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# Foreign Exchange Markets and Transactions

Among the 193 countries in the world, there are over 164 different types of currencies with which individuals, companies, and governments conduct trade and financial transactions. Globalization and economic expansion creates a need for a mechanism to convert one currency into another. Without such a mechanism, it would be difficult for individuals to travel and spend money in other countries, for companies to purchase and import foreign goods, or for investors to participate in developing economies around the world. For example, vacationing in Thailand requires Thai bahts, importing German BMW's for resale in the U.S. requires euros, and investing in Mexican government bonds requires Mexican pesos. International trade requires individuals, companies, and institutions to negotiate and transact using foreign currencies.

The first section of this note, "The Foreign Exchange Market," provides an overview of the foreign exchange market and a brief outline of its development. The second section, "What is an Exchange Rate?" provides a definition of exchange rates and describes the different ways in which exchange rates are quoted and calculated. This section explains how to convert one currency into another currency, how to calculate cross-exchange rates, and the meaning of bid/ask quotes on the foreign exchange market. Readers who are already familiar with these foreign exchange calculations may skip this section. The third section, "Exchange Rate Movements," focuses on changes in exchange rates: what does it mean for a currency to appreciate or depreciate, how are these changes measured, and what do changes in exchange rates mean? The final section of the note, "Foreign Exchange Transactions," describes the different types of foreign exchange instruments, including spot transactions, forwards, swaps, futures, and options. The examples in this last section illustrate how different foreign exchange instruments work and how they are valued. Throughout the note, there are examples (in shaded boxes), and formulas (in white boxes) to assist the reader. Each section also includes references to exercises in the Appendix. These exercises test and reinforce the understanding of the various foreign exchange calculations and transactions covered in this note.

## Foreign Exchange Market

One currency is exchanged for another currency on the foreign exchange market. Until the 1970s, the foreign exchange market was small and specialized but the market changed fundamentally when the post-war Bretton Woods system broke down. Under the Bretton Woods system, the U.S. dollar

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was convertible to gold and other currencies were convertible to U.S. dollars at fixed exchange rates. In 1971, the U.S. suspended the convertibility of the dollar to gold, and by 1973 the U.S. and other nations had accepted floating exchange rates. The change to floating exchange rates, the growth in international trade, and the increase in capital flows around the world led to the rapid growth of the foreign exchange market. Today, it is the largest market in the world with $1.2 trillion average daily turnover in 2001. The U.S. dollar is involved in a majority of all transactions in the foreign exchange market, and in 2001 the most traded currency pair was the U.S. dollar/euro, accounting for 30% of average daily turnover.[1]

The market is an elaborate network of trading desks, banks, corporations, and individuals who buy and sell currencies all over the world. The largest trading center is the United Kingdom with 31% of foreign exchange turnover in 2001. The U.S. has a 16% share of foreign exchange trading, and Japan has a 9% share.[2] Australia, Hong Kong, Singapore, Switzerland, and Germany are also large centers for foreign exchange trading, and there are numerous smaller centers in other countries. These centers are highly integrated globally, 24 hours a day, with real-time price information gathered from numerous sources and distributed globally by firms such as Reuters and Moneyline Telerate.[3] Most trading is over-the-counter (OTC) and transactions include spot transactions, outright forwards and swaps. Other foreign exchange products – currency futures and currency options – are traded on organized exchanges. The major participants in the foreign exchange market are commercial and investment banks.

The foreign exchange market continues to evolve. The introduction of the euro eliminated the need for exchange among several European currencies and contributed to a 14% decline in foreign exchange market turnover between 1998 and 2001. World-wide consolidation in the financial sector has also affected market turnover, because of less interbank trading. The number of banks participating in the foreign exchange market declined from 2,417 to 1,945 between 1995 and 2001, and there is a trend towards fewer banks with larger market shares in the foreign exchange market.[4] Another significant change has been the introduction of electronic brokering systems. Such systems account for an increasing share of turnover, especially in the spot market, and there are initiatives to expand such systems into other market segments.[5]

## What is an Exchange Rate?

This section of the note provides a definition of exchange rates and explains how exchange rates are quoted and calculated. Included in this section are examples of different kinds of exchange rate calculations using direct and indirect quotes, cross-exchange rates, and bid/ask quotes.

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[1] Bank for International Settlements, *Triennial Central Bank Survey: Foreign Exchange and Derivatives Market Activity in 2001,* March 2002, pp. 3, 11 available at <http://www.bis.org/publ/rpfx02.htm>.

[2] Ibid, p. 12.

[3] For Reuters, see <http://about.reuters.com/productinfo/data_treasury/>; for Moneyline Telerate see <http://www.moneyline.com/about/about_home.jsp>.

[4] Bank for International Settlements, *Triennial Central Bank Survey: Foreign Exchange and Derivatives Market Activity in 2001,* March 2002, pp. 9-10 available at <http://www.bis.org/publ/rpfx02.htm>.

[5] Sam Y. Cross, *The Foreign Exchange Market in the United States,* Federal Reserve Bank of New York, 1998, pp. 121-2 available at <http://www.ny.frb.org/education/addpub/usfxm/>; also see European Central Bank, *Review of the Foreign Exchange Market Structure*, March 2003 available at <http://www.ecb.int/pub/pdf/fxmarketstructure200303en.pdf.>.

An exchange rate is the rate at which one currency can be exchanged for another. These rates are available from many print and electronic sources. *The Wall Street Journal,* for example, posts the exchange rates of the 48 most commonly traded currencies in its "Money & Investing" section every day. **Table 1** is a snapshot of the listings for Tuesday April 15, 2003. Tuesday's listings use rates as quoted at 1 PM Eastern Time the previous Monday (as written in the small print at the top of the table). Most exchange rate tables list the latest quotes (in this case, Monday's quotes) as well as the quotes of the previous business day (in this case, Friday's quotes).

**Table 1** Exchange Rates as listed in *The Wall Street Journal*

**Exchange Rates**

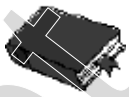
The foreign exchange mid-range rates below apply to trading among banks in amounts of $1 million and more, as quoted at 1 p.m. Eastern time by Reuters and other sources. Retail transactions provide fewer units of foreign currency per dollar.

| | U.S. $ Equivalent | | Currency per U.S. $ | |
|---|---|---|---|---|
| **Country** | **Mon** | **Fri** | **Mon** | **Fri** |
| Australia (Dollar) | 0.6049 | 0.6052 | 1.6532 | 1.6523 |
| Brazil (Real) | 0.3164 | 0.3123 | 3.1606 | 3.2020 |
| Chile (Peso) | 0.001387 | 0.001387 | 720.98 | 720.98 |
| Denmark (Krone) | 0.1451 | 0.1448 | 6.8918 | 6.9061 |
| Russia (Ruble) | 0.03205 | 0.03197 | 31.201 | 31.279 |
| Thailand (Baht) | 0.02331 | 0.02326 | 42.9 | 42.992 |

Source: *The Wall Street Journal*, Tuesday April 15, 2003, p. C14.

## *Understanding Exchange Rates*

An exchange rate is the price of a currency. Just as a product in a store has a price, a unit of currency has a price. For example, a book in a British airport can cost 12.75 British pounds or 20 U.S. dollars. Likewise, a euro can cost either £ 0.68 or $1.07.

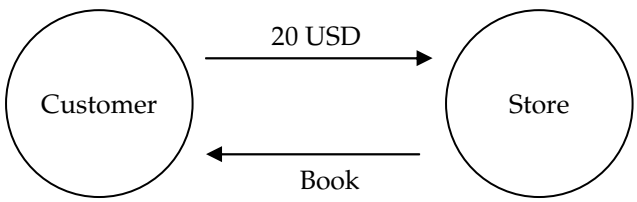


| | |
|---|---|
| £ | 12.75 |
| $ | 20.00 |

€

| | |
|---|---|
| £ | 0.68 |
| $ | 1.07 |

Focusing on the U.S. dollar price for the book and the euro, there are two ways to look at a transaction – from the customer perspective and from the store perspective. In the case of the book, from the customer perspective, the customer gets a book in exchange for 20 dollars.



We can write this relationship in terms of an "exchange rate":

$$\frac{1 \text{ book}}{20 \text{ USD}} = \frac{1}{20} \text{ book/USD} = 0.05 \text{ book/USD}$$

This ratio says that the customer gets…

one book per 20 U.S. dollars

OR, put another way,

one-twentieth of a book per 1 U.S. dollar

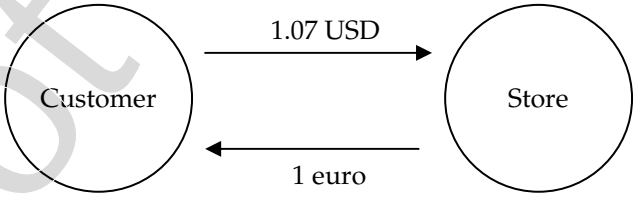
From the store perspective, it gets 20 U.S. dollars per book, or:

$$\frac{20 \text{ USD}}{1 \text{ book}} = \frac{20}{1} \text{ USD/book} = 20 \text{ USD/book}$$

This ratio says that the store gets 20 U.S. dollars per one book.

Note that the exchange rates above - 1/20 (or 0.05) book/USD and 20/1 (or 20) USD/book - are simply inverse ratios of one another.

In the case of the euro, from the customer perspective, the customer gets one euro in exchange for 1.07 U.S. dollars.




The "exchange rate" then, is:

$$\frac{1 \text{ euro}}{1.07 \text{ USD}} = \frac{1}{1.07} \text{ euros/USD} = 0.93 \text{ euros/USD}$$

This ratio, 0.93 euros/USD, says that the customer gets…

1 euro per 1.07 U.S. dollars

OR, put another way,

0.93 euros per 1 U.S. dollar

The inverse of that ratio gives the store perspective:

$$\frac{1.07 \text{ USD}}{1 \text{ euro}} = \frac{1.07}{} \text{ USD/euro} = 1.07 \text{ USD/ euro}$$

This ratio says that the store gets 1.07 U.S. dollars per 1 euro.

No matter which form the exchange rate takes – the ratio or inverse ratio– the relationship between the currencies is the same. Getting 1.07 U.S. dollars per 1 euro is the same as getting 1 U.S. dollar per 0.93 euro.

## *Calculating Exchange Rates*

Exchange rates that are listed in the form of "U.S. $ Equivalent" are called direct quotes, and give the price of a unit of foreign currency in U.S. dollars, or how many U.S. dollars it costs to buy a unit of the foreign currency. Rates listed in the form of "Currency per U.S. $" are called indirect quotes, and give the price of one U.S. dollar in the foreign currency, or the number of units of foreign currency required to buy one U.S. dollar. **Table 1** above lists both direct and indirect quotes.

**Example 1** Changing an indirect quote into a direct quote

In **Table 1,** the indirect quote ("Currency per U.S. $) for Monday for the Danish krone is 6.8918.

The rate, 6.8918, means that a trader on the foreign exchange market would get 6.8918 krone per 1 USD:

$$\frac{6.8918 \text{ krone}}{1 \text{ USD}}$$

To turn this into a direct quote, take the inverse of the ratio:

$$\frac{1 \text{ USD}}{6.8918 \text{ krone}} = \frac{1}{6.8919} \text{ USD/krone} = 0.1451 \text{ USD/krone}$$

The answer, 0.1451 USD/krone, means that a trader on the foreign exchange market would get 0.1451 U.S. dollar per Danish krone. This rate is shown in **Table 1** as the "U.S. $ Equivalent" for the krone, on Monday.

**Example 2** Calculating transaction amounts based on exchange rates

General Motors has a project in Brazil and needs to buy materials from Brazilian suppliers. The company will need 1,000,000 Brazilian reals to buy its materials. How many U.S. dollars does General Motors need in order to purchase the reals?

Using **Table 1,** the Monday indirect quote for Brazilian reals is 3.1606, meaning one USD will buy 3.1606 reals. To buy 1,000,000 reals, the company needs $316,395.62:

$$\frac{\text{USD}}{3.1606\ \text{Reals}} \times 1{,}000{,}000\ \text{Reals} = 316{,}395.62\ \text{USD}$$

The same calculation can be done using the direct quote for Brazilian reals. In **Table 1,** the direct quote is 0.3164, meaning one real costs 0.3164 USD. To buy 1,000,000 reals, the company will need:

$$\frac{0.3164\ \text{USD}}{\text{Real}} \times 1{,}000{,}000\ \text{Reals} = 316{,}400.00\ \text{USD}$$

(The two answers differ only because of a rounding error. If you use the indirect quote to calculate the direct quote (1/3.1606) the direct quote for the real is .316395, rounded to .3164 in **Table 1**.)

This example shows that no matter which quote is used - direct or indirect - the results are the same. Calculations simply need to be set up so that the correct units eliminate.

See **Exercise 1** in the Appendix to calculate other direct and indirect exchange rates.

## *Cross Exchange Rates*

Most quotations in exchange rate tables--like those provided in **Table 1**—are expressed in terms of the U.S. dollar. However, certain occasions require exchange rates expressed in terms of two non-U.S. dollar currencies. These rates are called **cross exchange rates**. For example, if a Japanese company and a Chinese company anticipate a business transaction, they would be interested in the yen-yuan renminbi exchange rate rather than either the yen-U.S. dollar or the yuan renminbi-U.S. dollar rate. Below is an example of a cross rates table provided in *The Wall Street Journal*.

**Table 2** Key Currency Cross Rates (Late New York Trading Monday, April 14, 2003

| | Dollar | Euro | Pound | SFranc | Peso | Yen | CdnDlr |
|---|---|---|---|---|---|---|---|
| **Canada** | 1.4537 | 1.5661 | 2.2873 | 1.0462 | 0.13659 | 0.01208 | … |
| **Japan** | 120.38 | 129.69 | 189.41 | 86.638 | 11.311 | … | 82.810 |
| **Mexico** | 10.6428 | 11.4655 | 16.745 | 7.6596 | … | 0.08841 | 7.3212 |
| **Switzerland** | 1.3895 | 1.4969 | 2.1862 | … | 0.13055 | 0.01154 | 0.9558 |
| **U.K.** | 0.63560 | 0.6847 | … | 0.4574 | 0.05972 | 0.00528 | 0.43721 |
| **Euro** | 0.92820 | … | 1.4605 | 0.66806 | 0.08722 | 0.00771 | 0.63854 |
| **U.S.** | … | 1.0773 | 1.5734 | 0.71970 | 0.09396 | 0.00831 | 0.68790 |

Source: *The Wall Street Journal*, Tuesday April 15, 2003, p. C14.

In reading a cross rates table, each row represents the exchange rate from the perspective of the country in the far left column. For example, reading the top row for Canada from left to right: there are 1.4537 Canadian dollars per U.S. dollar, 1.5661 Canadian dollars per euro, 2.2873 Canadian dollars per British pound, and so on across the line.

In the absence of a published cross rate for a pair of currencies, cross exchange rates can be determined using USD-referenced exchange rates.

**Example 3** Determining cross exchange rates[6]

A Mexican traveler wants to go hiking in the Nepalese Himalayas and would like to change his pesos (MXN) for Nepalese rupees (NPR). Given the USD-MXN exchange rate (0.09760 USD = 1 MXN) and the USD-NPR exchange rate (0.01358 USD = 1 NPR), find the MXN-NPR cross rate.

With the rates available, set up the problem so that the USD terms cancel, giving the required rate of MXN/NPR:

$$\frac{1 \text{ MXN}}{0.09760 \text{ USD}} \times \frac{0.01358 \text{ USD}}{1 \text{ NPR}} = \frac{0.01358}{0.09760} \text{ MXN/NPR} = 0.1391 \text{ MXN/NPR}$$

Once the MXN/NPR rate has been calculated, the inverse ratio (1/0.1391) provides the NPR/MXN exchange rate.

**Formula 1** As a general rule, to find the cross rate of two USD-referenced exchange rates, set up the problem so that the correct terms cancel.

Given…
X USD/Currency A and…
Y USD/Currency B

Calculate the cross rate with the formula below:

$$\frac{\text{Y USD/Currency B}}{\text{X USD/Currency A}} = \text{Cross Rate in terms of Currency A/Currency B}$$

This formula can also be set up as a multiplication problem, like the one used above in **Example 3**:

$$\frac{\text{Currency A}}{\text{X USD}} \times \frac{\text{Y USD}}{\text{Currency B}} = \frac{\text{Y}}{\text{X}} \text{ Currency A/Currency B}$$

NOTE: These two formulas are different forms of the same equation.

**Exercises 2 and 3** in the Appendix provide practice in calculating cross exchange rates.

[6] The international currency codes (e.g. MXN) used here and in other examples are available at <www.oanda.com>.

## *Bid/Ask Spread*

When banks or brokers facilitate currency transactions such as the ones discussed above, they charge a fee for their services. In many cases part of this fee comes from the difference between the bank's bid and ask quotes, called the **bid/ask spread**. A bid quote is a bank's "buy" price and an ask quote is a bank's "sell" price. The difference between the quotes—the bid/ask spread—constitutes the bank's brokerage fee or profit on the transaction.

Bank currency quotes are usually given in pairs, with the first rate being the bid quote and the second rate the ask quote. For example, the euro is quoted at $1.23-31, which means that the bid price is $1.23 per euro and the ask price is $1.31 per euro. Differences in bid and ask prices are inherent in all currency transactions when dealing with financial intermediaries, but, for simplicity's sake, they are ignored in most of the examples used in this note. **Example 4** illustrates how the bid/ask spread affects foreign exchange transactions.

**Example 4** Bid/Ask spreads and the cost of currency conversions

You plan to take a business trip to Europe and want to convert $1,000 to euros. The U.S. bank quote for the euro is $1.23-31, meaning the bank will buy euros at $1.23 and sell euros at $1.31. The bank sells you $1000 worth of euros at its sell price of $1.31 and you receive € 763.36:

$$\text{US \$1,000} \times \frac{€}{\text{US \$1.31}} = € 763.36$$

On your trip, you complete all of your business in the U.K. and therefore use none of your euros. When you return to the U.S., you want to change your euros back to dollars. You note that the bank's quote for euros is unchanged at $1.23-31. The bank buys your euros at its bid price of $1.23, and for your euros you receive $938.93:

$$€ 763.36 \times \frac{\text{US \$1.23}}{€} = \text{US \$938.93}$$

Due to the bank's bid/ask spread, you have paid $61.07 for the two currency conversions, or 6.11% of the total amount ($61.07/$1000 = 6.11%).

**Formula 2** Calculating Bid/Ask Spreads

To calculate the percentage spread use the following formula:

$$\frac{\text{Ask rate} - \text{Bid rate}}{\text{Ask rate}} = \text{\% Bid/Ask Spread}$$

Using the numbers from **Example 4** above, the spread of the euro is:

$$\frac{\text{US\$1.31} - \text{US\$1.23}}{\text{US\$1.31}} = 6.11\%$$

**Exercise 4** in the Appendix provides practice in calculating bid/ask spreads.

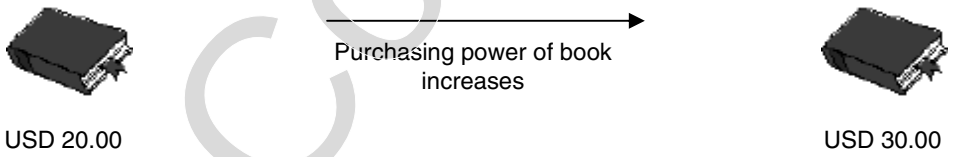
## Exchange Rate Movements

Prices of currencies can fluctuate just as prices of goods can fluctuate. This section examines currency appreciations and depreciations, how currency fluctuations are measured, and the meaning of changes in exchange rates.

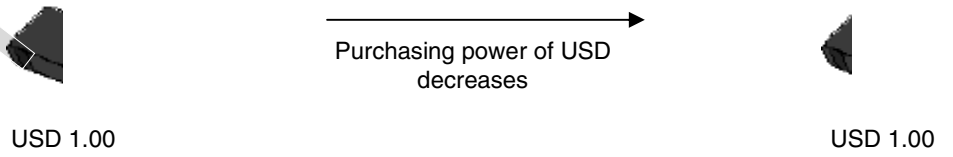
### *Currency Appreciation and Depreciation*

When a currency increases in value relative to other currencies, it is said to "appreciate"; when a currency decreases in value, it is said to "depreciate." The concept of currency appreciation and depreciation can be demonstrated with the book example used earlier. Assume that the value of the book has appreciated due to increased customer demand. We can look at this relationship again from the store perspective and from the customer perspective.

**Store Perspective** Because the value of the book increased, the store can demand more of the customer's dollars per book sold. Instead of getting 20 USD per book, the store can now get 30 USD per book. If the store is using the book as currency to gain U.S. dollars, the book's "purchasing power" has increased because one book can "purchase" 10 more U.S. dollars than before.




**Customer Perspective:** Because the value of the book has appreciated, the customer gets less of a book per dollar spent. One dollar used to buy the customer $1/20^{th}$ of a book (20 USD bought the whole book). Now, one dollar will only buy $1/30^{th}$ of the book (now it takes 30 USD to buy the whole book). In essence, the purchasing power of the customer's money has decreased.




The increase in the value of the book means that the store gains more purchasing power while the customer's dollar loses purchasing power. If the value of the book depreciates, the inverse scenario occurs. The book's purchasing power lessens, lowering the price of the book, and the customer's purchasing power in U.S. dollars increases.

In the same way, the purchasing power of one currency relative to another currency can appreciate or depreciate. For example, if the British pound appreciates relative to the U.S. dollar, then the pound can buy more U.S. dollars and a U.S. dollar can buy fewer British pounds.

**Example 5** Determining whether a currency has appreciated or depreciated

Examine the euro-U.S. dollar exchange rate on two different dates:

| Date | Exchange Rate |
|---|---|
| April 20, 2003 | 0.92109 EUR/USD |
| April 24, 2003 | 0.90570 EUR/USD |

According to these rates, on April 20th, 100 U.S. dollars could buy 92.11 euros…

$$\frac{0.92109 \text{ EUR}}{\text{USD}} \times 100 \text{ USD} = 92.11 \text{ EUR}$$

…while on April 24th, 100 U.S. dollars could only buy 90.57 euros, 1.54 fewer euros than before.

Since the U.S. dollar buys less on April 24th, its purchasing power has decreased and the dollar is said to have depreciated. Because the euro now has more value relative to the U.S. dollar, the euro is said to have appreciated.

**Formula 3** To determine whether a currency has appreciated or depreciated, follow these simple rules.

Given that…

Previous Exchange Rate: X Currency A/Currency B and…
Current Exchange Rate: Y Currency A/Currency B …

If $X > Y$ ($X - Y > 0$), Currency A has appreciated and Currency B has depreciated, relative to one another.

If $X < Y$ ($X - Y < 0$), Currency A has depreciated and Currency B has appreciated relative to one another.

**Exercise 5** in the Appendix requires you to determine if currencies have appreciated or depreciated.

## *Measuring Fluctuations*

Exchange rate fluctuations are often presented in percentage terms, relative to some reference currency. For example, the Mexican peso could depreciate 25% relative to the U.S. dollar or the euro

could appreciate 10% relative to the British pound. Calculating these fluctuations correctly can be confusing, so it is important to set up the problem correctly.

**Example 6** Calculating the percentage fluctuation of an exchange rate

Consider the movement of the Mexican peso (MXN) - U.S. dollar (USD) exchange rate from 10 to 20:

| Previous Exchange Rate | | Current Exchange Rate |
|---|---|---|
| $\frac{10 \text{ MXN}}{1 \text{ USD}}$ | → | $\frac{20 \text{ MXN}}{1 \text{ USD}}$ |

To calculate its percentage fluctuation, follow the steps below.

**Step 1:** Convert exchange rates into a standard form of:

$$\frac{\text{Benchmark Currency}}{\text{Fluctuating Currency}}$$

We are interested in the fluctuation of the Mexican peso, so we rearrange the exchange rates in terms of benchmark currency/fluctuating currency. The benchmark currency is the U.S. dollar and the fluctuating currency is the Mexican peso.

| Previous Exchange Rate | | Current Exchange Rate |
|---|---|---|
| $\frac{1 \text{ USD}}{10 \text{ MXN}}$ | → | $\frac{1 \text{ USD}}{20 \text{ MXN}}$ |
| 0.10 USD/MXN | → | 0.05 USD/MXN |

**Step 2:** Determine if the fluctuating currency has appreciated or depreciated, and by how much. In this case, the USD has appreciated (.10 > .05), and the MXN has depreciated by .05.

**Step 3:** Calculate the change as a percentage of the original exchange rate.

$$\frac{\text{Amount change}}{\text{Original exchange rate}} \times 100 = \text{\% change}$$

$$\frac{0.05}{0.10} \times 100 = 50\% \text{ depreciation}$$

These calculations indicate that the Mexican peso depreciated 50% against the U.S. dollar.

To measure the percentage appreciation of the U.S. dollar:

$$\frac{\text{Amount change}}{\text{Original exchange rate}} \times 100 = \text{\% change}$$

$$\frac{10}{10} \times 100 = 100\% \text{ appreciation}$$

The U.S. dollar has appreciated 100% against the Mexican peso.

**Exercises 6** and **7** in the Appendix provide practice in measuring currency fluctuations.

## *Why Exchange Rates Change*

The determinants of exchange rates are complex, and a full discussion of this topic is beyond the scope of this note.[7] It is useful, nonetheless, to consider briefly why currencies appreciate and depreciate, and why currencies are sometimes described as overvalued or undervalued.

**Purchasing Power Parity** A well-known (and controversial) theory about why exchange rates change is the theory of Purchasing Power Parity (PPP), which is derived from the law of one price. According to this theory, goods that are freely traded should cost the same everywhere, measured in the same currency. The exchange rates between currencies, therefore, should be such that the currencies have equivalent purchasing power. According to the theory of PPP, exchange rates change, over the long term, because the purchasing power of one currency increases (or decreases) relative to another currency.

Economists use complex 'baskets' of goods to assess how exchange rates reflect purchasing power parity across countries, but simpler approaches can also provide insights into exchange rates and currency fluctuations. *The Economist*, for example, compares the price of a McDonald's Big Mac hamburger in the U.S. and in various other countries in an annual survey.[8] In 2003, the average price of a Big Mac in the U.S. was $2.71 while in Denmark the burger cost the equivalent of $4.10 at the then-current exchange rate. According to the theory of PPP, the difference in the purchasing power of the dollar and the krone will, over time, result in changes in the exchange rate between the two currencies. In this case, the krone would be expected to depreciate against the dollar until its purchasing power was equivalent to that of the dollar.

**Example 7** *The Economist* Big Mac Index

| | Big Mac Prices | | Implied PPP of the dollar | Actual dollar exchange rates April 22, 2003 | Under(-)/ over(+) valuation against the dollar % |
|---|---|---|---|---|---|
| | In local currency | In dollars | | | |
| United States | $2.71 | 2.71 | | | |
| China | Yuan 9.90 | 1.20 | 3.65 | 8.28 | -56 |
| Denmark | Krone 27.75 | 4.10 | 10.20 | 6.78 | +51 |
| Japan | Yen 262 | 2.19 | 96.7 | 120 | -19 |

Source: "McCurrencies," *The Economist*, April 24, 2003, p. 80.

Taking Japan as an example, the table is read as follows: In the U.S., a Big Mac costs $2.71. The price of a Big Mac in Japan is ¥262. In dollars, the cost is $2.19, using the actual dollar exchange rate of 120 yen/dollar (262/120 = $2.19).

Since a Big Mac in Japan has a price of ¥262, the implied PPP of the dollar is 96.7 yen (262/2.71=96.7). The implied PPP is the exchange rate that would give the Big Mac the equivalent price in both currencies.

Comparing the implied PPP exchange rate and the actual exchange rate for the yen to the dollar suggests that the yen is undervalued by 19% relative to the dollar, calculated from the actual exchange rate and the implied PPP exchange rate (120-96.7/120).

[7] Textbooks on international finance and international economics address the question of the determinants of exchange rates; a recommended reference is Paul R. Krugman and Maurice Obstfeld, *International Economics: Theory and Policy*, 5th ed. (Reading, Mass.: Addison-Wesley, 2000).

[8] "McCurrencies," *The Economist*, April 24, 2003, p. 80.

In **Exercise 8** in the Appendix you can use the Big Mac index to calculate exchange rates based on purchasing power parity and to evaluate the strength or weakness of the U.S. dollar relative to other currencies.

**Interest Parity** Another theory on exchange rate movements is the theory of Interest Parity. This theory states that the foreign exchange market is in equilibrium when the expected rates of return on deposits of any two currencies measured in the same currency are equal. The argument is that if deposits in one currency offered higher expected returns than those in another, there would be excess demand for the former and excess supply of the latter, since investors would all demand deposits that give better returns. Exchange rate movements, therefore, are caused by changes in interest rates. Interest Parity implies that potential holders of foreign currency deposits should be indifferent between any two currencies as far as expected returns are concerned.

## Foreign Exchange Transactions

Learning how to read, calculate and convert exchange rates will help in understanding the foreign exchange market and its transactions. Five main groups of transactions are covered in this note: spot transactions, forwards, swaps, futures, and options. Forwards, swaps, futures, and options belong to the class of financial instruments called **derivatives**. Derivatives are contracts that derive their value from some underlying asset—in this case, the asset is currency. They are used to manage foreign exchange risk or take speculative positions on currency movements. This section of the note explains the different types of foreign exchange transactions and how companies use financial instruments to hedge their currency exposure.

### *Spot Transactions*

The daily exchange rates quoted in *The Wall Street Journal* and other news sources are called **spot rates** – market rates that hold for transactions that take place on the "spot." Foreign exchange transactions based on these rates are called **spot transactions**. For example, if you were to go to a foreign exchange window and convert U.S. dollars into British pounds, the exchange rate the teller would use is the spot rate, and the conversion would be called a spot transaction.

### *Forwards*

Spot transactions are useful and commonly employed in the foreign exchange market, but there are times when organizations or individuals want to make trades, not today, but some time in the future. These types of transactions are called forward transactions, and the rate used is called the **forward rate**. The forward rate is greater or less than the spot rate, depending on whether the currency is expected to appreciate or depreciate. If the currency is expected to appreciate in the future, the forward rate is priced higher than the spot rate, and the rate is said to contain a **premium**. If the currency is expected to depreciate in the future, the forward rate is priced lower than the spot rate, and the rate is said to contain a **discount**. A premium or discount simply denotes the direction of the forward rate in relation to the spot rate.

*The Wall Street Journal* posts the forward rates of commonly traded currencies in its daily 'Exchange Rates' table. Below are the rates published on Tuesday April 15, 2003, recorded at close of business Monday April 14, 2003.

**Table 3** Exchange Rates (with forward rates) as listed in *The Wall Street Journal*

**Exchange Rates**

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

| | U.S. $ Equivalent | | Currency per U.S. $ | |
|---|---|---|---|---|
| **Country** | **Mon** | **Fri** | **Mon** | **Fri** |
| Canada (Dollar) | 0.6879 | 0.6879 | 1.4537 | 1.4537 |
| 1-month forward | 0.6868 | 0.6869 | 1.4560 | 1.4558 |
| 3-months forward | 0.6844 | 0.6845 | 1.4611 | 1.4609 |
| 6-months forward | 0.6803 | 0.6804 | 1.4699 | 1.4697 |
| Switzerland (franc) | 0.7197 | 0.7179 | 1.3895 | 1.3930 |
| 1-month forward | 0.7203 | 0.7183 | 1.3883 | 1.3922 |
| 3-months forward | 0.7215 | 0.7192 | 1.3860 | 1.3904 |
| 6-months forward | 0.7232 | 0.7213 | 1.3827 | 1.3864 |
| U.K. (Pound) | 1.5734 | 1.5715 | 0.6356 | 0.6363 |
| 1-month forward | 1.5703 | 1.5783 | 0.6368 | 0.6376 |
| 3-months forward | 1.5644 | 1.5624 | 0.6392 | 0.6400 |
| 6-months forward | 1.5555 | 1.5536 | 0.6429 | 0.6437 |

Source: *The Wall Street Journal*, Tuesday April 15, 2003, p. C14.

Forward transactions are based on the buying and selling of **forward contracts**. A forward contract is an agreement between a buyer and seller to trade a particular currency on some date in the future for a fixed price, regardless of the currency's spot rate on the future date. The contracts are usually made for one, three, or six months into the future. Forward contracts are negotiated between two parties—usually a company and a bank—and are customized for the maturity date and transaction amount. Therefore, it is possible to create what are called "perfect hedges" with forwards. Perfect hedges are when companies or individuals can completely eliminate their exposure in the market for the transaction amount and time frame they need.

**Example 8**

A U.S. auto importer buys 4 Rolls Royces from a manufacturer in England at £ 250,000 per car. The U.S. firm puts in the order, but does not have to pay the British manufacturer until it receives the cars in 3 months. Upon receiving the cars, the U.S. importer will have to pay the British manufacturer £1,000,000 (4 x £ 250,000).

When dealing with such large sums of money, even the slightest movement in the exchange rate means that a company's obligations may fluctuate by thousands of dollars. If the company decides not to enter into a forward contract, it is "exposed" to the market and susceptible to exchange rate movement. A forward contract eliminates the company's exposure to exchange rate movements over the next three months because the company knows the exact rate at which it will exchange currencies. The U.S. importer decides to enter into a forward contract to lock in a rate for its currency transaction. Below is an outline of the importer's transaction:

1. On April 15, 2003 the importer calls bank and requests a forward contract for:
    - £ 1,000,000
    - Settlement date: July 15, 2003 (three months later)
    - At forward rate: 1.5644 USD/£ (see **Table 3** above). The forward rate is lower than the spot rate (forward discount) because the pound is expected to depreciate
2. On July 15, 2003 the U.S. importer receives the car shipment in its warehouse
    - Importer settles the contract with bank, using the agreed-upon rate of 1.5644 USD/£, regardless of the spot rate. Importer pays the bank US$ 1,564,400 in return for £ 1,000,000.

$$\frac{1.5644 \text{ US\$}}{\text{£}} \times \text{£ } 1{,}000{,}000 = \text{US\$ } 1{,}564{,}400$$

    - Importer pays British manufacturer in pounds

See **Exercise 8** in the Appendix to calculate the cost of a forward contract.

## *Swaps*

To hedge against the risk of exchange rate fluctuations, a company may use a forward contract, as described above, or it may set up a **swap**—essentially a series of forwards under one contract that hedges long-term, sustained foreign exchange exposure. For example, a U.S. firm that anticipates receiving annual payments in krona from a subsidiary in Sweden might enter a swap agreement with a Swedish firm that receives regular fees in U.S. dollars for work done in the U.S. Swaps are arranged by brokers and banks. There are many types of swap arrangements with different payment schedules and contract structures, but the basic idea is that a swap enables two parties who have complementary foreign exchange exposure/obligations to pair up and trade their currencies privately. Like forwards, swap contracts are customized for the needs of the signing parties, with a predetermined rate of exchange and a contract maturity date. Swaps and forwards differ in that a swap contract typically covers multiple future transactions and can have anywhere between five and ten years until maturity, whereas a forward contract is drawn for one transaction and usually has a shorter maturity.

## *Futures*

Futures contracts are contracts that specify a *standard* volume of a currency to be exchanged on a settlement date some time in the future. Futures contracts are similar to forward contracts, except that forward contracts are customized between buyers and sellers who are genuinely interested in conducting the currency transactions, whereas futures contracts are standardized for trading on markets like the Chicago Mercantile Exchange. The following table shows currency futures prices published in *The Wall Street Journal* on Tuesday April 15, 2003. You can also look up current futures prices online at http://www.prophetfinance.com/tradequest/futuresquotes.asp.

**Table 4** Currency Futures Table

**Currency Futures**

| | | | | | | LIFETIME | | |
|---|---|---|---|---|---|---|---|---|
| | OPEN | HIGH | LOW | SETTLE | CHG | HIGH | LOW | OPEN INT |
| **Canadian Dollar (CME)-CAD 100,000; $ per CAD** | | | | | | | | |
| June | .6857 | .6866 | .6828 | .6854 | ---- | .6876 | .6197 | 88,699 |
| Sept | .6816 | .6827 | .6797 | .6816 | ---- | .6840 | .6185 | 3,602 |
| Est vol 4,251; vol Fri 13,063; open int 95,922, -668. | | | | | | | | |
| **Swiss Franc (CME)-CHF 125,000; $ per CHF** | | | | | | | | |
| June | .7182 | .7239 | .7170 | .7213 | .0020 | .7577 | .5940 | 36,712 |
| Sept | ---- | ---- | ---- | .7229 | .0020 | .7565 | .6270 | 551 |
| Est vol 2,570; vol Fri 12,408; open int 37,292, +1,721. | | | | | | | | |
| **British Pound (CME)-£ 62,500; $ per £** | | | | | | | | |
| June | 1.5636 | 1.5704 | 1.5620 | 1.5672 | .0024 | 1.6416 | 1.5000 | 23,138 |
| Sept | 1.5600 | 1.5600 | 1.5540 | 1.5572 | .0024 | 1.6256 | 1.5100 | 464 |
| Est vol 1,154; vol Fri 6,541; open int 23,671, +49. | | | | | | | | |

Source: *The Wall Street Journal*, Tuesday April 15, 2003, p. C12.

**Example 10** How to read the listing for a futures contract

The listing for the June Swiss franc contract in **Table 4** can be read as:

On Friday, April 11, 2003 (Friday's rates published on Tuesday), a Swiss futures contract with an expiration on the third Wednesday of June 2003, opened at 0.7182 USD/CHF and settled at 0.7213 USD/CHF. The rate hit a high of 0.7239 and a low of 0.7170 for the day, compared to a lifetime high and low of 0.7577 and 0.5940, respectively. There was a 0.0020 USD/CHF increase from Thursday's settle price to Friday's settle price.

In the market for Swiss franc futures, there are approximately 2,570 contracts bought and sold per day, with 12,408 contracts bought and sold on Friday April 11, 2003. In the entire Chicago Mercantile exchange, there are 37,292 Swiss franc futures contracts open. Though there was activity in 12,408 contracts Friday, the net change in number of open contracts was only 1,721 (interest in Swiss franc futures increased by 1,721 contracts).

A typical futures contract will specify basic elements such as type of currency, amount of currency included in one contract, futures rate, and settlement date. As much as possible, these elements are standardized to facilitate fast trading on the exchange floor and a futures contract will specify a standardized volume of the currency being sold. For example, **Table 4** notes that each Canadian dollar futures contract contains 100,000 CAD ("CAD 100,000"), each Swiss franc contract contains 125,000 CHF ("CHF 125,000") and each British pound contract contains 62,500 GBP ("£ 62,500"). Because futures can only be bought in these increments and cannot be tailored to specific transaction amounts, they are often used as a vehicle for currency speculation rather than as a hedging tool since it can be difficult to structure a "perfect hedge" with futures.

The notations, "$ per CAD," "$ per CHF," and "$ per £" mean that the rates listed under the "open," "high," "low," and "settle" columns are direct exchange rate quotes—expressed as U.S. dollar amount per unit of foreign currency. The months in the left-most column represent the expiration month of the contract (futures have standardized settlement dates, which are the third Wednesdays of March, June, September, and December).

Other information about currency futures included in the table are price movements for futures during the day (shown in the "OPEN", "SETTLE", "HIGH", and "LOW" columns) and over the lifetime of the contract. The table also shows the number of open contracts for futures with a particular expiration date in the column headed "OPEN INT" (short for "open interest"). For example, as of Friday April 11, 2003, there were 88,699 Canadian futures contract (expiration third Wednesday of June 2003) open. This number is important to traders because it indicates how popular that particular contract is; the more demand there is for the contract in the market, the greater the open interest. "Est vol," or estimated volume, shows the average number of contracts bought and sold in one day; this value lets a trader know how much activity there is in the market for futures contracts in that particular currency. "vol <day>" gives the actual number of contracts bought and sold during the trading day. The "open int" value following "vol <day>" shows the number of contracts open for that currency in the entire exchange, and the negative or positive value at the end of the line shows the net change in open interest. That value indicates whether interest in futures for that currency is increasing or decreasing.

In comparing **Tables 3** and **4**, it becomes apparent that the rates of currency futures are similar to those of currency forwards. Like forwards, futures allow traders to lock in the prices at which they can purchase currencies some time in the future. Though futures do not allow perfect hedges, there are still some companies that use them for imperfect hedges because of their smaller sized contracts. While the typical size of a forward contract is in excess of $1 million, the size of a futures contract is usually only around $100,000.

While forward contracts usually end in the actual exchange of currencies, most futures contracts are "closed out"—or sold—before settlement since most traders have no interest in taking delivery of the actual currency. The gain or loss to the holder of a futures contract is determined by the difference between the buy and sell prices of the contract. The change in the price of a contract (with a given future rate and settlement date) depends on two things: 1) movement of the spot rate over time, and 2) changing expectations about the spot rate's value on the settlement date. For example, if the spot rate of a British pound rose over a one-month period, a British pound futures contract would also rise in value by approximately the same amount. In this case, the purchase and subsequent sale of the contract would be profitable. If the spot rate depreciated, the value of the contract would likewise decline, and the sale of the contract would be unprofitable. These price movements in futures contracts account for the gains and losses of the traders on the currency futures market.

## *Options*

Understanding how forwards work helps in understanding how options work. Consider this first scenario: A U.S. construction company puts in a bid to build a 42-hectare software park for the Vietnamese government. If the company gets the bid, it will have to purchase materials and hire workers in Vietnam, which will require approximately 17 billion Vietnamese dong (VND). However, if the company does not get the bid, it will not need to purchase anything in Vietnam, and therefore will not need any Vietnamese currency. Since the dong is a highly volatile currency, the construction company does not want to risk having to pay higher prices on the currency in the future and would like to lock in at a set exchange rate. However, a forward obligates a currency purchase, whereas the company does not want to purchase the money if it does not get the contract. Ideally, the company would be able to lock in at a certain price, and then have the *option* of buying the currency if it wins the bid.

Now consider a second scenario: A French biotech company hires an American company to build its advanced science laboratories in Paris. At the request of the French company, the American company accepts payment in euros. The American company might have the opportunity to use its euros on a different project in the near future and therefore does not want to exchange its euros for dollars immediately. If the company does not use the euros it receives, it wants to insulate itself against the possible depreciation of the euro. Ideally, the American company would be able to lock in at a certain exchange rate, and then have the *option* of selling its euros within a specified period of time.

Both these companies' needs could be fulfilled with the use of currency **options**. Options are contracts that allow their owners to either buy or sell a currency at a designated price within a specific period of time. *The Wall Street Journal* lists currency options daily in the 'Marketplace' section of the newspaper under the heading, 'Futures Options Prices.' **Table 5** below is a snapshot of options prices published on Wednesday April 16, 2003 of rates recorded at close of business Tuesday April 15, 2003.

**Table 5** Currency options prices as listed in *The Wall Street Journal*

| FUTURES OPTIONS PRICES | | | | | | |
|---|---|---|---|---|---|---|
| **Tuesday, April 15, 2003**<br>Final or settlement prices of selected contracts. Volume and open interest are totals in all contract months. | | | | | | |
| **Currency** | | | | | | |
| **STRIKE** | **CALL-SETTLE** | | | **PUTS-SETTLE** | | |
| **Japanese Yen** (CME) | | | | | | |
| 12,500,000 yen; cents per 100 yen | | | | | | |
| PRICE | MAY | JUN | JLY | MAY | JUN | JLY |
| 8250 | 1.24 | … | … | 0.34 | 0.66 | … |
| 8300 | 0.92 | 1.26 | 1.69 | 0.52 | 0.86 | 1.04 |
| 8350 | 0.66 | 1.02 | … | 0.76 | 1.12 | 1.27 |
| 8400 | 0.46 | 0.81 | 1.19 | 1.06 | 1.41 | … |
| Est vol 1,154 Mn 539 calls 1,017 puts<br>Op int. Mon 32,664 calls 45,759 puts | | | | | | |
| **Euro Fx** (CME) | | | | | | |
| 125,000 euros; cents per euro | | | | | | |
| PRICE | MAY | JUN | JLY | MAY | JUN | JLY |
| 10700 | 1.48 | 1.97 | 2.15 | 0.58 | 1.07 | 1.57 |
| 10750 | 1.17 | 1.69 | … | 0.77 | 1.29 | … |
| 10800 | 0.92 | 1.44 | 1.66 | 1.02 | 1.54 | … |
| 10850 | 0.70 | 1.21 | … | 1.30 | 1.81 | … |
| Est vol 3,887 Mn 956 calls 1,420 puts<br>Op int. Mon 35,924 calls 24,257 puts | | | | | | |

Source: *The Wall Street Journal*, Wednesday April 16, 2003, p. C11.

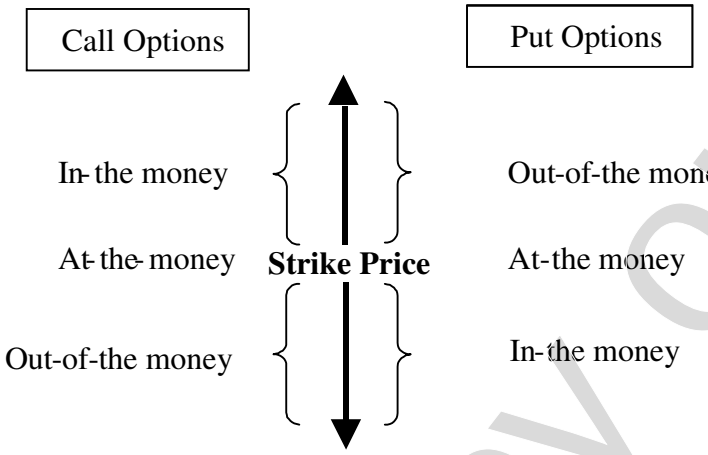
**Definition and Nomenclature** A currency **call** option is a contract that grants its owner the right – not the obligation – to *buy* a specific currency, and a currency **put** option grants its owner the right to *sell*. Both call and put options have designated prices and volumes, as well as defined periods within which the options must be exercised. Exercising an option simply means acting upon your right to buy or sell the currency. An **American option** can be exercised anytime during the contract period. A **European option** can only be exercised on the date the contract expires.

Like futures, options are sold in standard volumes, which are specific to each currency. For example, the table above shows that there are 12,500,000 currency units per one Japanese yen option and 125,000 units per one euro option. Options traded on exchanges can only be purchased in increments of these standard volumes.

In order for the contract owner to exercise his call or put option, the spot rate of the currency must reach a certain threshold, called a **strike** price, before the option expires. For call options, the spot rate has to rise above the strike price, and for put options, the spot rate has to fall below the strike price before the owner can exercise. **Table 5** lists four different strike prices for yen option contracts. The strike price of 8250 translates into $.00825 per yen. A call option at this strike price could be exercised if the spot rate for yen is higher than $.00825.

Call options are said to be "in the money" when the current spot rate is above the strike price. When the spot rate equals the strike price, the option is referred to as "at the money." When the spot rate is below the strike price, the call option is said to be "out of the money." For put options, the terms mean just the opposite; a put option is "in the money" when the spot rate is lower than the strike price.

**Figure 1** Call and Put Options Classifications




The fee paid to buy an option is called the premium. Regardless of whether you exercise the option, you still must pay the premium. Listed in **Table 5** above, under the 'call-settle' and 'put-settle' columns, are the premiums for different option contracts. For Japanese yen options, the premium is listed as "cents per 100 yen." This means that at a strike price of 0.008250 US$/¥, the buyer must pay US$ 0.0124 (1.24 cents) per 100 yen for a contract that settles in May. Since there are 12,500,000 yen in one option, each option costs US$1,550.00.

**Example 11** How much is the premium on a 3-month put option for euros at a strike price of US$1.07?

From **Table 5,** the details of a 3-month option purchased in April and settled in July are:

Strike price: 10700, or $1.07

Premium: 1.57 cents/euro

Volume: 125,000 euros/option

Calculation:

$$\frac{1.57 \text{ cents}}{\text{euro}} \times \frac{125{,}000 \text{ euros}}{1 \text{ option}} \div \frac{100 \text{ cents}}{1 \text{ US \$}} = \text{US \$1,962.50/option}$$

The premium on the option contract is $1962.50.

Options premiums are based on many factors but, in general, the more likely it is that the contract owner will exercise the option, the higher the premium. Thus, premiums on call options with a strike

price close to the current spot rate are higher than the premiums for call options with strike prices greater than the current spot rate. Options that are already "in-the-money" (meaning, for call options, that the strike price is lower than the current spot rate) have the highest premiums because they can be exercised immediately. Longer-term option contracts generally have higher premiums than short-term contracts. For example, in **Table 5,** the premiums for euro options expiring in July are higher than the premiums for euro call options expiring in May at the same strike price; this is because there is more time for the euro to reach the price for the option to be in-the-money – and therefore worth exercising - with the longer contract.

Corporations that conduct international trade can sometimes use currency options to cover their risk against unfavorable exchange rate movements. Companies with future foreign currency needs and wanting to hedge against exchange rate appreciation would purchase call options; companies holding large amounts of foreign currency and wanting to hedge against depreciation over time would purchase put options.

## *Evaluating Foreign Exchange Instruments*

The availability of different foreign exchange instruments provides firms with choices for hedging their foreign exchange exposure. This section compares the benefits and risks of buying or selling foreign currency at spot rates, forward contracts, and options.

Consider a situation in which a firm anticipates a possible need for foreign currency, but is not yet certain of that need. For example, Thriller Driller Corporation (TDC) of Massachusetts places a bid on an oil drilling contract off the coast of Russia in March of 2003. If it wins the bid, it will need approximately 62,000,000 rubles to purchase Russian materials and services. However, it will not know if the bid is accepted until June of 2003 (3 months after placing the bid). The company considers four different strategies to obtain the rubles it might need, and considers the benefits and risks of each strategy.

1. Purchase rubles at today's spot rate. TDC could purchase rubles at the March 2003 spot rate before it knows the results of the bid. If the company's bid is successful in June and the spot rate goes up, it will have saved money because it bought the currency at a lower rate. If it wins the bid and the spot rate depreciates, TDC will have effectively lost money because it could have bought the currency at a lower rate in June. If TDC does not get the bid and the spot rate appreciates, the company can still sell the rubles at the June spot rate and make a profit. Conversely, if the company's bid fails and the exchange rate depreciates, TDC can either hold the currency and hope that the exchange rate rises, or sell the currency at a loss.

2. Purchase rubles at the June spot rate. The company could wait until it knows the results of the bid and only purchase the currency at the June 2003 spot rate if the bid is successful. If the bid is successful and the spot rate appreciates, the company will have effectively lost money because it now pays more for the currency than it would have had it bought at the March price. However, if the bid is successful and the spot rate depreciates, waiting will have saved the company money. If the bid is not successful, TDC simply does not buy.

3. Purchase a forward contract for rubles. The company could purchase a forward contract and lock in the March 2003 forward rate for purchase of the rubles in June 2003. If TDC's bid is successful, no matter what the movement of the spot rate, the difference was already taken into account in the premium or discount on the forward rate. If TDC's bid is not successful, the company would still be obligated to purchase the rubles at the forward rate. If the spot rate has

appreciated by June 2003, TDC can resell the currency on the spot market and make a profit. If the spot rate has depreciated, TDC can either keep the currency or sell it at a loss.

4. Purchase a ruble call option. The company could purchases a call option contract in March 2003 that expires in June. If the company's bid is successful and the spot rate rises above the strike price, the company exercises and buys rubles at a lower rate than the June spot rate. If the bid is successful and the spot rate declines, the company does not exercise the option and simply buys rubles at the lower June spot rate. On the other hand, if the bid is unsuccessful and the spot rate rises above the strike price, the company can still exercise and sell the currency back to the spot market and make a profit. If the bid is unsuccessful and the spot rate declines, the company does nothing and experiences a net loss on the premium it paid for the contract. The call option locks the company into a strike price and caps the company's losses if it does not win the bid. All risk variables are hedged.

**Table 6** summarizes the benefits and risks of the different foreign currency instruments for TDC.

**Table 6** Analysis of TDC Purchase of Russian Rubles

| | **Bid successful; ruble ↑** | **Bid successful; ruble ↓** | **Bid unsuccessful; ruble ↑** | **Bid unsuccessful; ruble ↓** | **Unhedged risk** |
|---|---|---|---|---|---|
| **Scenario 1** Purchase rubles in March 2003 at spot rate | Effective gain; rubles bought at lower rate | Effective loss; rubles bought at higher rate | Sell rubles at profit | Sell rubles at loss | Bid result; spot rate movement |
| **Scenario 2** Purchase rubles in June 2003 at spot rate | Effective loss; rubles bought at higher rate | Effective gain; rubles bought at lower rate | N/A | N/A | Spot rate movement |
| **Scenario 3** Purchase forward contract for rubles | N/A | N/A | Settle forward contract; sell rubles at profit | Settle forward contract; sell rubles at loss | Bid result |
| **Scenario 4**[a] Purchase call option for rubles | Exercise **or** sell option and exchange currency on spot market | Lose premium; buy rubles at June spot rate | Exercise; sell rubles at profit | Lose premium | None |

Source: Created by casewriter

[a] Assume for "currency ↑" situations that the spot rate rises above the strike price.

## Appendix

### *Calculating and Using Exchange Rates*

**Exercise 1** Fill in the table using the direct and indirect quotes provided.

| Currency | U.S.$ Equivalent | Currency per U.S.$ | Equivalent of 100 U.S.$ |
|---|---|---|---|
| China (Yuan Renminbi) | 0.1208 | | |
| Japan (Yen) | | 120.38 | |
| Mexico (Peso) | | | 1064.28 |
| Singapore (Dollar) | | 1.7803 | |
| Taiwan (Dollar) | 0.02878 | | |
| Turkey (Lira) | | | 161,290,300 |
| U.K. (Pound) | 1.5734 | | |
| Venezuela (Bolivar) | | 1597.44 | |
| Euro | 1.0773 | | |

### *Calculating cross exchange rates*

**Exercise 2**

Use these exchange rates to answer the questions below:

| Country | Currency per U.S. $ |
|---|---|
| China - yuan renminbi (CNY) | 8.2871 |
| Japan -yen (JPY) | 119.040 |
| Argentina – peso (ARS) | 2.975 |
| Vietnam – dong (VND) | 16041 |

A Japanese manufacturing firm, Japanohondapokemon, placed a purchase order with Beijing conglomerate, Maydinchina, to procure 10,000 tons of raw materials at a cost of 9,030,200 yuan renminbi. How many yen does the Japanese firm have to exchange in order to pay the bill in yuan renminbi?

A trader at well-known investment banking firm, Silverman Pouches, has an Argentinean client who is interested in investing in emerging markets. The trader suggests the purchase of Vietnamese government-issued bonds, currently selling at 1,604,100 Vietnamese dong (VND) per bond. How many Argentine pesos (ARS) will it cost if the client wants to purchase 250 bonds?

**Exercise 3** Fill in the cross rates table below. Derive the missing rates from the rates already provided.

| | U.S. Dollar | Vietnam VNDong | Taiwan TDollar | Indonesia Rupiah | Egypt EPound |
|---|---|---|---|---|---|
| **Egypt** | 5.97540 | | | | …… |
| **Indonesia** | | | 248.845 | …… | |
| **Taiwan** | | 0.002344 | …… | | |
| **Vietnam** | 16,041.0 | …… | | | |
| **U.S.** | …… | | | | |

(Hint: The Egypt EPound/U.S. dollar rate is given as 5.9754. The inverse of this – 1/5.9754 – is the U.S. dollar/EPound exchange rate, which can be inserted in the table. In the same way, use the other exchange rates given to calculate the inverse rates. To complete the table, use currency pairs referenced to the same currency to calculate cross exchange rates according to **Formula 1**.)

## *Calculating Bid/Ask Spreads*

**Exercise 4** You are planning a trip to Europe and Japan and want to change U.S. dollars into euros and yen. Your bank provides the following quotes:

| | Bid | Ask |
|---|---|---|
| Euros | $1.194 | $1.245 |
| Yen | $.009245 | $.00967 |

What are the bank's bid/ask spreads? How much would you lose if you converted $500 into euros and $500 into yen, and then back into dollars?

## *Currency Appreciations and Depreciations*

**Exercise 5** You are given two different exchange rates per pair of currencies. Determine whether the currency in question appreciated or depreciated. Mark the correct column. NOTE: You are given a mixture of direct and indirect quotes.

| Dates | Exchange Rate | Currency to Consider | Appreciated | Depreciated |
|---|---|---|---|---|
| 4/24/2003<br>4/28/2003 | 0.91130 EUR/USD<br>0.90630 EUR/USD | EUR | | |
| 6/17/1997<br>1/13/1998 | 23.2 BHT/USD<br>55.8 BHT/USD | BHT | | |
| 4/25/2002<br>4/26/2002 | 1.6430 CHF /USD<br>0.6140 USD/CHF | CHF | | |
| 6/26/2002<br>2/18/2003 | 0.0008324 USD/KRW<br>0.0008286 USD/KRW | KRW | | |
| 1/30/1999<br>2/5/2001 | 1.0038 ARS /USD<br>1.00050 USD/ARS | USD | | |
| 1/30/2000<br>9/20/2000 | 2.3442 CAD/GBP<br>2.0927 CAD/GBP | CAD | | |
| 12/12/2002<br>2/2/2003 | 0.01629 INR /IQD<br>68.0289 IQD/INR | INR | | |
| 12/27/2002<br>12/28/2002 | 1.776 AUD /USD<br>1.7831 AUD/USD | USD | | |

The international currency codes used above are as follows:

| | | | | | |
|---|---|---|---|---|---|
| AUD | Australian Dollar | EUR | Euro | USD | U.S. Dollar |
| ARS | Argentine Peso | GBP | British Pound | | |
| BHT | Thai Baht | INR | Indian Rupee | | |
| CAD | Canadian Dollar | IQR | Iraqi Dinar | | |
| CHF | Swiss Franc | KRW | Korean Won | | |

## *Measuring Currency Fluctuations*

**Exercise 6** If the Mexican peso depreciates 50% against the U.S. dollar, how much would the peso have to appreciate to get back to its original level?

**Exercise 7** The Brazilian real (BRL) exchange rate moved from 3.2020 BRL/USD to 3.1606 BRL/USD over two days. Calculate the real's percentage change and note whether it appreciated or depreciated.

## *Calculating Actual and Implied PPP Exchange Rates*

**Exercise 8** Below is an excerpt from the 2003 Big Mac Index. Using the values given, fill in the table with the missing values.

*The Economist* Big Mac Index

| | Big Mac Prices | | Implied PPP of the dollar | Actual dollar exchange rates April 22, 2003 | Under(-)/ over(+) valuation against the dollar % |
|---|---|---|---|---|---|
| | In local currency | In dollars | | | |
| United States | $2.71 | 2.71 | - | - | - |
| Australia | A$ 3.00 | 1.86 | 1.11 | 1.61 | |
| Brazil | Real 4.55 | 1.48 | 1.68 | | -45 |
| China | Yuan 9.90 | | 3.65 | 8.28 | -56 |
| Denmark | Krone 27.75 | 4.10 | | 6.78 | +51 |
| Egypt | Pound 8.00 | 1.35 | 2.95 | | -50 |
| Hong Kong | HK$11.50 | | 4.24 | 7.80 | -46 |
| Malaysia | M$5.04 | 1.33 | | 3.80 | -51 |
| Russia | Ruble 41.00 | 1.32 | 15.1 | 31.1 | |
| South Korea | Won 3,300 | 2.71 | | 1,220 | nil |
| Switzerland | SFr 6.30 | 4.59 | 2.32 | | |

Source: "McCurrencies," *The Economist*, April 24, 2003, p. 80.

(Note: See **Example 7** above for an explanation of the Big Mac Index.)

## *Calculating the Cost of a Forward Contract*

**Exercise 8** A U.S. multinational, Hoola Hoopa, Inc., hired a Canadian IT consulting firm to upgrade its internal network. In 6 months when the contract is over, Hoola Hoopa will need 1.5 million Canadian dollars to pay the consultants. The company needs to decide whether or not it should enter into a forward contract to hedge its exchange rate risk. Fill in the answers below using the US $ Equivalent rates listed in the table below.

| | U.S. $ Equivalent | | Currency per U.S. $ | |
|---|---|---|---|---|
| **Country** | **Mon** | **Fri** | **Mon** | **Fri** |
| Canada (Dollar) | 0.6879 | 0.6879 | 1.4537 | 1.4537 |
| 1-month forward | 0.6868 | 0.6869 | 1.4560 | 1.4558 |
| 3-months forward | 0.6844 | 0.6845 | 1.4611 | 1.4609 |
| 6-months forward | 0.6803 | 0.6804 | 1.4699 | 1.4697 |
| Switzerland (franc) | 0.7197 | 0.7179 | 1.3895 | 1.3930 |
| 1-month forward | 0.7203 | 0.7183 | 1.3883 | 1.3922 |
| 3-months forward | 0.7215 | 0.7192 | 1.3860 | 1.3904 |
| 6-months forward | 0.7232 | 0.7213 | 1.3827 | 1.3864 |
| U.K. (Pound) | 1.5734 | 1.5715 | 0.6356 | 0.6363 |
| 1-month forward | 1.5703 | 1.5783 | 0.6368 | 0.6376 |
| 3-months forward | 1.5644 | 1.5624 | 0.6392 | 0.6400 |
| 6-months forward | 1.5555 | 1.5536 | 0.6429 | 0.6437 |

Source: *The Wall Street Journal*, Tuesday April 15, 2003, p. C14.

a. Canadian dollar spot rate: _____

b. Canadian dollar 6-months forward rate: _____

c. What it would cost Hoola Hoopa if the company were to purchase the Canadian dollars spot on April 15, 2003: _____

d. What it would cost Hoola Hoopa if it hedged with a forward contract on April 15, 2003 to purchase 1.5 million Canadian dollars 6 months later on October 15, 2003:_____

Compare the cost of the forward contract, or the hedged position, with the cost of buying the Canadian dollars on the spot market on October 15, 2003. Fill in the table below to show the cost of buying C$1.5 million at different spot rates, and then calculate Hoola Hoopa's potential gains or losses from hedging with a futures contract.

| Spot Rate on Oct 15, 2003 | Unhedged Position | Hedged Position | Potential Gains/Losses in US$ from Hedge |
|---|---|---|---|
| 0.6521 | | | |
| 0.6700 | | | |
| 0.6803 | | | |
| 0.6850 | | | |
| 0.6900 | | | |

(Note: The Company's unhedged position is the cost in US$ of C$1.5 million at the various spot rates given for Oct. 15, 2003. The Company's hedged position is the cost of a forward contract on April 15, 2003 to purchase 1.5 million Canadian dollars 6 months later on October 15, 2003.)