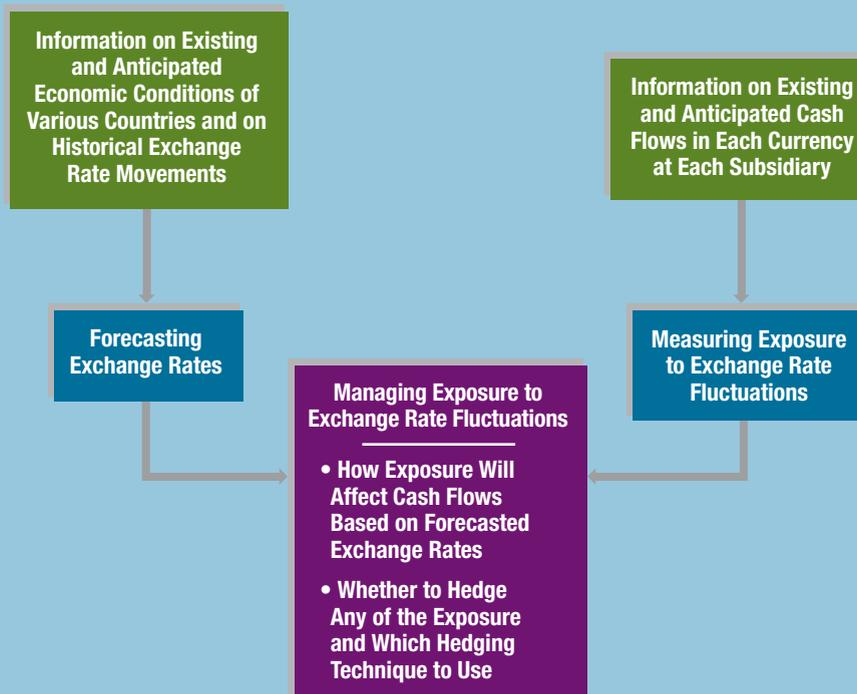# Part 3: Exchange Rate Risk Management

Part 3 (Chapters 9 through 12) explains the various functions involved in managing exposure to exchange rate risk. Chapter 9 describes various methods used to forecast exchange rates and explains how to assess forecasting performance. Chapter 10 demonstrates how to measure exposure to exchange rate movements. Given a firm's exposure and forecasts of future exchange rates, Chapters 11 and 12 explain how to hedge that exposure.

Information on Existing and Anticipated Economic Conditions of Various Countries and on Historical Exchange Rate Movements

Information on Existing and Anticipated Cash Flows in Each Currency at Each Subsidiary

Forecasting Exchange Rates

Measuring Exposure to Exchange Rate Fluctuations

Managing Exposure to Exchange Rate Fluctuations

- How Exposure Will Affect Cash Flows Based on Forecasted Exchange Rates

- Whether to Hedge Any of the Exposure and Which Hedging Technique to Use

9: Forecasting Exchange Rates

Many decisions of MNCs are influenced by exchange rate projections. Financial managers must understand how to forecast exchange rates so that they can make decisions that maximize the value of their MNCs.

The specific objectives of this chapter are to:

■ explain how firms can benefit from forecasting exchange rates,

■ describe the common techniques used for forecasting, and

■ explain how forecasting performance can be evaluated.

Why Firms Forecast Exchange Rates

Virtually every operation of an MNC can be influenced by changes in exchange rates. The following are some of the corporate functions for which exchange rate forecasts are necessary:

- *Hedging decision*. MNCs constantly face the decision of whether to hedge future payables and receivables in foreign currencies. Whether a firm hedges may be determined by its forecasts of foreign currency values.

E X A M P L E Laredo Co., based in the United States, plans to pay for clothing imported from Mexico in 90 days. If the forecasted value of the peso in 90 days is sufficiently below the 90-day forward rate, the MNC may decide not to hedge. Forecasting may enable the firm to make a decision that will increase its cash flows. ■

- *Short-term financing decision*. When large corporations borrow, they have access to several different currencies. The currency they borrow will ideally (1) exhibit a low interest rate and (2) weaken in value over the financing period.

E X A M P L E Westbury Co. considers borrowing Japanese yen to finance its U.S. operations because the yen has a low interest rate. If the yen depreciates against the U.S. dollar over the financing period, the firm can pay back the loan with fewer dollars (when converting those dollars in exchange for the amount owed in yen). The decision of whether to finance with yen or dollars is dependent on a forecast of the future value of the yen. ■

- *Short-term investment decision*. Corporations sometimes have a substantial amount of excess cash available for a short time period. Large deposits can be established in several currencies. The ideal currency for deposits will (1) exhibit a high interest rate and (2) strengthen in value over the investment period.

E X A M P L E Lafayette Co. has excess cash and considers depositing the cash into a British bank account. If the British pound appreciates against the dollar by the end of the deposit period when pounds will be withdrawn and exchanged for U.S. dollars, more dollars will be received. Thus, the firm can use forecasts of the pound's exchange rate when determining whether to invest the short-term cash in a British account or a U.S. account. ■

- *Capital budgeting decision.* When an MNC's parent assesses whether to invest funds in a foreign project, the firm takes into account that the project may periodically require the exchange of currencies. The capital budgeting analysis can be completed only when all estimated cash flows are measured in the parent's local currency.

E X A M P L E Evansville Co. wants to determine whether to establish a subsidiary in Thailand. Forecasts of the future cash flows used in the capital budgeting process will be dependent on the future exchange rate of Thailand's currency (the baht) against the dollar. This dependency can be due to (1) future inflows denominated in baht that will require conversion to dollars and/or (2) the influence of future exchange rates on demand for the subsidiary's products. Accurate forecasts of currency values will improve the estimates of the cash flows and therefore enhance the MNC's decision making. ■

- *Earnings assessment.* The parent's decision about whether a foreign subsidiary should reinvest earnings in a foreign country or remit earnings back to the parent may be influenced by exchange rate forecasts. If a strong foreign currency is expected to weaken substantially against the parent's currency, the parent may prefer to expedite the remittance of subsidiary earnings before the foreign currency weakens.

  Exchange rate forecasts are also useful for forecasting an MNC's earnings. When earnings of an MNC are reported, subsidiary earnings are consolidated and translated into the currency representing the parent firm's home country.

E X A M P L E DuPont has a large amount of business in Europe. Its forecast of consolidated earnings requires a forecast of earnings generated by subsidiaries in each country along with a forecast of the exchange rate at which those earnings will be translated into dollars (in order to consolidate all earnings into a single currency). Given the uncertainty of exchange rates and other factors that affect earnings, DuPont uses a range when forecasting its earnings. The low end allows for the possibility of a weak euro (European earnings translated at low exchange rates), while the high end allows for the possibility of a strong euro (European earnings translated at high exchange rates). ■

For accounting purposes, DuPont's European subsidiaries' earnings in euros must be measured by translating them to U.S. dollars. Its British subsidiary's earnings in pounds must also be measured by translation to U.S. dollars. "Translation" does not mean that the earnings are physically converted to U.S. dollars. It is simply a periodic recording process so that consolidated earnings can be reported in a single currency. In this case, appreciation of the euro will boost the European subsidiaries' earnings when they are reported in (translated to) U.S. dollars. Forecasts of exchange rates thus play an important role in the overall forecast of an MNC's consolidated earnings.

- *Long-term financing decision.* Corporations that issue bonds to secure long-term funds may consider denominating the bonds in foreign currencies. They prefer that the currency borrowed depreciate over time against the currency they are receiving from sales. To estimate the cost of issuing bonds denominated in a foreign currency, forecasts of exchange rates are required.

E X A M P L E   Bryce Co. needs long-term funds to support its U.S. business. It can issue 10-year bonds denominated in Japanese yen at a 1 percent coupon rate, which is 5 percentage points less than the prevailing coupon rate on dollar-denominated bonds. However, Bryce will need to convert dollars to make the coupon or principal payments on the yen-denominated bond, so if the yen's value rises, the yen-denominated bond could be more costly to Bryce than the U.S. bond. Bryce's decision to issue yen-denominated bonds versus dollar-denominated bonds will be dependent on its forecast of the yen's exchange rate over the 10-year period. ■

Most forecasting is applied to currencies whose exchange rates fluctuate continuously, and that is the focus of this chapter. However, some forecasts are also derived for currencies whose exchange rates are fixed.

E X A M P L E   Even though the Argentine peso's value was still tied to the U.S. dollar in 2001, some U.S.-based MNCs created forecasts for the peso at that time because they anticipated that it would be devalued. The peso was devalued in 2002, and its exchange rate is no longer tied to the U.S. dollar. The Hong Kong dollar has been tied to the U.S. dollar since 1983, but some MNCs still prepare long-term forecasts of the Hong Kong dollar in anticipation that it may be revalued. ■

An MNC's motives for forecasting exchange rates are summarized in Exhibit 9.1. The motives are distinguished according to whether they can enhance the MNC's value by influencing its cash flows or its cost of capital. The need for accurate exchange rate projections should now be clear. The following section describes the forecasting methods available.

Forecasting Techniques

The numerous methods available for forecasting exchange rates can be categorized into four general groups: (1) technical, (2) fundamental, (3) market based, and (4) mixed.

Exhibit 9.1   Corporate Motives for Forecasting Exchange Rates
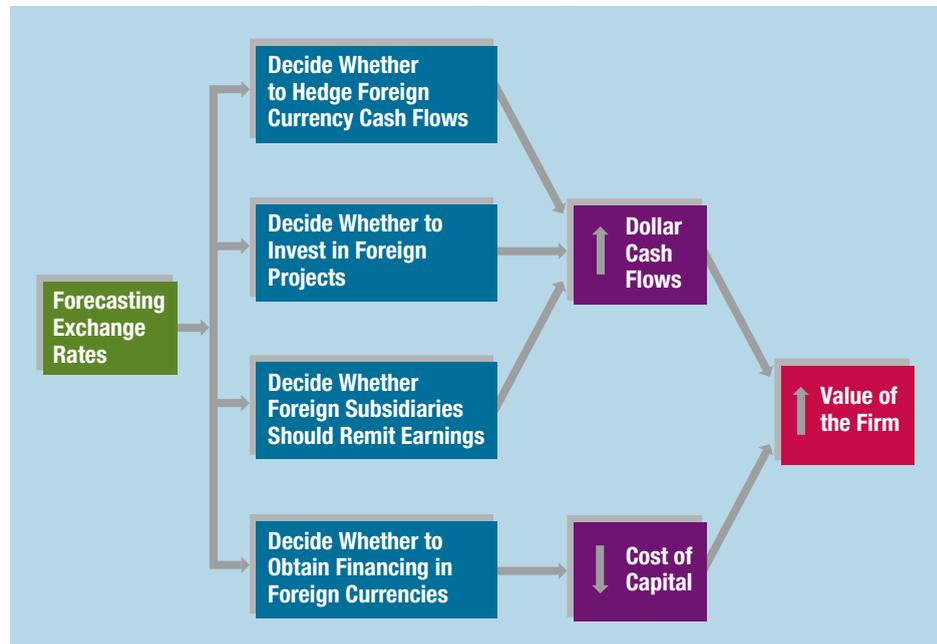
Technical Forecasting

Technical forecasting involves the use of historical exchange rate data to predict future values.

There may be a trend of successive daily exchange rate adjustments in the same direction, which could lead to a continuation of that trend. Alternatively, there may be a trend of the average daily change in the exchange rate per week over several recent weeks. A trend of higher mean daily exchange rate adjustments on a weekly basis may indicate that the exchange rate will continue to appreciate in the future.

Alternatively, there may be some technical indicators that a correction in the exchange rate is likely, which would result in a forecast that the exchange rate will reverse its direction.

E X A M P L E   Tomorrow Kansas Co. has to pay 10 million Mexican pesos for supplies that it recently received from Mexico. Today, the peso has appreciated by 3 percent against the dollar. Kansas Co. could send the payment today so that it would avoid the effects of any additional appreciation tomorrow. Based on an analysis of historical time series, Kansas has determined that whenever the peso appreciates against the dollar by more than 1 percent, it experiences a reversal of about 60 percent of that change on the following day. That is,

$$e_{t+1} = e_t \times (-60\%) \text{ when } e_t > 1\%$$

Applying this tendency to the current situation in which the peso appreciated by 3 percent today, Kansas Co. forecasts that tomorrow's exchange rate will change by

$$e_{t+1} = e_t \times (-60\%)$$
$$= (3\%) \times (-60\%)$$
$$= -1.8\%$$

Given this forecast that the peso will depreciate tomorrow, Kansas Co. decides that it will make its payment tomorrow instead of today. ∎

Technical factors are sometimes cited as the main reason for changing speculative positions that cause an adjustment in the dollar's value. For example, headlines often attribute a change in the dollar's value to technical factors:

- Technical factors overwhelmed economic news.
- Technical factors triggered sales of dollars.
- Technical factors indicated that dollars had been recently oversold, triggering purchases of dollars.

Limitations of Technical Forecasting. MNCs tend to make only limited use of technical forecasting because it typically focuses on the near future, which is not very helpful for developing corporate policies. Most technical forecasts apply to very short-term periods such as one day because patterns in exchange rate movements are more systematic over such periods. Since patterns may be less reliable for forecasting long-term movements over a quarter, a year, or 5 years from now, technical forecasts are less useful for forecasting exchange rates in the distant future. Thus, technical forecasting may not be suitable for firms that need to forecast exchange rates in the distant future.

In addition, technical forecasting rarely provides point estimates or a range of possible future values. Because technical analysis typically cannot estimate future exchange rates in precise terms, it is not, by itself, an adequate forecasting tool for financial managers of MNCs.

A technical forecasting model that has worked well in one particular period will not necessarily work well in another. With the abundance of technical models existing today, some are bound to generate speculative profits in any given period. If the pattern of currency values over time appears to be random, then technical forecasting is not appropriate. Unless historical trends in exchange rate movements can be identified, examination of past movements will not be useful for indicating future movements.

Many foreign exchange participants argue that even if a particular technical forecasting model is shown to lead consistently to speculative profits, it will no longer be useful once other participants begin to use it. Trading based on the model's recommendation will push the currency value to a new position immediately. Speculators using technical exchange rate forecasting often incur large transaction costs due to their frequent trading. In addition, monitoring currency movements in search of a systematic pattern can be time-consuming. Furthermore, speculators need sufficient capital to absorb losses that may occur.

Fundamental Forecasting

Fundamental forecasting is based on fundamental relationships between economic variables and exchange rates. Recall from Chapter 4 that a change in a currency's spot rate is influenced by the following factors:

$$e = f(\Delta INF, \Delta INT, \Delta INC, \Delta GC, \Delta EXP)$$

where

$$\begin{aligned}
e &= \text{percentage change in the spot rate} \\
\Delta INF &= \text{change in the differential between U.S. inflation and the} \\
&\quad\ \text{foreign country's inflation} \\
\Delta INT &= \text{change in the differential between the U.S. interest rate} \\
&\quad\ \text{and the foreign country's interest rate} \\
\Delta INC &= \text{change in the differential between the U.S. income level} \\
&\quad\ \text{and the foreign country's income level} \\
\Delta GC &= \text{change in government controls} \\
\Delta EXP &= \text{change in expectations of future exchange rates}
\end{aligned}$$

Given current values of these variables along with their historical impact on a currency's value, corporations can develop exchange rate projections.

A forecast may arise simply from a subjective assessment of the degree to which general movements in economic variables in one country are expected to affect exchange rates. From a statistical perspective, a forecast would be based on quantitatively measured impacts of factors on exchange rates. Although some of the full-blown fundamental models are beyond the scope of this text, a simplified discussion follows.

E X A M P L E   The focus here is on only two of the many factors that affect currency values. Before identifying them, consider that the corporate objective is to forecast the percentage change (rate of appreciation or depreciation) in the British pound with respect to the U.S. dollar during the next quarter. For simplicity, assume the firm's forecast for the British pound is dependent on only two factors that affect the pound's value:

1. Inflation in the United States relative to inflation in the United Kingdom.

2. Income growth in the United States relative to income growth in the United Kingdom (measured as a percentage change).

The first step is to determine how these variables have affected the percentage change in the pound's value based on historical data. This is commonly achieved with regression

analysis. First, quarterly data are compiled for the inflation and income growth levels of both the United Kingdom and the United States. The dependent variable is the quarterly percentage change in the British pound value (called *BP*). The independent (influential) variables may be set up as follows:

1. Previous quarterly percentage change in the inflation differential (U.S. inflation rate minus British inflation rate), referred to as INF_{t-1}.
2. Previous quarterly percentage change in the income growth differential (U.S. income growth minus British income growth), referred to as INC_{t-1}.

The regression equation can be defined as

$$BP_t = b_0 + b_1 INF_{t-1} + b_2 INC_{t-1} + \mu_t$$

where b_0 is a constant, b_1 measures the sensitivity of BP_t to changes in INF_{t-1}, b_2 measures the sensitivity of BP_t to changes in INC_{t-1}, and μ_t represents an error term. A set of historical data is used to obtain previous values of *BP*, *INF*, and *INC*. Using this data set, regression analysis will generate the values of the regression coefficients (b_0, b_1, and b_2). That is, regression analysis determines the direction and degree to which *BP* is affected by each independent variable. The coefficient b_1 will exhibit a positive sign if, when INF_{t-1} changes, BP_t changes in the same direction (other things held constant). A negative sign indicates that BP_t and INF_{t-1} move in opposite directions. In the equation given, b_1 is expected to exhibit a positive sign because when U.S. inflation increases relative to inflation in the United Kingdom, upward pressure is exerted on the pound's value.

The regression coefficient b_2 (which measures the impact of INC_{t-1} on BP_t) is expected to be positive because when U.S. income growth exceeds British income growth, there is upward pressure on the pound's value. These relationships have already been thoroughly discussed in Chapter 4.

Once regression analysis is employed to generate values of the coefficients, these coefficients can be used to forecast. To illustrate, assume the following values: b_0 = .002, b_1 = .8, and b_2 = 1.0. The coefficients can be interpreted as follows. For a one-unit percentage change in the inflation differential, the pound is expected to change by .8 percent in the same direction, other things held constant. For a one-unit percentage change in the income differential, the British pound is expected to change by 1.0 percent in the same direction, other things held constant. To develop forecasts, assume that the most recent quarterly percentage change in INF_{t-1} (the inflation differential) is 4 percent and that INC_{t-1} (the income growth differential) is 2 percent. Using this information along with our estimated regression coefficients, the forecast for BP_t is

$$\begin{aligned} BP_t &= b_0 + b_1 INF_{t-1} + b_2 INC_{t-1} \\ &= .002 + .8(4\%) + 1(2\%) \\ &= .2\% + 3.2\% + 2\% \\ &= 5.4\% \end{aligned}$$

Thus, given the current figures for inflation rates and income growth, the pound should appreciate by 5.4 percent during the next quarter. ■

This example is simplified to illustrate how fundamental analysis can be implemented for forecasting. A full-blown model might include many more than two factors, but the application would still be similar. A large time-series database would be necessary to warrant any confidence in the relationships detected by such a model.

Use of Sensitivity Analysis for Fundamental Forecasting.

When a regression model is used for forecasting, and the values of the influential factors have a lagged impact on exchange rates, the actual value of those factors can be

used as input for the forecast. For example, if the inflation differential has a lagged impact on exchange rates, the inflation differential in the previous period may be used to forecast the percentage change in the exchange rate over the future period. Some factors, however, have an instantaneous influence on exchange rates. Since these factors obviously cannot be known, forecasts must be used. Firms recognize that poor forecasts of these factors can cause poor forecasts of the exchange rate movements, so they may attempt to account for the uncertainty by using **sensitivity analysis,** which considers more than one possible outcome for the factors exhibiting uncertainty.

E X A M P L E   Phoenix Corp. develops a regression model to forecast the percentage change in the Mexican peso's value. It believes that the real interest rate differential and the inflation differential are the only factors that affect exchange rate movements, as shown in this regression model:

$$e_t = a_0 + a_1 INT_t + a_2 INF_{t-1} + \mu_t$$

where

$$
\begin{aligned}
e_t &= \text{percentage change in the peso's exchange rate over period } t \\
INT_t &= \text{real interest rate differential over period } t \\
INF_{t-1} &= \text{inflation differential in the previous period } t \\
a_0, a_1, a_2 &= \text{regression coefficients} \\
\mu_t &= \text{error term}
\end{aligned}
$$

Historical data are used to determine values for e_t along with values for INT_t and INF_{t-1} for several periods (preferably, 30 or more periods are used to build the database). The length of each historical period (quarter, month, etc.) should match the length of the period for which the forecast is needed. The historical data needed per period for the Mexican peso model are (1) the percentage change in the peso's value, (2) the U.S. real interest rate minus the Mexican real interest rate, and (3) the U.S. inflation rate in the previous period minus the Mexican inflation rate in the previous period. Assume that regression analysis has provided the following estimates for the regression coefficients:

Regression Coefficient	Estimate
a_0	.001
a_1	−.7
a_2	.6

The negative sign of a_1 indicates a negative relationship between INT_t and the peso's movements, while the positive sign of a_2 indicates a positive relationship between INF_{t-1} and the peso's movements.

To forecast the peso's percentage change over the upcoming period, INT_t and INF_{t-1} must be estimated. Assume that INF_{t-1} was 1 percent. However, INT_t is not known at the beginning of the period and must therefore be forecasted. Assume that Phoenix Corp. has developed the following probability distribution for INT_t:

Probability	Possible Outcome
20%	−3%
50%	−4%
30%	−5%
100%	

A separate forecast of e_t can be developed from each possible outcome of INT_t as follows:

Forecast of *INT*	Forecast of e_t	Probability
−3%	.1% + (−.7)(−3%) + .6(1%) = 2.8%	20%
−4%	.1% + (−.7)(−4%) + .6(1%) = 3.5%	50%
−5%	.1% + (−.7)(−5%) + .6(1%) = 4.2%	30%

■

If the firm needs forecasts for other currencies, it can develop the probability distributions of their movements over the upcoming period in a similar manner.

E X A M P L E   Phoenix Corp. can forecast the percentage change in the Japanese yen by regressing historical percentage changes in the yen's value against (1) the differential between U.S. real interest rates and Japanese real interest rates and (2) the differential between U.S. inflation in the previous period and Japanese inflation in the previous period. The regression coefficients estimated by regression analysis for the yen model will differ from those for the peso model. The firm can then use the estimated coefficients along with estimates for the interest rate differential and inflation rate differential to develop a forecast of the percentage change in the yen. Sensitivity analysis can be used to reforecast the yen's percentage change based on alternative estimates of the interest rate differential. ■

Use of PPP for Fundamental Forecasting.   Recall that the theory of purchasing power parity (PPP) specifies the fundamental relationship between the inflation differential and the exchange rate. In simple terms, PPP states that the currency of the relatively inflated country will depreciate by an amount that reflects that country's inflation differential. Recall that according to PPP, the percentage change in the foreign currency's value (e) over a period should reflect the differential between the home inflation rate (I_h) and the foreign inflation rate (I_f) over that period.

E X A M P L E   The U.S. inflation rate is expected to be 1 percent over the next year, while the Australian inflation rate is expected to be 6 percent. According to PPP, the Australian dollar's exchange rate should change as follows:

$$e_f = \frac{1 + I_{U.S.}}{1 + I_f} - 1$$

$$= \frac{1.01}{1.06} - 1$$

$$\cong -4.7\%$$

This forecast of the percentage change in the Australian dollar can be applied to its existing spot rate to forecast the future spot rate at the end of one year. If the existing spot rate (S_t) of the Australian dollar is $.50, the expected spot rate at the end of one year, $E(S_{t+1})$, will be about $.4765:

$$E(S_{t+1}) = S_t(1 + e_f)$$
$$= \$.50[1 + (-.047)]$$
$$= \$.4765$$

■

In reality, the inflation rates of two countries over an upcoming period are uncertain and therefore would have to be forecasted when using PPP to forecast the future exchange rate at the end of the period. This complicates the use of PPP to forecast

future exchange rates. Even if the inflation rates in the upcoming period were known with certainty, PPP might not be able to forecast exchange rates accurately.

If the PPP theory were accurate in reality, there would be no need to even consider alternative forecasting techniques. However, using the inflation differential of two countries to forecast their exchange rate is not always accurate. Problems arise for several reasons: (1) the timing of the impact of inflation fluctuations on changing trade patterns, and therefore on exchange rates, is not known with certainty; (2) data used to measure relative prices of two countries may be somewhat inaccurate; (3) barriers to trade can disrupt the trade patterns that should emerge in accordance with PPP theory; and (4) other factors, such as the interest rate differential between countries, can also affect exchange rates. For these reasons, the inflation differential by itself is not sufficient to accurately forecast exchange rate movements. Nevertheless, it should be included in any fundamental forecasting model.

Limitations of Fundamental Forecasting. Although fundamental forecasting accounts for the expected fundamental relationships between factors and currency values, the following limitations exist:

1. The precise timing of the impact of some factors on a currency's value is not known. It is possible that the full impact of factors on exchange rates will not occur until two, three, or four quarters later. The regression model would need to be adjusted accordingly.

2. As mentioned earlier, some factors exhibit an immediate impact on exchange rates. They can be usefully included in a fundamental forecasting model only if forecasts can be obtained for them. Forecasts of these factors should be developed for a period that corresponds to the period for which a forecast of exchange rates is necessary. In this case, the accuracy of the exchange rate forecasts will be somewhat dependent on the accuracy of these factors. Even if a firm knows exactly how movements in these factors affect exchange rates, its exchange rate projections may be inaccurate if it cannot predict the values of the factors.

3. Some factors that deserve consideration in the fundamental forecasting process cannot be easily quantified. For example, what if large Australian exporting firms experience an unanticipated labor strike, causing shortages? This will reduce the availability of Australian goods for U.S. consumers and therefore reduce U.S. demand for Australian dollars. Such an event, which would put downward pressure on the Australian dollar value, normally is not incorporated into the forecasting model.

4. Coefficients derived from the regression analysis will not necessarily remain constant over time. In the previous example, the coefficient for INF_{t-1} was .6, suggesting that for a one-unit change in INF_{t-1}, the Mexican peso would appreciate by .6 percent. Yet, if the Mexican or U.S. governments imposed new trade barriers, or eliminated existing barriers, the impact of the inflation differential on trade (and therefore on the Mexican peso's exchange rate) could be affected.

These limitations of fundamental forecasting have been discussed to emphasize that even the most sophisticated forecasting techniques (fundamental or otherwise) cannot provide consistently accurate forecasts. MNCs that develop forecasts must allow for some margin of error and recognize the possibility of error when implementing corporate policies.

Market-Based Forecasting

The process of developing forecasts from market indicators, known as **market-based forecasting,** is usually based on either (1) the spot rate or (2) the forward rate.

Use of the Spot Rate. Today's spot rate may be used as a forecast of the spot rate that will exist on a future date. To see why the spot rate can be a useful market-based forecast, assume the British pound is expected to appreciate against the dollar in the very near future. This expectation will encourage speculators to buy the pound with U.S. dollars today in anticipation of its appreciation, and these purchases can force the pound's value up immediately. Conversely, if the pound is expected to depreciate against the dollar, speculators will sell off pounds now, hoping to purchase them back at a lower price after they decline in value. Such actions can force the pound to depreciate immediately. Thus, the current value of the pound should reflect the expectation of the pound's value in the very near future. Corporations can use the spot rate to forecast since it represents the market's expectation of the spot rate in the near future.

Use of the Forward Rate. A forward rate quoted for a specific date in the future is commonly used as the forecasted spot rate on that future date. That is, a 30-day forward rate provides a forecast for the spot rate in 30 days, a 90-day forward rate provides a forecast of the spot rate in 90 days, and so on. Recall that the forward rate is measured as

$$F = S(1 + p)$$

where p represents the forward premium. Since p represents the percentage by which the forward rate exceeds the spot rate, it serves as the expected percentage change in the exchange rate:

$$E(e) = p$$
$$= (F/S) - 1 \; [\textbf{by rearranging terms}]$$

E X A M P L E   If the one-year forward rate of the Australian dollar is $.63, while the spot rate is $.60, the expected percentage change in the Australian dollar is

$$E(e) = p$$
$$= (F/S) - 1$$
$$= (.63/.60) - 1$$
$$= .05, \textbf{ or 5\%}$$ ■

Rationale for Using the Forward Rate. To understand why the forward rate can serve as a forecast of the future spot rate, consider the following example.

E X A M P L E   If speculators expect the spot rate of the British pound in 30 days to be $1.45, and the prevailing forward rate is $1.40, they might buy pounds 30 days forward at $1.40 and then sell them when received (in 30 days) at the spot rate existing then. If a large number of speculators implement this strategy, the substantial forward purchases of pounds will cause the forward rate to increase until this speculative demand stops.

Perhaps this speculative demand will terminate when the forward rate reaches $1.45, since at this rate no profits will be expected by implementing the strategy. Thus, the forward rate should move toward the market's general expectation of the future spot rate. In this sense, the forward rate serves as a market-based forecast since it reflects the market's expectation of the spot rate at the end of the forward horizon (30 days from now in this example). ■

Although the focus of this chapter is on corporate forecasting rather than speculation, it is speculation that helps to push the forward rate to the level that reflects the

general expectation of the future spot rate. If corporations are convinced that the forward rate is a reliable indicator of the future spot rate, they can simply monitor this publicly quoted rate to develop exchange rate projections.

Long-Term Forecasting with Forward Rates.
Long-term exchange rate forecasts can be derived from long-term forward rates.

E X A M P L E Assume that the spot rate of the euro is currently $1.00, while the 5-year forward rate of the euro is $1.06. This forward rate can serve as a forecast of $1.06 for the euro in 5 years, which reflects a 6 percent appreciation in the euro over the next 5 years. ∎

Forward rates are normally available for periods of 2 to 5 years or even longer, but the bid/ask spread is wide because of the limited trading volume. Although such rates are rarely quoted in financial newspapers, the quoted interest rates on risk-free instruments of various countries can be used to determine what the forward rates would be under conditions of interest rate parity.

E X A M P L E The U.S. 5-year interest rate is currently 10 percent, annualized, while the British 5-year interest rate is 13 percent. The 5-year compounded return on investments in each of these countries is computed as follows:

Country	Five-Year Compounded Return
United States	$(1.10)^5 - 1 = 61\%$
United Kingdom	$(1.13)^5 - 1 = 84\%$

Thus, the appropriate 5-year forward rate premium (or discount) of the British pound would be

$$p = \frac{1 + i_{U.S.}}{1 + i_{U.K.}} - 1$$

$$= \frac{1.61}{1.84} - 1$$

$$= -.125, \text{ or } -12.5\%$$

The results of this comparison suggest that the 5-year forward rate of the pound should contain a 12.5 percent discount. That is, the spot rate of the pound is expected to depreciate by 12.5 percent over the 5-year period for which the forward rate is used to forecast. ∎

The governments of some emerging markets (such as those in Latin America) do not issue long-term fixed-rate bonds very often. Consequently, long-term interest rates are not available, and long-term forward rates cannot be derived in the manner shown here.

The forward rate is easily accessible and therefore serves as a convenient and free forecast. Like any method of forecasting exchange rates, the forward rate is typically more accurate when forecasting exchange rates for short-term horizons than for long-term horizons. Exchange rates tend to wander farther from expectations over longer periods of time.

Implications of the IFE and IRP for Forecasts Using the Forward Rate.
Recall that if interest rate parity (IRP) holds, the forward rate premium reflects the interest rate differential between two countries. Also recall that if the international Fisher effect (IFE) holds, a currency that has a higher interest rate than the U.S. interest rate should depreciate against the dollar because the higher

interest rate implies a higher level of expected inflation in that country than in the United States. Since the forward rate captures the nominal interest rate (and therefore the expected inflation rate) between two countries, it should provide more accurate forecasts for currencies in high-inflation countries than the spot rate.

E X A M P L E   Alves, Inc., is a U.S. firm that does business in Brazil, and it needs to forecast the exchange rate of the Brazilian real for one year ahead. It considers using either the spot rate or the forward rate to forecast the real. The spot rate of the Brazilian real is $.40. The one-year interest rate in Brazil is 20 percent, versus 5 percent in the United States. The one-year forward rate is $.35, which reflects a discount to offset the interest rate differential according to IRP (check this yourself). Alves believes that the future exchange rate of the real will be driven by the inflation differential between Brazil and the United States. It also believes that the real rate of interest in both Brazil and the United States is 3 percent. This implies that the expected inflation rate for next year is 17 percent in Brazil and 2 percent in the United States. The forward rate discount is based on the interest rate differential, which in turn is related to the inflation differential. In this example, the forward rate of the Brazilian real reflects a large discount, which means that it implies a forecast of substantial depreciation of the real. Conversely, using the spot rate of the real as a forecast would imply that the exchange rate at the end of the year will be what it is today. Since the forward rate forecast indirectly captures the differential in expected inflation rates, it is a more appropriate forecast method than the spot rate. ■

Firms may not always believe that the forward rate provides more accurate forecasts than the spot rate. If a firm is forecasting over a very short term horizon such as a day or a week, the interest rate (and therefore expected inflation) differential may not be as influential. Second, some firms may believe that the interest rate differential may not even be influential in the long run. Third, if the foreign country's interest rate is usually similar to the U.S. rate, the forward rate premium or discount will be close to zero, meaning that the forward rate and spot rate will provide similar forecasts.

Mixed Forecasting

Because no single forecasting technique has been found to be consistently superior to the others, some MNCs prefer to use a combination of forecasting techniques. This method is referred to as **mixed forecasting.** Various forecasts for a particular currency value are developed using several forecasting techniques. The techniques used are assigned weights in such a way that the weights total 100 percent, with the techniques considered more reliable being assigned higher weights. The actual forecast of the currency is a weighted average of the various forecasts developed.

E X A M P L E   College Station, Inc., needs to assess the value of the Mexican peso because it is considering expanding its business in Mexico. The conclusions drawn from each forecasting technique are shown in Exhibit 9.2. Notice that, in this example, the forecasted direction of the peso's value is dependent on the technique used. The fundamental forecast predicts the peso will appreciate, but the technical forecast and the market-based forecast predict it will depreciate. Also, notice that even though the fundamental and market-based forecasts are both driven by the same factor (interest rates), the results are distinctly different. ■

Sometimes MNCs assign one technique a lower weight when forecasting in one period, but a higher weight when forecasting in a later period. Some firms even weight a given technique more for some currencies than for others at a given point in time. For example, a firm may decide that a market-based forecast provides the best prediction for the pound, but that fundamental forecasting works best for the New Zealand dollar, and technical forecasting for the Mexican peso.

Exhibit 9.2   Forecasts of the Mexican Peso Drawn from Each Forecasting Technique

	Factors Considered	Situation	Forecast
Technical Forecast	Recent movement in peso	The peso's value declined below a specific threshold level in the last few weeks.	The peso's value will continue to fall now that it is beyond the threshold level.
Fundamental Forecast	Economic growth, inflation, interest rates	Mexico's interest rates are high, and inflation should remain low.	The peso's value will rise as U.S. investors capitalize on the high interest rates by investing in Mexican securities.
Market-Based Forecast	Spot rate, forward rate	The peso's forward rate exhibits a significant discount, which is attributed to Mexico's relatively high interest rates.	Based on the forward rate, which provides a forecast of the future spot rate, the peso's value will decline.

While each forecasting method has its merits, some changes in exchange rates are not anticipated by any method.

E X A M P L E   During the Asian crisis, the Indonesian rupiah depreciated by more than 80 percent against the dollar within a 9-month period. Before the rupiah's decline, neither technical factors, nor fundamental factors, nor the forward rate indicated any potential weakness. The depreciation of the rupiah was primarily attributed to concerns by institutional investors about the safety of their investments in Indonesia, which encouraged them to liquidate the investments and convert the rupiah into other currencies, putting downward pressure on the rupiah. ■

Weakness in some currencies may best be anticipated by a subjective assessment of conditions in a particular country and not by the quantitative methods described here. Thus, MNCs may benefit from using the methods described in this chapter along with their own sense of the conditions in a particular country. Nevertheless, it is still difficult to anticipate that a currency will weaken before a speculative outflow occurs. By that time, the currency will have weakened as a result of the outflow.

Forecasting Services

The corporate need to forecast currency values has prompted the emergence of several forecasting service firms, including Business International, Conti Currency, Predex, and Global Insight. In addition, some large investment banks such as Goldman Sachs and commercial banks such as Citigroup offer forecasting services. Many consulting services use at least two different types of analysis to generate separate forecasts and then determine the weighted average of the forecasts. Some forecasting services focus on technical forecasting, while others focus on fundamental forecasting.

Forecasts are even provided for currencies that are not widely traded. Forecasting service firms provide forecasts on any currency for time horizons of interest to their clients, ranging from one day to 10 years from now. In addition, some firms offer advice on international cash management, assessment of exposure to exchange rate risk, and hedging. Many of the firms provide their clients with forecasts and recommendations monthly, or even weekly, for an annual fee.

Reliance on Forecasting Services

Rather than rely on any forecasting method, an MNC may prefer to rely on a forecasting service. Some studies have compared several forecasting services' forecasts for different currencies to the forward rate and found that the forecasts provided by ser-

vices are no better than using the forward rate. Such results are frustrating for the corporations that have paid substantial amounts for expert opinions.

Perhaps some corporate clients of these forecasting services believe the fee is justified even when the forecasting performance is poor, if other services (such as cash management) are included in the package. It is also possible that a corporate treasurer, in recognition of the potential for error in forecasting exchange rates, may prefer to pay a forecasting service firm for its forecasts. Then the treasurer is not directly responsible for corporate problems that result from inaccurate currency forecasts. Not all MNCs hire forecasting service firms to do their forecasting. For example, Kodak, Inc., once used a service but became dissatisfied with it and has now developed its own forecasting system.

Forecast Error

Regardless of which method is used or which service is hired to forecast exchange rates, it is important to recognize that forecasted exchange rates are rarely perfect. The potential forecast error is larger for currencies that are more volatile because the spot rates of these currencies could easily wander far from any forecasted value in the future.

The potential forecast error also depends on the forecast horizon. A forecast of the spot rate of the euro for tomorrow will have a relatively small error because it probably will not deviate from today's spot rate by more than 1 percent in one day. However, a forecast of the euro in one month is more difficult because the euro's value has more time to stray from today's value. A forecast of one year in advance is even more difficult, and a forecast of 10 years ahead will very likely be subject to large error.

Potential Impact of Forecast Errors

When MNCs forecast future exchange rates incorrectly, their financial decisions can backfire. The outcomes of long-term projects in foreign countries are especially vulnerable to exchange rate movements, so that an MNC could invest in a $50 million subsidiary that ultimately fails because it forecasted future exchange rates poorly. Because of the potential for error in forecasting exchange rates, MNCs commonly consider how their potential error may affect their financial decisions before they implement decisions.

E X A M P L E   If Disney considers building a new theme park in Argentina, its final investment decision could be influenced by its forecasts of the Argentine peso value for future years. The forecasts of the Argentine peso's value in the distant future are subject to large error. Therefore, Disney would probably reassess its investment decision based on many possible exchange rate scenarios before deciding whether the theme park should be established. It may only pursue the project if it was expected to provide a satisfactory return on investment under most of the exchange rate scenarios considered. ■

Measurement of Forecast Error

An MNC that forecasts exchange rates must monitor its performance over time to determine whether the forecasting procedure is satisfactory. For this purpose, a measurement of the forecast error is required. There are various ways to compute forecast errors. One popular measurement will be discussed here and is defined as follows:

$$\text{Absolute forecast error as a percentage of the realized value} = \frac{\left| \text{Forecasted value} - \text{Realized value} \right|}{\text{Realized value}}$$

The error is computed using an absolute value because this avoids a possible off-setting effect when determining the mean forecast error. If the forecast error is .05 in the first period and −.05 in the second period (if the absolute value is not taken), the mean error is zero. Yet, that is misleading because the forecast was not perfectly accurate in either period. The absolute value avoids such a distortion.

When comparing a forecasting technique's performance among different currencies, it is often useful to adjust for their relative sizes.

E X A M P L E   Consider the following forecasted and realized values by New Hampshire Co. during one period:

	Forecasted Value	Realized Value
British pound	$1.35	$1.50
Mexican peso	$ .12	$ .10

In this case, the difference between the forecasted value and the realized value is $.15 for the pound versus $.02 for the peso. This does not necessarily mean that the forecast for the peso is more accurate. When the size of what is forecasted is considered (by dividing the difference by the realized value), one can see that the British pound has been predicted with more accuracy on a percentage basis. With the data given, the forecasting error (as defined earlier) of the British pound is

$$\frac{|\$1.35 - \$1.50|}{\$1.50} = \frac{\$.15}{\$1.50} = .10, \text{ or } 10\%$$

In contrast, the forecast error of the Mexican peso is

$$\frac{|.12 - .10|}{.10} = \frac{.02}{.10} = .20, \text{ or } 20\%$$

Thus, the peso has been predicted with less accuracy. ∎

Forecast Accuracy over Time

MNCs are likely to have more confidence in their measurement of the forecast error when they measure it over each of several periods. The absolute forecast error as a percentage of the realized value can be estimated for each period to derive the mean error over all of these periods. If an MNC is most interested in forecasting the value of a currency 90 days (one quarter) from now, it will assess errors from the application of various forecast procedures over the last several quarters.

Have forecasts improved in recent years? The answer depends on the method used to develop forecasts. Exhibit 9.3 shows the magnitude of the absolute errors when the forward rate is used as a predictor for the British pound over time. The size of the errors changes over time. The errors are larger in periods when the pound's value was more volatile.

Forecast Accuracy among Currencies

The ability to forecast currency values may vary with the currency of concern. The Canadian dollar stands out as the currency most accurately predicted. Its mean error is typically less than the mean absolute forecast errors for other major currencies because its value is more stable over time. This information is important because it means that a financial manager of a U.S. firm can feel more confident about the number of dollars to be received (or needed) on Canadian transactions. However, even the

Exhibit 9.3   Absolute Forecast Errors over Time for the British Pound (Using the Forward Rate to Forecast)
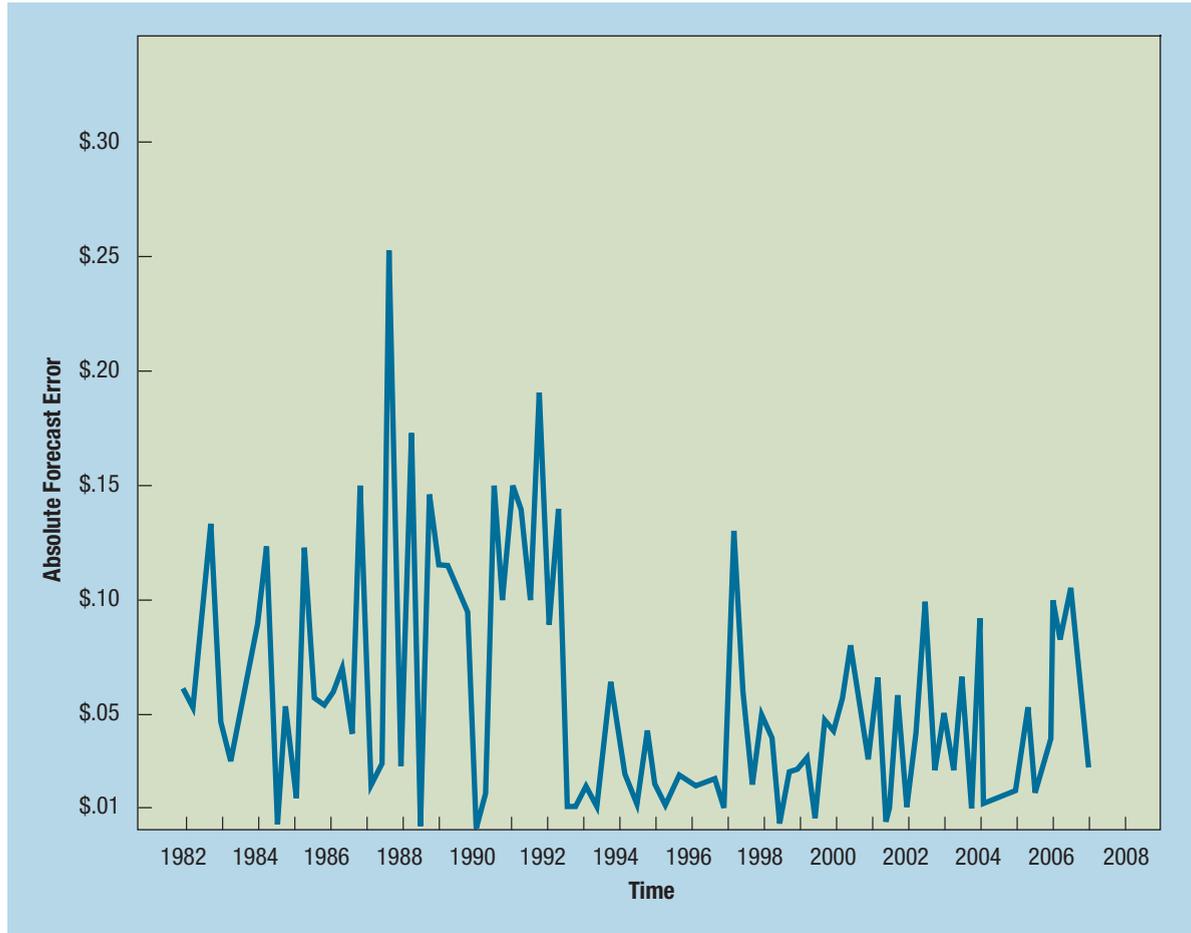
Canadian dollar is subject to a large forecast error. It appreciated substantially against the U.S. dollar in the 2004–2007 period, which would have resulted in larger forecast errors when using most forecasting techniques.

Forecast Bias

The difference between the forecasted and realized exchange rates for a given point in time is a nominal forecast error. Negative errors over time indicate underestimating, while positive errors indicate overestimating. If the errors are consistently positive or negative over time, then a bias in the forecasting procedure does exist. It appears that a bias did exist in distinct periods. During the strong-pound periods, the forecasts underestimated, while in weak-pound periods, the forecasts overestimated.

Statistical Test of Forecast Bias. If the forward rate is a biased predictor of the future spot rate, this implies that there is a systematic forecast error, which could be corrected to improve forecast accuracy. If the forward rate is unbiased, it fully reflects all available information about the future spot rate. In any case, any forecast errors would be the result of events that could not have been antic-

ipated from existing information at the time of the forecast. A conventional method of testing for a forecast bias is to apply the following regression model to historical data:

$$S_t = a_0 + a_1 F_{t-1} + \mu_t$$

where

$$S_t = \text{spot rate at time } t$$
$$F_{t-1} = \text{forward rate at time } t - 1$$
$$\mu_t = \text{error term}$$
$$a_0 = \text{intercept}$$
$$a_1 = \text{regression coefficient}$$

If the forward rate is unbiased, the intercept should equal zero, and the regression coefficient a_1 should equal 1.0. The t-test for a_1 is

$$t = \frac{a_1 - 1}{\textbf{Standard error of } a_1}$$

If $a_0 = 0$ and a_1 is significantly less than 1.0, this implies that the forward rate is systematically overestimating the spot rate. For example, if $a_0 = 0$ and $a_1 = .90$, the future spot rate is estimated to be 90 percent of the forecast generated by the forward rate.

Conversely, if $a_0 = 0$ and a_1 is significantly greater than 1.0, this implies that the forward rate is systematically underestimating the spot rate. For example, if $a = 0$ and $a_1 = 1.1$, the future spot rate is estimated to be 1.1 times the forecast generated by the forward rate.

When a bias is detected and anticipated to persist in the future, future forecasts may incorporate that bias. For example, if $a_1 = 1.1$, future forecasts of the spot rate may incorporate this information by multiplying the forward rate by 1.1 to create a forecast of the future spot rate.

By detecting a bias, an MNC may be able to adjust for the bias so that it can improve its forecasting accuracy. For example, if the errors are consistently positive, an MNC could adjust today's forward rate downward to reflect the bias. Over time, a forecasting bias can change (from underestimating to overestimating, or vice versa). Any adjustment to the forward rate used as a forecast would need to reflect the anticipated bias for the period of concern.

Graphic Evaluation of Forecast Performance

Forecast performance can be examined with the use of a graph that compares forecasted values with the realized values for various time periods.

E X A M P L E   For eight quarters, Tunek Co. used the 3-month forward rate of Currency Q to forecast Q's value 3 months ahead. The results from this strategy are shown in Exhibit 9.4, and the predicted and realized exchange rate values in Exhibit 9.4 are compared graphically in Exhibit 9.5.

The 45-degree line in Exhibit 9.5 represents perfect forecasts. If the realized value turned out to be exactly what was predicted over several periods, all points would be located on that 45-degree line in Exhibit 9.5. For this reason, the 45-degree line is referred to as the **perfect forecast line.** The closer the points reflecting the eight periods are vertically to the 45-degree line, the better the forecast. The vertical distance between each point and the 45-degree line is the forecast error. If the point is $.04 above the 45-degree line, this means that the realized spot rate was $.04 higher than the exchange rate forecasted. All points above the 45-degree line reflect underestimation, while all points below the 45-degree line reflect overestimation. ∎

Exhibit 9.4   Evaluation of Forecast Performance

Period	Predicted Value of Currency Q for End of Period	Realized Value of Currency Q as of End of Period
1	$.20	$.16
2	.18	.14
3	.24	.16
4	.26	.22
5	.30	.28
6	.22	.26
7	.16	.14
8	.14	.10

Exhibit 9.5   Graphic Evaluation of Forecast Performance
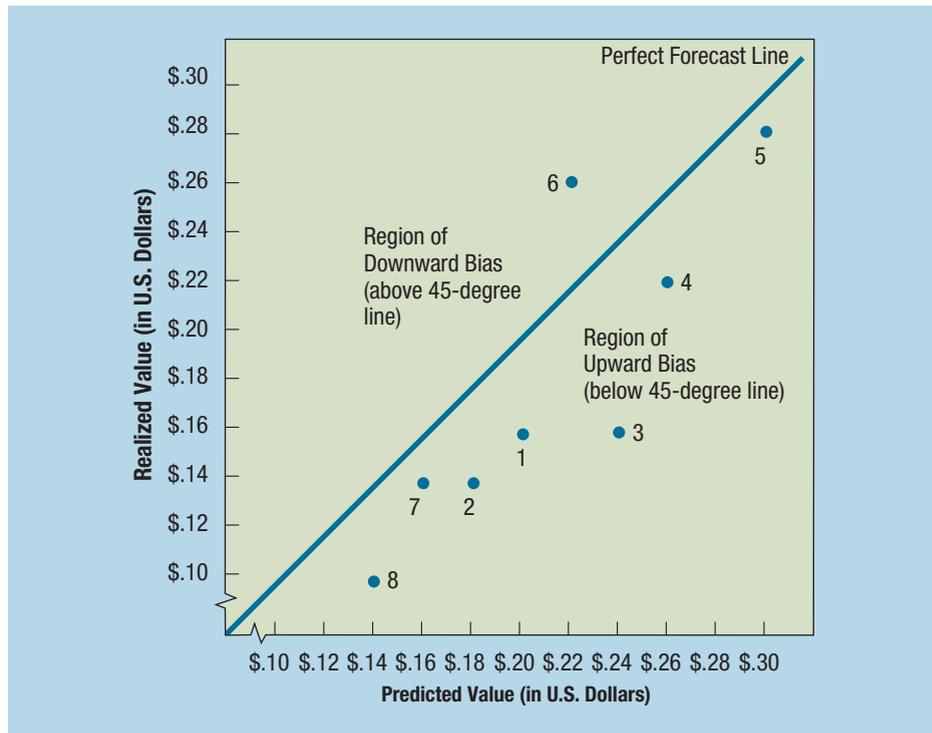
If points appear to be scattered evenly on both sides of the 45-degree line, then the forecasts are said to be *unbiased* since they are not consistently above or below the realized values. Whether evaluating the size of forecast errors or attempting to search for a bias, more reliable results are obtained when examining a large number of forecasts.

A more thorough assessment of a forecast bias can be conducted by separating the entire period into subperiods as shown in Exhibit 9.6 for the British pound. Each graph reflects a particular subperiod. Some graphs show a general underestimation while others show overestimation, which means that the forecast bias changed from one subperiod to another.

Exhibit 9.6 Graphic Comparison of Forecasted and Realized Spot Rates in Different Subperiods for the British Pound (Using the Forward Rate as the Forecast)
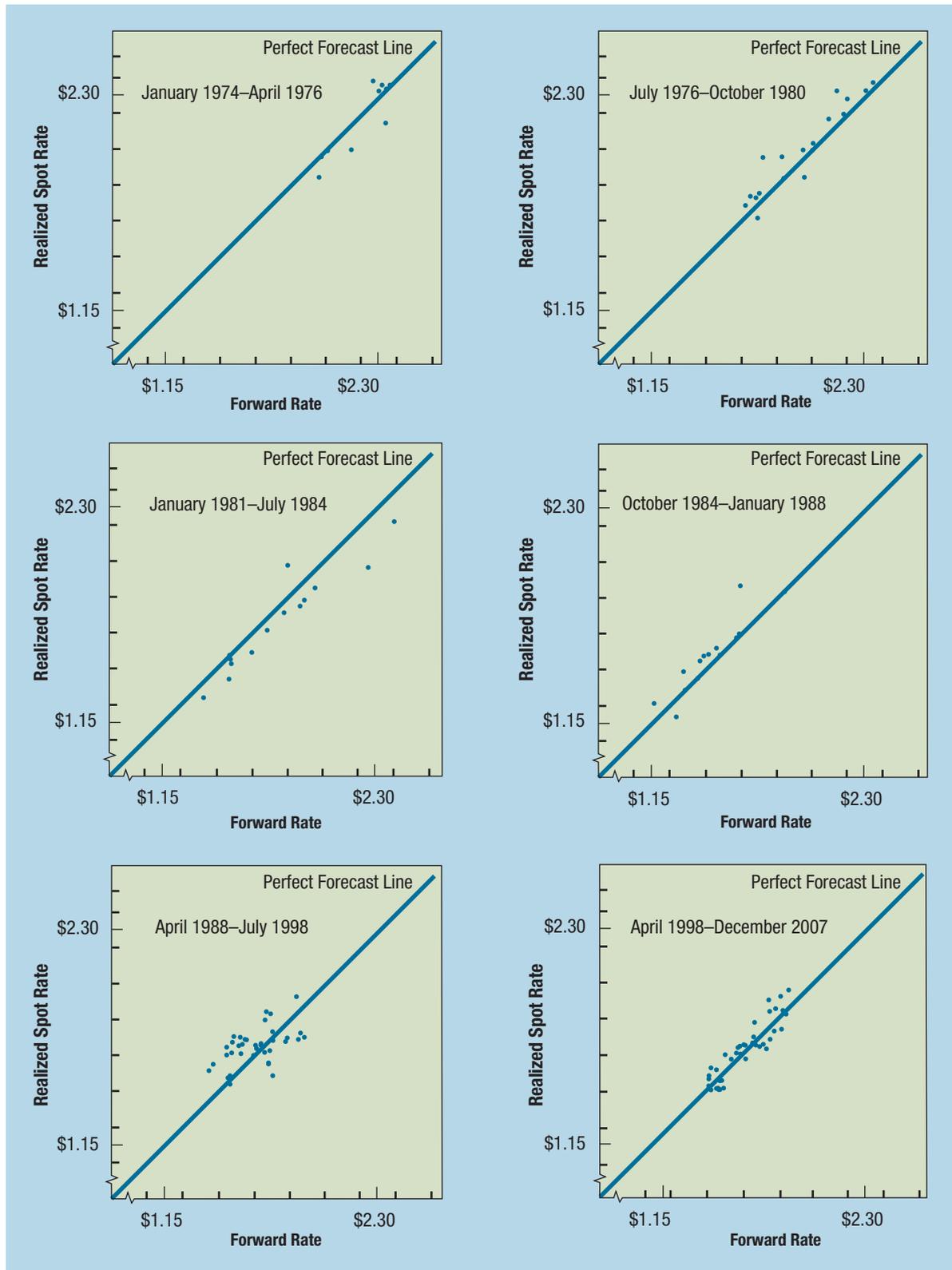
Comparison of Forecasting Methods

An MNC can compare forecasting methods by plotting the points relating to two methods on a graph similar to Exhibit 9.5. The points pertaining to each method can be distinguished by a particular mark or color. The performance of the two methods can be evaluated by comparing distances of points from the 45-degree line. In some cases, neither forecasting method may stand out as superior when compared graphically. If so, a more precise comparison can be conducted by computing the forecast errors for all periods for each method and then comparing these errors.

E X A M P L E   Xavier Co. uses a fundamental forecasting method to forecast the Polish currency (zloty), which it will need to purchase to buy imports from Poland. Xavier also derives a second forecast for each period based on an alternative forecasting model. Its previous forecasts of the zloty, using Model 1 (the fundamental method) and Model 2 (the alternative method), are shown in columns 2 and 3, respectively, of Exhibit 9.7, along with the realized value of the zloty in column 4.

The absolute forecast errors of forecasting with Model 1 and Model 2 are shown in columns 5 and 6, respectively. Notice that Model 1 outperformed Model 2 in six of the eight periods. The mean absolute forecast error when using Model 1 is $.04, meaning that forecasts with Model 1 are off by $.04 on the average. Although Model 1 is not perfectly accurate, it does a better job than Model 2, whose mean absolute forecast error is $.07. Overall, predictions with Model 1 are on the average $.03 closer to the realized value. ∎

For a complete comparison of performance among forecasting methods, an MNC should evaluate as many periods as possible. Only eight periods are used in our example because that is enough to illustrate how to compare forecasting performance. If the MNC has a large number of periods to evaluate, it could statistically test for significant differences in forecasting errors.

Forecasting under Market Efficiency

The efficiency of the foreign exchange market also has implications for forecasting. If the foreign exchange market is **weak-form efficient,** then historical and current

Exhibit 9.7   Comparison of Forecast Techniques

(1) Period	(2) Predicted Value of Zloty by Model 1	(3) Predicted Value of Zloty by Model 2	(4) Realized Value of Zloty	(5) Absolute Forecast Error Using Model 1	(6) Absolute Forecast Error Using Model 2	(7) = (5) − (6) Difference in Absolute Forecast Errors (Model 1 − Model 2)
1	$.20	$.24	$.16	$.04	$.08	$−.04
2	.18	.20	.14	.04	.06	−.02
3	.24	.20	.16	.08	.04	.04
4	.26	.20	.22	.04	.02	.02
5	.30	.18	.28	.02	.10	−.08
6	.22	.32	.26	.04	.06	−.02
7	.16	.20	.14	.02	.06	−.04
8	.14	.24	.10	.04	.14	−.10
				Sum = .32 Mean = .04	Sum = .56 Mean = .07	Sum = −.24 Mean = −.03

exchange rate information is not useful for forecasting exchange rate movements because today's exchange rates reflect all of this information. That is, technical analysis would not be capable of improving forecasts. If the foreign exchange market is **semistrong-form efficient,** then all relevant public information is already reflected in today's exchange rates. If today's exchange rates fully reflect any historical trends in exchange rate movements, but not other public information on expected interest rate movements, the foreign exchange market is weak-form efficient but not semistrong-form efficient. Much research has tested the efficient market hypothesis for foreign exchange markets. Research suggests that foreign exchange markets appear to be weak-form efficient and semistrong-form efficient. However, there is some evidence of inefficiencies for some currencies in specific periods.

If foreign exchange markets are **strong-form efficient,** then all relevant public and private information is already reflected in today's exchange rates. This form of efficiency cannot be tested because private information is not available.

Even though foreign exchange markets are generally found to be at least semistrong-form efficient, forecasts of exchange rates by MNCs may still be worthwhile. Their goal is not necessarily to earn speculative profits but to use reasonable exchange rate forecasts to implement policies. When MNCs assess proposed policies, they usually prefer to develop their own forecasts of exchange rates over time rather than simply use market-based rates as a forecast of future rates. MNCs are often interested in more than a point estimate of an exchange rate 1 year, 3 years, or 5 years from now. They prefer to develop a variety of scenarios and assess how exchange rates may change for each scenario. Even if today's forward exchange rate properly reflects all available information, it does not indicate to the MNC the possible deviation of the realized future exchange rate from what is expected. MNCs need to determine the range of various possible exchange rate movements in order to assess the degree to which their operating performance could be affected.

GOVERNANCE

Governance of Managerial Forecasting

Managers of an MNC may use forecasts of exchange rates that satisfy their self-centered goals. For example, they may forecast exchange rates that make an international investment that they want to pursue more feasible. This may allow them to expand internationally to increase their responsibility (and compensation). An MNC can prevent the use of such forecasts by imposing controls. It can reassess the feasibility of the international projects based on alternative exchange rate scenarios. Its reassessment may be based on market-based forecasts and forecasts provided by outside consultants. In general, any key managerial decision that is based on forecasted exchange rates should consider other possible outcomes based on alternative exchange rate scenarios. If the feasibility of a proposal by the managers is dependent on the specific exchange rate scenario, the proposal deserves more scrutiny before determining whether it should be approved. ■

Using Interval Forecasts

It is nearly impossible to predict future exchange rates with perfect accuracy. For this reason, MNCs may specify an interval around their point estimate forecast.

E X A M P L E

Harp, Inc., based in Oklahoma, imports products from Canada. It uses the spot rate of the Canadian dollar (currently $.70) to forecast the value of the Canadian dollar one month from now. It also specifies an interval around its forecasts, based on the historical volatility of the Canadian dollar. The more volatile the currency, the more likely it is to wander far from the forecasted value in the future (the larger is the expected forecast error). Harp determines that the standard deviation of the Canadian dollar's movements over the last 12 months is 2 percent. Thus, assuming the movements are normally distributed, it expects that there is

a 68 percent chance that the actual value will be within 1 standard deviation (2 percent) of its forecast, which results in an interval from $.686 to $.714. In addition, it expects that there is a 95 percent chance that the Canadian dollar will be within 2 standard deviations (4 percent) of the predicted value, which results in an interval from $.672 to $.728. By specifying an interval, Harp can more properly anticipate how far the actual value of the currency might deviate from its predicted value. If the currency was more volatile, its standard deviation would be larger, and the interval surrounding the point estimate forecast would also be larger. ∎

As this example shows, the measurement of a currency's volatility is useful for specifying an interval around a forecast. However, the volatility of a currency can change over time, which means that past volatility levels will not necessarily be the optimal method of establishing an interval around a point estimate forecast. Therefore, MNCs may prefer to forecast exchange rate volatility to determine the interval surrounding their forecast.

The first step in forecasting exchange rate volatility is to determine the relevant period of concern. If an MNC is forecasting the value of the Canadian dollar each day over the next quarter, it may also attempt to forecast the standard deviation of daily exchange rate movements over this quarter. This information could be used along with the point estimate forecast of the Canadian dollar for each day to derive confidence intervals around each forecast.

Methods of Forecasting Exchange Rate Volatility

In order to use an interval forecast, the volatility of exchange rate movements can be forecast from (1) recent exchange rate volatility, (2) historical time series of volatilities, and (3) the implied standard deviation derived from currency option prices.

Use of the Recent Volatility Level. The volatility of historical exchange rate movements over a recent period can be used to forecast the future. In our example, the standard deviation of monthly exchange rate movements in the Canadian dollar during the previous 12 months could be used to estimate the future volatility of the Canadian dollar over the next month.

Use of a Historical Pattern of Volatilities. Since historical volatility can change over time, the standard deviation of monthly exchange rate movements in the last 12 months is not necessarily an accurate predictor of the volatility of exchange rate movements in the next month. To the extent that there is a pattern to the changes in exchange rate volatility over time, a series of time periods may be used to forecast volatility in the next period.

E X A M P L E The standard deviation of monthly exchange rate movements in the Canadian dollar can be determined for each of the last several years. Then, a time-series trend of these standard deviation levels can be used to form an estimate for the volatility of the Canadian dollar over the next month. The forecast may be based on a weighting scheme such as 60 percent times the standard deviation in the last year, plus 30 percent times the standard deviation in the year before that, plus 10 percent times the standard deviation in the year before that. This scheme places more weight on the most recent data to derive the forecast but allows data from the last 3 years to influence the forecast. Normally, the weights that achieved the most accuracy (lowest forecast error) over previous periods would be used when applying this method to forecast exchange rate volatility. ∎

Various economic and political factors can cause exchange rate volatility to change abruptly, however, so even sophisticated time-series models do not necessarily generate

accurate forecasts of exchange rate volatility. A poor forecast of exchange rate volatility can lead to an improper interval surrounding a point estimate forecast.

Implied Standard Deviation. A third method for forecasting exchange rate volatility is to derive the exchange rate's implied standard deviation (ISD) from the currency option pricing model. Recall that the premium on a call option for a currency is dependent on factors such as the relationship between the spot exchange rate and the exercise (strike) price of the option, the number of days until the expiration date of the option, and the anticipated volatility of the currency's exchange rate movements.

There is a currency option pricing model for estimating the call option premium based on various factors. The actual values of each of these factors are known, except for the anticipated volatility. By plugging in the prevailing option premium paid by investors for that specific currency option, however, it is possible to derive the market's anticipated volatility for that currency. The volatility is measured by the standard deviation, which can be used to develop a probability distribution surrounding the forecast of the currency's exchange rate.

SUMMARY

■ Multinational corporations need exchange rate forecasts to make decisions on hedging payables and receivables, short-term financing and investment, capital budgeting, and long-term financing.

■ The most common forecasting techniques can be classified as (1) technical, (2) fundamental, (3) market based, and (4) mixed. Each technique has limitations, and the quality of the forecasts produced varies. Yet, due to the high variability in exchange rates, it should not be surprising that forecasts are not always accurate.

■ Forecasting methods can be evaluated by comparing the actual values of currencies to the values predicted by the forecasting method. To be meaningful, this comparison should be conducted over several periods. Two criteria used to evaluate performance of a forecast method are bias and accuracy. When comparing the accuracy of forecasts for two currencies, the absolute forecast error should be divided by the realized value of the currency to control for differences in the relative values of currencies.

POINT COUNTER-POINT

Which Exchange Rate Forecast Technique Should MNCs Use?

Point **Use the spot rate to forecast.** When a U.S.-based MNC firm conducts financial budgeting, it must estimate the values of its foreign currency cash flows that will be received by the parent. Since it is well documented that firms cannot accurately forecast future values, MNCs should use the spot rate for budgeting. Changes in economic conditions are difficult to predict, and the spot rate reflects the best guess of the future spot rate if there are no changes in economic conditions.

Counter-Point **Use the forward rate to forecast.** The spot rates of some currencies do not represent accurate or even unbiased estimates of the future

spot rates. Many currencies of developing countries have generally declined over time. These currencies tend to be in countries that have high inflation rates. If the spot rate had been used for budgeting, the dollar cash flows resulting from cash inflows in these currencies would have been highly overestimated. The expected inflation in a country can be accounted for by using the nominal interest rate. A high nominal interest rate implies a high level of expected inflation. Based on interest rate parity, these currencies will have pronounced discounts. Thus, the forward rate captures the expected inflation differential between countries

because it is influenced by the nominal interest rate differential. Since it captures the inflation differential, it should provide a more accurate forecast of currencies, especially those currencies in high-inflation countries.

Who Is Correct? Use the Internet to learn more about this issue. Which argument do you support? Offer your own opinion on this issue.

SELF TEST

Answers are provided in Appendix A at the back of the text.

1. Assume that the annual U.S. return is expected to be 7 percent for each of the next 4 years, while the annual interest rate in Mexico is expected to be 20 percent. Determine the appropriate 4-year forward rate premium or discount on the Mexican peso, which could be used to forecast the percentage change in the peso over the next 4 years.

2. Consider the following information:

Currency	90-Day Forward Rate	Spot Rate That Occurred 90 Days Later
Canadian dollar	$.80	$.82
Japanese yen	$.012	$.011

   Assuming the forward rate was used to forecast the future spot rate, determine whether the Canadian dollar or the Japanese yen was forecasted with more accuracy, based on the absolute forecast error as a percentage of the realized value.

3. Assume that the forward rate and spot rate of the Mexican peso are normally similar at a given point in time. Assume that the peso has depreciated consistently and substantially over the last 3 years. Would the forward rate have been biased over this period? If so, would it typically have overestimated or underestimated the future spot rate of the peso (in dollars)? Explain.

4. An analyst has stated that the British pound seems to increase in value over the 2 weeks following announcements by the Bank of England (the British central bank) that it will raise interest rates. If this statement is true, what are the inferences regarding weak-form or semistrong-form efficiency?

5. Assume that Mexican interest rates are much higher than U.S. interest rates. Also assume that interest rate parity (discussed in Chapter 7) exists. If you use the forward rate of the Mexican peso to forecast the Mexican peso's future spot rate, would you expect the peso to appreciate or depreciate? Explain.

6. Warden Co. is considering a project in Venezuela, which will be very profitable if the local currency (bolivar) appreciates against the dollar. If the bolivar depreciates, the project will result in losses. Warden Co. forecasts that the bolivar will appreciate. The bolivar's value historically has been very volatile. As a manager of Warden Co., would you be comfortable with this project? Explain.

QUESTIONS AND APPLICATIONS

1. **Motives for Forecasting.** Explain corporate motives for forecasting exchange rates.

2. **Technical Forecasting.** Explain the technical technique for forecasting exchange rates. What are some limitations of using technical forecasting to predict exchange rates?

3. **Fundamental Forecasting.** Explain the fundamental technique for forecasting exchange rates. What are some limitations of using a fundamental technique to forecast exchange rates?

4. **Market-Based Forecasting.** Explain the market-based technique for forecasting exchange rates.

What is the rationale for using market-based forecasts? If the euro appreciates substantially against the dollar during a specific period, would market-based forecasts have overestimated or underestimated the realized values over this period? Explain.

5. **Mixed Forecasting.** Explain the mixed technique for forecasting exchange rates.

6. **Detecting a Forecast Bias.** Explain how to assess performance in forecasting exchange rates. Explain how to detect a bias in forecasting exchange rates.

7. **Measuring Forecast Accuracy.** You are hired as a consultant to assess a firm's ability to forecast. The

firm has developed a point forecast for two different currencies presented in the following table. The firm asks you to determine which currency was forecasted with greater accuracy.

Period	Yen Forecast	Actual Yen Value	Pound Forecast	Actual Pound Value
1	$.0050	$.0051	$1.50	$1.51
2	.0048	.0052	1.53	1.50
3	.0053	.0052	1.55	1.58
4	.0055	.0056	1.49	1.52

8. **Limitations of a Fundamental Forecast.** Syracuse Corp. believes that future real interest rate movements will affect exchange rates, and it has applied regression analysis to historical data to assess the relationship. It will use regression coefficients derived from this analysis, along with forecasted real interest rate movements, to predict exchange rates in the future. Explain at least three limitations of this method.

9. **Consistent Forecasts.** Lexington Co. is a U.S.-based MNC with subsidiaries in most major countries. Each subsidiary is responsible for forecasting the future exchange rate of its local currency relative to the U.S. dollar. Comment on this policy. How might Lexington Co. ensure consistent forecasts among the different subsidiaries?

10. **Forecasting with a Forward Rate.** Assume that the 4-year annualized interest rate in the United States is 9 percent and the 4-year annualized interest rate in Singapore is 6 percent. Assume interest rate parity holds for a 4-year horizon. Assume that the spot rate of the Singapore dollar is $.60. If the forward rate is used to forecast exchange rates, what will be the forecast for the Singapore dollar's spot rate in 4 years? What percentage appreciation or depreciation does this forecast imply over the 4-year period?

11. **Foreign Exchange Market Efficiency.** Assume that foreign exchange markets were found to be weak-form efficient. What does this suggest about utilizing technical analysis to speculate in euros? If MNCs believe that foreign exchange markets are strong-form efficient, why would they develop their own forecasts of future exchange rates? That is, why wouldn't they simply use today's quoted rates as indicators about future rates? After all, today's quoted rates should reflect all relevant information.

12. **Forecast Error.** The director of currency forecasting at Champaign-Urbana Corp. says, "The most critical task of forecasting exchange rates is not to derive a point estimate of a future exchange rate but to assess how wrong our estimate might be." What does this statement mean?

13. **Forecasting Exchange Rates of Currencies That Previously Were Fixed.** When some countries in Eastern Europe initially allowed their currencies to fluctuate against the dollar, would the fundamental technique based on historical relationships have been useful for forecasting future exchange rates of these currencies? Explain.

14. **Forecast Error.** Royce Co. is a U.S. firm with future receivables one year from now in Canadian dollars and British pounds. Its pound receivables are known with certainty, and its estimated Canadian dollar receivables are subject to a 2 percent error in either direction. The dollar values of both types of receivables are similar. There is no chance of default by the customers involved. Royce's treasurer says that the estimate of dollar cash flows to be generated from the British pound receivables is subject to greater uncertainty than that of the Canadian dollar receivables. Explain the rationale for the treasurer's statement.

15. **Forecasting the Euro.** Cooper, Inc., a U.S.-based MNC, periodically obtains euros to purchase German products. It assesses U.S. and German trade patterns and inflation rates to develop a fundamental forecast for the euro. How could Cooper possibly improve its method of fundamental forecasting as applied to the euro?

16. **Forward Rate Forecast.** Assume that you obtain a quote for a one-year forward rate on the Mexican peso. Assume that Mexico's one-year interest rate is 40 percent, while the U.S. one-year interest rate is 7 percent. Over the next year, the peso depreciates by 12 percent. Do you think the forward rate overestimated the spot rate one year ahead in this case? Explain.

17. **Forecasting Based on PPP versus the Forward Rate.** You believe that the Singapore dollar's exchange rate movements are mostly attributed to purchasing power parity. Today, the nominal annual interest rate in Singapore is 18 percent. The nominal annual interest rate in the United States is 3 percent. You expect that annual inflation will be about 4 percent in Singapore and 1 percent in the United States. Assume that interest rate parity holds. Today the spot rate of the Singapore dollar is $.63. Do you think the one-year forward rate would underestimate, overestimate, or be an unbiased estimate of the future spot rate in one year? Explain.

18. **Interpreting an Unbiased Forward Rate.** Assume that the forward rate is an unbiased but not necessarily accurate forecast of the future exchange rate

of the yen over the next several years. Based on this information, do you think Raven Co. should hedge its remittance of expected Japanese yen profits to the U.S. parent by selling yen forward contracts? Why would this strategy be advantageous? Under what conditions would this strategy backfire?

Advanced Questions

19. **Probability Distribution of Forecasts.** Assume that the following regression model was applied to historical quarterly data:

$$e_t = a_0 + a_1 INT_t + a_2 INF_{t-1} + \mu_t$$

where e_t = percentage change in the exchange rate of the Japanese yen in period t

INT_t = average real interest rate differential (U.S. interest rate minus Japanese interest rate) over period t

INF_{t-1} = inflation differential (U.S. inflation rate minus Japanese inflation rate) in the previous period

a_0, a_1, a_2 = regression coefficients

μ_t = error term

Assume that the regression coefficients were estimated as follows:

$$a_0 = .0$$
$$a_1 = .9$$
$$a_2 = .8$$

Also assume that the inflation differential in the most recent period was 3 percent. The real interest rate differential in the upcoming period is forecasted as follows:

Interest Rate Differential	Probability
0%	30%
1	60
2	10

If Stillwater, Inc., uses this information to forecast the Japanese yen's exchange rate, what will be the probability distribution of the yen's percentage change over the upcoming period?

20. **Testing for a Forecast Bias.** You must determine whether there is a forecast bias in the forward rate. You apply regression analysis to test the relationship between the actual spot rate and the forward rate forecast (F):

$$S = a_0 + a_1(F)$$

The regression results are as follows:

Coefficient	Standard Error
$a_0 = .006$	.011
$a_1 = .800$	.05

Based on these results, is there a bias in the forecast? Verify your conclusion. If there is a bias, explain whether it is an overestimate or an underestimate.

21. **Effect of September 11 on Forward Rate Forecasts.** The September 11, 2001, terrorist attack on the United States was quickly followed by lower interest rates in the United States. How would this affect a fundamental forecast of foreign currencies? How would this affect the forward rate forecast of foreign currencies?

22. **Interpreting Forecast Bias Information.** The treasurer of Glencoe, Inc., detected a forecast bias when using the 30-day forward rate of the euro to forecast future spot rates of the euro over various periods. He believes he can use this information to determine whether imports ordered every week should be hedged (payment is made 30 days after each order). Glencoe's president says that in the long run the forward rate is unbiased and that the treasurer should not waste time trying to "beat the forward rate" but should just hedge all orders. Who is correct?

23. **Forecasting Latin American Currencies.** The value of each Latin American currency relative to the dollar is dictated by supply and demand conditions between that currency and the dollar. The values of Latin American currencies have generally declined substantially against the dollar over time. Most of these countries have high inflation rates and high interest rates. The data on inflation rates, economic growth, and other economic indicators are subject to error, as limited resources are used to compile the data.

a. If the forward rate is used as a market-based forecast, will this rate result in a forecast of appreciation, depreciation, or no change in any particular Latin American currency? Explain.

b. If technical forecasting is used, will this result in a forecast of appreciation, depreciation, or no change in the value of a specific Latin American currency? Explain.

c. Do you think that U.S. firms can accurately forecast the future values of Latin American currencies? Explain.

24. **Selecting between Forecast Methods.** Bolivia currently has a nominal one-year risk-free interest rate of 40 percent, which is primarily due to the high level of expected inflation. The U.S. nominal one-year risk-free interest rate is 8 percent. The spot rate of Bolivia's currency (called the boliviana) is $.14. The one-year forward rate of the boliviana is $.108. What is the forecasted percentage change in the boliviana if the spot rate is used as a one-year forecast? What is the forecasted percentage change in the boliviana if the one-year forward rate is used as a one-year forecast? Which forecast do you think will be more accurate? Why?

25. **Comparing Market-based Forecasts.** For all parts of this question, assume that interest rate parity exists, the prevailing one-year U.S. nominal interest rate is low, and that you expect U.S. inflation to be low this year.

    a. Assume that the country Dinland engages in much trade with the United States and the trade involves many different products. Dinland has had a zero trade balance with the United States (the value of exports and imports is about the same) in the past. Assume that you expect a high level of inflation (about 40 percent) in Dinland over the next year because of a large increase in the prices of many products that Dinland produces. Dinland presently has a one-year risk-free interest rate of more than 40 percent. Do you think that the prevailing spot rate or the one-year forward rate would result in a more accurate forecast of Dinland's currency (the din) one year from now? Explain.

    b. Assume that the country Freeland engages in much trade with the United States and the trade involves many different products. Freeland has had a zero trade balance with the United States (the value of exports and imports is about the same) in the past. You expect high inflation (about 40 percent) in Freeland over the next year because of a large increase in the cost of land (and therefore housing) in Freeland. You believe that the prices of products that Freeland produces will not be affected. Freeland presently has a one-year risk-free interest rate of more than 40 percent. Do you think that the prevailing one-year forward rate of Freeland's currency (the fre) would overestimate, underestimate, or be a reasonably accurate forecast of the spot rate one year from now? (Presume a direct quotation of the exchange rate, so that if the forward rate underestimates, it means that its value is less than the realized spot rate in one year. If the forward rate overestimates, it means that its value is more than the realized spot rate in one year.)

26. **IRP and Forecasting.** New York Co. has agreed to pay 10 million Australian dollars (A$) in 2 years for equipment that it is importing from Australia. The spot rate of the Australian dollar is $.60. The annualized U.S. interest rate is 4 percent, regardless of the debt maturity. The annualized Australian dollar interest rate is 12 percent regardless of the debt maturity. New York plans to hedge its exposure with a forward contract that it will arrange today. Assume that interest rate parity exists. Determine the amount of U.S. dollars that New York Co. will need in 2 years to make its payment.

27. **Forecasting Based on the International Fisher Effect.** Purdue Co. (based in the United States) exports cable wire to Australian manufacturers. It invoices its product in U.S. dollars and will not change its price over the next year. There is intense competition between Purdue and the local cable wire producers based in Australia. Purdue's competitors invoice their products in Australian dollars and will not be changing their prices over the next year. The annualized risk-free interest rate is presently 8 percent in the United States, versus 3 percent in Australia. Today the spot rate of the Australian dollar is $.55. Purdue Co. uses this spot rate as a forecast of the future exchange rate of the Australian dollar. Purdue expects that revenue from its cable wire exports to Australia will be about $2 million over the next year.

    If Purdue decides to use the international Fisher effect rather than the spot rate to forecast the exchange rate of the Australian dollar over the next year, will its expected revenue from its exports be higher, lower, or unaffected? Explain.

28. **IRP, Expectations, and Forecast Error.** Assume that interest rate parity exists and it will continue to exist in the future. Assume that interest rates of the United States and the United Kingdom vary substantially in many periods. You expect that interest rates at the beginning of each month have a major effect on the British pound's exchange rate at the end of each month because you believe that capital flows between the United States and the United Kingdom influence the pound's exchange rate. You expect that money will flow to whichever country has the higher nominal interest rate. At the beginning of each month, you will either use the spot rate or the one-month forward rate to forecast the future spot rate of the pound that will exist at the end of the month. Will the use of the spot rate as a forecast result in smaller, larger, or the same mean absolute forecast error as the forward rate when forecasting the future spot rate of the pound on a monthly basis? Explain.

Discussion in the Boardroom

This exercise can be found in Appendix E at the back of this textbook.

Running Your Own MNC

This exercise can be found on the Xtra! website at **http://maduraxtra.swlearning.com**.

B L A D E S ,   I N C .   C A S E

Forecasting Exchange Rates

Recall that Blades, Inc., the U.S.-based manufacturer of roller blades, is currently both exporting to and importing from Thailand. Ben Holt, Blades' chief financial officer (CFO), and you, a financial analyst at Blades, Inc., are reasonably happy with Blades' current performance in Thailand. Entertainment Products, Inc., a Thai retailer for sporting goods, has committed itself to purchase a minimum number of Blades' "Speedos" annually. The agreement will terminate after 3 years. Blades also imports certain components needed to manufacture its products from Thailand. Both Blades' imports and exports are denominated in Thai baht. Because of these arrangements, Blades generates approximately 10 percent of its revenue and 4 percent of its cost of goods sold in Thailand.

Currently, Blades' only business in Thailand consists of this export and import trade. Ben Holt, however, is thinking about using Thailand to augment Blades' U.S. business in other ways as well in the future. For example, Holt is contemplating establishing a subsidiary in Thailand to increase the percentage of Blades' sales to that country. Furthermore, by establishing a subsidiary in Thailand, Blades will have access to Thailand's money and capital markets. For instance, Blades could instruct its Thai subsidiary to invest excess funds or to satisfy its short-term needs for funds in the Thai money market. Furthermore, part of the subsidiary's financing could be obtained by utilizing investment banks in Thailand.

Due to Blades' current arrangements and future plans, Ben Holt is concerned about recent developments in Thailand and their potential impact on the company's future in that country. Economic conditions in Thailand have been unfavorable recently. Movements in the value of the baht have been highly volatile, and foreign investors in Thailand have lost confidence in the baht, causing massive capital outflows from Thailand. Consequently, the baht has been depreciating.

When Thailand was experiencing a high economic growth rate, few analysts anticipated an economic downturn. Consequently, Holt never found it necessary to forecast economic conditions in Thailand even though Blades was doing business there. Now, however, his attitude has changed. A continuation of the unfavorable economic conditions prevailing in Thailand could affect the demand for Blades' products in that country. Consequently, Entertainment Products may not renew its commitment for another 3 years.

Since Blades generates net cash inflows denominated in baht, a continued depreciation of the baht could adversely affect Blades, as these net inflows would be converted into fewer dollars. Thus, Blades is also considering hedging its baht-denominated inflows.

Because of these concerns, Holt has decided to reassess the importance of forecasting the baht-dollar exchange rate. His primary objective is to forecast the baht-dollar exchange rate for the next quarter. A secondary objective is to determine which forecasting technique is the most accurate and should be used in future periods. To accomplish this, he has asked you, a financial analyst at Blades, for help in forecasting the baht-dollar exchange rate for the next quarter.

Holt is aware of the forecasting techniques available. He has collected some economic data and conducted a preliminary analysis for you to use in your analysis. For example, he has conducted a time-series analysis for the exchange rates over numerous quarters. He then used this analysis to forecast the baht's value next quarter. The technical forecast indicates a depreciation of the baht by 6 percent over the next quarter from the baht's current level of \$.023 to \$.02162. He has also conducted a fundamental forecast of the baht-dollar exchange rate using historical inflation and interest rate data. The fundamental forecast, however, depends on what happens to Thai interest rates during the next quarter and therefore reflects a probability distribution. Based on the inflation and interest rates, there is a 30 percent chance that the baht will depreciate by 2 percent, a 15 percent chance that the baht will depreciate by 5 percent, and a 55 percent chance that the baht will depreciate by 10 percent.

Ben Holt has asked you to answer the following questions:

1. Considering both Blades' current practices and future plans, how can it benefit from forecasting the baht-dollar exchange rate?

2. Which forecasting technique (i.e., technical, funda-mental, or market-based) would be easiest to use in forecasting the future value of the baht? Why?

3. Blades is considering using either current spot rates or available forward rates to forecast the future value of the baht. Available forward rates currently exhibit a large discount. Do you think the spot or the forward rate will yield a better market-based forecast? Why?

4. The current 90-day forward rate for the baht is $.021. By what percentage is the baht expected to change over the next quarter according to a market-based forecast using the forward rate? What will be the value of the baht in 90 days according to this forecast?

5. Assume that the technical forecast has been more accurate than the market-based forecast in recent weeks. What does this indicate about market ef-ficiency for the baht-dollar exchange rate? Do you think this means that technical analysis will always be superior to other forecasting techniques in the future? Why or why not?

6. What is the expected value of the percentage change in the value of the baht during the next quarter based on the fundamental forecast? What is the forecasted value of the baht using the expected value as the forecast? If the value of the baht 90 days from now turns out to be $.022, which forecasting tech-nique is the most accurate? (Use the absolute fore-cast error as a percentage of the realized value to an-swer the last part of this question.)

7. Do you think the technique you have identified in question 6 will always be the most accurate? Why or why not?

SMALL BUSINESS DILEMMA

Exchange Rate Forecasting by the Sports Exports Company

The Sports Exports Company converts British pounds into dollars every month. The prevailing spot rate is about $1.65, but there is much uncertainty about the future value of the pound. Jim Logan, owner of the Sports Exports Company, expects that British inflation will rise substantially in the future. In previous years when British inflation was high, the pound depreciated. The prevailing British interest rate is slightly higher than the prevailing U.S. interest rate. The pound has risen slightly over each of the last several months. Jim wants to forecast the value of the pound for each of the next 20 months.

1. Explain how Jim can use technical forecasting to forecast the future value of the pound. Based on the information provided, do you think that a tech-nical forecast will predict future appreciation or de-preciation in the pound?

2. Explain how Jim can use fundamental forecasting to forecast the future value of the pound. Based on the information provided, do you think that a fun-damental forecast will predict appreciation or de-preciation in the pound?

3. Explain how Jim can use a market-based forecast to forecast the future value of the pound. Do you think the market-based forecast will predict appre-ciation, depreciation, or no change in the value of the pound?

4. Does it appear that all of the forecasting techniques will lead to the same forecast of the pound's future value? Which technique would you prefer to use in this situation?

INTERNET/EXCEL EXERCISES

The website of the Chicago Mercantile Exchange (CME) provides information about the exchange and the futures contracts offered on the exchange. Its ad-dress is **http://www.cme.com**.

1. Use the CME website to review the historical quotes of futures contracts and obtain a recent quote for the Japanese yen and British pound con-tracts. Then go to **http://www.oanda.com/convert/**

fxhistory. Obtain the spot exchange rate for the Japanese yen and British pound on the same date that you have futures contract quotations. Does the Japanese yen futures price reflect a premium or a discount relative to its spot rate? Does the futures price imply appreciation or depreciation of the Japanese yen? Repeat these two questions for the British pound.

2. Go to **http://www.oanda.com/convert/fxhistory** and obtain the direct exchange rate of the Canadian dollar at the beginning of each of the last 7 years. Insert this information in a column on an electronic spreadsheet. (See Appendix C for help on conducting analyses with Excel.) Repeat the process to obtain the direct exchange rate of the euro. Assume that you use the spot rate to forecast the future spot rate one year ahead. Determine the forecast error (measured as the absolute forecast error as a percentage of the realized value for each year) for the Canadian dollar in each year. Then determine the mean of the annual forecast error over all years. Repeat this process for the euro. Which currency has a lower forecast error on average? Would you have expected this result? Explain.