Foreign Exchange Markets and Rates of Return

People trade one national currency for another for one reason: they want to do something with the other currency. What they might do consists of one of two things: either they wish to spend the money, acquiring goods and services, or they wish to invest the money.

This chapter introduces the foreign exchange market for currency trades. It highlights some of the more obvious, although sometimes confusing, features and then turns attention to the motivations of foreign investors. One of the prime motivations for investing in another country is because one hopes to make more money on an investment abroad. How an investor calculates and compares those rates of returns are explored in this chapter.

1. THE FOREX: PARTICIPANTS AND OBJECTIVES

LEARNING OBJECTIVE

1. Learn who participates in foreign exchange markets and why.

The foreign exchange market (Forex) is not a market like the New York Stock Exchange, where daily trades of stock are conducted in a central location. Instead, the Forex refers to the activities of major international banks that engage in currency trading. These banks act as intermediaries between the true buyers and sellers of currencies (i.e., governments, businesses, and individuals). These banks will hold foreign currency deposits and stand ready to exchange these for domestic currency upon demand. The exchange rate (ER) will be determined independently by each bank but will essentially be determined by supply and demand in the market. In other words, the bank sets the exchange rate at each moment to equalize its supply of foreign currency with the market demand. Each bank makes money by collecting a transactions fee for its "exchange services."

It is useful to categorize two distinct groups of participants in the Forex, those whose transactions are recorded on the current account (importers and exporters) and those whose transactions are recorded on the financial account (investors).

1.1 Importers and Exporters

Anyone who imports or exports goods and services will need to exchange currencies to make the transactions. This includes tourists who travel abroad; their transactions would appear as services in the current account. These businesses and individuals will engage in currency trades daily; however, these transactions are small in comparison to those made by investors.

1.2 International Investors, Banks, Arbitrageurs, and Others

Most of the daily currencies transactions are made by investors. These investors, be they investment companies, insurance companies, banks, or others, are making currency transactions to realize a greater return on their investments or holdings. Many of these companies are responsible for managing the savings of others. Pension plans and mutual funds buy and sell billions of dollars worth of assets daily. Banks, in the temporary possession of the deposits of others, do the same. Insurance companies

manage large portfolios that act as their capital to be used to pay off claims on accidents, casualties, and deaths. More and more of these companies look internationally to make the most of their investments.

It is estimated by the Bank of International Settlements that over $3 trillion (or $3,000 billion) worth of currency is traded every day. Only about $60 to $100 billion of trade in goods and services takes place daily worldwide. This suggests that many of the currency exchanges are done by international investors rather than importers and exporters.

1.3 Investment Objectives

Investors generally have three broad concerns when an investment is made. They care about how much money the investment will earn over time, they care about how risky the investment is, and they care about how liquid, or convertible, the asset is.

rate of return (RoR)
The percentage change in the value of an asset over some period.

1. **Rate of return (RoR)**. The percentage change in the value of an asset over some period.

   Investors purchase assets as a way of saving for the future. Anytime an asset is purchased, the purchaser is forgoing current consumption for future consumption. To make such a transaction worthwhile the investors hope (sometimes expect) to have more money for future consumption than the amount they give up in the present. Thus investors would like to have as high a rate of return on their investments as possible.

   Example 1: Suppose a Picasso painting is purchased in 1996 for $500,000. One year later, the painting is resold for $600,000. The rate of return is calculated as

   $$\frac{(600{,}000 - 500{,}000)}{500{,}000} \times 100 = \frac{100{,}000}{500{,}000} \times 100 = 0.20 \times 100 = 20\%.$$

   Example 2: $1,000 is placed in a savings account for one year at an annual interest rate of 10 percent. The interest earned after one year is $1,000 × 0.10 = $100. Thus the value of the account after one year is $1,100. The rate of return is

   $$\frac{1100 - 1000}{1000} \times 100 = \frac{100}{1000} \times 100 = 0.10 \times 100 = 10\%.$$

   This means that the rate of return on a domestic interest-bearing account is merely the interest rate.

2. **Risk**. The second primary concern of investors is the riskiness of the assets. Generally, the greater the expected rate of return, the greater the risk. Invest in an oil wildcat endeavor and you might get a 1,000 percent return on your investment—that is, if you strike oil. The chances of doing so are likely to be very low, however. Thus a key concern of investors is how to manage the trade-off between risk and return.
3. **Liquidity**. Liquidity essentially means the speed with which assets can be converted to cash. Insurance companies need to have assets that are fairly liquid in the event that they need to pay out a large number of claims. Banks also need to be able to make payouts to their depositors, who may request their money back at any time.

KEY TAKEAWAYS

- Participants in the foreign exchange markets can be classified into traders and investors.
- Traders export or import goods and services whose transactions appear on the current account of the balance of payments.
- Investors purchase or sell assets whose transactions appear on the financial account of the balance of payments.
- The three main concerns for any investor are first to obtain a high rate of return, second to minimize the risk of default, and third to maintain an acceptable degree of liquidity.
- The rate of return on an asset is the percentage change in its value over a period.

EXERCISE

1. ***Jeopardy Questions***. As in the popular television game show, you are given an answer to a question and you must respond with the question. For example, if the answer is "a tax on imports," then the correct question is "What is a tariff?"
   a. This group enters the foreign exchange market to make transactions that will be recorded on the current account.
   b. This group enters the foreign exchange market to make transactions that will be recorded on the financial account.
   c. The percentage change in the value of an asset over some period.
   d. The term used to describe the ease with which an asset can be converted to cash.
   e. The term used to describe the possibility that an asset will not return what is originally expected.
   f. A list of three main objectives for international investors.
   g. The rate of return on a share of stock whose value rises during the year from $5.50 per share to $6.50 per share.
   h. The rate of return on a commercial office building that was purchased one year ago for $650,000 and sold today for $600,000.

2. EXCHANGE RATE: DEFINITIONS

LEARNING OBJECTIVE

1. **Learn some of the basic definitions regarding currency markets and exchange rates.**

Anyone who has ever traveled to another country has probably had to deal with an exchange rate between two currencies. (I say "probably" because a person who travels from, say, Italy to Spain continues to use euros.) In a sense, exchange rates are very simple. However, despite their simplicity they never fail to generate confusion. To overcome that confusion this chapter begins by offering straightforward definitions and several rules of thumb that can help with these problems.

The **exchange rate (ER)** represents the number of units of one currency that exchanges for a unit of another. There are two ways to express an exchange rate between two currencies (e.g., between the U.S. dollar [$] and the British pound [£]). One can either write $/£ or £/$. These are reciprocals of each other. Thus if E is the $/£ exchange rate and V is the £/$ exchange rate, then $E = 1/V$.

exchange rate (ER)
Represents the number of units of one currency that exchanges for a unit of another.

For example, on January 6, 2010, the following exchange rates prevailed:

$$E_{\$/£} = 1.59, \text{ which implies } V_{£/\$} = 0.63,$$

and

$$V_{¥/\$} = 92.7, \text{ which implies } E_{\$/¥} = 0.0108.$$

2.1 Currency Value

It is important to note that the value of a currency is always given in terms of another currency. Thus the value of a U.S. dollar in terms of British pounds is the £/$ exchange rate. The value of the Japanese yen in terms of dollar is the $/¥ exchange rate.

Note that we always express the value of all items in terms of something else. Thus the value of a quart of milk is given in dollars, not in quarts of milk. The value of car is also given in dollar terms, not in terms of cars. Similarly, the value of a dollar is given in terms of something else, usually another currency. Hence, the rupee/dollar exchange rate gives us the value of the dollar in terms of rupees.

This definition is especially useful to remember when one is dealing with unfamiliar currencies. Thus the value of the euro (€) in terms of British pounds is given as the £/€ exchange rate.

Similarly, the peso/euro exchange rate refers to the value of the euro in terms of pesos.

currency appreciation

A currency *appreciates* with respect to another when *its value rises* in terms of the other.

currency depreciation

A currency *depreciates* with respect to another when *its value falls* in terms of the other.

Currency appreciation means that a currency *appreciates* with respect to another when *its value rises* in terms of the other. The dollar appreciates with respect to the yen if the ¥/$ exchange rate rises.

Currency depreciation, on the other hand, means that a currency *depreciates* with respect to another when *its value falls* in terms of the other. The dollar depreciates with respect to the yen if the ¥/$ exchange rate falls.

Note that if the ¥/$ rate rises, then its reciprocal, the $/¥ rate, falls. Since the $/¥ rate represents the value of the yen in terms of dollars, this means that when the dollar appreciates with respect to the yen, the yen must depreciate with respect to the dollar.

The rate of appreciation (or depreciation) is the percentage change in the value of a currency over some period.

Example 1: U.S. dollar (US$) to the Canadian dollar (C$)

$$\text{On January 6, 2010, } E_{C\$/US\$} = 1.03.$$

$$\text{On January 6, 2009, } E_{C\$/US\$} = 1.19.$$

Use the percentage change formula, (new value − old value)/old value:

$$\frac{(1.03 - 1.19)}{1.19} = \frac{-0.16}{1.19} = -0.134.$$

Multiply by 100 to write as a percentage to get

$$-0.134 \times 100 = -13.4\%.$$

Since we have calculated the change in the value of the U.S. dollar in terms of Canadian dollar, and since the percentage change is negative, this means that the dollar has depreciated by 13.4 percent with respect to the C$ during the previous year.

Example 2: U.S. dollar ($) to the Pakistani rupee (R)

$$\text{On January 6, 2010, } E_{R/\$} = 84.7.$$

$$\text{On January 6, 2010, } E_{R/\$} = 79.1.$$

Use the percentage change formula, (new value − old value)/old value:

$$\frac{(84.7 - 79.1)}{79.1} = +\frac{5.6}{79.1} = +0.071.$$

Multiply by 100 to write as a percentage to get

$$+0.071 \times 100 = +7.1\%.$$

Since we have calculated the change in the value of the U.S. dollar, in terms of rupees, and since the percentage change is positive, this means that the dollar has appreciated by 7.1 percent with respect to the Pakistani rupee during the past year.

2.2 Other Exchange Rate Terms

arbitrage

The process of buying a product when its price is low and then reselling it after its price rises to make a profit.

spot exchange rate

The exchange rate that prevails *on the spot*, that is, for trades to take place immediately.

Arbitrage generally means buying a product when its price is low and then reselling it after its price rises in order to make a profit. Currency arbitrage means buying a currency in one market (e.g., New York) at a low price and reselling, moments later, in another market (e.g., London) at a higher price.

The **spot exchange rate** refers to the exchange rate that prevails *on the spot*, that is, for trades to take place immediately. (Technically, it is for trades that occur within two days.)

The **forward exchange rate** refers to the rate that appears on a contract to exchange currencies either 30, 60, 90, or 180 days in the future.

forward exchange rate

The rate that appears on a contract to exchange currencies either 30, 60, 90, or 180 days in the future.

For example, a corporation might sign a contract with a bank to buy euros for U.S. dollars sixty days from now at a predetermined ER. The predetermined rate is called the sixty-day forward rate. Forward contracts can be used to reduce exchange rate risk.

For example, suppose an importer of BMWs is expecting a shipment in sixty days. Suppose that upon arrival the importer must pay €1,000,000 and the current spot ER is 1.20 $/€.

Thus if the payment were made today it would cost $1,200,000. Suppose further that the importer is fearful of a U.S. dollar depreciation. He doesn't currently have the $1,200,000 but expects to earn more than enough in sales over the next two months. If the U.S. dollar falls in value to, say, 1.30 $/€ within sixty days, how much would it cost the importer in dollars to purchase the BMW shipment?

The shipment would still cost €1,000,000. To find out how much this is in dollars, multiply €1,000,000 by 1.30 $/€ to get $1,300,000.

Note that this is $100,000 more for the cars simply because the U.S. dollar value changed.

One way the importer could protect himself against this potential loss is to purchase a forward contract to buy euros for U.S. dollars in sixty days. The ER on the forward contract will likely be different from the current spot ER. In part, its value will reflect market expectations about the degree to which currency values will change in the next two months. Suppose the current sixty-day forward ER is 1.25 $/€, reflecting the expectation that the U.S. dollar value will fall. If the importer purchases a sixty-day contract to buy €1,000,000, it will cost him $1,250,000 (i.e., $1,000,000 × 1.25 $/€). Although this is higher than what it would cost if the exchange were made today, the importer does not have the cash available to make the trade today, and the forward contract would protect the importer from an even greater U.S. dollar depreciation.

When the forward ER is such that a forward trade costs more than a spot trade today costs, there is said to be a **forward premium**. If the reverse were true, such that the forward trade were cheaper than a spot trade, then there is a **forward discount**.

forward premium

When the forward exchange rate is such that a forward trade costs more (or buys less foreign currency) than a trade on the spot market today.

forward discount

When the forward exchange rate is such that a forward trade costs less (or buys more foreign currency) than a trade on the spot market today.

A currency trader is **hedging** if he or she enters into a forward contract to protect oneself from a downside loss. However, by hedging the trader also forfeits the potential for an upside gain. Suppose in the story above that the spot ER falls rather than rises. Suppose the ER fell to 1.10 $/€. In this case, had the importer waited, the €1,000,000 would only have cost $1,100,000 (i.e., $1,000,000 × 1.10 $/€). Thus hedging protects against loss but at the same time eliminates potential unexpected gain.

hedging

The process of protecting oneself from the riskiness of exchange rate movements; one method is by entering into a forward contract.

KEY TAKEAWAYS

- An exchange rate denominated *x/y* gives the value of *y* in terms of *x*. When an exchange rate denominated *x/y* rises, then *y* has appreciated in value in terms of *x*, while *x* has depreciated in terms of *y*.
- Spot exchange rates represent the exchange rate prevailing for currency trades today. Forward, or future, exchange rates represent the exchange values on trades that will take place in the future to fulfill a predetermined contract.
- Currency arbitrage occurs when someone buys a currency at a low price and sells shortly afterward at a higher price to make a profit.
- Hedging refers to actions taken to reduce the risk associated with currency trades.

EXERCISES

1. ***Jeopardy Questions***. As in the popular television game show, you are given an answer to a question and you must respond with the question. For example, if the answer is "a tax on imports," then the correct question is "What is a tariff?"
    a. The term used to describe an increase in the value of the yen.
    b. This currency value is expressed by the euro/peso exchange rate.
    c. This has happened to the value of the U.S. dollar if the dollar/euro exchange rate rises from 1.10 $/€ to 1.20 $/€.
    d. The term used to describe the process of buying low and selling high to make a profit.
    e. The term used to describe the exchange rate that appears on a contract to exchange currencies either 30, 60, 90, or 180 days in the future.
    f. The term used to describe the exchange rate that prevails for (almost) immediate trades.
    g. The term used to describe process of protecting oneself from the riskiness of exchange rate movements.
2. Use the exchange rate data in the table to answer the following questions. The first two exchange rates are the spot rates on those dates. The third exchange rate is the one-year forward exchange rate as of February 2004.

	February 4, 2003	February 4, 2004	Forward February 4, 2005
United States–Europe	1.08 $/€	1.25 $/€	1.24 $/€
South Africa–United States	8.55 rand/$	6.95 rand/$	7.42 rand/$

    a. Calculate the rate of change in the euro value relative to the dollar between 2003 and 2004.
    b. Calculate the rate of change in the dollar value relative to the euro between 2003 and 2004.
    c. Calculate the rate of change in the dollar value relative to the South African rand between 2003 and 2004.
    d. Calculate the expected change in the dollar value relative to the euro between 2004 and 2005.
    e. Calculate the expected change in the dollar value relative to the rand between 2004 and 2005.

3. CALCULATING RATE OF RETURNS ON INTERNATIONAL INVESTMENTS

LEARNING OBJECTIVE

1. **Learn how to calculate the rate of return (RoR) for a domestic deposit and a foreign deposit.**

certificate of deposit (CD)
A type of deposit that provides a higher rate of interest to the depositor in return for a promise to keep the money deposited for a fixed amount of time.

Suppose that an investor holding U.S. dollars must decide between two investments of equal risk and liquidity. Suppose one potential investment is a one-year **certificate of deposit (CD)** issued by a U.S. bank while a second potential investment is a one-year CD issued by a British bank. For simplicity we'll assume that interest is calculated on both CDs using a simple interest rather than with a compounding formula. A CD is a type of deposit that provides a higher rate of interest to the depositor in return for a promise to keep the money deposited for a fixed amount of time. The time period could be six months, one year, two years, or any other period decided by the bank. If the depositor wants to withdraw the money earlier, she must pay a penalty.

Since we imagine that an investor wants to obtain the highest rate of return (RoR) possible, given acceptable risk and liquidity characteristics, that investor will choose the investment with the highest rate of return. If the investor acted naively, she might simply compare interest rates between the two investments and choose the one that is higher. However, this would not necessarily be the best choice. To see why, we need to walk through the calculation of rates of return on these two investments.

First, we need to collect some data, which we will do in general terms rather than use specific values. Examples with actual values are presented in a later section.

Let $E_{\$/£}$ = the spot ER.

$E_{\$/£}^{e}$ = the expected ER one year from now.

$i_{\$}$ = the one-year interest rate on a CD in the United States (in decimal form).

$i_{£}$ = the one-year interest rate on a CD in Britain (in decimal form).

3.1 U.S. Rate of Return

The rate of return on the U.S. CD is simply the interest rate on that deposit. More formally,

$$RoR_{\$} = i_{\$}.$$

This is because the interest rate describes the percentage increase in the value of the deposit over the course of the year. It is also simple because there is no need to convert currencies.

3.2 British Rate of Return

The rate of return on the British CD is more difficult to determine. If a U.S. investor, with dollars, wants to invest in the British CD, she must first exchange dollars for pounds on the spot market and then use the British pound (£) to purchase the British CD. After one year, she must convert pounds back to dollars at the exchange rate that prevails then. The rate of return on that investment is the percentage change in dollar value during the year. To calculate this we can follow the procedure below.

Suppose the investor has P dollars to invest (P for principal).

Step 1: Convert the dollars to pounds.

$\frac{P}{E_{\$/£}}$ is the number of pounds the investor will have at the beginning of the year.

Step 2: Purchase the British CD and earn interest in pounds during the year.

$\frac{P}{E_{\$/£}}(1 + i_{£})$ is the number of pounds the investor will have at the end of the year. The first term in parentheses returns the principal. The second term is the interest payment.

Step 3: Convert the principal plus interest back into dollars in one year.

$\frac{P}{E_{\$/£}}(1 + i_{£})E^{e}_{\$/£}$ is the number of dollars the investor can expect to have at the end of the year.

The rate of return in dollar terms from this British investment can be found by calculating the expected percentage change in the value of the investor's dollar assets over the year, as shown below:

$$RoR_{£} = \frac{\frac{P}{E_{\$/£}}(1 + i_{£})E^{e}_{\$/£} - P}{P}.$$

After factoring out the P, this reduces to

$$RoR_{£} = \frac{E^{e}_{\$/£}}{E_{\$/£}}(1 + i_{£}) - 1.$$

Thus the rate of return on the foreign investment is more complicated because the set of transactions is more complicated. For the U.S. investment, the depositor simply deposits the dollars and earns dollar interest at the rate given by the interest rate. However, for the foreign deposit, the investor must first convert currency, then deposit the money abroad earning interest in foreign currency units, and finally reconvert the currency back to dollars. The rate of return depends not only on the foreign interest rate but also on the spot exchange rate and the expected exchange rate one year in the future.

Note that according to the formula, the rate of return on the foreign deposit is positively related to changes in the foreign interest rate and the expected foreign currency value and negatively related to the spot foreign currency value.

KEY TAKEAWAYS

- For a dollar investor, the rate of return on a U.S. deposit is equal to the interest rate: $RoR_{\$} = i_{\$}$.
- For a dollar investor, the rate of return on a foreign deposit depends on the foreign interest rate, the spot exchange rate, and the exchange rate expected to prevail at the time the deposit is redeemed: In particular, $RoR_{£} = \frac{E^{e}_{\$/£}}{E_{\$/£}}(1 + i_{£}) - 1$.

EXERCISE

1. ***Jeopardy Questions***. As in the popular television game show, you are given an answer to a question and you must respond with the question. For example, if the answer is "a tax on imports," then the correct question is "What is a tariff?"
    a. These three variables influence the rate of return on a foreign deposit.
    b. For a U.S. dollar investor, this is the rate of return on a U.S. dollar deposit yielding 3 percent per year.
    c. The term used to describe the exchange rate predicted to prevail at some point in the future.
    d. The term for the type of bank deposit that offers a higher yield on a deposit that is maintained for a predetermined period of time.

4. INTERPRETATION OF THE RATE OF RETURN FORMULA

LEARNING OBJECTIVE

1. **Break down the rate of return on foreign deposits into three distinct components.**

Although the derivation of the rate of return formula is fairly straightforward, it does not lend itself easily to interpretation or intuition. By applying some algebraic "tricks," it is possible to rewrite the British rate of return formula in a form that is much more intuitive.

Step 1: Begin with the British rate of return formula derived in Chapter 15, Section 3:

$$RoR_{£} = \frac{E^{e}_{\$/£}}{E_{\$/£}}(1 + i_{£}) - 1.$$

Step 2: Factor out the term in parentheses. Add $i_{£}$ and then subtract it as well. Mathematically, a term does not change in value if you add and subtract the same value:

$$RoR_{£} = \frac{E^{e}_{\$/£}}{E_{\$/£}} + i_{£}\frac{E^{e}_{\$/£}}{E_{\$/£}} - 1 + i_{£} - i_{£}.$$

Step 3: Change the (-1) in the expression to its equivalent, $-\frac{E_{\$/£}}{E_{\$/£}}$. Also change $-i_{£}$ to its equivalent, $-i_{£}\frac{E_{\$/£}}{E_{\$/£}}$. Since $\frac{E_{\$/£}}{E_{\$/£}} = 1$, these changes do not change the value of the rate of return expression:

$$RoR_{£} = \frac{E^{e}_{\$/£}}{E_{\$/£}} + i_{£}\frac{E^{e}_{\$/£}}{E_{\$/£}} - \frac{E_{\$/£}}{E_{\$/£}} + i_{£} - i_{£}\frac{E_{\$/£}}{E_{\$/£}}.$$

Step 4: Rearrange the expression:

$$RoR_{£} = i_{£} + \frac{E^{e}_{\$/£}}{E_{\$/£}} - \frac{E_{\$/£}}{E_{\$/£}} + i_{£}\frac{E^{e}_{\$/£}}{E_{\$/£}} - i_{£}\frac{E_{\$/£}}{E_{\$/£}}.$$

Step 5: Simplify by combining terms with common denominators:

$$RoR_{£} = i_{£} + \frac{E^{e}_{\$/£} - E_{\$/£}}{E_{\$/£}} + i_{£}\frac{E^{e}_{\$/£} - E_{\$/£}}{E_{\$/£}}.$$

Step 6: Factor out the percentage change in the exchange rate term:

$$RoR_{£} = i_{£} + (1 + i_{£})\frac{E^{e}_{\$/£} - E_{\$/£}}{E_{\$/£}}.$$

This formula shows that the expected rate of return on the British asset depends on two things, the British interest rate and the expected percentage change in the value of the pound. Notice that if $\frac{E^{e}_{\$/£} - E_{\$/£}}{E_{\$/£}}$ is a positive number, then the expected \$/£ ER is greater than the current spot ER, which means that one expects a pound appreciation in the future. Furthermore, $\frac{E^{e}_{\$/£} - E_{\$/£}}{E_{\$/£}}$ represents the expected rate of appreciation of the pound during the following year. Similarly, if $\frac{E^{e}_{\$/£} - E_{\$/£}}{E_{\$/£}}$ were negative, then it corresponds to the expected rate of depreciation of the pound during the subsequent year.

The expected rate of change in the pound value is multiplied by $(1 + i_{£})$, which generally corresponds to a principal and interest component in a rate of return calculation.

To make sense of this expression, it is useful to consider a series of simple numerical examples.

Suppose the following values prevail,

$i_{£}$	5% per year
$E^{e}_{\$/£}$	1.1 \$/£
$E_{\$/£}$	1.0 \$/£

Plugging these into the rate of return formula yields

$$RoR_{£} = 0.05 + (1 + 0.05)\frac{1.10 - 1.00}{1.00}, \infty$$

which simplifies to

$$RoR£ = 0.05 + (1 + 0.05) \times 0.10 = .155 \text{ or } 15.5\%.$$

Note that because of the exchange rate change, the rate of return on the British asset is considerably higher than the 5 percent interest rate.

To decompose these effects suppose that the British asset yielded no interest whatsoever.

This would occur if the individual held pound currency for the year rather than purchasing a CD. In this case, the rate of return formula reduces to

$$RoR£ = 0.0 + (1 + 0.0) \times 0.10 = .10 \text{ or } 10\%.$$

This means that 10 percent of the rate of return arises solely because of the pound appreciation. Essentially an investor in this case gains because of currency arbitrage over time. Remember that arbitrage means buying something when its price is low, selling it when its price is high, and thus making a profit on the series of transactions. In this case, the investor buys pounds at the start of the year, when their price (in terms of dollars) is low, and then resells them at the end of the year when their price is higher.

Next, suppose that there was no exchange rate change during the year, but there was a 5 percent interest rate on the British asset. In this case, the rate of return becomes

$$RoR£ = 0.05 + (1 + 0.05) \times 0.0 = .05 \text{ or } 5\%.$$

Thus with no change in the exchange rate, the rate of return reduces to the interest rate on the asset.

Finally, let's look back at the rate of return formula:

$$RoR_{£} = i_{£} + (1 + i_{£})\frac{E^{e}_{\$/£} - E_{\$/£}}{E_{\$/£}}.$$

The first term simply gives the contribution to the total rate of return that derives solely from the interest rate on the foreign asset. The second set of terms has the percentage change in the exchange rate times one plus the interest rate. It corresponds to the contribution to the rate of return that arises solely due to the exchange rate change. The one plus interest rate term means that the exchange rate return can be separated into two components, a principal component and an interest component.

Suppose the exchange rate change is positive. In this case, the principal that is originally deposited will grow in value by the percentage exchange rate change. But the principal also accrues interest and as the £ value rises, the interest value, in dollar terms, also rises.

Thus the second set of terms represents the percentage increase in the value of one's principal and interest that arises solely from the change in the exchange rate.

KEY TAKEAWAYS

- The rate of return on a foreign deposit consists of three components: the interest rate itself, the change in the value of the principal due to the exchange rate change, and the change in the value of the interest due to the exchange rate change.
- Another formula, but one that is equivalent to the one in the previous section, for the rate of return on a foreign deposit is $RoR_{£} = i_{£} + (1 + i_{£})\frac{E^{e}_{\$/£} - E_{\$/£}}{E_{\$/£}}$.

EXERCISES

1. Consider the following data. Suppose the expected exchange rates are the average expectations by investors for exchange rates in one year. Imagine that the interest rates are for equally risky assets and are annual rates.

	United States	Australia	Singapore
Current Exchange Rate	–	1.80 A$/US$	1.75 S$/US$
Expected Exchange Rate	–	1.90 A$/US$	1.65 S$/US$
Current Interest Rate (%)	2.0	4.0	1.0

   a. Calculate the rate of return for a U.S. dollar investor investing in the Australian deposit for one year.
   b. Calculate the rate of return for a U.S. dollar investor investing in the Singapore deposit for one year.
   c. Among these three options (United States, Australia, and Singapore), which is the best place for the investor to invest? Which is the worst place?

2. The covered interest parity condition substitutes the forward exchange rate for the expected exchange rate. The condition is labeled "covered" because the forward contract assures a certain rate of return (i.e., without risk) on foreign deposits. The table below lists a spot exchange rate, a ninety-day forward rate, and a ninety-day money market interest rate in Germany and Canada. Use this information to answer the following questions.

	Germany	Canada
Spot Exchange Rate	0.5841 $/DM	0.7451 US$/C$
90-Day Forward Exchange Rate	0.5807 $/DM	0.7446 US$/C$
90-Day Interest Rate (%)	1.442	0.875

   What would the U.S. ninety-day interest rate have to be for the United States to have the highest rate of return for a U.S. investor? (Use the exact formulas to calculate the rates of return.)

5. APPLYING THE RATE OF RETURN FORMULAS

LEARNING OBJECTIVE

1. **Learn how to apply numerical values for exchange rates and interest rates to the rate of return formulas to determine the best international investment.**

Use the data in the tables below to calculate in which country it would have been best to purchase a one-year interest-bearing asset.[1]

5.1 Example 1

Consider the following data for interest rates and exchange rates in the United States and Britain:

$i_{\$}$	2.37% per year
$i_{£}$	4.83% per year
$E^{04}_{\$/£}$	1.96 \$/£
$E^{05}_{\$/£}$	1.75 \$/£

We imagine that the decision is to be made in 2004, looking forward into 2005. However, we calculate this in hindsight after we know what the 2005 exchange rate is. Thus we plug in the 2005 rate for the expected exchange rate and use the 2004 rate as the current spot rate. Thus the ex-post (i.e., after the fact) rate of return on British deposits is given by

$$RoR_{£} = 0.0483 + (1 + 0.0483)\frac{1.75 - 1.96}{1.96},$$

which simplifies to

$$RoR_{£} = 0.0483 + (1 + 0.0483)(-0.1071) = -0.064 \text{ or } -6.4\%.$$

A negative rate of return means that the investor would have lost money (in dollar terms) by purchasing the British asset.

Since $RoR_{\$} = 2.37\% > RoR_{£} = -6.4\%$, the investor seeking the highest rate of return should have deposited her money in the U.S. account.

5.2 Example 2

Consider the following data for interest rates and exchange rates in the United States and Japan.

$i_{\$}$	2.37% per year
$i_{¥}$	0.02% per year
$E^{04}_{¥/\$}$	104 ¥/\$
$E^{05}_{¥/\$}$	120 ¥/\$

Again, imagine that the decision is to be made in 2004, looking forward into 2005. However, we calculate this in hindsight after we know what the 2005 exchange is. Thus we plug in the 2005 rate for the expected exchange rate and use the 2004 rate as the current spot rate. Note also that the interest rate in Japan *really* was 0.02 percent. It was virtually zero.

Before calculating the rate of return, it is necessary to convert the exchange rate to the yen equivalent rather than the dollar equivalent. Thus

$$E^{04}_{\$/¥} = \frac{1}{104} = 0.0096 \text{ and } E^{05}_{\$/¥} = \frac{1}{120} = 0.0083.$$

Now, the ex-post (i.e., after the fact) rate of return on Japanese deposits is given by

$$RoR_{¥} = 0.0002 + (1 + 0.0002)\frac{0.0083 - 0.0096}{0.0096},$$

which simplifies to

$$RoR_{¥} - 0.0002 + (1 + 0.0002)(-0.1354) = -0.1352 \text{ or } -13.52\%.$$

A negative rate of return means that the investor would have lost money (in dollar terms) by purchasing the Japanese asset.

Since $RoR_{\$} = 2.37\% > RoR_{¥} = -13.52\%$, the investor seeking the highest rate of return should have deposited his money in the U.S. account.

5.3 Example 3

Consider the following data for interest rates and exchange rates in the United States and South Korea. Note that South Korean currency is in won (W).

$i_{\$}$	2.37% per year
i_{W}	4.04% per year
$E^{04}_{W/\$}$	1,059 W/$
$E^{05}_{W/\$}$	1,026 W/$

As in the preceding examples, the decision is to be made in 2004, looking forward to 2005. However, since the previous year interest rate is not listed, we use the current short-term interest rate. Before calculating the rate of return, it is necessary to convert the exchange rate to the won equivalent rather than the dollar equivalent. Thus

$$E^{04}_{\$/W} = \frac{1}{1059} = 0.000944 \text{ and } E^{05}_{\$/W} = \frac{1}{1026} = 0.000975.$$

Now, the ex-post (i.e., after the fact) rate of return on Italian deposits is given by

$$RoR_{W} = 0.0404 + (1 + 0.0404)\frac{0.000975 - 0.000944}{0.000944},$$

which simplifies to

$$RoR_{W} = 0.0404 + (1 + 0.0404)(0.0328) = 0.0746 \text{ or } +7.46\%.$$

In this case, the positive rate of return means an investor would have made money (in dollar terms) by purchasing the South Korean asset.

Also, since $RoR_{\$} = 2.37$ percent $< RoR_{W} = 7.46$ percent, the investor seeking the highest rate of return should have deposited his money in the South Korean account.

KEY TAKEAWAY

- An investor should choose the deposit or asset that promises the highest expected rate of return assuming equivalent risk and liquidity characteristics.

EXERCISES

1. Consider the following data collected on February 9, 2004. The interest rate given is for a one-year money market deposit. The spot exchange rate is the rate for February 9. The expected exchange rate is the one-year forward rate. Express each answer as a percentage.

$i_{C\$}$	2.5%
$E_{US\$/C\$}$	0.7541 US$/C$
$E^e_{US\$/C\$}$	0[0].7468 US$/C$

   a. Use both RoR formulas (one from Chapter 15, Section 3, the other from Chapter 15, Section 4, Step 5) to calculate the expected rate of return on the Canadian money market deposit and show that both formulas generate the same answer.
   b. What part of the rate of return arises only due to the interest earned on the deposit?
   c. What part of the rate of return arises from the percentage change in the value of the principal due to the change in the exchange rate?
   d. What component of the rate of return arises from the percentage change in the value of the interest payments due to the change in the exchange rate?

2. Consider the following data collected on February 9, 2004. The interest rate given is for a one-year money market deposit. The spot exchange rate is the rate for February 9. The expected exchange rate is the one-year forward rate. Express each answer as a percentage.

$i_{£}$	4.5%
$E_{\$/£}$	1.8574 $/£
$E^e_{\$/£}$	1.7956 $/£

   a. Use both RoR formulas (one from Chapter 15, Section 3, the other from Chapter 15, Section 4, Step 5) to calculate the expected rate of return on the British money market deposit and show that both formulas generate the same answer.
   b. What part of the rate of return arises only due to the interest earned on the deposit?
   c. What part of the rate of return arises from the percentage change in the value of the principal due to the change in the exchange rate?
   d. What component of the rate of return arises from the percentage change in the value of the interest payments due to the change in the exchange rate?

ENDNOTES

1. These numbers were taken from the *Economist*, Weekly Indicators, December 17, 2005, p. 90, http://www.economist.com.

Fixed Exchange Rates

Fixed exchange rates around the world were once the only game in town; however, since the collapse of the Bretton Woods system in 1973, floating exchange rates predominate for the world's most-traded currencies. Nonetheless, many countries continue to use some variant of fixed exchange rates even today. This chapter addresses both the historical fixed exchange rate systems like the gold standard as well as the more modern variants like crawling pegs and currency boards.

1. OVERVIEW OF FIXED EXCHANGE RATES

LEARNING OBJECTIVE

1. **Preview the discussion about fixed exchange rate systems, their varieties, and their mechanisms.**

This chapter begins by defining several types of fixed exchange rate systems, including the gold standard, the reserve currency standard, and the gold exchange standard. The **price-specie flow mechanism** is described for the gold standard. It continues with other modern fixed exchange variations such as fixing a currency to a basket of several other currencies, crawling pegs, fixing within a band or range of exchange rates, currency boards, and finally the most extreme way to fix a currency: adopting another country's currency as your own, as is done with **dollarization** or euroization.

The chapter proceeds with the basic mechanics of a **reserve currency standard** in which a country fixes its currency to another's. In general, a country's central bank must intervene in the foreign exchange (Forex) markets, buying foreign currency whenever there is excess supply (resulting in a **balance of payments surplus**) and selling foreign currency whenever there is excess demand (resulting in a **balance of payments deficit**). These actions will achieve the fixed exchange rate version of the interest parity condition in which interest rates are equalized across countries. However, to make central bank actions possible, a country will need to hold a stock of foreign exchange reserves. If a country's central bank does not intervene in the Forex in a fixed exchange system, black markets are shown to be a likely consequence.

price-specie flow mechanism

A description about how adjustments to shocks or changes are handled within a pure gold standard system.

dollarization

Currency fixing by adopting the U.S. dollar as one's currency.

reserve currency standard

A currency standard in which all countries fix to one central reserve currency, while the reserve currency is not fixed to anything.

balance of payments surplus

The balance on the balance of payments when the central bank sells domestic currency and buys foreign currency.

balance of payments deficit

The balance on the balance of payments when the central bank buys domestic currency and sells foreign reserves.

1.1 Results

gold standard

A currency standard in which currency is fixed to a weight of gold, and the central bank freely exchanges gold for currency with the public.

- **Gold standard** rules: (1) fix currency to a weight of gold; (2) central bank freely exchanges gold for currency with public.
- Adjustment under a gold standard involves the flow of gold between countries, resulting in equalization of prices satisfying purchasing power parity (PPP) and/or equalization of rates of return on assets satisfying interest rate parity (IRP) at the current fixed exchange rate.
- Reserve currency rules: (1) fix currency to another currency, known as the reserve currency; (2) central bank must hold a stock of foreign exchange reserves to facilitate Forex interventions.
- Gold-exchange standard rules: (1) reserve country fixes its currency to a weight of gold, (2) all other countries fix their currencies to the reserve, (3) reserve central bank freely exchanges gold for currency with other central banks, (4) nonreserve countries hold a stock of the reserve currency to facilitate intervention in the Forex.
- The post–World War II fixed exchange rate system, known as the Bretton Woods system, was a gold exchange standard.
- Some countries fix their currencies to a weighted average of several other currencies, called a "basket of currencies."
- Some countries implement a crawling peg in which the fixed exchange rate is adjusted regularly.
- Some countries set a central exchange rate and allow free floating within a predefined range or band.
- Some countries implement currency boards to legally mandate Forex interventions.
- Some countries simply adopt another country's currency, as with dollarization, or choose a brand-new currency, as with the euro.
- The interest rate parity condition becomes the equalization of interest rates between two countries in a fixed exchange rate system.
- A balance of payments surplus (deficit) arises when the central bank buys (sells) foreign reserves on the Forex in exchange for its own currency.
- A black market in currency trade arises when there is unsatisfied excess demand or supply of foreign currency in exchange for domestic currency on the Forex.

KEY TAKEAWAY

- See the main results previewed above.

EXERCISE

1. ***Jeopardy Questions***. As in the popular television game show, you are given an answer to a question and you must respond with the question. For example, if the answer is "a tax on imports," then the correct question is "What is a tariff?"
    a. The term for the currency standard that fixes its circulating currency to a quantity of gold.
    b. The term for the currency standard in which a reserve currency is fixed to a quantity of gold while all other currencies are fixed to the reserve currency.
    c. The currency standard used during the post–World War II Bretton Woods era.
    d. The term describing the deficits and surpluses run by a country to maintain a fixed exchange rate.
    e. The term used to describe a decision by another country to adopt the U.S. dollar as its currency.
    f. The nonintervention in the Forex market by a country's central bank is likely to lead to the development of these kinds of market activities.

2. FIXED EXCHANGE RATE SYSTEMS

LEARNING OBJECTIVES

1. Recognize the varieties of ways that exchange rates can be fixed to a particular value.
2. Understand the basic operation and the adjustment mechanism of a gold standard.

There are two basic systems that can be used to determine the exchange rate between one country's currency and another's: a floating exchange rate system and a fixed exchange rate system.

Under a floating exchange rate system, the value of a country's currency is determined by the supply and demand for that currency in exchange for another in a private market operated by major international banks.

In contrast, in a fixed exchange rate system, a country's government announces (or decrees) what its currency will be worth in terms of *something else* and also sets up the *rules of exchange*. The "something else" to which a currency value is set and the "rules of exchange" determine the type of fixed exchange rate system, of which there are many. For example, if the government sets its currency value in terms of a fixed weight of gold, then we have a gold standard. If the currency value is set to a fixed amount of another country's currency, then it is a reserve currency standard.

As we review several ways in which a fixed exchange rate system can work, we will highlight some of the advantages and disadvantages of the system. In anticipation, it is worth noting that one key advantage of fixed exchange rates is the intention to eliminate exchange rate risk, which can greatly enhance international trade and investment. A second key advantage is the discipline a fixed exchange rate system imposes on a country's monetary authority, with the intention of inducing a much lower inflation rate.

2.1 The Gold Standard

Most people are aware that at one time the world operated under something called a gold standard. Some people today, reflecting back on the periods of rapid growth and prosperity that occurred when the world was on a gold standard, have suggested that the world abandon its current mixture of fixed and floating exchange rate systems and return to this system. (For a discussion of some pros and cons see Alan Greenspan's remarks on this from the early 1980s.[1] See Murray Rothbard's article for an argument in favor of a return to the gold standard.[2]) Whether or not countries seriously consider this in the future, it is instructive to understand the workings of a gold standard, especially since, historically, it is the first major international system of fixed exchange rates.

Most of the world maintained a pure gold standard during the late 1800s and early 1900s, with a major interruption during World War I. Before the enactment of a gold standard, countries were generally using a **Bimetallic standard** consisting of both gold and silver.[3] The earliest establishment of a gold standard was in Great Britain in 1821, followed by Australia in 1852 and Canada in 1853. The United States established its gold standard system with the Coinage Act of 1873, sometimes known as "The Crime of '73."[4] The gold standard was abandoned in the early days of the Great Depression. Britain dropped the standard in 1931, the United States in 1933.

Bimetallic standard

A currency standard using both gold and silver.

The rules of a gold standard are quite simple. First, a country's government declares that its issued currency (it may be coin or paper currency) will exchange for a weight in gold. For example, in the United States during the late 1800s and early 1900s, the government set the dollar exchange rate to gold at the rate $20.67 per troy ounce. During the same period, Great Britain set its currency at the rate £4.24 per troy ounce. Second, in a pure gold standard, a country's government declares that it will freely exchange currency for actual gold at the designated exchange rate. This "rule of exchange" means that anyone can go to the central bank with coin or currency and walk out with pure gold. Conversely, one could also walk in with pure gold and walk out with the equivalent in coin or currency.

Because the government bank must always be prepared to give out gold in exchange for coin and currency on demand, it must maintain a storehouse of gold. That store of gold is referred to as "**gold reserves**." That is, the central bank maintains a reserve of gold so that it can always fulfill its promise of exchange. As discussed in Chapter 22, Section 4, a well-functioning system will require that the central bank always have an adequate amount of reserves.

gold reserves

Gold held in storage by a central bank, usually to make possible the exchange of currency for gold under a gold standard.

The two simple rules, when maintained, guarantee that the exchange rate between dollars and pounds remains constant. Here's why.

First, the dollar/pound exchange rate is defined as the ratio of the two-currency-gold exchange rates. Thus

$$E_{\$/£} = \frac{20.67\ \$/\text{oz}}{4.24\ £/\text{oz}} = 4.875\frac{\$\ \text{oz}}{\text{oz}\ £} = 4.875\frac{\$}{£}.$$

Next, suppose an individual wants to exchange $4.875 for one pound. Following the exchange rules, this person can enter the central bank in the United States and exchange dollars for gold to get

$$\frac{\$4.875}{20.67\ \$/\text{oz}} = 0.23585 \text{ oz of gold.}$$

This person can then take the gold into the central bank in the United Kingdom, and assuming no costs of transportation, can exchange the gold into pounds as follows:

$$0.23585 \text{ oz} \times 4.24\frac{£}{\text{oz}} = £1.00.$$

Hence, the $4.875 converts to precisely £1 and this will remain the fixed exchange rate between the two currencies, as long as the simple exchange rules are followed. If many countries define the value of their own currency in terms of a weight of gold and agree to exchange gold freely at that rate with all who desire to exchange, then all these countries will have fixed currency exchange rates with respect to each other.

2.2 Price-Specie Flow Mechanism

The price-specie flow mechanism is a description about how adjustments to shocks or changes are handled within a pure gold standard system. Although there is some disagreement whether the gold standard functioned as described by this mechanism, the mechanism does fix the basic principles of how a gold standard is supposed to work.

Consider the United States and United Kingdom operating under a pure gold standard. Suppose there is a gold discovery in the United States. This will represent a shock to the system. Under a gold standard, a gold discovery is like digging up money, which is precisely what inspired so many people to *rush* to California after 1848 to strike it rich.

Once the gold is unearthed, the prospectors bring it into town and proceed to the national bank where it can be exchanged for coin and currency at the prevailing dollar/gold exchange rate. The new currency in circulation represents an increase in the domestic money supply.

Indeed, it is this very transaction that explains the origins of the gold and silver standards in the first place. The original purpose of banks was to store individuals' precious metal wealth and to provide exchangeable notes that were backed by the gold holdings in the vault. Thus rather than carrying around heavy gold, one could carry lightweight paper money. Before national or central banks were founded, individual commercial banks issued their own currencies, which circulated together with many other bank currencies. However, it was also common for governments to issue coins that were made directly from gold or silver.

Now, once the money supply increases following the gold discovery, it can have two effects: operating through the goods market and financial market. The price-specie flow mechanism describes the adjustment through goods markets.

First, let's assume that the money increase occurs in an economy that is not growing—that is, with a fixed level of GDP. Also assume that both purchasing power parity (PPP) and interest rate parity (IRP) holds. PPP implies an equalization of the cost of a market basket of goods between the United States and the United Kingdom at the current fixed exchange rate. IRP implies an equalization of the rates of return on comparable assets in the two countries.

As discussed in Chapter 18, [Unsupported Reference Type: chapter-section], when the U.S. money supply increases, and when there is no subsequent increase in output, the prices of goods and services will begin to rise. This inflationary effect occurs because more money is chasing (i.e., demanding) the same amount of goods and services. As the price level rises in an economy open to international trade, domestic goods become more expensive relative to foreign goods. This will induce domestic residents to increase demand for foreign goods; hence import demand will rise. Foreign consumers will also find domestic goods more expensive, so export supply will fall. The result is a demand for a current account deficit. To make these transactions possible in a gold standard, currency exchange will take place as follows.

U.S. residents wishing to buy cheaper British goods will first exchange dollars for gold at the U.S. central bank. Then they will ship that gold to the United Kingdom to exchange for the pounds that can be used to buy UK goods. As gold moves from the United States to the United Kingdom, the money supply in the United States falls while the money supply in the United Kingdom rises. Less money in the United States will eventually reduce prices, while more money in the United Kingdom will raise prices. This means that the prices of goods will move together until purchasing power parity holds again. Once PPP holds, there is no further incentive for money to move between countries. There will

continue to be demand for UK goods by U.S. residents, but this will balance with the United Kingdom demands for similarly priced U.S. goods. Hence, the trade balance reverts to zero.

The adjustment process in the financial market under a gold standard will work through changes in interest rates. When the U.S. money supply rises after the gold discovery, average interest rates will begin to fall. Lower U.S. interest rates will make British assets temporarily more attractive, and U.S. investors will seek to move investments to the United Kingdom. The adjustment under a gold standard is the same as with goods. Investors trade dollars for gold in the United States and move that gold to the United Kingdom where it is exchanged for pounds and used to purchase UK assets. Thus the U.S. money supply will begin to fall, causing an increase in U.S. interest rates, while the UK money supply rises, leading to a decrease in UK interest rates. The interest rates will move together until interest rate parity again holds.

In summary, *adjustment under a gold standard involves the flow of gold between countries, resulting in equalization of prices satisfying purchasing power parity (PPP) and/or equalization of rates of return on assets satisfying interest rate parity (IRP) at the current fixed exchange rate*. The only requirement for the government to maintain this type of fixed exchange rate system is to maintain the fixed price of its currency in terms of gold *and* to freely and readily exchange currency for gold on demand.

2.3 Reserve Currency Standard

In a reserve currency system, another country's currency takes the role that gold played in a gold standard. In other words a country fixes its own currency value to a unit of another country's currency. For example, suppose Britain decided to fix its currency to the dollar at the exchange rate $E_{\$/£} = 1.50$. To maintain this fixed exchange rate, the Bank of England would stand ready to exchange pounds for dollars (or dollars for pounds) on demand at the specified exchange rate. To accomplish this, the Bank of England would need to hold dollars *on reserve* in case there was ever any excess demand for dollars in exchange for pounds on the Forex. In the gold standard, the central bank held gold to exchange for its own currency; with a reserve currency standard, it must hold a stock of the reserve currency. Always, the reserve currency is the currency to which the country fixes.

A reserve currency standard is the typical method for fixing a currency today. Most countries that fix its exchange rate will fix to a currency that either is prominently used in international transactions or is the currency of a major trading partner. Thus many countries fixing their exchange rate today fix to the U.S. dollar because it is the most widely traded currency internationally. Alternatively, fourteen African countries that were former French colonies had established the CFA franc zone and fixed the CFA franc (current currency used by these African countries) to the French franc. Since 1999, the CFA franc has been fixed to the euro. Namibia, Lesotho, and Swaziland are all a part of the common monetary area (CMA) and fix their currency to the South African rand.

2.4 Gold Exchange Standard

A **gold exchange standard** is a mixed system consisting of a cross between a reserve currency standard and a gold standard. In general, it includes the following two rules:

gold exchange standard

When all countries fix to one central reserve currency, while the reserve currency is fixed to gold.

1. A reserve currency is chosen. All nonreserve countries agree to fix their exchange rates to the reserve at some announced rate. To maintain the fixity, these nonreserve countries will hold a stockpile of reserve currency assets.
2. The reserve currency country agrees to fix its currency value to a weight in gold. Finally, the reserve country agrees to exchange gold for its own currency with other central banks within the system on demand.

One key difference in this system from a gold standard is that the reserve country does not agree to exchange gold for currency with the general public, only with other central banks.

The system works exactly like a reserve currency system from the perspective of the nonreserve countries. However, if over time the nonreserve countries accumulate the reserve currency, they can demand exchange for gold from the reserve country central bank. In this case, gold reserves will flow away from the reserve currency country.

The fixed exchange rate system set up after World War II was a gold exchange standard, as was the system that prevailed between 1920 and the early 1930s. The post–World War II system was agreed to by the allied countries at a conference in Bretton Woods, New Hampshire, in the United States in June 1944. As a result, the exchange rate system after the war also became known as the **Bretton Woods system**.

Bretton Woods system

The fixed exchange rate system (using a gold exchange standard) set up after World War II and lasting until 1973.

International Monetary Fund (IMF)
The international organization created after World War II to oversee the Bretton Woods system of fixed exchange rates.

Also proposed at Bretton Woods was the establishment of an international institution to help regulate the fixed exchange rate system. This institution was the **International Monetary Fund (IMF)**. The IMF's main mission was to help maintain the stability of the Bretton Woods fixed exchange rate system.

2.5 Other Fixed Exchange Rate Variations

Basket of Currencies

Countries that have several important trading partners, or who fear that one currency may be too volatile over an extended period, have chosen to fix their currency to a basket of several other currencies. This means fixing to a weighted average of several currencies. This method is best understood by considering the creation of a composite currency. Consider the following hypothetical example: a new unit of money consisting of 1 euro, 100 Japanese yen, and one U.S. dollar. Call this new unit a Eur-yen-dol. A country could now fix its currency to one Eur-yen-dol. The country would then need to maintain reserves in one or more of the three currencies to satisfy excess demand or supply of its currency on the Forex.

special drawing rights (SDR)
A composite currency created by the International Monetary Fund (IMF), used only for transactions between central banks.

A better example of a composite currency is found in the SDR. SDR stands for **special drawing rights**. It is a composite currency created by the International Monetary Fund (IMF). One SDR now consists of a fixed quantity of U.S. dollars, euros, Japanese yen, and British pounds. For more info on the SDR see the IMF factsheet.[5] Now Saudi Arabia officially fixes its currency to the SDR. Botswana fixes to a basket consisting of the SDR and the South African rand.

Crawling Pegs

A crawling peg refers to a system in which a country fixes its exchange rate but also changes the fixed rate at periodic or regular intervals. Central bank interventions in the Forex may occur to maintain the temporary fixed rate. However, central banks can avoid interventions and save reserves by adjusting the fixed rate instead. Since crawling pegs are adjusted gradually, they can help eliminate some exchange rate volatility without fully constraining the central bank with a fixed rate. In 2010 Bolivia, China, Ethiopia, and Nicaragua were among several countries maintaining a crawling peg.

Pegged within a Band

In this system, a country specifies a central exchange rate together with a percentage allowable deviation, expressed as plus or minus some percentage. For example, Denmark, an EU member country, does not yet use the euro but participates in the Exchange Rate Mechanism (ERM2). Under this system, Denmark sets its central exchange rate to 7.46038 krona per euro and allows fluctuations of the exchange rate within a 2.25 percent band. This means the krona can fluctuate from a low of 7.63 kr/€ to a high of 7.29 kr/€. (Recall that the krona is at a high with the smaller exchange rate value since the kr/euro rate represents the euro value.) If the market determined floating exchange rate rises above or falls below the bands, the Danish central bank must intervene in the Forex. Otherwise, the exchange rate is allowed to fluctuate freely.

As of 2010, Slovenia, Syria, and Tonga were fixing their currencies within a band.

Currency Boards

A currency board is a legislated method to provide greater assurances that an exchange rate fixed to a reserve currency will indeed remain fixed. In this system, the government requires that domestic currency is always exchangeable for the specific reserve at the fixed exchange rate. The central bank authorities are stripped of all discretion in the Forex interventions in this system. As a result, they must maintain sufficient foreign reserves to keep the system intact.

In 2010 Bulgaria, Hong Kong, Estonia, and Lithuania were among the countries using a currency board arrangement. Argentina used a currency board system from 1991 until 2002. The currency board was very effective in reducing inflation in Argentina during the 1990s. However, the collapse of the exchange rate system and the economy in 2002 demonstrated that currency boards are not a panacea.

Dollarization/Euroization

The most extreme and convincing method for a country to fix its exchange rate is to give up one's national currency and adopt the currency of another country. In creating the euro-zone among twelve of the European Union (EU) countries, these European nations have given up their own national currencies and have adopted the currency issued by the European Central Bank. This is a case of euroization. Since all twelve countries now share the euro as a common currency, their exchange rates are