two countries). Conversely, when a country's currency depreciates, its goods abroad become cheaper and foreign goods in that country become more expensive.***

Appreciation of a currency can make it harder for domestic manufacturers to sell their goods abroad and can increase competition at home from foreign goods, because they cost less. From 1980 to early 1985, the appreciating dollar hurt U.S. industries. For instance, the U.S. steel industry was hurt not just because sales abroad of the more expensive American steel declined, but also because sales of relatively cheap foreign steel in the United States increased. Although appreciation of the U.S. dollar hurt some domestic businesses, American consumers benefited because foreign goods were less expensive. Japanese videocassette recorders and cameras and the cost of vacationing in Europe fell in price as a result of the strong dollar.

How Is Foreign Exchange Traded?

You cannot go to a centralized location to watch exchange rates being determined; currencies are not traded on exchanges such as the New York Stock Exchange. Instead, the foreign exchange market is organized as an over-the-counter market in which several hundred dealers (mostly banks) stand ready to buy and sell deposits denominated in foreign currencies. Because these dealers are in constant telephone and computer contact, the market is very competitive; in effect, it functions no differently from a centralized market.

An important point to note is that while banks, companies, and governments talk about buying and selling currencies in foreign exchange markets, they do not take a fistful of dollar bills and sell them for British pound notes. Rather, most trades involve the buying and selling of bank deposits denominated in different currencies. So when

we say that a bank is buying dollars in the foreign exchange market, what we actually mean is that the bank is buying *deposits denominated in dollars*. The volume in this market is colossal, exceeding \$1 trillion per day.

Trades in the foreign exchange market consist of transactions in excess of \$1 million. The market that determines the exchange rates in the “Following the Financial News” box is not where one would buy foreign currency for a trip abroad. Instead, we buy foreign currency in the retail market from dealers such as American Express or from banks. Because retail prices are higher than wholesale, when we buy foreign exchange, we obtain fewer units of foreign currency per dollar than exchange rates in the box indicate.

Exchange Rates in the Long Run

Like the price of any good or asset in a free market, exchange rates are determined by the interaction of supply and demand. To simplify our analysis of exchange rates in a free market, we divide it into two parts. First, we examine how exchange rates are determined in the long run; then we use our knowledge of the long-run determinants of the exchange rate to help us understand how they are determined in the short run.

Law of One Price

The starting point for understanding how exchange rates are determined is a simple idea called the **law of one price**: If two countries produce an identical good, and transportation costs and trade barriers are very low, the price of the good should be the same throughout the world no matter which country produces it. Suppose that American steel costs \$100 per ton and identical Japanese steel costs 10,000 yen per ton. For the law of one price to hold, the exchange rate between the yen and the dollar must be 100 yen per dollar (\$0.01 per yen) so that one ton of American steel sells for 10,000 yen in Japan (the price of Japanese steel) and one ton of Japanese steel sells for \$100 in the United States (the price of U.S. steel). If the exchange rate were 200 yen to the dollar, Japanese steel would sell for \$50 per ton in the United States or half the price of American steel, and American steel would sell for 20,000 yen per ton in Japan, twice the price of Japanese steel. Because American steel would be more expensive than Japanese steel in both countries and is identical to Japanese steel, the demand for American steel would go to zero. Given a fixed dollar price for American steel, the resulting excess supply of American steel will be eliminated only if the exchange rate falls to 100 yen per dollar, making the price of American steel and Japanese steel the same in both countries.

Theory of Purchasing Power Parity

www.oecd.org/EN/home/0,,EN-home-513-15-no-no-no-0,00.html

The purchasing power parities home page includes the PPP program overview, statistics, research, publications, and OECD meetings on PPP.

One of the most prominent theories of how exchange rates are determined is the **theory of purchasing power parity (PPP)**. It states that exchange rates between any two currencies will adjust to reflect changes in the price levels of the two countries. The theory of PPP is simply an application of the law of one price to national price levels rather than to individual prices. Suppose that the yen price of Japanese steel rises 10% (to 11,000 yen) relative to the dollar price of American steel (unchanged at \$100). For the law of one price to hold, the exchange rate must rise to 110 yen to the dollar, a 10% appreciation of the dollar. Applying the law of one price to the price levels in the two countries produces the theory of purchasing power parity, which maintains that if the Japanese price level rises 10% relative to the U.S. price level, the dollar will appreciate by 10%.

As our U.S./Japanese example demonstrates, the theory of PPP suggests that if one country's price level rises relative to another's, its currency should depreciate (the other country's currency should appreciate). As you can see in Figure 2, this prediction is borne out in the long run. From 1973 to the end of 2002, the British price level rose 99% relative to the U.S. price level, and as the theory of PPP predicts, the dollar appreciated against the pound; though by 73%, an amount smaller than the 99% increase predicted by PPP.

Yet, as the same figure indicates, PPP theory often has little predictive power in the short run. From early 1985 to the end of 1987, for example, the British price level rose relative to that of the United States. Instead of appreciating, as PPP theory predicts, the U.S. dollar actually depreciated by 40% against the pound. So even though PPP theory provides some guidance to the long-run movement of exchange rates, it is not perfect and in the short run is a particularly poor predictor. What explains PPP theory's failure to predict well?

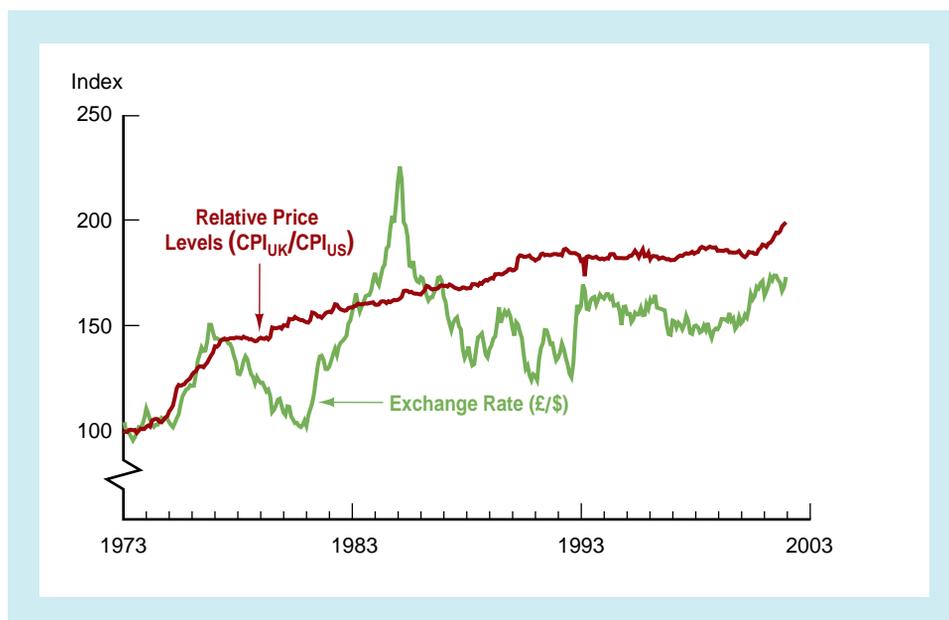
Why the Theory of Purchasing Power Parity Cannot Fully Explain Exchange Rates

The PPP conclusion that exchange rates are determined solely by changes in relative price levels rests on the assumption that all goods are identical in both countries and that transportation costs and trade barriers are very low. When this assumption is true, the law of one price states that the relative prices of all these goods (that is, the relative price level between the two countries) will determine the exchange rate. The assumption that goods are identical may not be too unreasonable for American and Japanese steel, but is it a reasonable assumption for American and Japanese cars? Is a Toyota the equivalent of a Chevrolet?

Because Toyotas and Chevys are obviously not identical, their prices do not have to be equal. Toyotas can be more expensive relative to Chevys and both Americans and Japanese will still purchase Toyotas. Because the law of one price does not hold for all goods, a rise in the price of Toyotas relative to Chevys will not necessarily mean

FIGURE 2 Purchasing Power Parity, United States/United Kingdom, 1973–2002
(Index: March 1973 = 100.)

Source: www.statistics.gov.uk/statbase/tsdataset2.asp.



that the yen must depreciate by the amount of the relative price increase of Toyotas over Chevys.

PPP theory furthermore does not take into account that many goods and services (whose prices are included in a measure of a country's price level) are not traded across borders. Housing, land, and services such as restaurant meals, haircuts, and golf lessons are not traded goods. So even though the prices of these items might rise and lead to a higher price level relative to another country's, there would be little direct effect on the exchange rate.

Factors That Affect Exchange Rates in the Long Run

Our analysis indicates that in the long run, four major factors affect the exchange rate: relative price levels, tariffs and quotas, preferences for domestic versus foreign goods, and productivity. We examine how each of these factors affects the exchange rate while holding the others constant.

The basic reasoning proceeds along the following lines: Anything that increases the demand for domestic goods relative to foreign goods tends to appreciate the domestic currency because domestic goods will continue to sell well even when the value of the domestic currency is higher. Similarly, anything that increases the demand for foreign goods relative to domestic goods tends to depreciate the domestic currency because domestic goods will continue to sell well only if the value of the domestic currency is lower.

Relative Price Levels. In line with PPP theory, when prices of American goods rise (holding prices of foreign goods constant), the demand for American goods falls and the dollar tends to depreciate so that American goods can still sell well. By contrast, if prices of Japanese goods rise so that the relative prices of American goods fall, the demand for American goods increases, and the dollar tends to appreciate, because American goods will continue to sell well even with a higher value of the domestic currency. *In the long run, a rise in a country's price level (relative to the foreign price level) causes its currency to depreciate, and a fall in the country's relative price level causes its currency to appreciate.*

Trade Barriers. Barriers to free trade such as **tariffs** (taxes on imported goods) and **quotas** (restrictions on the quantity of foreign goods that can be imported) can affect the exchange rate. Suppose that the United States increases its tariff or puts a lower quota on Japanese steel. These increases in trade barriers increase the demand for American steel, and the dollar tends to appreciate because American steel will still sell well even with a higher value of the dollar. *Increasing trade barriers cause a country's currency to appreciate in the long run.*

Preferences for Domestic Versus Foreign Goods. If the Japanese develop an appetite for American goods—say, for Florida oranges and American movies—the increased demand for American goods (exports) tends to appreciate the dollar, because the American goods will continue to sell well even at a higher value for the dollar. Likewise, if Americans decide that they prefer Japanese cars to American cars, the increased demand for Japanese goods (imports) tends to depreciate the dollar. *Increased demand for a country's exports causes its currency to appreciate in the long run; conversely, increased demand for imports causes the domestic currency to depreciate.*

Productivity. If one country becomes more productive than other countries, businesses in that country can lower the prices of domestic goods relative to foreign goods and still earn a profit. As a result, the demand for domestic goods rises, and the domestic currency tends to appreciate. If, however, its productivity lags behind that of other countries, its goods become relatively more expensive, and the currency tends to depreciate. *In the long run, as a country becomes more productive relative to other countries, its currency appreciates.*¹

Study Guide

The trick to figuring out what long-run effect a factor has on the exchange rate is to remember the following: *If a factor increases the demand for domestic goods relative to foreign goods, the domestic currency will appreciate, and if a factor decreases the relative demand for domestic goods, the domestic currency will depreciate.* See how this works by explaining what happens to the exchange rate when any of the factors in Table 1 decreases rather than increases.

Our long-run theory of exchange rate behavior is summarized in Table 1. We use the convention that the exchange rate E is quoted so that an appreciation of the currency corresponds to a rise in the exchange rate. In the case of the United States, this means that we are quoting the exchange rate as units of foreign currency per dollar (say, yen per dollar).²

SUMMARY Table 1 Factors That Affect Exchange Rates in the Long Run

Factor	Change in Factor	Response of the Exchange Rate, E^*
Domestic price level†	↑	↓
Trade barriers†	↑	↑
Import demand	↑	↓
Export demand	↑	↑
Productivity†	↑	↑

*Units of foreign currency per dollar: ↑ indicates domestic currency appreciation; ↓, depreciation.
 †Relative to other countries.
 Note: Only increases (↑) in the factors are shown; the effects of decreases in the variables on the exchange rate are the opposite of those indicated in the “Response” column.

¹A country might be so small that a change in productivity or the preferences for domestic or foreign goods would have no effect on prices of these goods relative to foreign goods. In this case, changes in productivity or changes in preferences for domestic or foreign goods affect the country's income but will not necessarily affect the value of the currency. In our analysis, we are assuming that these factors can affect relative prices and consequently the exchange rate.

²Exchange rates can be quoted either as units of foreign currency per domestic currency or alternatively as units of domestic currency per foreign currency. In professional writing, many economists quote exchange rates as units of domestic currency per foreign currency so that an appreciation of the domestic currency is portrayed as a fall in the exchange rate. The opposite convention is used in the text here, because it is more intuitive to think of an appreciation of the domestic currency as a rise in the exchange rate.

Exchange Rates in the Short Run

[www.federalreserve.gov
/releases/](http://www.federalreserve.gov/releases/)

The Federal Reserve reports current and historical exchange rates for many countries.

We have developed a theory of the long-run behavior of exchange rates. However, if we are to understand why exchange rates exhibit such large changes (sometimes several percent) from day to day, we must develop a theory of how current exchange rates (spot exchange rates) are determined in the short run.

The key to understanding the short-run behavior of exchange rates is to recognize that an exchange rate is the price of domestic bank deposits (those denominated in the domestic currency) in terms of foreign bank deposits (those denominated in the foreign currency). Because the exchange rate is the price of one asset in terms of another, the natural way to investigate the short-run determination of exchange rates is through an asset market approach that relies heavily on the theory of asset demand developed in Chapter 5. As you will see, however, the long-run determinants of the exchange rate we have just outlined also play an important role in the short-run asset market approach.³

Earlier approaches to exchange rate determination emphasized the role of import and export demand. The more modern asset market approach used here does not emphasize the flows of purchases of exports and imports over short periods, because these transactions are quite small relative to the amount of domestic and foreign bank deposits at any given time. For example, foreign exchange transactions in the United States each year are well over 25 times greater than the amount of U.S. exports and imports. Thus over short periods such as a year, decisions to hold domestic or foreign assets play a much greater role in exchange rate determination than the demand for exports and imports does.

Comparing Expected Returns on Domestic and Foreign Deposits

In this analysis, we treat the United States as the home country, so as an example, domestic bank deposits are denominated in dollars. For simplicity, we use euros to stand for any foreign country's currency, so foreign bank deposits are denominated in euros. The theory of asset demand suggests that the most important factor affecting the demand for domestic (dollar) deposits and foreign (euro) deposits is the expected return on these assets relative to each other. When Americans or foreigners expect the return on dollar deposits to be high relative to the return on foreign deposits, there is a higher demand for dollar deposits and a correspondingly lower demand for euro deposits. To understand how the demands for dollar and foreign deposits change, we need to compare the expected returns on dollar deposits and foreign deposits.

To illustrate further, suppose that dollar deposits have an interest rate (expected return payable in dollars) of i^D , and foreign bank deposits have an interest rate (expected return payable in the foreign currency, euros) of i^F . To compare the expected returns on dollar deposits and foreign deposits, investors must convert the returns into the currency unit they use.

First let us examine how François the Foreigner compares the returns on dollar deposits and foreign deposits denominated in his currency, the euro. When he considers the expected return on dollar deposits in terms of euros, he recognizes that it does not equal i^D ; instead, the expected return must be adjusted for any expected appreciation or depreciation of the dollar. If the dollar were expected to appreciate by 7%, for example, the expected return on dollar deposits in terms of euros would be

³For a further description of the modern asset market approach to exchange rate determination that we use here, see Paul Krugman and Maurice Obstfeld, *International Economics*, 6th ed. (Reading, Mass.: Addison Wesley Longman, 2003).

7% higher because the dollar has become worth 7% more in terms of euros. Thus if the interest rate on dollar deposits is 10%, with an expected appreciation of the dollar of 7%, the expected return on dollar deposits in terms of euros is 17%: the 10% interest rate plus the 7% expected appreciation of the dollar. Conversely, if the dollar were expected to depreciate by 7% over the year, the expected return on dollar deposits in terms of euros would be only 3%: the 10% interest rate minus the 7% expected depreciation of the dollar.

Writing the currency exchange rate (the spot exchange rate) as E_t and the expected exchange rate for the next period as E_{t+1}^e , we can write the expected rate of appreciation of the dollar as $(E_{t+1}^e - E_t)/E_t$. Our reasoning indicates that the expected return on dollar deposits R^D in terms of foreign currency can be written as the sum of the interest rate on dollar deposits plus the expected appreciation of the dollar:⁴

$$R^D \text{ in terms of euros} = i^D + \frac{E_{t+1}^e - E_t}{E_t}$$

However, François's expected return on foreign deposits R^F in terms of euros is just i^F . Thus in terms of euros, the relative expected return on dollar deposits (that is, the difference between the expected return on dollar deposits and euro deposits) is calculated by subtracting i^F from the expression just given to yield

$$\text{Relative } R^D = i^D - i^F + \frac{E_{t+1}^e - E_t}{E_t} \quad (1)$$

As the relative expected return on dollar deposits increases, foreigners will want to hold more dollar deposits and fewer foreign deposits.

Next let us look at the decision to hold dollar deposits versus euro deposits from Al the American's point of view. Following the same reasoning we used to evaluate the decision for François, we know that the expected return on foreign deposits R^F in terms of dollars is the interest rate on foreign deposits i^F plus the expected appreciation of the foreign currency, equal to minus the expected appreciation of the dollar, $-(E_{t+1}^e - E_t)/E_t$, that is:

$$R^F \text{ in terms of dollars} = i^F - \frac{E_{t+1}^e - E_t}{E_t}$$

⁴This expression is actually an approximation of the expected return in terms of euros, which can be more precisely calculated by thinking how a foreigner invests in the dollar deposit. Suppose that François decides to put one euro into dollar deposits. First he buys $1/E_t$ of U.S. dollar deposits (recall that E_t , the exchange rate between dollar and euro deposits, is quoted in euros per dollar), and at the end of the period he is paid $(1 + i^D)(1/E_t)$ in dollars. To convert this amount into the number of euros he expects to receive at the end of the period, he multiplies this quantity by E_{t+1}^e . François's expected return on his initial investment of one euro can thus be written as $(1 + i^D)(E_{t+1}^e/E_t)$ minus his initial investment of one euro:

$$(1 + i^D) \left(\frac{E_{t+1}^e}{E_t} \right) - 1$$

which can be rewritten as

$$i^D \left(\frac{E_{t+1}^e}{E_t} \right) + \frac{E_{t+1}^e - E_t}{E_t}$$

which is approximately equal to the expression in the text because E_{t+1}^e/E_t is typically close to 1.

If the interest rate on euro deposits is 5%, for example, and the dollar is expected to appreciate by 4%, then the expected return on euro deposits in terms of dollars is 1%. Al earns the 5% interest rate, but he expects to lose 4% because he expects the euro to be worth 4% less in terms of dollars as a result of the dollar's appreciation.

Al's expected return on the dollar deposits R^D in terms of dollars is just i^D . Hence in terms of dollars, the relative expected return on dollar deposits is calculated by subtracting the expression just given from i^D to obtain:

$$\text{Relative } R^D = i^D - \left(i^F - \frac{E_{t+1}^e - E_t}{E_t} \right) = i^D - i^F + \frac{E_{t+1}^e - E_t}{E_t}$$

This equation is the same as the one describing François's relative expected return on dollar deposits (calculated in terms of euros). The key point here is that the relative expected return on dollar deposits is the same whether it is calculated by François in terms of euros or by Al in terms of dollars. Thus as the relative expected return on dollar deposits increases, both foreigners and domestic residents respond in exactly the same way—both will want to hold more dollar deposits and fewer foreign deposits.

Interest Parity Condition

We currently live in a world in which there is **capital mobility**: Foreigners can easily purchase American assets such as dollar deposits, and Americans can easily purchase foreign assets such as euro deposits. Because foreign bank deposits and American bank deposits have similar risk and liquidity and because there are few impediments to capital mobility, it is reasonable to assume that the deposits are perfect substitutes (that is, equally desirable). When capital is mobile and when bank deposits are perfect substitutes, if the expected return on dollar deposits is above that on foreign deposits, both foreigners and Americans will want to hold only dollar deposits and will be unwilling to hold foreign deposits. Conversely, if the expected return on foreign deposits is higher than on dollar deposits, both foreigners and Americans will not want to hold any dollar deposits and will want to hold only foreign deposits. For existing supplies of both dollar deposits and foreign deposits to be held, it must therefore be true that there is no difference in their expected returns; that is, the relative expected return in Equation 1 must equal zero. This condition can be rewritten as:

$$i^D = i^F - \frac{E_{t+1}^e - E_t}{E_t} \quad (2)$$

This equation is called the **interest parity condition**, and it states that the domestic interest rate equals the foreign interest rate minus the expected appreciation of the domestic currency. Equivalently, this condition can be stated in a more intuitive way: The domestic interest rate equals the foreign interest rate plus the expected appreciation of the foreign currency. If the domestic interest rate is above the foreign interest rate, this means that there is a positive expected appreciation of the foreign currency, which compensates for the lower foreign interest rate. A domestic interest rate of 15% versus a foreign interest rate of 10% means that the expected appreciation of the foreign currency must be 5% (or, equivalently, that the expected depreciation of the dollar must be 5%).

There are several ways to look at the interest parity condition. First, we should recognize that interest parity means simply that the expected returns are the same on both dollar deposits and foreign deposits. To see this, note that the left side of the interest parity condition (Equation 2) is the expected return on dollar deposits, while

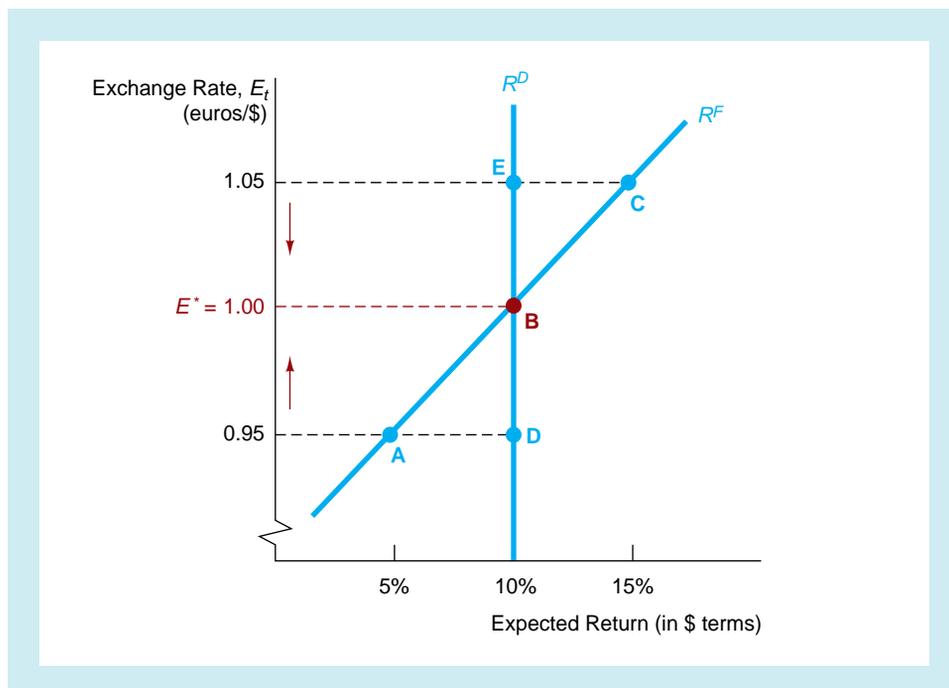
the right side is the expected return on foreign deposits, both calculated in terms of a single currency, the U.S. dollar. Given our assumption that domestic and foreign bank deposits are perfect substitutes (equally desirable), the interest parity condition is an equilibrium condition for the foreign exchange market. Only when the exchange rate is such that expected returns on domestic and foreign deposits are equal—that is, when interest parity holds—will the outstanding domestic and foreign deposits be willingly held.

Equilibrium in the Foreign Exchange Market

To see how the interest parity equilibrium condition works in determining the exchange rate, our first step is to examine how the expected returns on euro and dollar deposits change as the current exchange rate changes.

Expected Return on Euro Deposits. As we demonstrated earlier, the expected return in terms of dollars on foreign deposits R^F is the foreign interest rate minus the expected appreciation of the domestic currency: $i^F - (E_{t+1}^e - E_t)/E_t$. Suppose that the foreign interest rate i^F is 10% and that the expected exchange rate next period E_{t+1}^e is 1 euro per dollar. When the current exchange rate E_t is 0.95 euros per dollar, the expected appreciation of the dollar is $(1.00 - 0.95)/0.95 = 0.052 = 5.2\%$, so the expected return on euro deposits R^F in terms of dollars is 4.8% (equal to the 10% foreign interest rate minus the 5.2% dollar appreciation). This expected return when $E_t = 0.95$ euros per dollar is plotted as point A in Figure 3. At a higher current exchange rate of $E_t = 1$ euro per dollar, the expected appreciation of the dollar is zero because E_{t+1}^e also equals 1 euro per dollar. Hence R^F , the expected dollar return on euro deposits, is now just $i^F = 10\%$. This expected return on euro deposits when $E_t = 1$ euro per dollar is plotted as point B. At an even higher exchange rate of $E_t = 1.05$ euros per dollar

FIGURE 3 Equilibrium in the Foreign Exchange Market
Equilibrium in the foreign exchange market occurs at the intersection of the schedules for the expected return on euro deposits R^F and the expected return on dollar deposits R^D at point B. The equilibrium exchange rate is $E^* = 1$ euro per dollar.



dollar, the expected change in the value of the dollar is now -4.8% [$= (1.00 - 1.05)/1.05 = -0.048$], so the expected dollar return on foreign deposits R^F has now risen to 14.8% [$= 10\% - (-4.8\%)$]. This combination of exchange rate and expected return on euro deposits is plotted as point C.

The curve connecting these points is the schedule for the expected return on euro deposits in Figure 3, labeled R^F , and as you can see, it slopes upward; that is, as the exchange rate E_t rises, the expected return on euro deposits rises. The intuition for this upward slope is that because the expected next-period exchange rate is held constant as the current exchange rate rises, there is less expected appreciation of the dollar. Hence a higher current exchange rate means a greater expected appreciation of the foreign currency in the future, which increases the expected return on foreign deposits in terms of dollars.

Expected Return on Dollar Deposits. The expected return on dollar deposits in terms of dollars R^D is always the interest rate on dollar deposits i^D no matter what the exchange rate is. Suppose that the interest rate on dollar deposits is 10% . The expected return on dollar deposits, whether at an exchange rate of 0.95 , 1.00 , or 1.05 euros per dollar, is always 10% (points D, B, and E) since no foreign-exchange transaction is needed to convert the interest payments into dollars. The line connecting these points is the schedule for the expected return on dollar deposits, labeled R^D in Figure 3.

Equilibrium. The intersection of the schedules for the expected return on dollar deposits R^D and the expected return on euro deposits R^F is where equilibrium occurs in the foreign exchange market; in other words,

$$R^D = R^F$$

At the equilibrium point B where the exchange rate E^* is 1 euro per dollar, the interest parity condition is satisfied because the expected returns on dollar deposits and on euro deposits are equal.

To see that the exchange rate actually heads toward the equilibrium exchange rate E^* , let's see what happens if the exchange rate is 1.05 euros per dollar, a value above the equilibrium exchange rate. As we can see in Figure 3, the expected return on euro deposits at point C is greater than the expected return on dollar deposits at point E. Since dollar and euro deposits are perfect substitutes, people will not want to hold any dollar deposits, and holders of dollar deposits will try to sell them for euro deposits in the foreign exchange market (which is referred to as "selling dollars" and "buying euros"). However, because the expected return on these dollar deposits is below that on euro deposits, no one holding euros will be willing to exchange them for dollar deposits. The resulting excess supply of dollar deposits means that the price of the dollar deposits relative to euro deposits must fall; that is, the exchange rate (amount of euros per dollar) falls as is illustrated by the downward arrow drawn in the figure at the exchange rate of 1.05 euros per dollar. The decline in the exchange rate will continue until point B is reached at the equilibrium exchange rate of 1 euro per dollar, where the expected return on dollar and euro deposits is now equalized.

Now let us look at what happens when the exchange rate is 0.95 euros per dollar, a value below the equilibrium level. Here the expected return on dollar deposits is greater than that on euro deposits. No one will want to hold euro deposits, and everyone will try to sell them to buy dollar deposits ("sell euros" and "buy dollars"), thus driving up the exchange rate as illustrated by the upward arrow. As the exchange

rate rises, there is a higher expected depreciation of the dollar and so a higher expected appreciation of the euro, thereby increasing the expected return on euro deposits. Finally, when the exchange rate has risen to $E^* = 1$ euro per dollar, the expected return on euro deposits has risen enough so that it again equals the expected return on dollar deposits.

Explaining Changes in Exchange Rates

To explain how an exchange rate changes over time, we have to understand the factors that shift the expected-return schedules for domestic (dollar) deposits and foreign (euro) deposits.

Shifts in the Expected-Return Schedule for Foreign Deposits

As we have seen, the expected return on foreign (euro) deposits depends on the foreign interest rate i^F minus the expected appreciation of the dollar $(E_{t+1}^e - E_t)/E_t$. Because a change in the current exchange rate E_t results in a movement along the expected-return schedule for euro deposits, factors that shift this schedule must work through the foreign interest rate i^F and the expected future exchange rate E_{t+1}^e . We examine the effect of changes in these factors on the expected-return schedule for euro deposits R^F , holding everything else constant.

Study Guide

To grasp how the expected-return schedule for euro deposits shifts, just think of yourself as an investor who is considering putting funds into foreign deposits. When a variable changes (i^F , for example), decide whether at a given level of the current exchange rate, holding all other variables constant, you would earn a higher or lower expected return on euro deposits.

Changes in the Foreign Interest Rate. If the interest rate on foreign deposits i^F increases, holding everything else constant, the expected return on these deposits must also increase. Hence at a given exchange rate, the increase in i^F leads to a rightward shift in the expected-return schedule for euro deposits from R_1^F to R_2^F in Figure 4. As you can see in the figure, the outcome is a depreciation of the dollar from E_1 to E_2 . An alternative way to see this is to recognize that the increase in the expected return on euro deposits at the original equilibrium exchange rate resulting from the rise in i^F means that people will want to buy euros and sell dollars, so the value of the dollar must fall. Our analysis thus generates the following conclusion: **An increase in the foreign interest rate i^F shifts the R^F schedule to the right and causes the domestic currency to depreciate ($E \downarrow$).**

Conversely, if i^F falls, the expected return on euro deposits falls, the R^F schedule shifts to the left, and the exchange rate rises. This yields the following conclusion: **A decrease in i^F shifts the R^F schedule to the left and causes the domestic currency to appreciate ($E \uparrow$).**

Changes in the Expected Future Exchange Rate. Any factor that causes the expected future exchange rate E_{t+1}^e to fall decreases the expected appreciation of the dollar and hence raises the expected appreciation of the euro. The result is a higher expected return