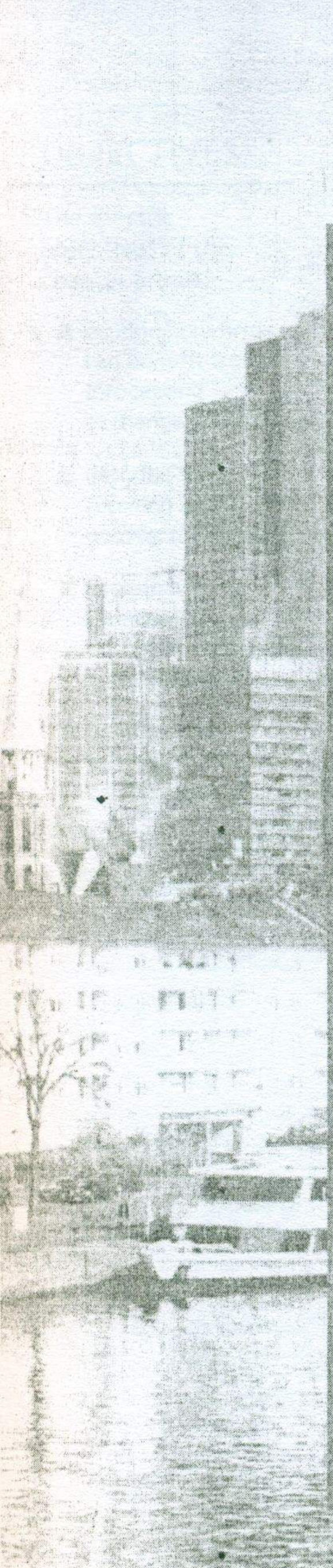
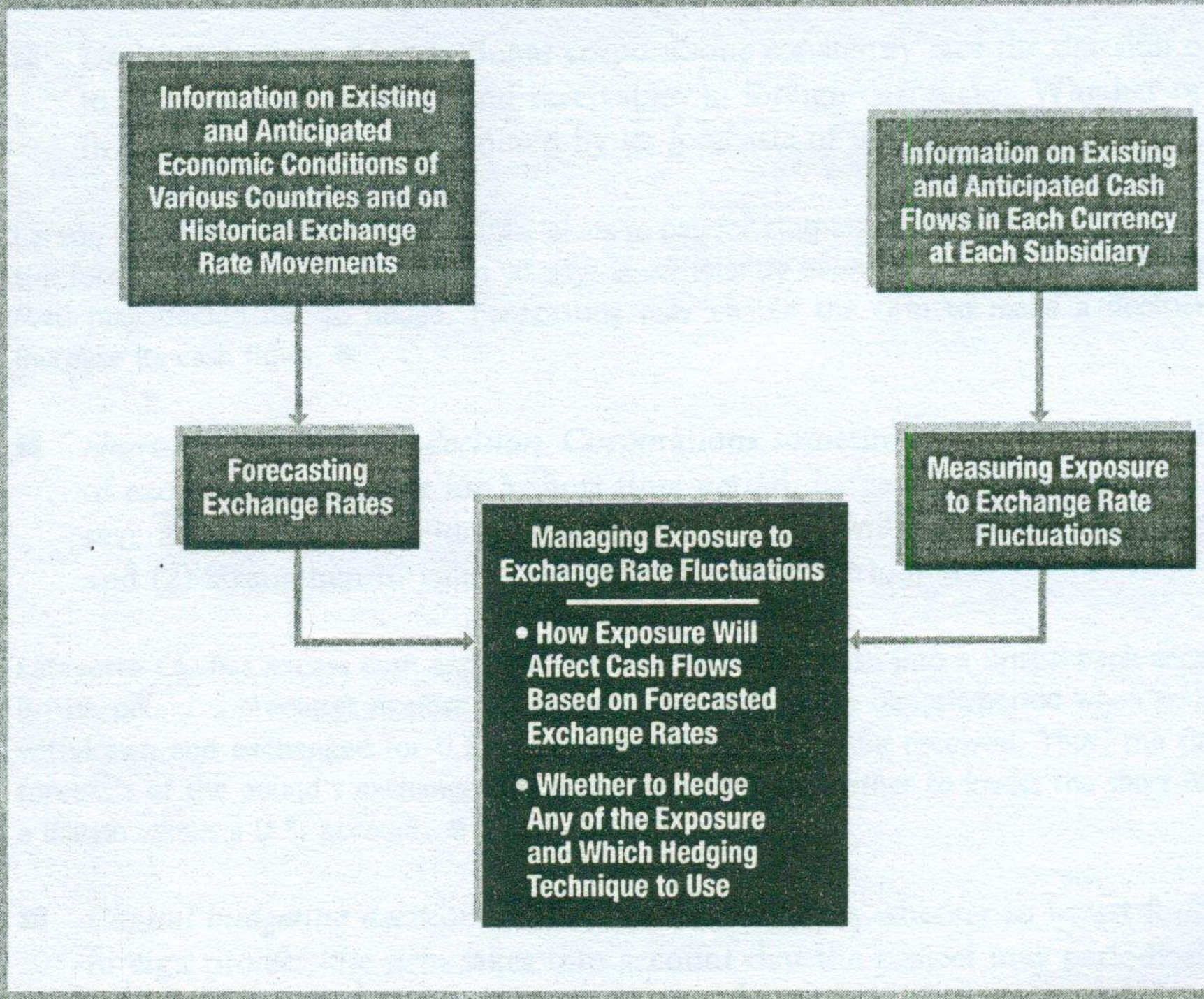
PART 3
Exchange Rate Risk Management



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 a multinational corporation can measure its exposure to exchange rate movements. Given its forecasts of future exchange rates and its exposure to exchange rate movements, an MNC can decide whether and how to hedge that exposure. Chapters 11 and 12 describe this hedging by MNCs.



9
Forecasting Exchange Rates

CHAPTER OBJECTIVES

The specific objectives of this chapter are to:

- explain how firms can benefit from forecasting exchange rates,
- describe the common techniques used for forecasting,
- explain how forecasting performance can be evaluated, and
- explain how interval forecasts can be applied.

Both the cost of an MNC's operations and the revenue it receives from operations are affected by exchange rate movements. Therefore, an MNC's forecasts of exchange rate movements can affect the feasibility of its planned projects and might influence its managerial decisions. Any revision of exchange rate forecasts can change the relative benefits of alternative proposed operations and may lead the MNC to revise its business strategies.

9-1 Why Firms Forecast Exchange Rates

In reality, it is extremely difficult to forecast exchange rates with much accuracy. However, MNCs can still benefit from forecasting exchange rates; doing so allows them to derive reasonable forecasts of future cash flows, which enables them to make informed financial decisions. The following corporate functions typically require exchange rate forecasts.

- *Hedging decision.* Multinational corporations constantly face the decision of whether to hedge future payables and receivables in foreign currencies. Whether or not a firm hedges may be determined by its forecasts of foreign currency values.

EXAMPLE 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, then the MNC may decide not to hedge. Forecasting may enable the firm to make a decision that will increase its cash flows. ●

- *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.

EXAMPLE 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 versus a U.S. account. ●

- *Capital budgeting decision.* When an MNC 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 MNC's local currency.

EXAMPLE Evansville Co. wants to determine whether to establish a subsidiary in Thailand. The earnings to be generated by the proposed subsidiary in Thailand would need to be periodically converted into dollars to be remitted to the U.S. parent. The capital budgeting process requires estimates of future dollar cash flows to be received by the U.S. parent. These dollar cash flows depend on the forecasted exchange rate of Thailand's currency (the baht) against the dollar over time. Accurate forecasts of currency values will improve the accuracy of the estimated cash flows and therefore enhance the MNC's decision making. ●

- *Earnings assessment.* An MNC's decision about whether a foreign subsidiary should reinvest earnings in a foreign country or instead remit those earnings back to the parent may be influenced by exchange rate forecasts. If a strong foreign currency is expected to weaken substantially against the MNC's home country currency, then 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.
- *Long-term financing decision.* Multinational corporations that issue bonds to secure long-term funds may consider denominating those 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.

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 pegged. MNCs recognize that a pegged exchange rate today does not necessarily serve as a good forecast because the government might devalue the currency in the future.

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.

9-2 Forecasting Techniques

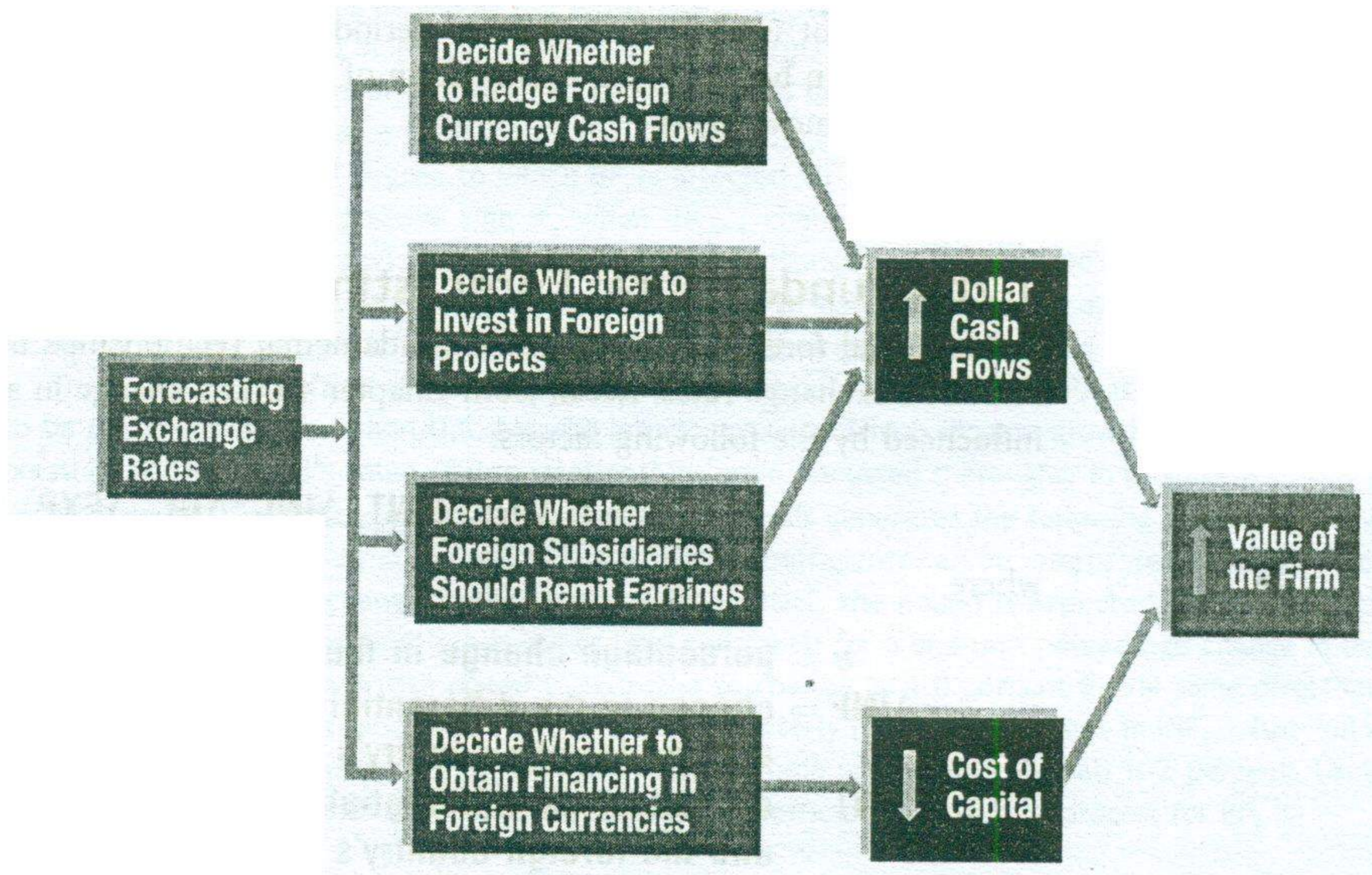
The numerous methods available for forecasting exchange rates can be categorized into four general groups: (1) technical, (2) fundamental, (3) market-based, and (4) mixed.

9-2a 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 some technical indication that a correction in the exchange rate is likely, which would result in a forecast that the exchange rate will reverse its direction.

EXAMPLE Tomorrow Kansas Co. must 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

Exhibit 9.1 Corporate Motives for Forecasting Exchange Rates



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

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

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

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www.ny.frb.org/markets/foreignex.html
Historical exchange rate data that can be used to create technical forecasts of exchange rates.

Technical forecasting is sometimes cited as the main technique used by investors who speculate in the foreign exchange market, especially when their investment is for a very short time period.

Limitations of Technical Forecasting Multinational corporations make only limited use of technical forecasting because it typically focuses on the near future, which is not that helpful for developing corporate policies. Most technical forecasts apply to very short-term periods (e.g., one day) because patterns in exchange rate movements may be more predictable over such periods. Because such patterns are likely less reliable for forecasting long-term movements (e.g., over a quarter, a year, or five years),

technical forecasts are less useful for forecasting exchange rates in the distant future. Thus, technical forecasting may not be suitable for firms that require a long-range forecast of exchange rates.

Furthermore, a technical forecasting model that has worked well in one particular period may not work well in another period. Unless historical trends in exchange rate movements can be identified, examination of past movements will not be useful for indicating future movements.

9-2b 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

e = percentage change in the spot rate
ΔINF = change in the differential between U.S. inflation and the foreign country's inflation
ΔINT = change in the differential between the U.S. interest rate and the foreign country's interest rate
ΔINC = change in the differential between the U.S. income level and the foreign country's income level
ΔGC = change in government controls
ΔEXP = change in expectations of future exchange rates

Given current values of these variables along with their historical impact on a currency's value, a corporation 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 these rates. Although full-blown fundamental models are beyond the scope of this text, a simplified discussion follows.

EXAMPLE Galena, Inc., wants 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. Its forecast for the British pound depends on only two factors that affect the pound's value:

1. inflation in the United States relative to inflation in the United Kingdom; and
2. income growth in the United States relative to income growth in the United Kingdom (measured as a percentage change).

Galena must first determine how these variables have affected the percentage change in the pound's value based on historical data, a task for which regression analysis is well suited. 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 value of the British pound (BP). The independent (influential) variables are as follows.

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

The regression equation is then

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

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 is an error term. Galena, Inc., uses a set of historical data 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). In other words, 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 coefficient indicates that BP_t and INF_{t-1} move in opposite directions. In the regression equation, b_1 is expected to be positive because, when U.S. inflation increases relative to U.K. inflation, 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 likewise 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 were discussed thoroughly in Chapter 4.

Assume that Galena's application of regression analysis generates the following estimates of the coefficients: $b_0 = .002$, $b_1 = .8$, and $b_2 = 1.0$. These 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. 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 the estimated regression coefficients, Galena's 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 If a regression model is used for forecasting and if the values of the influential factors have a *lagged* (delayed) impact on exchange rates, then the actual value of those factors can be used as input for the forecast. For example, when 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. The firm recognizes that poor forecasts of these factors will produce poor forecasts of exchange rate movements and so may attempt to account for the resulting uncertainty by using **sensitivity analysis**, which considers more than one possible outcome for the factors exhibiting uncertainty.

EXAMPLE Phoenix Corp. has developed a regression model to forecast the percentage change in the Mexican peso's value. The company believes that the real interest rate differential and the inflation differential are the only factors that affect exchange rate movements, as indicated in its regression model:

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

where

e_t = percentage change in the peso's exchange rate over period t
INT_t = real interest rate differential over period t
INF_{t-1} = inflation differential in the previous period t
a_0, a_1, a_2 = regression coefficients
μ_t = error term

Historical data are used to determine values for e, 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.

Now suppose 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 value 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, both INT_t and INF_{t-1} must be estimated. Suppose INF_{t-1} was 1 percent. However, INT_t is not known at the beginning of the period and must therefore be forecast. 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.

EXAMPLE 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 between the United States and Japan, to develop a forecast of the percentage change in the

yen. Sensitivity analysis can be used to re-forecast 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 specifies the fundamental relationship between the inflation differential and the exchange rate. In simple terms, PPP states that the currency of the higher-inflation country will depreciate by an amount that reflects the two country's inflation differential. If PPP holds, then the percentage change in the foreign currency's value (e) over a given period should reflect the differential between the home inflation rate (I_h) and the foreign inflation rate (I_f) over that period.

EXAMPLE The U.S. inflation rate is expected to be 1 percent over the next year and the Australian inflation rate is expected to be 6 percent. According to PPP, the Australian dollar's exchange rate should change as follows:

$$e_f = \frac{1 + I_{\text{U.S.}}}{1 + I_f} - 1$$
$$= \frac{1.01}{1.06} - 1$$
$$\approx -4.7\%$$

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 then 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 thus would have to be forecast 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 still might not forecast exchange rates accurately because other factors, such as the interest rate differential between countries, can also affect exchange rates. Although the inflation differential by itself is not sufficient to accurately forecast exchange rate movements, 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, it has four main limitations.

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 previously, some factors have an immediate impact on exchange rates. Yet such factors can be usefully included in a fundamental forecasting model only if forecasts can be obtained for them. Those forecasts should be developed for a period corresponding to that for which an exchange rate forecast is needed. In this case, the accuracy of the exchange rate forecasts is affected by the accuracy of these factors. Even if a firm knows exactly how their movements affect exchange rates, its exchange rate projections may be inaccurate if it cannot predict the factors' values.
3. Some factors that deserve consideration in the fundamental forecasting process cannot be easily quantified. For example, suppose large Australian exporting firms

experience an unanticipated labor strike the causes 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, is not normally incorporated into a forecasting model.

4. Coefficients derived from the regression analysis may not remain constant over time. In the previous example, the coefficient for INF_{t-1} is .6; this value indicates that, for a one-unit change in INF_{t-1}, the Mexican peso appreciates by .6 percent. But if either the Mexican or U.S. government imposed new trade barriers (or eliminated existing barriers), the impact of the inflation differential on trade, and thus on the Mexican peso's exchange rate, could be affected.

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www.cmegroup.com
Quotes on currency futures that can be used to create market-based forecasts.

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. This means that the forecasts developed by MNCs must allow for some margin of error and recognize the possibility of error when implementing corporate policies.

9-2c Market-Based Forecasting

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

Using 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, suppose the British pound is expected to appreciate against the dollar in the 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 then 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 near future. When the spot rate is used as the forecast of the future spot rate, the implication is that the expected percentage change in the currency will be zero over the forecast period:

$$E(e) = 0$$

Of course, MNCs realize that the currency's value will not remain constant. Even so, they might use today's spot rate as their best guess of the spot rate at a future point in time.

Using 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. Thus, a 30-day forward rate forecasts the spot rate in 30 days, a 90-day forward rate forecasts the spot rate in 90 days, and so on. Recall that the forward rate is measured as

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

where p denotes 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:

$$\begin{aligned} E(e) &= p \\ &= (F/S) - 1 \text{ [by rearranging terms]} \end{aligned}$$

EXAMPLE If the one-year forward rate of the Australian dollar is $.63 while the spot rate is $.60, then the expected percentage change in the Australian dollar is

$$\begin{aligned} E(e) &= p \\ &= (F/S) - 1 \\ &= (.63/.60) - 1 \\ &= .05, \text{ or } 5\% \end{aligned}$$

Rationale for Using the Forward Rate The forward rate should serve as a reasonable forecast for the future spot rate because otherwise speculators would trade forward contracts (or futures contracts) to capitalize on the difference between these two rates.

EXAMPLE Assume that most speculators expect the spot rate of the British pound in 30 days to be $1.45, and suppose the prevailing forward rate is $1.40. The speculators would buy pounds 30 days forward at $1.40 and, when received 30 days later, sell them at the prevailing spot rate. As speculators implement this strategy today, the substantial demand to purchase pounds 30 days forward will cause today's 30-day forward rate to increase. Once the forward rate reaches $1.45 (the expected future spot rate in 30 days), there is no incentive for additional speculation in the forward market. 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 because it reflects the market's expectation of the spot rate at the end of the forward horizon (in this example, 30 days from now). ●

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www.bmonesbittburns.com/economics/fxrates

Forward rates for the euro, British pound, Canadian dollar, and Japanese yen for 1-month, 3-month, 6-month, and 12-month maturities. These forward rates may serve as forecasts of future spot rates.

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, then they can simply monitor this publicly quoted rate to develop exchange rate projections. Forward rates are commonly quoted in financial newspapers for short-term periods (such as 30 days or 90 days) for currencies of developed countries, and these rates can be used to derive short-term forecasts for those currencies.

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

EXAMPLE Assume that the spot rate of the euro is currently $1.00 while its five-year forward rate is $1.06. This forward rate can serve as a forecast of $1.06 for the euro in five years, which reflects a 6 percent appreciation in the euro over that period. ●

Forward rates are normally available for periods of two to five 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.

EXAMPLE The U.S. five-year interest rate is currently 10 percent (annualized) while the British five-year interest rate is 13 percent. If interest rate parity holds, then the five-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	$(1.13)^5 - 1 = 84\%$

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

$$\begin{aligned} p &= \frac{1 + i_{U.S.}}{1 + i_{U.K.}} - 1 \\ &= \frac{1.61}{1.84} - 1 \\ &= -.125, \text{ or } -12.5\% \end{aligned}$$

So if the five-year forward rate of the pound is used as a forecast, then the spot rate of the pound is expected to depreciate by 12.5 percent over the five-year period. ●

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

Like any method of forecasting exchange rates, the forward rate is typically more accurate when forecasting exchange rates for short-term than for long-term horizons. Exchange rates tend to wander farther from expectations over longer periods of time.

Implications of the IFE for Forecasts Recall that if the international Fisher effect holds then a currency with a higher quoted (nominal) interest rate than the U.S. interest rate should depreciate against the dollar; the reason is that 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 difference in interest rates (and thus in expected inflation rates) between two countries, it should provide more accurate forecasts for currencies in high-inflation countries than does the spot rate.

EXAMPLE Alves, Inc., is a U.S. firm that does business in Brazil, and it needs to forecast the exchange rate of the Brazilian currency (the 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 currency is $.40. The one-year interest rate in Brazil is 20 percent, versus 5 percent in the United States. The one-year forward rate of the Brazilian real is $.35, which reflects a discount to offset the interest rate differential (according to IRP; check this yourself). Alves believes that the real's future exchange rate 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. These values imply that the expected inflation rate for next year is 17 percent in Brazil and 2 percent in the United States. The pronounced forward rate discount is based on the interest rate differential, which in turn is related to the inflation differential.

In contrast, using the spot rate of the real as a forecast would imply that the exchange rate at the end of the year will be the same as it is today. Since the forward rate forecast (indirectly) captures the differential in expected inflation rates, Alves considers it a more appropriate forecast metric than the spot rate. ●

An MNC that does not believe in the IFE may well disagree that using the forward rate is a more appropriate forecast method than using the spot rate. One could argue that either the high Brazilian interest rates do not reflect high expected inflation or that, even if the inflation occurs, it will not depress the Brazilian real. In either case, the preceding example's use of the forward rate as a forecast would be a mistake.

When a country's interest rate is similar to the U.S. interest rate, the forward rate premium or discount of that country's currency will be close to zero. That currency's forward rate is therefore similar to its spot rate, so the two will yield similar forecasts.

9-2d 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 relative weights that 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.

EXAMPLE College Station, Inc., needs to assess the value of the Mexican peso because it is considering expanding its business in that country. The conclusions that would be drawn from each forecasting technique are listed in Exhibit 9.2, which reveals that the forecasted direction of the peso's value

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

FORECAST TECHNIQUE	FACTORS CONSIDERED	SITUATION	FORECAST
Technical	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	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	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.

depends on the technique used. The fundamental forecast predicts the peso will appreciate, whereas the technical and market-based forecast predict it will depreciate. It is noteworthy that, even though the fundamental and market-based forecasts are both driven by the same factor (interest rates), the results are distinctly different. ●

An MNC might decide that only the technical and market-based forecasts are relevant when forecasting in one period but that, in some other period, only the fundamental forecast is relevant. The selection of a forecasting technique may also vary with the particular currency involved. At any given time the MNC may decide, for instance, that a market-based forecast provides the best prediction for the pound whereas fundamental forecasting generates the best prediction for the New Zealand dollar and technical forecasting the best prediction for the Mexican peso.

9-2e Guidelines for Implementing a Forecast

Regardless of the technique used to forecast exchange rates, managers of MNCs should consider the following guidelines when implementing their forecasts.

Apply Forecasts Consistently within the MNC All managers of an MNC should rely on the same exchange rate forecasts. Otherwise, one manager may be making decisions based on forecasted appreciation of a currency while another is making decisions based on forecasted depreciation of the same currency! For this reason, forecasts should normally be established by a centralized department and not from a department focused on the sales of a particular product.

Measure Impact of Alternative Forecasts Managers of an MNC are expected to derive what they believe to be the best forecast for an exchange rate; however, they should also check for whether (and how) alternative forecasts would affect their decisions. If a major proposed project is judged to be feasible only when one particular technique is used to forecast exchange rates, then that project deserves closer analysis before being implemented. An MNC is more confident about such managerial project decisions when the project's feasibility remains unchanged under alternative exchange rate forecasts.

Consider Other Sources of Forecasts Because forecasting exchange rates is subject to considerable error, managers of MNCs may complement their forecast with one from another source, such as a bank that provides forecasting services. Some forecasting services specialize in technical forecasts while others specialize in fundamental forecasts. These services can accommodate a wide range of forecast horizons ranging from one month to ten years.

There is, of course, no guarantee that a forecasting service will provide more accurate forecasts than those that the MNCs can generate on their own. However, managers might have more confidence in their decisions if they consider forecasts from other sources. Treasurers of some MNCs may choose to rely on forecasting services simply because they recognize how difficult it is to generate accurate exchange rate forecasts and prefer not to be directly accountable for the potential error.

9-3 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. Multinational corporations commonly assess their past forecast errors to evaluate the accuracy of their forecasting techniques.

9-3a 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 is discussed here and is defined as follows:

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

The error is computed using an absolute value (in the numerator) because this avoids a possible offsetting effect when determining the mean forecast error. For example, if the forecast error is .05 in the first period and −.05 in the second period (i.e., if the absolute value is not taken) the mean error is zero. Yet that would be misleading because the forecast was not perfectly accurate in either period. Taking the absolute value avoids distortions of this type.

When comparing a forecasting technique's performance among different currencies, examine the relative size of the discrepancy between the forecasted and realized value.

EXAMPLE 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 and realized value is $.15 for the pound versus $.02 for the peso. This does not mean that the forecast for the peso is more accurate. When measured as a percentage of the realized value, the forecast error 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's value was predicted with less accuracy. ●

9-3b Forecast Errors among Time Horizons

The potential forecast error for a particular currency depends on the forecast horizon. A forecast of the spot rate of the euro for tomorrow will have a relatively small error because tomorrow's spot rate probably will not deviate much from today's. However, a forecast of the euro in 1 month is more difficult because there is more time for economic conditions to change, which can cause the euro's value to stray farther from today's spot rate. A forecast of the euro for 1 year ahead is even more difficult, and a forecast of 10 years aheadwill very likely be subject to very large error.

9-3c Forecast Errors over Time Periods

The forecast error for a given currency changes over time. In periods when a country is experiencing economic and political problems, its currency is more volatile and more difficult to predict. The size of the errors changes over time, because the errors are larger in periods when the currency's value is more volatile.

9-3d Forecast Errors among Currencies

The ability to forecast currency values may vary with the currency of concern. From a U.S. perspective, the currencies that are more stable are susceptible to less error. As an extreme example, for a currency whose value is pegged to an exact dollar level, the spot rate would always be a perfect forecast of the future spot rate and the forecast error would be zero. The central bank of China maintains the value of the Chinese yen within narrow boundaries, so the yuan is quite stable and should be subject to a lower forecast error. In contrast, currencies (e.g., Australian dollar, Brazilian real, New Zealand dollar) that are volatile should be subject to larger forecast errors. Some currencies, including the Canadian dollar and Japanese yen, usually exhibit moderate volatility (even without central bank intervention) and hence should be subject to moderate forecast errors.

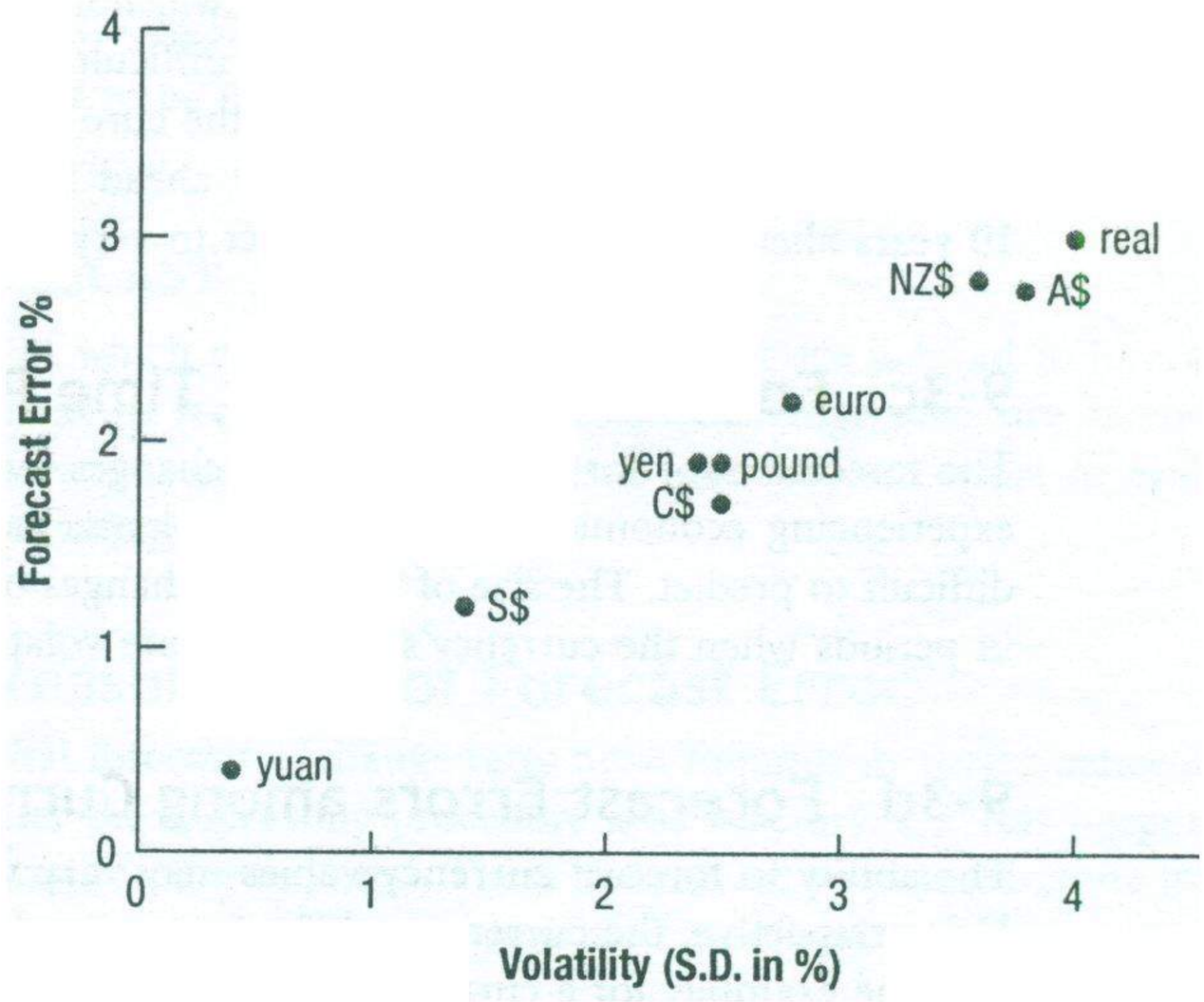
Exhibit 9.3 displays the results from comparing the mean absolute forecast error to the volatility (standard deviation of exchange rate movements) for selected currencies; the points are plotted based on monthly data over the 2007–2012 period. The monthly forecasts for each currency were derived using the currency's prevailing spot rate as the forecast for one month ahead. The exhibit demonstrates how forecast errors are generally lower for less volatile currencies, including the Chinese yuan and Singapore dollar (S$), and higher for more volatile currencies, which include the Australian dollar (A$), the Brazlian real, and the New Zealand dollar (NZ$). Financial managers of U.S.-based MNCs should be especially concerned if they are exposed to these more volatile currencies because they are subject to greater forecast errors. Managers may therefore wish to hedge that exposure, as discussed in detail in the next chapter.

9-3e Forecast Bias

When a forecast error is measured as the forecasted value minus the realized value, negative errors indicate underestimating whereas positive errors indicate overestimating. If the forecast errors for a particular currency are consistently positive or negative over time, then there must be some bias in the forecasting procedure.

Statistical Test of Forecast Bias If the forward rate is a biased predictor of the future spot rate, then there is a systematic forecast error whose correction would

Exhibit 9.3 How Forecast Error Is Affected by Volatility



improve forecast accuracy. A conventional method of testing for 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 = spot rate at time t
F_{t-1} = forward rate at time $t-1$
μ_t = error term
a_0 = intercept
a_1 = regression coefficient

If the forward rate is unbiased, then the intercept a_0 should equal 0 and the regression coefficient a_1 should equal 1. The t-test for a_1 is

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

If $a_0 = 0$ and if a_1 is significantly less than 1, this implies that the forward rate is systematically overestimating the spot rate. For example, if $a_0 = 0$ and $a_1 = .90$ then the future spot rate is estimated to be 90 percent of the forecast generated by the forward rate.

If $a_0 = 0$ and a_1 is significantly greater than 1, this implies that the forward rate is systematically underestimating the spot rate. For example, if $a_0 = 0$ and $a_1 = 1.1$ then the future spot rate is estimated to be 110 percent of 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 instance, if $a_1 = 1.1$ then future forecasts of the spot rate may

well incorporate this information, 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 that bias and so improve its forecasting accuracy. For example, if the errors are consistently positive, an MNC could adjust today's forward rate downward to reflect this bias.

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

EXAMPLE For eight consecutive quarters, Tunek Co. used the three-month forward rate of Currency Q to forecast its value three 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, then all points would be located on that 45-degree line in Exhibit 9.5. For this reason, that line is known as the **perfect forecast line**. The closer the points reflecting the eight periods are to the 45-degree line, the better the forecast; the vertical distance between each point and the 45-degree line is the forecast error. A point that is $.04 above the 45-degree line indicates 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. ●

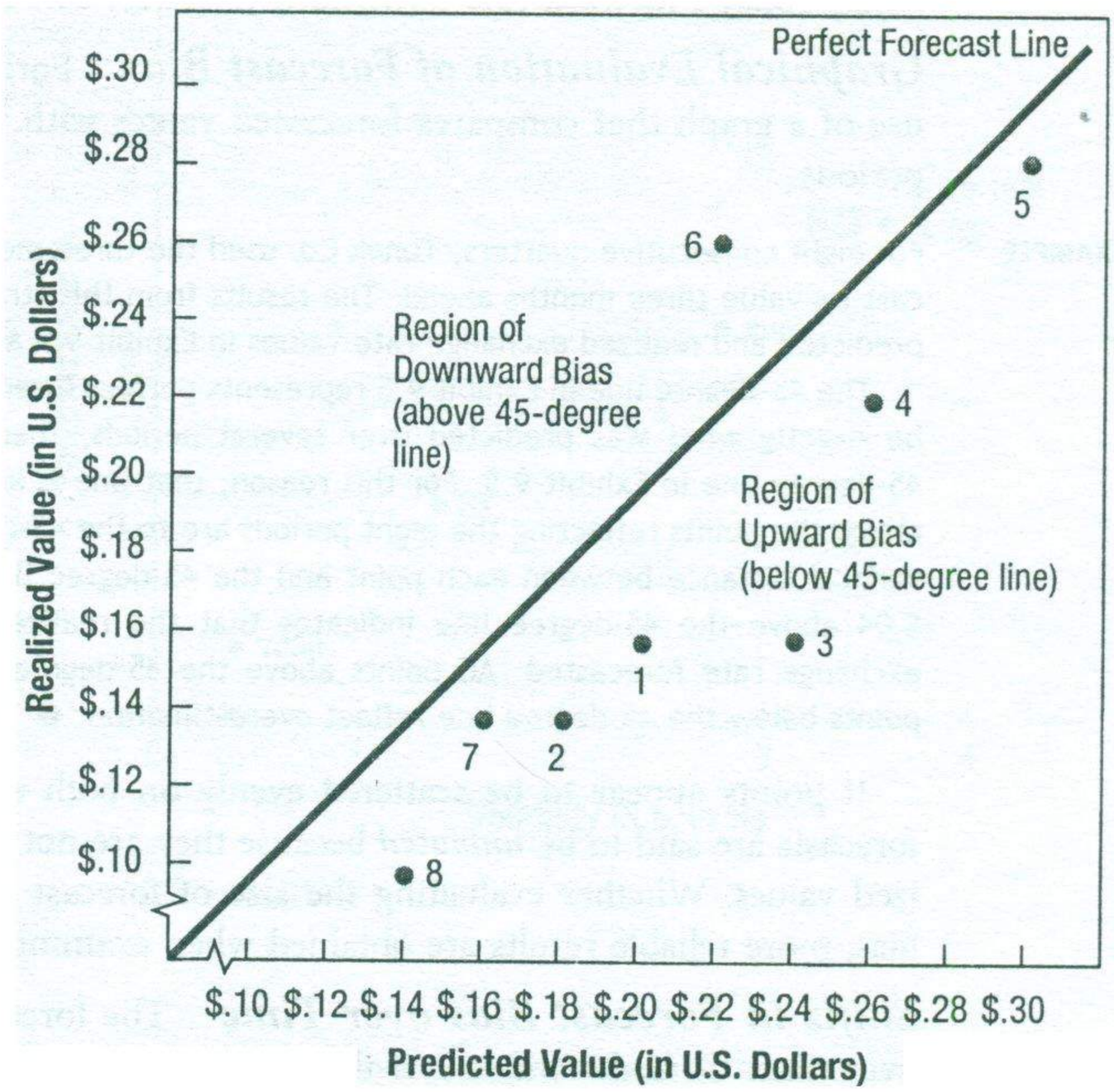
If points appear to be scattered evenly on both sides of the 45-degree line, then the forecasts are said to be *unbiased* because they are not consistently above or below the realized values. Whether evaluating the size of forecast errors or attempting to search for a bias, more reliable results are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

Shifts in Forecast Bias over Time The forecast bias of a currency tends to shift over time. Consider the use of the spot rate of the euro to forecast the euro's value one month later. During the period from January 2006 to October 2008, the euro exhibited fairly consistent appreciation. Thus, the one-month forecast typically underestimated the spot rate one month ahead. During the period from December 2009 to June 2010, however, the euro consistently depreciated; hence the one-month forecast typically overestimated the spot rate one month ahead. Even if the one-month forward rate of the euro (rather than its prevailing spot rate) had been used to predict the spot rate one month ahead, the forecast bias would have been similar because the one-month forward rate was usually close to the prevailing spot rate in the periods considered and so would yield a similar forecast as the prevailing spot rate. Because the forecast bias can change over time, adjusting forecasts to reflect past bias is not a reliable technique.

Exhibit 9.4 Evaluation of Forecast Performance

PERIOD	PREDICTED VALUE OF CURRENCY Q FOR END OF PERIOD	REALIZED VALUE OF CURRENCY Q AT 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



9-3f Comparison of Forecasting Methods

An MNC can compare forecasting methods by plotting the points that each method generates on a graph similar to Exhibit 9.5. The points pertaining to each method can be distinguished by a distinctive mark or color, and their respective performance can be evaluated by comparing the distances of these points from the 45-degree line. It may be that neither forecasting method stands out as superior when compared graphically. In that case, a more precise comparison can be conducted by computing the forecast errors for all periods for each method and then comparing those errors.

EXAMPLE 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 9.6; column 4 gives the realized value of the zloty.

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, so this model's forecasts are off by $.04 on average. Model 1 is not perfectly accurate but does a better job than Model 2, which had a mean absolute forecast error of $.07. Overall, predictions with Model 1 are (on 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

Exhibit 9.6 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

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.

9-3g 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* exchange rate information is not useful for forecasting exchange rate movements because today's exchange rates already reflect this information. In other words, technical analysis would not be able to improve forecasts. If the foreign exchange market is **semistrong-form efficient**, then not only historical and current information but also all relevant *public* information is reflected in today's exchange rates.

If today's exchange rates fully reflect any historical trends in exchange rate movements yet do not reflect other public information on expected interest rate movements, then 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. Most of this research indicates that foreign exchange markets are weak-form efficient and semistrong-form efficient. However, there is some evidence of inefficiencies for some currencies in certain 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 by definition unavailable.

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 is to derive reasonable exchange rate forecasts in order to make managerial decisions. When MNCs assess proposed policies, they usually prefer developing their own forecasts of exchange rates to simply using market-based rates for this purpose. Multinational corporations are nearly always interested in more than a single point estimate of some exchange rate one year, three years, or five years from now; they usually prefer

developing a variety of scenarios and assessing how exchange rates may change under each scenario. Even if today's forward exchange rate properly reflects all available information, it does not indicate how much the realized future exchange rate could deviate from what is expected. An MNC must determine the range of various possible exchange rate movements in order to assess the extent to which its operating performance could be affected.

9-4 Using Interval Forecasts

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

EXAMPLE

Harp, Inc., which is 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. In addition, Harp specifies an interval around its forecasts that is based on the Canadian dollar's historical volatility. The more volatile the currency, the more likely it is to deviate significantly from its forecasted value (i.e., 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. So assuming the movements are normally distributed, there is a 68 percent chance that the actual value will be within a single standard deviation (2 percent) of its forecasted value; the resulting interval ranges from $.686 to $.714. Furthermore, Harp assumes there is a 95 percent chance that the Canadian dollar will be within two standard deviations (4 percent) of the predicted value; this results in an interval ranging from $.672 to $.728. By specifying an interval, Harp can anticipate more specifically how much the currency's actual value might deviate from its predicted value. For currencies that are more volatile, the standard deviation is larger and the interval surrounding the point estimate forecast is wider. ●

WEB

www.fednewyork.org/markets/impliedvolatility.html
Implied volatilities of major currencies. The implied volatility can be used to measure the market's expectations of a specific currency's volatility in the future.

As this example shows, knowing a currency's volatility is useful when specifying an interval around a forecast. Yet because a currency's volatility can change over time, past volatility levels may not be the best way to establish an interval around a point estimate forecast. Hence MNCs may prefer forecasting exchange rate volatility to determine this interval.

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, then it may also attempt to forecast the standard deviation of daily exchange rate movements over this quarter. That information could be combined with the point estimate forecast of the Canadian dollar for each day to derive confidence intervals around each day's forecast.

9-4a Methods of Forecasting Exchange Rate Volatility

An interval forecast requires values for the volatility of exchange rate movements. These values can be forecast using (1) recent exchange rate volatility, (2) historical time series of volatilities, and (3) the implied standard deviation derived from currency option prices.

Using Recent Levels of Volatility 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 volatility of the Canadian dollar over the next month.

Using Historical Patterns of Volatilities Historical volatility can change over time, so the standard deviation of monthly exchange rate movements in the last 12 months is not necessarily an accurate predictor of such volatility in the next month.

To the extent that there is a pattern to changes in the exchange rate's volatility, a series of time periods may be used to forecast volatility in the subsequent period.

EXAMPLE 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 time-based 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 previous years to influence the forecast as well. The weights that achieved the most accuracy (lowest forecast error) over previous periods are normally used when applying this method to forecast exchange rate volatility. ●

Because various economic and political factors can cause exchange rate volatility to change abruptly, not even sophisticated time-series models can necessarily forecast it accurately. A poor forecast of exchange rate volatility can lead to an improper interval surrounding a point estimate forecast.

Using the 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 depends on such factors as the relationship between the spot exchange rate and the exercise (strike) price of the option, the number of days until the option's expiration date, and the anticipated volatility of the denominating 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 these factors are all known *except* for the anticipated volatility. By considering the existing option premium paid by investors for a specific currency option, MNCs can derive the anticipated volatility (also known as implied volatility or implied standard deviation) of a currency that they are forecasting. After accounting for the currency's existing spot rate (relative to the option's exercise price) and the time until expiration of the option, a larger premium must be paid for options on currencies that are expected to be volatile before the option expires. The logic is that investors who sell the option would demand a sufficiently high premium to reflect the degree of anticipated volatility before the option expires because they are subject to greater losses when the currency is more volatile. The higher the implied volatility (as determined by the currency option pricing model), the more dispersed it is in the probability distribution that surrounds a forecast of the currency's exchange rate; in other words, the interval surrounding the forecast is wider.

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, or (4) mixed. Each technique has limitations, and the quality of the forecasts produced varies. Yet, exchange rates are very difficult to forecast accurately, because their movements can be volatile over time.
- 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 in order to control for differences in the currencies' relative values.

Because future exchange rates cannot be predicted with perfect accuracy, MNCs specify an interval around their point estimate forecast. Such an interval can be derived from the recent exchange rate volatility, the historical time series of volatilities, and the implied standard deviation from currency option prices.

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 semi-strong–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 that 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 FORE-CAST	ACTUAL YEN VALUE	POUND FORE-CAST	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 1 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 1-year forward rate on the Mexican peso. Assume that Mexico's 1-year interest rate is 40 percent, while the U.S. 1-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 1 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 1-year forward rate would underestimate, overestimate, or be an unbiased estimate of the future spot rate in 1 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 1-year risk-free interest rate of 40 percent, which is primarily due to the high level of expected inflation. The U.S. nominal 1-year risk-free interest rate is 8 percent. The spot rate of Bolivia's currency (called the boliviano) is $.14. The 1-year forward rate of the boliviano is $.108. What is the forecasted percentage change in the boliviano if the spot rate is used as a 1-year forecast? What is the forecasted percentage change in the boliviano if the 1-year forward rate is used as a 1-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 1-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 it produces. Dinland presently has a 1-year risk-free interest rate of more than 40 percent. Do you think that the prevailing spot rate or the 1-year forward rate would result in a more accurate forecast of Dinland's currency (the din) 1 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 1-year risk-free interest rate of more than 40 percent. Do you think that the prevailing 1-year forward rate of Freeland's currency (the fre) would overestimate, underestimate, or be a reasonably accurate forecast of the spot rate 1 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 1 year. If the forward rate overestimates, it means that its value is more than the realized spot rate in 1 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 1-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.

29. Deriving Forecasts from Forward Rates Assume that interest rate parity exists. Today the 1-year U.S. interest rate is equal to 8 percent, while Mexico's 1-year interest rate is equal to 10 percent. Today the 2-year annualized U.S. interest rate is equal to 11 percent, while the 2-year annualized Mexican interest rate is equal to 11 percent. West Virginia Co. uses the forward rate to predict the future spot rate. Based on forward rates for 1 year ahead and 2 years ahead, will the peso appreciate or depreciate from the end of year 1 until the end of year 2?

30. Forecast Errors from Forward Rates Assume that interest rate parity exists. One year ago, the spot rate of the euro was $1.40 and the spot rate of the Japanese yen was $.01. At that time, the 1-year interest rate of the euro and Japanese yen was 3 percent and the 1-year U.S. interest rate was 7 percent. One year ago, you used the 1-year forward rate of the euro to derive a forecast of the future spot rate of the euro and the yen 1 year ahead. Today, the spot rate of the euro is $1.39, while the spot rate of the yen is $.009. Which currency did you forecast more accurately?

31. Forward versus Spot Rate Forecasts Assume that interest rate parity exists and it will continue to exist in the future. Kentucky Co. wants to forecast the value of the Japanese yen in 1 month. The Japanese interest rate is lower than the U.S. interest rate. Kentucky Co. will either use the spot rate or the 1-month forward rate to forecast the future spot rate of the yen at the end of 1 month. Your opinion is that net capital flows between countries tend to move toward whichever country has the higher nominal interest rate and that these capital flows are the primary factor that affects the value of the currency. Will the forward rate as a forecast result in a smaller, larger, or the same absolute forecast error as the use of today's spot rate when forecasting the future spot rate of the yen in 1 month? Briefly explain.

32. Forward versus Spot Rate Forecast Assume that interest rate parity exists. The 1-year risk-free interest rate in the United States is 3 percent versus 16 percent in Singapore. You believe in purchasing power parity, and you also believe that Singapore will experience a 2 percent inflation rate and the United States will experience a 2 percent inflation rate over the next year. If you wanted to forecast the Singapore dollar's spot rate for 1 year ahead, do you think that the forecast error would be smaller when using today's 1-year forward rate of the Singapore dollar as the forecast or using today's spot rate as the forecast? Briefly explain.

33. Forecasting Based on the IFE The prevailing one-year risk-free interest rate in Argentina is higher than in the U.S. and will continue to be higher over

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.

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, fundamental, 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 efficiency 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 technique is the most accurate? (Use the absolute forecast error as a percentage of the realized value to answer 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. Logan wants to forecast the value of the pound for each of the next 20 months.

1. Explain how Logan can use technical forecasting to forecast the future value of the pound. Based on the information provided, do you think that a technical forecast will predict future appreciation or depreciation in the pound?
2. Explain how Logan can use fundamental forecasting to forecast the future value of the pound. Based on the information provided, do you think that a fundamental forecast will predict appreciation or depreciation in the pound?
3. Explain how Logan can use a market-based forecast to forecast the future value of the pound. Do you think the market-based forecast will predict appreciation, 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 Web site of the CME Group (www.cmegroup.com), which now owns the Chicago Mercantile Exchange among others, provides information about the exchange and the futures contracts offered on the exchange.

Use this Web site to review the historical quotes of futures contracts and to obtain a recent quote for contracts on the Japanese yen and the British pound. Then go to www.oanda.com/convert/fxhistory. Obtain the spot exchange rate for the Japanese yen and British

pound on the same date for which you have futures contract quotations. Does the Japanese yen futures price reflect a premium or a discount relative to its spot rate? Does this futures price imply appreciation or depreciation of the Japanese yen? Answer these two questions also for the British pound.

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 1 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.

Online Articles with Real-World Examples

Find a recent article online that describes an actual international finance application or a real world example about a specific MNC's actions that reinforces one or more concepts covered in this chapter.

If your class has an online component, your professor may ask you to post your summary there and provide the web link of the article so that other students can access it. If your class is live, your professor may ask you to summarize your application in class. Your professor may assign specific students to complete this assignment for this chapter, or may allow any students to do the assignment on a volunteer basis.

For recent online articles and real world examples applied to this chapter, consider using the following search terms and include the current year as a search term to ensure that the online articles are recent:

1. forecast AND exchange rate
2. currency AND forecast
3. company AND exchange rate forecast
4. Inc. AND currency forecast
5. expected currency movements
6. forecast accuracy AND exchange rate
7. exchange rate AND forecast bias
8. currency AND forecast bias
9. forward rate AND forecast
10. currency AND forecast services

10 Measuring Exposure to Exchange Rate Fluctuations

CHAPTER OBJECTIVES

The specific objectives of this chapter are to:

- discuss the relevance of an MNC's exposure to exchange rate risk,
- explain how transaction exposure can be measured,
- explain how economic exposure can be measured, and
- explain how translation exposure can be measured.

Exchange rate risk can be broadly defined as the risk that a company's performance will be affected by exchange rate movements. Since exchange rate movements can affect a multinational corporation's cash flow, they can affect an MNC's performance and value. Exchange rate movements are volatile and can therefore can have a substantial impact on an MNC's cash flows. Multinational corporations closely monitor their operations to assess their exposure to various forms of exchange rate risk. Financial managers must understand how to measure the exposure to exchange rate fluctuations so that they can determine whether and how to protect their operations from that exposure. In this way, they can reduce the sensitivity of their MNC's value to exchange rate movements.

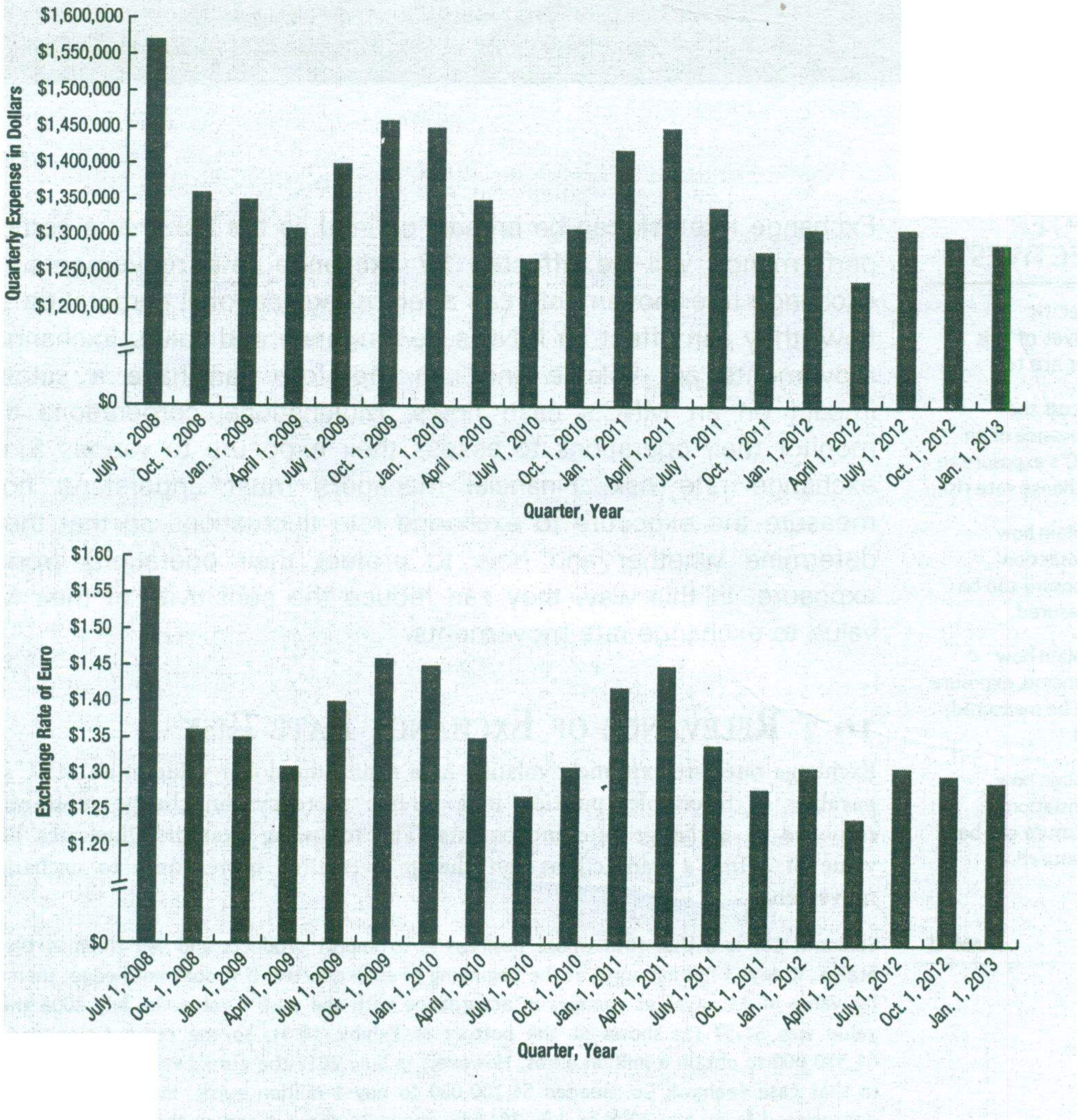
10-1 Relevance of Exchange Rate Risk

Exchange rates are extremely volatile. As a result, the dollar value of an MNC's future payables or receivables position in a foreign currency can change substantially in response to exchange rate movements. The following example illustrates how the value of a firm's transactions can change over time in response to exchange rate movements.

EXAMPLE Seahawk Co. is a U.S. firm whose business is to import products and sell them in the United States. It pays 1 million euros at the beginning of each quarter. If it does not hedge, then the dollar value of its payables changes in accordance with the euro's value. In July 2008 the euro's value was $1.57 (as shown at the bottom of Exhibit 10.1), so the company needed to pay $1,570,000 to obtain a million euros. However, in July 2012 the euro's value was about $1.20, so in that case Seahawk Co. needed $1,200,000 to buy 1 million euros. In other words, the euro depreciated from July 2008 to July 2012 by about 24 percent and so the amount of dollars the company needed to make its payment declined by about 24 percent. ●

Now change the example by assuming that Seahawk Co. is instead an exporter that receives 1 million euros every quarter and converts them into dollars. In this revised example, the company would have generated much more revenue in July 2008, when the euro was strong, than in July 2012, when the euro was weak. Although some arguments suggest that an MNC's exposure to exchange rate risk is irrelevant, for each of these arguments there is a counterargument, as discussed next.

Exhibit 10.1 Amount of Dollars Needed to Obtain Imports (transaction value = 1 million euros)



10-1a The Investor Hedge Argument

One argument for exchange rate irrelevance is that investors in MNCs can hedge exchange rate risk on their own. This argument assumes that investors have complete information on corporate exposure to exchange rate fluctuations as well as the ability to insulate their individual exposure. To the extent that investors prefer that corporations

perform the hedging, exchange rate exposure is relevant to corporations. Note that an MNC may be able to hedge at a lower cost than individual investors. It also has more information about its exposure and can more effectively hedge that exposure.

10-1b Currency Diversification Argument

Another argument is that, if a U.S.-based MNC is well diversified across numerous countries, then its value will not be affected by exchange rate movements because of offsetting effects. However, it would be naive to suppose that exchange rate effects will offset each other just because an MNC has transactions in many different currencies, especially since the movements of many currencies against the dollar are highly correlated.

10-1c Stakeholder Diversification Argument

Some have argued that if stakeholders (such as creditors or stockholders) are well diversified then they will be sufficiently insulated against the losses (due to exchange rate risk) incurred by any particular MNC. Yet many MNCs are similarly affected by exchange rate movements, so it is difficult to construct even a diversified portfolio of stocks that will be insulated from exchange rate movements.

10-1d Response from MNCs

Hedging against exchange rate movements can reduce the uncertainty surrounding future cash flows. The hedging process can stabilize an MNC's revenue and expenses, thereby stabilizing its earnings and cash flows. A creditor that provides loans to MNCs may prefer that they maintain a low exposure to exchange rate risk. Consequently, MNCs that hedge their exposure to risk may be able to borrow funds at a lower cost.

Many MNCs (including Colgate-Palmolive, Eastman Kodak, and Merck) have attempted to stabilize their earnings with hedging strategies because they believe that exchange rate risk is relevant. Further evidence that MNCs view such risk as relevant can be found in annual reports. The following comments from recent annual reports of MNCs are typical.

> *Because we manufacture and sell products in a number of countries throughout the world, we are exposed to the impact on revenue and expenses of movements in currency exchange rates.*
>
> *—Procter & Gamble Co.*

> *Increased volatility in foreign exchange rates ... may have an adverse impact on our business results and financial condition.*
>
> *—PepsiCo*

When Facebook went public in 2012, its registration statement explained its exposure as follows.

> *In general, we are a net receiver of currencies other than the U.S. dollar. Accordingly, changes in exchange rates, and in particular a strengthening of the U.S. dollar, will negatively affect our revenue and other operating results as expressed in U.S. dollars.*

Because MNCs recognize that exchange rate risk is relevant, they may consider hedging their positions. However, an MNC must determine the extent of its exposure before

it can hedge that exposure. Firms are commonly subject to the following forms of exchange rate exposure:

- transaction exposure,
- economic exposure, and
- translation exposure.

Each type will be discussed in turn.

10-2 Transaction Exposure

One obvious way in which most MNCs are exposed to exchange rate risk is through contractual transactions that are invoiced in foreign currencies. The sensitivity of the firm's contractual transactions in foreign currencies to exchange rate movements is referred to as **transaction exposure**.

In order to assess transaction exposure, an MNC must(1) estimate its net cash flows in each currency and (2) measure the possible effects of its exposure to those currencies.

10-2a Estimating "Net" Cash Flows in Each Currency

Multinational corporations tend to focus on transaction exposure over an upcoming short-term period (such as the next month or the next quarter), for which they can anticipate foreign currency cash flows with reasonable accuracy. Since MNCs commonly have foreign subsidiaries spread around the world, they need an information system that can track their expected currency transactions. Subsidiaries should be able to access the same network and provide information on their existing currency positions and their expected transactions for the next month, quarter, or year.

To measure its transaction exposure, an MNC needs to project the consolidated net amount in currency inflows (or outflows) for all its subsidiaries categorized in terms of the currency used. One foreign subsidiary may have expected cash inflows of a foreign currency while another has cash outflows of that same currency. In this case, the MNC's net cash flows of that particular currency may be negligible overall. However, if most of the MNC's subsidiaries have future inflows in another currency then there could be substantial net cash flows in that currency. Estimating the consolidated net cash flows per currency is useful when assessing an MNC's exposure because doing so helps determine its overall position in each currency.

EXAMPLE Miami Co. conducts its international business in four currencies. The company's objective is first to measure its exposure in each currency over the next quarter and then to estimate its consolidated cash flows based on expected transactions for one quarter ahead; see Exhibit 10.2. For example,

Exhibit 10.2 Consolidated Net Cash Flow Assessment of Miami Co.

CURRENCY	TOTAL INFLOW	TOTAL OUTFLOW	NET INFLOW OR OUTFLOW	EXPECTED EXCHANGE RATE AT END OF QUARTER	NET INFLOW OR OUTFLOW AS MEASURED IN U.S. DOLLARS
British pound	£17,000,000	£7,000,000	+£10,000,000	$1.50	+$15,000,000
Canadian dollar	C$12,000,000	C$2,000,000	+C$10,000,000	$.80	+$ 8,000,000
Swedish krona	SK20,000,000	SK120,000,000	−SK100,000,000	$.15	−$15,000,000
Mexican peso	MXP90,000,000	MXP10,000,000	+MXP80,000,000	$.10	+$ 8,000,000

Miami expects Canadian dollar inflows of C$12 million and outflows of C$2 million over the next quarter. Thus, Miami expects net inflows of C$10 million. Given an expected exchange rate of $.80 at the end of the quarter, it can convert the expected net inflow of Canadian dollars into an expected net inflow of $8 million (calculated as C$10 million × $.80).

The same process is used to determine the net cash flows of each of the other three currencies. Notice from the last column of Exhibit 10.2 that the expected net cash flows in three of the currencies are positive but that the net cash flows in the Swedish krona are negative (reflecting cash outflows). Thus, Miami will be favorably affected by appreciation of the pound, Canadian dollar, and Mexican peso; it will be adversely affected by appreciation of the krona.

The information in Exhibit 10.2 must be converted into dollars so that Miami Co. can assess its exposure to fluctuations in each currency's value by using a standardized measure. For each currency, the net cash flows are converted into dollars to determine the dollar amount of exposure. Observe that Miami has a smaller dollar amount of exposure in Mexican pesos and Canadian dollars than in the other currencies. However, this does not necessarily mean that Miami will be less affected by these exposures, as will be explained shortly.

Because the net inflows or outflows in each foreign currency are uncertain and because the exchange rates at the end of the period are uncertain, Miami Co. will develop a range of possible exchange rates for each currency (see Exhibit 10.3) instead of a point estimate. The company can then evaluate a range of net dollar cash flows in addition to the point estimate of those flows. Note that the range of dollar cash flows resulting from Miami Co.'s peso transactions is wide, which reflects the high degree of uncertainty regarding the peso's value over the next quarter. In contrast, the range of dollar cash flows resulting from the company's Canadian dollar transactions is narrow because that currency is expected to be relatively stable over the next quarter. ●

Miami Co. assessed its net cash flow situation for only one quarter. It could also derive its expected net cash flows for shorter periods, such as a week or a month. Some MNCs assess their transaction exposure during several periods by applying the methods just described to each period individually. The further into the future an MNC attempts to measure its transaction exposure, the less accurate the measurement will be because of the greater uncertainty about future inflows from and outflows to each foreign currency and about future exchange rates. An MNC's overall exposure can be assessed only after considering each currency's variability and the correlations among currencies. The overall exposure of Miami Co. will be assessed after the following discussion of currency variability and correlations.

10-2b Exposure of an MNC's Portfolio

The dollar net cash flows of an MNC are generated from a portfolio of currencies. The exposure of the portfolio of currencies can be measured by the standard deviation of the portfolio, which indicates how the portfolio's value may deviate from what is expected. Consider an MNC that will receive payments in two foreign currencies. The risk

Exhibit 10.3 Estimating the Range of Net Inflows or Outflows for Miami Co.

CURRENCY	NET INFLOW OR OUTFLOW	RANGE OF POSSIBLE EXCHANGE RATES AT END OF QUARTER	RANGE OF POSSIBLE NET INFLOWS OR OUTFLOWS IN U.S. DOLLARS (BASED ON RANGE OF POSSIBLE EXCHANGE RATES)
British pound	+£10,000,000	$1.40 to $1.60	+$14,000,000 to +$16,000,000
Canadian dollar	+C$10,000,000	$.79 to $.81	+$ 7,900,000 to +$ 8,100,000
Swedish krona	−SK100,000,000	$.14 to $.16	−$14,000,000 to −$16,000,000
Mexican peso	+MXP80,000,000	$.08 to $.11	+$ 6,400,000 to +$ 8,800,000

(as measured by the standard deviation of monthly percentage changes) of a two-currency portfolio, which is denoted σ_p, can be estimated as follows:

$$\sigma_p = \sqrt{W_X^2\sigma_X^2 + W_Y^2\sigma_Y^2 + 2W_X W_Y \sigma_X \sigma_Y \text{CORR}_{XY}}$$

where

W_X = Proportion of total portfolio value that is in currency X
W_Y = Proportion of total portfolio value that is in currency Y
σ_X = standard deviation of monthly percentage changes in currency X
σ_Y = standard deviation of monthly percentage changes in currency Y
CORR_{XY} = correlation coefficient of monthly percentage changes between currencies X and Y

WEB

www.fednewyork.org/markets/impliedvolatility.html
Measure of exchange rate volatility.

The equation shows that an MNC's exposure to multiple currencies is influenced by the variability of each currency and the correlation of movements between the currencies. The volatility of a currency portfolio is positively related to each currency's volatility and positively related to the correlation between currencies. Each component in the equation that affects a currency portfolio's risk can be measured using a series of monthly movements (percentage changes) in each currency. These components will now be described in more detail.

Measurement of Currency Volatility The standard deviation statistic measures the degree of movement for each currency. In any given period, some currencies clearly fluctuate much more than others. For example, the standard deviations of the monthly movements in currencies of emerging countries tend to be higher than deviations in the currencies of developed countries. Thus, if an MNC has a large net position in only one currency, it is generally more susceptible to major losses stemming from exchange rate movements if the currency is that of a developing rather than a developed country. There are some exceptions, however. The Chinese yuan has generally been more stable than the currencies of most developed countries. This stability may be due in part to restrictions that limit capital flows into China and intervention by the country's central bank to maintain a stable yuan value.

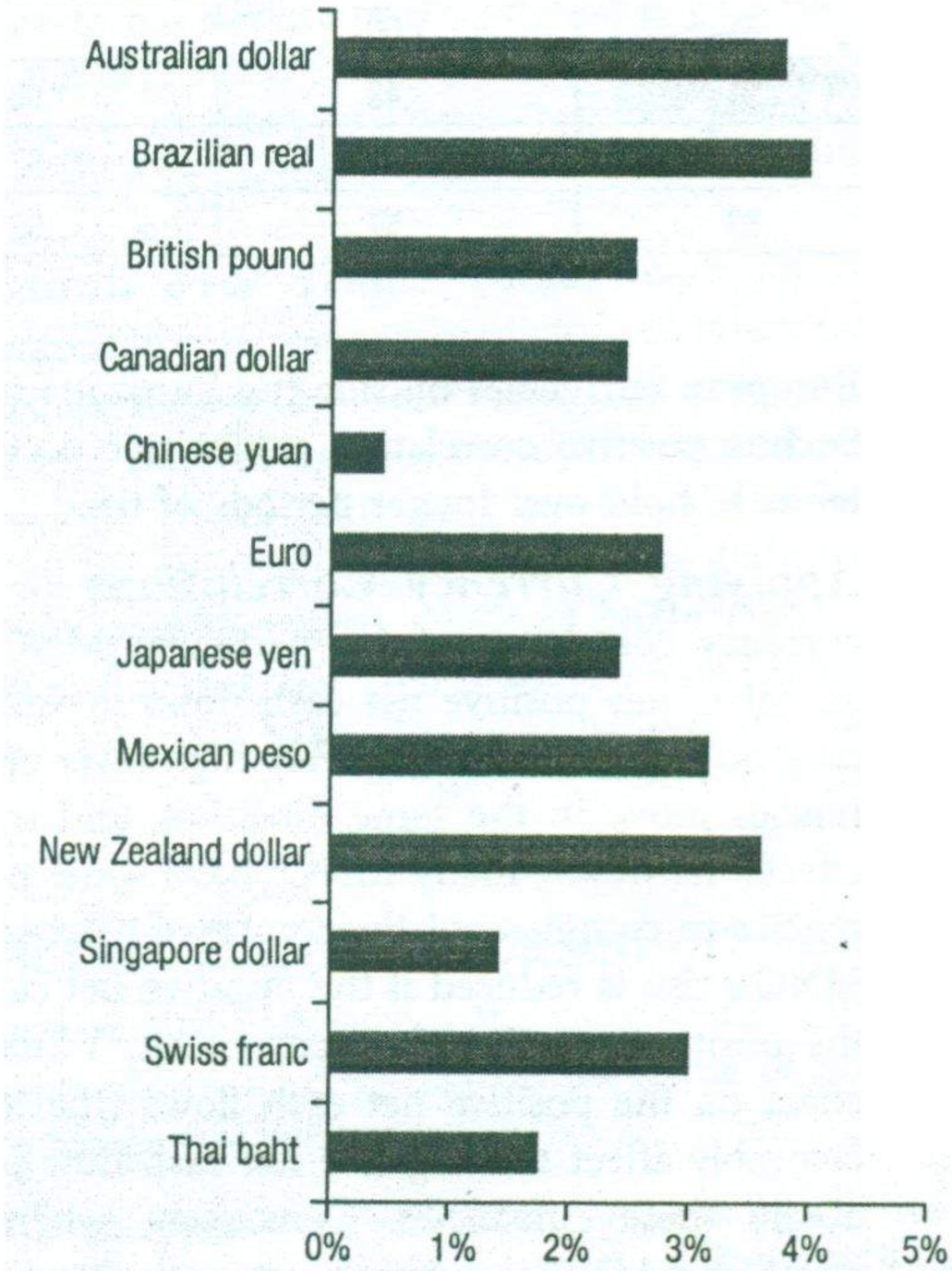
Exhibit 10.4 compares the volatility (as measured by the standard deviation) of monthly exchange rate movements against the dollar during the 2007–2012 period. The Chinese yuan is the least volatile currency, and the Brazilian real is about 10 times as volatile as the yuan. A U.S.-based MNC would normally be more concerned about exposure to those currencies that are relatively more volatile.

Currency Volatility over Time The volatility of a currency need not remain consistent from one period to the next. That being said, an MNC can identify currencies whose values are *most likely* to be stable (or highly volatile) in the future. For instance, the Canadian dollar's volatility has changed over time but is normally less than the volatility of other currencies.

During the credit crisis, there was much uncertainty about the future of foreign economic conditions. That uncertainty increased the volatility of exchange rates for most currencies. As a result, MNCs were subject to more exchange rate risk because of the greater exchange rate volatility that prevailed during the crisis. See Exhibit 10.5.

Measurement of Currency Correlations The correlations among currency movements can be measured by their *correlation coefficients*, which indicate the extent to which two currencies move in tandem with each other. The extreme case is perfect positive correlation, which is represented by a correlation coefficient equal to 1. Correlations that

Exhibit 10.4 Standard Deviation of Exchange Rate Movements Based on Quarterly Exchange Rates, 2007-2012



are negative reflect an inverse relationship between individual movements; the extreme case is −1.

Exhibit 10.6 shows the correlation coefficients (based on monthly data over the 2007–2012 period) for several currency pairs. It is clear that some currency pairs exhibit a much higher correlation than others. From a U.S. perspective, currency correlations are generally positive; this implies that currencies tend to move in the same direction against the U.S. dollar (though not always by the same degree). For example, the currencies of

Exhibit 10.5 Shift in Currency Volatility during the Financial Crisis

	AUSTRALIAN DOLLAR	BRITISH POUND	CANADIAN DOLLAR	CHINESE YUAN	EURO	MEXICAN PESO
Australian dollar	1.0					
British pound	.66	1.0				
Canadian dollar	.82	.59	1.0			
Chinese yuan	.19	.19	.09	1.0		
Euro	.73	.66	.52	.38	1.0	
Swedish krona	.82	.71	.69	.36	.83	1.0

Exhibit 10.6 Correlations among Movements in Quarterly Exchange Rates

	BRITISH POUND	CANADIAN DOLLAR	EURO	JAPANESE YEN	SWEDISH KRONA
British pound	1.00				
Canadian dollar	.35	1.00			
Euro	.91	.48	1.00		
Japanese yen	.71	.12	.67	1.00	
Swedish krona	.83	.57	.92	.64	1.00

European currencies outside the Eurozone normally exhibit a high degree of correlation. Such a positive correlation might not occur on every day, but for most currencies it tends to hold over longer periods of time.

Applying Currency Correlations to Net Cash Flows The implications of currency correlations for a particular MNC depend on its cash flow characteristics. If an MNC has positive net cash flows in various currencies that are highly correlated, it may be exposed to a relatively high level of exchange rate risk; the values of these currencies move in the same direction, and by similar degrees, so there are no offsetting effects. However, many MNCs have some negative net cash flow positions in some currencies to complement their positive net cash flows in other currencies. In that case, the MNC's risk is reduced if the negative net cash flow currencies are highly correlated with the positive net cash flow currencies. While depreciation of currencies has an adverse effect on the positive net cash flows (the inflows will convert to fewer dollars), it will favorably affect the negative net cash flow positions because it will take fewer dollars to obtain these currencies. Conversely, whereas currency appreciation would adversely affect the MNC's negative net cash flows (more dollars would be needed to obtain those currencies), it would favorably affect the MNC's positive net cash flows (the inflows will convert to more dollars). Exhibit 10.7 illustrates some common situations for an MNC that has exposure to only two currencies.

EXAMPLE The concept of currency correlations can be applied to the previous example of Miami Co.'s net cash flows (as summarized in Exhibit 10.3). Recall that Miami Co. anticipates cash inflows in the British pound equivalent to $15 million and cash outflows in the Swedish krona equivalent to $15 million. Thus, if the U.S. dollar weakens, then Miami Co. will be adversely affected by its exposure to the krona but favorably affected by its pound exposure; if the dollar strengthens, then the company will be adversely affected by its pound exposure but favorably affected by its krona exposure.

Exhibit 10.7 Impact of Cash Flow and Correlation Conditions on an MNC's Exposure

IF THE MNC'S EXPECTED CASH FLOW SITUATION IS	AND IF THE CURRENCIES ARE	THEN THE MNC'S EXPOSURE IS RELATIVELY
Equal amounts of net inflows in two currencies	Highly correlated	High
Equal amounts of net inflows in two currencies	Slightly positively correlated	Moderate
Equal amounts of net inflows in two currencies	Negatively correlated	Low
A net inflow in one currency and a net outflow of about the same amount in another currency	Highly correlated	Low
A net inflow in one currency and a net outflow of about the same amount in another currency	Slightly positively correlated	Moderate
A net inflow in one currency and a net outflow of about the same amount in another currency	Negatively correlated	High

If Miami expects that these two currencies will move in the same direction and to about the same extent over the next period, then its exposures to these two currencies partially offset each other.

Miami may not be too concerned about its exposure to the Canadian dollar's movements because it expects the Canadian dollar to be fairly stable, over time, against the U.S. dollar; in other words, there is little risk of the Canadian dollar depreciating substantially. However, Miami should be concerned about its exposure to the Mexican peso's movements given that (1) there is considerable uncertainty surrounding the peso's future value and (2) the company has no exposure to another currency that would offset its exposure to the peso. Therefore, Miami Co. should seriously consider hedging its expected net cash flow position in pesos. ●

Currency Correlations over Time Because currency correlations change over time, previous correlations are not perfect predictors of future correlations. Nevertheless, some general relationships tend to hold over time. For example, movements in values of the pound, the euro, and other European currencies against the U.S. dollar are highly correlated in most periods. Historically, the Canadian dollar has exhibited low correlation with other currencies, although its correlation has been increasing. From the U.S. perspective, the Chinese yuan has been relatively uncorrelated with other currencies in recent years. One reason is that the yuan's movements have been more limited than other currencies, so the yuan's value has not changed as much as other currencies against the dollar.

10-2c Transaction Exposure Based on Value at Risk

A related method for assessing exposure is the value-at-risk (VaR) method, which measures the maximum possible (one-day) loss on the value of positions held by an MNC that is exposed to exchange rate movements.

EXAMPLE

Celia Co. will receive 10 million Mexican pesos (MXP) tomorrow as a result of providing consulting services to a Mexican firm. It wants to determine, to within a 95 percent confidence level, the maximum one-day loss due to a potential decline in the peso's value. Celia estimates the standard deviation of daily percentage changes of the Mexican peso to be 1.2 percent over the last 100 days. If these daily percentage changes are normally distributed, then the maximum one-day loss is determined by the lower boundary (the left tail) of a one-tailed probability distribution, which is about 1.65 standard deviations away from the expected percentage change in the peso. Assuming an expected percentage change of 0 percent (implying no expected change in the peso) during the next day, then the maximum one-day loss is

$$\begin{aligned}\text{Maximum 1-day loss} &= E(e_t) - (1.65 \times \sigma_{MXP}) \\ &= 0\% - (1.65 \times 1.2\%) \\ &= -.0198, \text{ or } -1.98\%\end{aligned}$$

Suppose the spot rate of the peso is $.09. Then the maximum one-day loss of −1.98 percent implies a peso value of

$$\begin{aligned}\text{Peso value based on maximum 1-day loss} &= S \times (1 + \text{max 1-day loss}) \\ &= \$.09 \times [1 + (-.0198)] \\ &= \$.088218\end{aligned}$$

Thus, if the maximum one-day loss occurs then the peso's value will have declined to $.088218. The dollar value of this maximum one-day loss depends on Celia's position in Mexican pesos. For example, if Celia has MXP10 million then at $.09 per peso this amounts to $900,000; hence a decline of −1.98 percent in the peso's value would result in a loss of $900,000 × −1.98% = −$17,820. ●

Factors That Affect the Maximum One-Day Loss The maximum one-day loss of a currency depends on three factors as follows. First, it depends on the expected percentage change in the currency for the next day. If the expected outcome in the

previous example were −.2 percent instead of 0 percent, then the maximum loss over the one-day period would be

$$\begin{aligned}\text{Maximum 1-day loss} &= E(e_t) - (1.65 \times \sigma_{MXP}) \\ &= -.2\% - (1.65 \times 1.2\%) \\ &= -.0218, \text{ or } -2.18\%\end{aligned}$$

Second, the maximum one-day loss depends also on the confidence level used: a higher confidence level will lead to a greater maximum one-day loss (when all other factors are held constant). If the confidence level in the example were 97.5 percent instead of 95 percent, then the lower boundary would be not 1.65 but rather 1.96 standard deviations from the expected percentage change in the peso. Hence the maximum one-day loss becomes

$$\begin{aligned}\text{Maximum 1-day loss} &= E(e_t) - (1.96 \times \sigma_{MXP}) \\ &= 0\% - (1.96 \times 1.2\%) \\ &= -.02352, \text{ or } -2.352\%\end{aligned}$$

Third, the maximum one-day loss depends on the standard deviation of the daily percentage changes in the currency over a previous period. If the peso's standard deviation in the example has been 1 percent instead of 1.2 percent, then the maximum one-day loss (based on the original 95 percent confidence interval) would be

$$\begin{aligned}\text{Maximum 1-day loss} &= E(e_t) - (1.65 \times \sigma_{MXP}) \\ &= 0\% - (1.65 \times 1\%) \\ &= -.0165, \text{ or } -1.65\%\end{aligned}$$

Comparing these derived maximum losses illustrates how a currency's volatility can affect the MNC's potential loss due to a position in that currency. For currencies that are less volatile, the range of possible future exchange rate outcomes is narrower; this means that there is less chance of extreme exchange rate movements that could cause a major loss.

Applying VaR to Longer Time Horizons The VaR method can also be used to assess exposure over longer time horizons. The standard deviation should be estimated over the time horizon for which the maximum loss is to be measured.

EXAMPLE Lada, Inc., expects to receive Mexican pesos in one month for products it has exported. It wants to determine the maximum one-month loss due to a potential decline in the peso's value (based on a 95 percent confidence level). Lada estimates the standard deviation of monthly percentage changes of the Mexican peso to be 6 percent over the last 40 months. If these monthly percentage changes are normally distributed, then the maximum one-month loss is determined by the lower boundary (the left tail) of the probability distribution, which is about 1.65 standard deviations away from the expected percentage change in the peso. If the expected percentage change in the peso is −1 percent during the next month, then the maximum one-month loss is

$$\begin{aligned}\text{Maximum 1-month loss} &= E(e_t) - (1.65 \times \sigma_{MXP}) \\ &= -1\% - (1.65 \times 6\%) \\ &= -.109, \text{ or } -10.9\%\end{aligned}$$

●

If Lada, Inc., is uncomfortable with the magnitude of this possible loss, it can hedge its position as explained in the next chapter.

Applying VaR to the Transaction Exposure of a Portfolio Because MNCs are commonly exposed to more than one currency, they may wish to apply the VaR method to a portfolio of currencies. When considering multiple currencies, software packages can be used to perform the computations. An example of applying VaR to a two-currency portfolio is given next.

EXAMPLE Benou, Inc., a U.S. exporting firm, expects to receive substantial payments denominated in Indonesian rupiah and Thai baht in one month. Based on today's spot rates, the dollar value of the funds to be received is estimated at $600,000 for the rupiah and $400,000 for the baht. Thus, Benou is exposed to a currency portfolio weighted 60 percent in rupiah and 40 percent in baht. The company wants to determine the maximum expected one-month loss due to a potential decline in the value of these two currencies (based on a 95 percent confidence level). Using data for the last 20 months, Benou estimates the standard deviation of monthly percentage changes to be 7 percent for the rupiah and 8 percent for the baht; it also estimates a correlation coefficient of .50 between these two currencies. The portfolio's standard deviation is

$$\begin{aligned}\sigma_p &= \sqrt{(.36)(.0049) + (.16)(.0064) + 2(.60)(.40)(.07)(.08)(.50)} \\ &= \text{about } .0643, \text{ or about } 6.43\%\end{aligned}$$

If the monthly percentage changes of each currency are normally distributed, then the monthly percentage changes of the portfolio should be normally distributed. The maximum one-month loss of the currency portfolio is determined by the lower boundary (the left tail) of the probability distribution, which is about 1.65 standard deviations away from the expected percentage change in the currency portfolio. Assuming an expected percentage change of 0 percent for each currency during the next month (and thus an expected change of zero for the portfolio), the maximum one-month loss is

$$\begin{aligned}\text{Maximum 1-month loss of currency portfolio} &= E(e_t) - (1.65 \times \sigma_p) \\ &= 0\% - (1.65 \times 6.43\%) \\ &= \text{about } -.1061, \text{ or about } -10.61\%\end{aligned}$$

Now compare this maximum one-month loss to that of the rupiah or the baht individually:

$$\begin{aligned}\text{Maximum 1-month loss of rupiah} &= 0\% - (1.65 \times 7\%) \\ &= -.1155, \text{ or } -11.55\% \\ \text{Maximum 1-month loss of baht} &= 0\% - (1.65 \times 8\%) \\ &= -.132, \text{ or } -13.2\%\end{aligned}$$

Observe that the maximum one-month loss for the portfolio is lower than the maximum loss for either individual currency, which can be attributed to diversification effects. In other words, it is most unlikely that each currency will experience its maximum loss in the same month. The lower the correlation between the currencies' movements, the greater the diversification benefits.

Given the maximum losses calculated here, the company may decide to hedge its rupiah position, its baht position, neither position, or both positions. The decision of whether to hedge is discussed in the next chapter.

You can revise the assumptions of this example to illustrate how the volatilities or correlations affect the portfolio's maximum one-month loss. Both currencies are inflow currencies for the MNC in this example. So if either the currency volatilities or the correlation coefficient is assumed to be higher, then the portfolio's standard deviation will be higher and the MNC's maximum one-month loss will be higher. Likewise, if either the currency volatilities or the correlation coefficient is assumed to be lower, then both the portfolio's standard deviation and the MNC's maximum one-month loss will also be lower. ●

Estimating VaR with an Electronic Spreadsheet You can use Excel (or another electronic spreadsheet) to facilitate estimates of VaR for a portfolio of currencies by taking these steps.

1. Obtain the series of exchange rates for all relevant dates for each currency of concern and list each currency in its own column.
2. Compute the percentage changes per period (from one date to the next) for each exchange rate in a column.
3. Estimate the standard deviation of the column of percentage changes for each exchange rate.
4. In a separate column, compute the periodic percentage change in the portfolio value by applying weights to the individual currency returns. For instance, if the

portfolio is equal weighted (50 percent allocated to each currency), then the percentage change in the portfolio value per period is equal to 50 percent of the percentage change in value of one exchange rate *plus* 50 percent of the percentage change of the other exchange rate.

5. Use a "compute" statement to determine the standard deviation of the column of percentage changes in the portfolio value.

Once you have determined the standard deviation of percentage changes in the portfolio value, you can estimate the VaR of the portfolio (as explained earlier).

EXAMPLE Iowa Co. has cash inflows in Swiss francs and Argentine pesos, and its portfolio is weighted 50 percent in Swiss francs and 50 percent in Argentine pesos. The company wants to determine the maximum expected loss to this portfolio from exchange rate movements over a one-month period. (See Exhibit 10.8.) Iowa Co. records monthly exchange rates (shown in columns 2 and 3 of the exhibit) on an electronic spreadsheet so that it can estimate the monthly percentage changes in the exchange rates and in the portfolio before estimating the standard deviation of the exchange rate movements. Observe that the standard deviation (S.D.) of the portfolio's movements is substantially lower than the standard deviation of either individual currency's movements. If Iowa assumes an expected change of 0 percent for the portfolio over the next month, then its maximum one-month loss is

$$\text{Maximum 1-month loss} = 0\% - (1.65 \times 3.16\%) = 5.21\%$$ ●

Limitations of VaR The VaR method presumes that the distribution of exchange rate movements is normal. If the distribution of exchange rate movements is not normal, then estimating the maximum expected loss is subject to error. In addition, the VaR method assumes that the volatility (standard deviation) of exchange rate movements is stable over time. If past exchange rate movements are less volatile than future movements, then the estimated maximum expected loss derived from the VaR method will be underestimated.

EXAMPLE Carlsdale Co. has future cash inflows in euros. When applying VaR to recent movements in the euro, it determines that the maximum expected decline in the euro is small and thus would have only a minor adverse effect on its cash flows when converted to dollars. However, Carlsdale is concerned that one of the eurozone countries might abandon the euro as its home currency. This could cause a major decline in the euro's value (as described in Chapter 6), but the VaR analysis does not account for that risk. Therefore, Carlsdale complements its VaR analysis with a separate scenario analysis; in this way, it can determine how its exposure to euros would be affected in this special case where some country abandons the euro. It also wants to attach a probability to this special scenario; doing so would enable a more complete assessment of the company's exposure so that it can determine whether or not hedging it is appropriate. ●

Exhibit 10.8 Spreadsheet Analysis Used to Apply Value-at-Risk

BEGINNING OF MONTH	SWISS FRANC (SF)	ARGENTINE PESO (AP)	% CHANGE IN SF	% CHANGE IN AP	% CHANGE IN EQUAL-WEIGHTED PORTFOLIO
1	$0.60	$0.35	—	—	—
2	$0.64	$0.36	6.67%	2.86%	4.76%
3	$0.60	$0.38	−6.25%	5.56%	−0.35%
4	$0.66	$0.40	10.00%	5.26%	7.63%
5	$0.68	$0.39	3.03%	−2.50%	0.26%
6	$0.72	$0.37	5.88%	−5.13%	0.38%
7	$0.76	$0.36	5.56%	−2.70%	1.43%
			SD of SF = 5.57%	SD of AP = 4.58%	SD of Portfolio = 3.16%

10-3 Economic Exposure

The value of a firm's cash flows can be affected by exchange rate movements if it executes transactions in foreign currencies, receives revenue from foreign customers, or is subject to foreign competition. The sensitivity of the firm's cash flows to exchange rate movements is referred to as **economic exposure** (also sometimes referred to as operating exposure). An MNC's cash flows are affected by its transaction exposure (as illustrated earlier in this chapter). Thus, an MNC's transaction exposure is a subset of its economic exposure. But economic exposure includes other ways, besides transaction exposure, that a firm's cash flows can be affected by exchange rate movements.

EXAMPLE Intel invoices about 65 percent of its chip exports in U.S. dollars. If the euro weakened against the dollar, then European importers would need more euros to pay for them and so might decide to purchase chips from European manufacturers instead. So even though Intel's exports are invoiced in dollars, its cash flows to be received from exports may decline because of a weakened euro. In short: even though Intel's dollar-denominated exports do not result in transaction exposure, they do result in economic exposure. ●

Exhibit 10.9 gives some examples of how a firm can be subject to economic exposure. Consider each example by itself, as if the firm had no other international business. Since the first two examples involve contractual transactions in foreign currencies, they reflect transaction exposure. The remaining examples do not involve contractual transactions in foreign currencies and therefore do not reflect transaction exposure. However, they do reflect economic exposure because they affect the firm's cash flows. If a firm experienced the exposure described in the third and fourth examples but did not have any contractual transactions in foreign currencies, then it would be subject to economic exposure without being subject to transaction exposure.

Some of the more common international business transactions that typically subject an MNC's cash flows to economic exposure are listed in the first column of Exhibit 10.10. The second and third columns of that exhibit indicate how each transaction can be affected by, respectively, the appreciation and depreciation of the firm's home (local) currency. The next sections discuss these effects in turn.

10-3a Exposure to Local Currency Appreciation

The following discussion is related to the second column of Exhibit 10.10. Local sales (in the firm's home country) are expected to decrease if the local (home) currency appreciates because the firm will face increased foreign competition. That is, local customers will be able to obtain foreign substitute products cheaply with their strengthened currency. Cash inflows from exports denominated in the local currency will also likely be reduced as a result of appreciation in that currency because foreign importers will need more of their own currency to pay for these products. Any interest or dividends received from

Exhibit 10.9 Examples That Subject a Firm to Economic Exposure

A U.S. FIRM	THEN THE U.S. FIRM'S DOLLAR CASH FLOWS ARE ADVERSELY AFFECTED IF
1. Has a contract to export products in which it agreed to accept euros.	The euro depreciates.
2. Has a contract to import materials that are priced in Mexican pesos.	The peso appreciates.
3. Exports products to the United Kingdom that are priced in dollars, and competitors are located in the United Kingdom.	The pound depreciates (causing some customers to switch to the competitors).
4. Sells products to local customers, and its main competitor is based in Belgium.	The euro depreciates (causing some customers to switch to the competitors).

Exhibit 10.10 Economic Exposure to Exchange Rate Fluctuations

TRANSACTIONS THAT INFLUENCE THE FIRM'S LOCAL CURRENCY INFLOWS	IMPACT OF LOCAL CURRENCY APPRECIATION ON TRANSACTIONS	IMPACT OF LOCAL CURRENCY DEPRECIATION ON TRANSACTIONS
Local sales (relative to foreign competition in local markets)	Decrease	Increase
Firm's exports denominated in local currency	Decrease	Increase
Firm's exports denominated in foreign currency	Decrease	Increase
Interest received from foreign investments	Decrease	Increase
TRANSACTIONS THAT INFLUENCE THE FIRM'S LOCAL CURRENCY OUTFLOWS		
Firm's imported supplies denominated in local currency	No change	No change
Firm's imported supplies denominated in foreign currency	Decrease	Increase
Interest owed on foreign funds borrowed	Decrease	Increase

foreign investments will also convert to a reduced amount if the local currency has strengthened.

With regard to the firm's cash outflows, the cost of imported supplies denominated in the local currency will not be directly affected by changes in exchange rates. If the local currency appreciates, however, then the cost of imported supplies denominated in the foreign currency will be reduced. In addition, any interest to be paid on financing in foreign currencies will be reduced (in terms of the local currency) if the local currency appreciates because the strengthened local currency will be exchanged for the foreign currency to make the interest payments.

Thus, appreciation in the firm's local currency causes a reduction in both cash inflows and outflows. The impact on a firm's net cash flows will depend on which transaction type, outflow or inflow, is more affected by the appreciation. If, for example, the firm is in the exporting business but obtains its supplies and borrows funds locally, then the value of its inflow transactions will be reduced to a greater extent than will the value of its outflow transactions. In this case, net cash flows will be reduced. Conversely, cash inflows of a firm concentrating its sales locally with little foreign competition will not be severely reduced by appreciation of the local currency. If such a firm obtains supplies and borrows funds overseas, its outflows will be reduced. Overall, this firm's net cash flows will be enhanced by the appreciation of its local currency.

10-3b Exposure to Local Currency Depreciation

If the firm's local currency depreciates (see the third column of Exhibit 10.10), then its transactions will be affected in a manner opposite to how they are influenced by appreciation. Local sales should increase due to reduced foreign competition because prices denominated in strong foreign currencies will seem high to the local customers. The firm's exports denominated in the local currency will appear cheap to importers, thereby increasing foreign demand for those products. Even exports denominated in the foreign currency can increase cash flows because a given amount in foreign currency inflows to the firm will convert to a larger amount of the local currency. In addition, interest or dividends from foreign investments will now convert to more of the local currency.

With regard to cash outflows, imported supplies denominated in the local currency will not be directly affected by any change in exchange rates. The cost of imported supplies denominated in the foreign currency will rise, however, because more of the

weakened local currency will be required to obtain the foreign currency needed. Any interest payments paid on financing in foreign currencies will also increase.

In general, depreciation of the firm's local currency causes an increase in both cash inflows and outflows. A firm that concentrates on exporting and obtains supplies and borrows funds locally will likely benefit from a depreciated local currency. This would be the case for Caterpillar, Ford, and DuPont during periods in which the dollar weakens substantially against most major currencies. Conversely, a firm that concentrates on local sales, has very little foreign competition, and obtains foreign supplies (denominated in foreign currencies) will likely suffer negative effects from a weakened local currency.

10-3c Economic Exposure of Domestic Firms

Although our focus is on the financial management of MNCs, even purely domestic firms are affected by economic exposure.

EXAMPLE Barrington is a U.S. manufacturer of steel that purchases all of its supplies locally and sells all of its steel locally. Because its transactions are solely in the local currency, Barrington is not subject to transaction exposure. It is subject to economic exposure, however, because it faces foreign competition in its local markets. If the exchange rate of the foreign competitor's invoice currency depreciates against the dollar, then some of Barrington's customers might shift their purchases to the foreign steel producer. Then the demand for Barrington's steel will probably decrease, as will its net cash inflows. Thus, Barrington is subject to economic exposure even though it is not subject to transaction exposure. ●

10-3d Measuring Economic Exposure

Since MNCs are affected by economic exposure, they should assess the potential degree of exposure that exists and then determine whether to insulate themselves against it.

Using Sensitivity Analysis One method of measuring an MNC's economic exposure is to separately consider how sales and expense categories are affected by various exchange rate scenarios.

EXAMPLE Madison Co. is a U.S.-based MNC that purchases most of its materials from Canada and generates a small portion of its sales from exporting to Canada. Its U.S. sales are denominated in U.S. dollars whereas its Canadian sales are denominated in Canadian dollars (C$). The estimates of its cash flows, by country, are shown in Exhibit 10.11. Madison's exchange rate risk is partially due to specific contractual transactions, such as purchase orders of products three months in advance (transaction exposure). However, most of Madison's business is not based on contractual transactions because its customers typically purchase its products without advance notice. Madison wants to assess its economic exposure, which is the exposure of its total cash flows (whether due to contractual transactions or not) to exchange rate movements.

Exhibit 10.11 Estimated Sales and Expenses for Madison's U.S. and Canadian Business Segments (millions of currency units)

	U.S. BUSINESS	CANADIAN BUSINESS
Sales	$320	C$4
Cost of materials	$50	C$200
Operating expenses	$60	—
Interest expenses	$3	C$10
Cash flows	$207	–C$206

Assume that Madison Co. expects three possible exchange rates for the Canadian dollar over the period of concern: $.75, $.80, or $.85. These scenarios are separately analyzed in (respectively) the second, third, and fourth columns of Exhibit 10.12. Row 1 is constant across scenarios because the company's sales to U.S. businesses are not affected by exchange rate movements. In row 2, the estimated U.S. dollar sales to Canadian businesses are determined by converting the estimated Canadian dollar sales into U.S. dollars. Row 3 gives the sum of the U.S. dollar sales in rows 1 and 2.

Row 4 is constant across scenarios because the cost of materials in the United States is not affected by exchange rate movements. In row 5, the estimated U.S. dollar cost of materials purchased in Canada is determined by converting the estimated Canadian cost of materials into U.S. dollars. Row 6 is the sum of the U.S. dollar cost of materials in rows 4 and 5.

Row 7 is constant across scenarios because U.S. operating expenses are not affected by exchange rate movements, and row 8 is constant across scenarios because the interest expense on U.S. debt is not affected by exchange rate movements. In row 9, the estimated U.S. dollar interest expense from Canadian debt is determined by converting the estimated Canadian interest expenses into U.S. dollars. Row 10 is the sum of the U.S. dollar interest expenses in rows 8 and 9.

The effect of exchange rates on Madison's revenues and costs can now be reviewed. Exhibit 10.12 illustrates how the dollar value of Canadian sales and Canadian cost of materials would increase as a result of a stronger Canadian dollar. Because Madison's Canadian cost of materials exposure (C$200 million) is much greater than its Canadian sales exposure (C$4 million), a strong Canadian dollar has a negative overall impact on its cash flow. The total amount in U.S. dollars needed to make interest payments is also higher when the Canadian dollar is stronger. In general, Madison Co. would be adversely affected by a stronger Canadian dollar. It would be favorably affected by a weaker Canadian dollar because the reduced value of total sales would be more than offset by the reduced cost of materials and interest expenses. ●

A general conclusion from this example is that firms with more (less) in foreign costs than in foreign revenue will be unfavorably (favorably) affected by a stronger foreign currency. The precise anticipated impact, however, can be determined only by utilizing the procedure described here or some alternative procedure. The example given is based on a one-period time horizon. A firm that has developed forecasts of sales, expenses, and exchange rates for several periods ahead can assess its economic exposure over time. That exposure will be affected by any change in the firm's operating characteristics over time.

Exhibit 10.12 Impact of Possible Exchange Rates on Cash Flows of Madison Co. (millions of currency units)

	EXCHANGE RATE SCENARIO					
	C$1 = $.75		C$1 = $.80		C$1 = $.85	
Sales						
(1) U.S. sales		$320.00		$320.00		$320.00
(2) Canadian sales	C$4 =	$ 3.00	C$4 =	$ 3.20	C$4 =	$ 3.40
(3) Total sales in U.S. $		$323.00		$323.20		$323.40
Cost of Materials and Operating Expenses						
(4) U.S. cost of materials		$ 50.00		$ 50.00		$ 50.00
(5) Canadian cost of materials	C$200 =	$150.00	C$200 =	$160.00	C$200 =	$170.00
(6) Total cost of materials in U.S. $		$200.00		$210.00		$220.00
(7) Operating expenses		$ 60.00		$ 60.00		$ 60.00
Interest Expenses						
(8) U.S. interest expenses		$ 3		$ 3		$ 3
(9) Canadian interest expenses	C$10 =	$ 7.5	C$10 =	$ 8	C$10 =	$ 8.50
(10) Total interest expenses in U.S. $		$ 10.50		$ 11.00		$ 11.50
Cash Flows in U.S. $ before Taxes		$ 52.50		$ 42.20		$ 31.90

Use of Regression Analysis A firm's economic exposure to currency movements can also be assessed by applying regression analysis to historical cash flow and exchange rate data as follows:

$$PCF_t = a_0 + a_1 e_t + \mu_t$$

where

PCF_t = percentage change in inflation-adjusted cash flows measured in the firm's home currency over period t
e_t = percentage change in the direct exchange rate of the currency over period t
μ_t = random error term
a_0 = intercept
a_1 = slope coefficient

The regression coefficient a_1, which is estimated by regression analysis, indicates the sensitivity of PCF_t to e_t. If the coefficient is positive and significant, the implication is that an increase in the currency's value has a favorable effect on the firm's cash flows. A coefficient that is negative and significant implies an inverse relationship between the change in the currency's value and the firm's cash flows. If the firm anticipates no major adjustments in its operating structure, then it will expect the sensitivity detected from regression analysis to be similar in the future.

This regression model can be revised to handle more complex situations. For example, if additional currencies are to be assessed then they can be included in the model as additional independent variables. Each currency's impact is measured by estimating its respective regression coefficient. An MNC that is affected by numerous currencies can measure the sensitivity of PCF_t to an index (or composite) of currencies.

The analysis just described for a single period can also be extended over separate subperiods, as the sensitivity of a firm's cash flows to a currency's movements may change over time. Such a change would be indicated by a corresponding shift in the regression coefficient.

Some MNCs may prefer to use their stock price as a proxy for the firm's value and then assess how their stock price changes in response to currency movements. Regression analysis could also be used in this approach by replacing PCF_t with the percentage change in stock price in the model specified here. Some MNCs may also conduct similar analyses to assess the impact of exchange rates on their earnings, exports, and/or total sales.

10-4 Translation Exposure

An MNC creates its financial statements by consolidating all of its individual subsidiaries' financial statements. A subsidiary's financial statement is normally measured in its local currency. To be consolidated, each subsidiary's financial statement must be translated into the currency of the MNC's parent. Since exchange rates vary over time, the translation of the subsidiary's financial statement into a different currency is affected by exchange rate movements. The exposure of the MNC's consolidated financial statements to exchange rate fluctuations is known as **translation exposure**. In particular, subsidiary earnings translated into the reporting currency on the consolidated income statement are subject to fluctuations in the exchange rates.

To translate earnings, MNCs use a process established by the Financial Accounting Standards Board (FASB). The guidelines for translation are set by FASB 52.

10-4a Determinants of Translation Exposure

Some MNCs have more translation exposure than others. The extent of an MNC's translation exposure depends mainly on three factors:

- the proportion of its business conducted by foreign subsidiaries,
- the locations of its foreign subsidiaries, and
- the accounting methods that it uses.

Proportion of Business by Foreign Subsidiaries The greater the percentage of an MNC's business conducted by its foreign subsidiaries, the larger the percentage of a given financial statement item that is susceptible to translation exposure.

EXAMPLE Locus Co. and Zeuss Co. each generate about 30 percent of their sales from foreign countries. However, Locus Co. generates all of its international business by exporting whereas Zeuss Co. has a large Mexican subsidiary that generates all of its international business. Locus Co. is not subject to translation exposure (although it is subject to economic exposure), while Zeuss has substantial translation exposure. ●

Locations of Foreign Subsidiaries The countries in which subsidiaries are located can also influence the degree of translation exposure because the financial statement items of each subsidiary are typically measured by the respective subsidiary's home currency.

EXAMPLE Zeuss Co. and Canton Co. each have one large foreign subsidiary that generates about 30 percent of their respective sales. However, Zeuss Co. is subject to a much higher degree of translation exposure because its subsidiary is based in Mexico and the peso's value is subject to significant depreciation. In contrast, Canton's subsidiary is based in Canada, and the Canadian dollar is very stable against the U.S. dollar. ●

Accounting Methods An MNC's degree of translation exposure is strongly affected by the accounting procedures used to translate when consolidating financial statement data. Many important consolidated accounting rules for U.S.-based MNCs are based on FASB 52, which includes the following provisions.

1. The functional currency of an entity is the currency of the economic environment in which the entity operates.
2. The current exchange rate as of the reporting date is used to translate the assets and liabilities of a foreign entity from its functional currency into the reporting currency.
3. The weighted average exchange rate over the relevant period is used to translate revenue, expenses, and gains and losses of a foreign entity from its functional currency into the reporting currency.
4. Translated income gains or losses due to changes in foreign currency values are not recognized in current net income but are reported as a second component of stockholder's equity; an exception to this rule is a foreign entity located in a country with high inflation.
5. Realized income gains or losses due to foreign currency transactions are recorded in current net income, although there are some exceptions.

Under FASB 52, consolidated earnings are sensitive to the functional currency's weighted average exchange rate.

EXAMPLE Providence, Inc., is a U.S.-based MNC whose British subsidiary earned £10 million in year 1 and £10 million in year 2. When these earnings are consolidated along with other subsidiary earnings,

they are translated into U.S. dollars at the weighted average exchange rate for the year in question. Suppose the weighted average exchange rate is $1.70 in year 1 and $1.50 in year 2. Then the translated earnings (in U.S. dollars) for each reporting period are determined as follows:

REPORTING PERIOD	LOCAL EARNINGS OF BRITISH SUBSIDIARY	WEIGHTED AVERAGE EXCHANGE RATE OF POUND OVER THE REPORTING PERIOD	TRANSLATED U.S. DOLLAR EARNINGS OF BRITISH SUBSIDIARY
Year 1	£10,000,000	$1.70	$17,000,000
Year 2	£10,000,000	$1.50	$15,000,000

Note that even though the subsidiary's earnings in pounds were the same each year, the translated consolidated dollar earnings were reduced by $2 million in year 2. This discrepancy is due to the change in the weighted average of the British pound exchange rate. The drop in earnings is not the fault of the subsidiary but rather of the weakened British pound, which makes the subsidiary's year-2 earnings look small (when measured in U.S. dollars). The effect reported in the table occurs even if all of the earnings generated by the subsidiary are reinvested in the United Kingdom. ●

Translation exposure can explain some of the variation in earnings for any particular U.S.-based MNC over time because the reported consolidated earnings are boosted in periods when the currencies of foreign subsidiaries strengthen against the dollar and are reduced in periods when these currencies weaken against the dollar. Consolidated earnings of Black & Decker, The Coca-Cola Co., and many other large MNCs are highly sensitive to exchange rates because more than a third of their assets and sales are overseas. In some quarters, more than half of the change in reported earnings by MNCs is due to the translation effect. The potential impact of this effect on consolidated earnings is especially pronounced when foreign subsidiaries generate a relatively high proportion of the MNC's total earnings and when the local currencies used by those subsidiaries have changed substantially in value over the quarter.

10-4b Exposure of an MNC's Stock Price to Translation Effects

Many investors tend to use earnings when valuing the stock of MNCs, either by deriving estimates of expected cash flows from previous earnings or by applying an industry price/earnings (P/E) ratio to expected annual earnings in order to derive a value per share of stock. Because the translation exposure of each MNC affects its consolidated earnings, that exposure can also affect the MNC's valuation.

EXAMPLE Recall the previous example, in which Providence earned consolidated earnings (translated to dollars) of $17 million in year 1 but only $15 million in year 2 (because of depreciation in the British pound during that year). Providence has 10 million shares of stock outstanding. Assume that all consolidated earnings for Providence come from its subsidiaries (its U.S. parent had no earnings). Suppose the market valuation of Providence's stock is usually near the mean P/E ratio in its industry multiplied by its prevailing earnings per share (EPS), and suppose the mean P/E ratio in its industry was 20 in year 1 and also in year 2.

Given this information, the translation effect on earnings per share and on the stock price of Providence is determined in Exhibit 10.13. In year 1, its EPS is estimated to be $1.70; hence the stock valuation is $1.70 × 20 = $34 per share in that year. In year 2, however, the company's consolidated earnings (in dollars) are only $1.50 per share, which results in a stock value of only $30 per share. Thus, its stock valuation declined over the last year because its consolidated earnings

Exhibit 10.13 How Translation Exposure Can Affect an MNC's Stock Price

YEAR	CONSOLIDATED EARNINGS	EARNINGS PER SHARE (EPS), COMPUTED AS CONSOLIDATED EARNINGS DIVIDED BY 10 MILLION SHARES OUTSTANDING	PREVAILING PRICE-EARNINGS (P/E) RATIO IN THE INDUSTRY	VALUATION OF PROVIDENCE CO. STOCK [EPS BASED ON PREVAILING P/E RATIO × EPS]
1	$17,000,000	$1.70	20	$1.70 × 20 = $34
2	$15,000,000	$1.50	20	$1.50 × 20 = $30

declined over that period, which in turn resulted from a decline in the exchange rate used to translate the British pound earnings into dollar earnings. These results hold regardless of whether the subsidiary earnings are remitted to the U.S. parent or reinvested by the subsidiary in the United Kingdom. ●

Signals That Complement Translation Effects The exchange rate conditions that cause a translation effect can also signal changes in expected cash flows in future years. Such changes could also influence the stock price.

EXAMPLE In the previous example, the pound weakened from year 1 to year 2. The British subsidiary of Providence could possibly retain all of its earnings (rather than remit them to the parent) as long as the pound is weak. However, there is no guarantee that the pound's value will revert to its higher level of the previous year; in fact, the pound might even weaken further. The prevailing weak exchange rate may serve as a reasonable guess of the pound's future spot rate when the pound cash flows are converted to dollars. Consequently, stock analysts may expect a reduction in dollar cash flows that the parent of Providence will receive from the British subsidiary in the future years. This expectation complements the weaker reported consolidated earnings and provides further evidence that the stock price of Providence will decline. ●

Just as an unfavorable translation effect that reduces consolidated earnings may also reduce the MNC's stock price, a favorable translation effect that boosts consolidated earnings could boost the stock price. Specifically, if the British pound appreciates against the dollar in the next period then there would be a favorable effect on Providence's consolidated earnings. In addition, the prevailing strong exchange rate may serve as a reasonable estimate of the pound's future spot rate when pound cash flows are converted to dollars. Stock analysts may therefore expect an increase in dollar cash flows that the parent of Providence will receive from the British subsidiary in the future years. This expectation complements the higher reported consolidated earnings and provides further evidence that the stock price of Providence will increase in response to a favorable translation effect.

Exposure of Managerial Compensation to Translation Effects Since an MNC's stock may be subject to translation effects and since managerial compensation is often tied to the MNC's stock price, it follows that managerial compensation is affected by translation effects. Managers of one U.S.-based MNC may receive more compensation in a particular quarter than managers of other MNCs in its industry simply because its foreign subsidiaries are located in countries where the local currencies appreciated against the dollar over that quarter. Analogously, managers of some U.S.-based MNCs may receive low compensation because the currencies of their foreign subsidiaries depreciated against the dollar, thereby reducing earnings and stock price performance.

SUMMARY

- MNCs with less risk can obtain funds at lower financing costs. Since they may experience more volatile cash flows because of exchange rate movements, exchange rate risk can affect their financing costs. Thus, MNCs recognize the relevance of exchange rate risk, and may benefit from hedging their exposure.
- Transaction exposure is the exposure of an MNC's contractual transactions to exchange rate movements. MNCs can measure their transaction exposure by determining their future payables and receivables positions in various currencies, along with the volatility levels and correlations of these currencies. From this information, they can assess how their revenue and costs may change in response to various exchange rate scenarios.
- Economic exposure is any exposure of an MNC's cash flows (direct or indirect) to exchange rate movements. MNCs can attempt to measure their economic exposure by determining the extent to which their cash flows will be affected by their exposure to each foreign currency.
- Translation exposure is the exposure of an MNC's consolidated financial statements to exchange rate movements. To measure translation exposure, MNCs can forecast their earnings in each foreign currency and then determine how their earnings could be affected by the potential exchange rate movements of each currency.

POINT COUNTER-POINT

Should Investors Care about an MNC's Translation Exposure?

Point No. The present value of an MNC's cash flows is based on the cash flows that the parent receives. Any impact of the exchange rates on the financial statements is not important unless cash flows are affected. MNCs should focus their energy on assessing the exposure of their cash flows to exchange rate movements and should not be concerned with the exposure of their financial statements to exchange rate movements. Value is about cash flows, and investors focus on value.

Counter-Point Yes. Investors do not have sufficient financial data to derive cash flows. They commonly use earnings as a base, and if earnings are distorted, their estimates of cash flows will be also. If they underestimate cash flows because of how exchange rates affected the reported earnings, they may underestimate the value of the MNC. Even if the value is corrected in the future once the market realizes how the earnings were distorted, some investors may have sold their stock by the time the correction occurs. Investors should be concerned about an MNC's translation exposure. They should recognize that the earnings of MNCs with large translation exposure may be more distorted than the earnings of MNCs with low translation exposure.

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. Given that shareholders can diversify away an individual firm's exchange rate risk by investing in a variety of firms, why are firms concerned about exchange rate risk?
2. Bradley, Inc., considers importing its supplies from either Canada (denominated in C$) or Mexico (denominated in pesos) on a monthly basis. The quality is the same for both sources. Once the firm completes the agreement with a supplier, it will be obligated to continue using that supplier for at least 3 years. Based on existing exchange rates, the dollar amount to be paid (including transportation costs) will be the same. The firm has no other exposure to exchange rate movements. Given that the firm prefers to have less exchange rate risk, which alternative is preferable? Explain.

3. Assume your U.S. firm currently exports to Mexico on a monthly basis. The goods are priced in pesos. Once material is received from a source, it is quickly used to produce the product in the United States, and then the product is exported. Currently, you have no other exposure to exchange rate risk. You have a choice of purchasing the material from Canada (denominated in C$), from Mexico (denominated in pesos), or from within the United States (denominated in U.S. dollars). The quality and your expected cost are similar across the three sources. Which source is preferable, given that you prefer minimal exchange rate risk?

4. Using the information in the previous question, consider a proposal to price the exports to Mexico in dollars and to use the U.S. source for material. Would this proposal eliminate the exchange rate risk?

5. Assume that the dollar is expected to strengthen against the euro over the next several years. Explain how this will affect the consolidated earnings of U.S.-based MNCs with subsidiaries in Europe.

Questions and Applications

1. Transaction versus Economic Exposure Compare and contrast transaction exposure and economic exposure. Why would an MNC consider examining only its "net" cash flows in each currency when assessing its transaction exposure?

2. Assessing Transaction Exposure Your employer, a large MNC, has asked you to assess its transaction exposure. Its projected cash flows are as follows for the next year. Danish krone inflows equal DK50,000,000 while outflows equal DK40,000,000. British pound inflows equal £2,000,000 while out flows equal £1,000,000. The spot rate of the krone is $.15, while the spot rate of the pound is $1.50. Assume that the movements in the Danish krone and the British pound are highly correlated. Provide your assessment as to your firm's degree of transaction exposure (as to whether the exposure is high or low). Substantiate your answer.

3. Factors That Affect a Firm's Transaction Exposure What factors affect a firm's degree of transaction exposure in a particular currency? For each factor, explain the desirable characteristics that would reduce transaction exposure.

4. Currency Correlations Kopetsky Co. has net receivables in several currencies that are highly correlated with each other. What does this imply about the firm's overall degree of transaction exposure? Are currency correlations perfectly stable over time? What does your answer imply about Kopetsky Co. or any other firm using past data on correlations as an indicator for the future?

5. Currency Effects on Cash Flows How should appreciation of a firm's home currency generally affect its cash inflows? How should depreciation of a firm's home currency generally affect its cash outflows?

6. Transaction Exposure Fischer, Inc., exports products from Florida to Europe. It obtains supplies and borrows funds locally. How would appreciation of the euro likely affect its net cash flows? Why?

7. Exposure of Domestic Firms Why are the cash flows of a purely domestic firm exposed to exchange rate fluctuations?

8. Measuring Economic Exposure Memphis Co. hires you as a consultant to assess its degree of economic exposure to exchange rate fluctuations. How would you handle this task? Be specific.

9. Factors That Affect a Firm's Translation Exposure What factors affect a firm's degree of translation exposure? Explain how each factor influences translation exposure.

10. Translation Exposure Consider a period in which the U.S. dollar weakens against the euro. How will this affect the reported earnings of a U.S.-based MNC with European subsidiaries? Consider a period in which the U.S. dollar strengthens against most foreign currencies. How will this affect the reported earnings of a U.S.-based MNC with subsidiaries all over the world?

11. Transaction Exposure Aggie Co. produces chemicals. It is a major exporter to Europe, where its main competition is from other U.S. exporters. All of these companies invoice the products in U.S. dollars. Is Aggie's transaction exposure likely to be significantly affected if the euro strengthens or weakens? Explain. If the euro weakens for several years, can you think of any change that might occur in the global chemicals market?

12. Economic Exposure Longhorn Co. produces hospital equipment. Most of its revenues are in the United States. About half of its expenses require outflows in Philippine pesos (to pay for Philippine materials). Most of Longhorn's competition is from U.S. firms that have no international business at all. How will Longhorn Co. be affected if the peso strengthens?

13. Economic Exposure Lubbock, Inc., produces furniture and has no international business. Its major competitors import most of their furniture from Brazil and then sell it out of retail stores in the United States. How will Lubbock, Inc., be affected if Brazil's currency (the real) strengthens over time?

14. Economic Exposure Sooner Co. is a U.S. wholesale company that imports expensive high-quality luggage and sells it to retail stores around the United States. Its main competitors also import high-quality luggage and sell it to retail stores. None of these competitors hedge their exposure to exchange rate movements. Why might Sooner's market share be more volatile over time if it hedges its exposure?

15. PPP and Economic Exposure Boulder, Inc., exports chairs to Europe (invoiced in U.S. dollars) and competes against local European companies. If purchasing power parity exists, why would Boulder not benefit from a stronger euro?

16. Measuring Changes in Economic Exposure Toyota Motor Corp. measures the sensitivity of its exports to the yen exchange rate (relative to the U.S. dollar). Explain how regression analysis could be used for such a task. Identify the expected sign of the regression coefficient if Toyota primarily exports to the United States. If Toyota established more plants in the United States, how might the regression coefficient on the exchange rate variable change?

17. Impact of Exchange Rates on Earnings Cieplak, Inc., is a U.S.-based MNC that has expanded into Asia. Its U.S. parent exports to some Asian countries, with its exports denominated in the Asian currencies. It also has a large subsidiary in Malaysia that serves that market. Offer at least two reasons related to exposure to exchange rates that explain why Cieplak's earnings were reduced during the Asian crisis.

Advanced Questions

18. Speculating Based on Exposure Periodically, there are rumors that China will weaken its currency (the yuan) against the U.S. dollar and many European currencies. This causes investors to sell stocks in Asian countries such as Japan, Taiwan, and Singapore. Offer an intuitive explanation for such an effect. What types of Asian firms would be affected the most?

19. Comparing Transaction and Economic Exposure Erie Co. has most of its business in the United States, except that it exports to Belgium. Its exports were invoiced in euros (Belgium's currency) last year. It has no other economic exposure to exchange rate risk. Its main competition when selling to Belgium's customers is a company in Belgium that sells similar products, denominated in euros. Starting today, Erie Co. plans to adjust its pricing strategy to invoice its exports in U.S. dollars instead of euros. Based on the new strategy, will Erie Co. be subject to economic exposure to exchange rate risk in the future? Briefly explain.

20. Using Regression Analysis to Measure Exposure

a. How can a U.S. company use regression analysis to assess its economic exposure to fluctuations in the British pound?

b. In using regression analysis to assess the sensitivity of cash flows to exchange rate movements, what is the purpose of breaking the database into subperiods?

c. Assume the regression coefficient based on assessing economic exposure was much higher in the second subperiod than in the first subperiod. What does this tell you about the firm's degree of economic exposure over time? Why might such results occur?

21. Transaction Exposure Vegas Corp. is a U.S. firm that exports most of its products to Canada. It historically invoiced its products in Canadian dollars to accommodate the importers. However, it was adversely affected when the Canadian dollar weakened against the U.S. dollar. Since Vegas did not hedge, its Canadian dollar receivables were converted into a relatively small amount of U.S. dollars. After a few more years of continual concern about possible exchange rate movements, Vegas called its customers and requested that they pay for future orders with U.S. dollars instead of Canadian dollars. At this time, the Canadian dollar was valued at $.81. The customers decided to oblige since the number of Canadian dollars to be converted into U.S. dollars when importing the goods from Vegas was still slightly smaller than the number of Canadian dollars that would be needed to buy the product from a Canadian manufacturer. Based on this situation, has transaction exposure changed for Vegas Corp.? Has economic exposure changed? Explain.

22. Measuring Economic Exposure Using the cost and revenue information shown for DeKalb, Inc., on the next page, determine how the costs, revenue, and cash flow items would be affected by three possible exchange rate scenarios for the New Zealand dollar (NZ$): (1) NZ$ = $.50, (2) NZ$ = $.55, and (3) NZ$ = $.60. (Assume U.S. sales will be unaffected

by the exchange rate.) Assume that NZ$ earnings will be remitted to the U.S. parent at the end of the period. Ignore possible tax effects.

REVENUE AND COST ESTIMATES: DEKALB, INC. (IN MILLIONS OF U.S. DOLLARS AND NEW ZEALAND DOLLARS)

	U.S. BUSINESS	NEW ZEALAND BUSINESS
Sales	$800	NZ$800
Cost of materials	500	100
Operating Expenses	300	0
Interest expense	100	0
Cash flow	–$100	NZ$700

23. Changes in Economic Exposure The Walt Disney Company built an amusement park in France that opened in 1992. How do you think this project has affected Disney's economic exposure to exchange rate movements? Think carefully before you give your final answer. There is more than one way in which Disney's cash flows may be affected. Explain.

24. Lagged Effects of Exchange Rate Movements Cornhusker Co. is an exporter of products to Singapore. It wants to know how its stock price is affected by changes in the Singapore dollar's exchange rate. It believes that the impact may occur with a lag of 1 to 3 quarters. How could regression analysis be used to assess the impact?

25. Potential Effects if the United Kingdom Adopted the Euro The United Kingdom still has its own currency, the pound. The pound's interest rate has historically been higher than the euro's interest rate. The United Kingdom has considered adopting the euro as its currency. There have been many arguments about whether it should do so.

Use your knowledge and intuition to discuss the likely effects if the United Kingdom adopts the euro. For each of the 10 statements below, insert either *increase* or *decrease* in the first blank and complete the statement by adding a clear, short explanation (perhaps one to three sentences) of why the United Kingdom's adoption of the euro would have that effect.

To help you narrow your focus, follow these guidelines. Assume that the pound is more volatile than the euro. Do not base your answer on whether the pound would have been stronger than the euro in the future. Also, do not base your answer on an unusual change in economic growth in the United Kingdom or in the eurozone if the euro is adopted.

a. The economic exposure of British firms that are heavy exporters to the eurozone would ___ because ___.

b. The translation exposure of firms based in the eurozone that have British subsidiaries would ___ because ___.

c. The economic exposure of U.S. firms that conduct substantial business in the United Kingdom and have no other international business would ___ because ___.

d. The translation exposure of U.S. firms with British subsidiaries would ___ because ___.

e. The economic exposure of U.S. firms that export to the United Kingdom and whose only other international business is importing from firms based in the euro zone would ___ because ___.

f. The discount on the forward rate paid by U.S. firms that periodically use the forward market to hedge payables of British imports would ___ because ___.

g. The earnings of a foreign exchange department of a British bank that executes foreign exchange transactions desired by its European clients would ___ because ___.

h. Assume that the Swiss franc is more highly correlated with the British pound than with the euro. A U.S. firm has substantial monthly exports to the United Kingdom denominated in the British currency and also has substantial monthly imports of Swiss supplies (denominated in Swiss francs). The economic exposure of this firm would ___ because ___.

i. Assume that the Swiss franc is more highly correlated with the British pound than with the euro. A U.S. firm has substantial monthly exports to the United Kingdom denominated in the British currency and also has substantial monthly exports to Switzerland (denominated in Swiss francs). The economic exposure of this firm would ___ because ___.

j. The British government's reliance on monetary policy (as opposed to fiscal policy) as a means of fine-tuning the economy would ___ because ___.

26. Invoicing Policy to Reduce Exposure Celtic Co. is a U.S. firm that exports its products to England. It faces competition from many firms in England. Its price to customers in England has generally been lower than those of the competitors, primarily because the British pound has been strong. It has priced its exports in pounds and then converts the pound receivables into

dollars. All of its expenses are in the United States and are paid with dollars. It is concerned about its economic exposure. It considers a change in its pricing policy, in which it will price its products in dollars instead of pounds. Offer your opinion on why this will or will not significantly reduce its economic exposure.

27. Exposure to Cash Flows Raton Co. is a U.S. company that has net inflows of 100 million Swiss francs and net outflows of 100 million British pounds. The present exchange rate of the Swiss franc is about $.70 while the present exchange rate of the pound is $1.90. Raton Co. has not hedged these positions. The Swiss franc and British pound are highly correlated in their movements against the dollar. Explain whether Raton will be favorably or adversely affected if the dollar weakens against foreign currencies over time.

28. Assessing Exposure Washington Co. and Vermont Co. have no domestic business. They have similar dollar equivalent amount of international exporting business. Washington Co. exports all of its products to Canada. Vermont Co. exports its products to Poland and Mexico, with about half of its business in each of these two countries. Each firm receives the currency of the country where it sends its exports. You obtain the end-of-month spot exchange rates of the currencies mentioned above during the end of each of the last 6 months.

END OF MONTH	CANADIAN DOLLAR	MEXICAN PESO	POLISH ZLOTY
1	$.8142	$.09334	$.29914
2	.8176	.09437	.29829
3	.8395	.09241	.30187
4	.8542	.09263	.3088
5	.8501	.09251	.30274
6	.8556	.09448	.30312

You want to assess the data in a logical manner to determine which firm has a higher degree of exchange rate risk. Show your work and write your conclusion. (*Hint:* The percentage change in the portfolio of currencies is a weighted average of the percentage change in each currency in the portfolio.)

29. Exposure to Pegged Currency System Assume that the Mexican peso and the Brazilian currency (the real) have depreciated against the U.S. dollar recently due to the high inflation rates in those countries. Assume that inflation in these two countries is expected to continue and that it will have a major effect on these currencies if they are still allowed to float. Assume that the government of Brazil decides to peg its currency to the dollar and will definitely maintain the peg for the next year. Milez Co. is based in Mexico. Its main business is to export supplies from Mexico to Brazil. It invoices its supplies in Mexican pesos. Its main competition is from firms in Brazil that produce similar supplies and sell them locally. How will the sales volume of Milez Co. be affected (if at all) by the Brazilian government's actions? Explain.

30. Assessing Currency Volatility Zemart is a U.S. firm that plans to establish international business in which it will export to Mexico (these exports will be denominated in pesos) and to Canada (these exports will be denominated in Canadian dollars) once a month and will therefore receive payments once a month. It is concerned about exchange rate risk. It wants to compare the standard deviation of exchange rate movements of these two currencies against the U.S. dollar on a monthly basis. For this reason, it asks you to:

a. Estimate the standard deviation of the monthly movements in the Canadian dollar against the U.S. dollar over the last 12 months.

b. Estimate the standard deviation of the monthly movements in the Mexican peso against the U.S. dollar over the last 12 months.

c. Determine which currency is less volatile. You can use the website www.oanda.com (or any legitimate website that has currency data) to obtain the end of-month direct exchange rate of the peso and the Canadian dollar in order to do your analysis. Show your work. You can use a calculator or a spreadsheet (like Excel) to do the actual computations.

31. Exposure of Net Cash Flows Each of the following U.S. firms is expected to generate $40 million in net cash flows (after including the estimated cash flows from international sales if there are any) over the next year. Ignore any tax effects. Each firm has the same level of expected earnings. None of the firms has taken any position in exchange rate derivatives to hedge exchange rate risk. All payments for the international trade by each firm will occur 1 year from today.

Sunrise Co. has ordered imports from Austria, and its imports are invoiced in euros. The dollar value of the payables (based on today's exchange rate) from its imports during this year is $10 million. It has no international sales.

Copans Co. has ordered imports from Mexico, and its imports are invoiced in U.S. dollars. The dollar value of the payables from its imports during this year is $15 million. It has no international sales.

Yamato Co. ordered imports from Italy, and its imports are invoiced in euros. The dollar value of the payables (based on today's exchange rate) from its imports during this year is $12 million. In addition, Yamato exports to Portugal, and its exports are denominated in euros. The dollar value of the receivables (based on today's exchange rate) from its exports during this year is $8 million.

Glades Co. ordered imports from Belgium, and these imports are invoiced in euros. The dollar value of the payables (based on today's exchange rate) from its imports during this year is $7 million. Glades also ordered imports from Luxembourg, and these imports are denominated in dollars. The dollar value of these payables is $30 million. Glades has no international sales.

Based on this information, which firm is exposed to the most exchange rate risk? Explain.

32. Cash Flow Sensitivity to Exchange Rate Movements The Central Bank of Poland is about to engage in indirect intervention later today in which it will lower Poland's interest rates substantially. This will have an impact on the value of the Polish currency (zloty) against most currencies because it will immediately affect capital flows. Missouri Co. has a subsidiary in Poland that sells appliances. The demand for its appliances is not affected much by the local economy. Most of its appliances produced in Poland are typically invoiced in zloty and are purchased by consumers from Germany. The subsidiary's main competition is from appliance producers in Portugal, Spain, and Italy, which also export appliances to Germany.

a. Explain how the impact on the zloty's value will affect the sales of appliances by the Polish subsidiary.

b. The subsidiary owes a British company 1 million British pounds for some technology that the British company provided. Explain how the impact on the zloty's value will affect the cost of this technology to the subsidiary.

c. The subsidiary plans to take 2 million zloty from its recent earnings and will remit it to the U.S. parent in the near future. Explain how the impact on the zloty's value will affect the amount of dollar cash flows received by the U.S. parent due to this remittance of earnings by the subsidiary.

33. Applying the Value-at-Risk Method You use today's spot rate of the Brazilian real to forecast the spot rate of the real for 1 month ahead. Today's spot rate is $.4558. Use the value-at-risk method to determine the maximum percentage loss of the Brazilian real over the next month based on a 95 percent confidence level. Use the spot exchange rates at the end of each of the last 6 months to conduct your analysis. Forecast the exchange rate that would exist under these conditions.

34. Assessing Translation Exposure Kanab Co. and Zion Co. are U.S. companies that engage in much business within the United States and are about the same size. They both conduct some international business as well.

Kanab Co. has a subsidiary in Canada that will generate earnings of about C$20 million in each of the next 5 years. Kanab Co. also has a U.S. business that will receive about C$1 million (after costs) in each of the next 5 years as a result of exporting products to Canada that are denominated in Canadian dollars.

Zion Co. has a subsidiary in Mexico that will generate earnings of about 1 million pesos in each of the next 5 years. Zion Co. also has a business in the United States that will receive about 300 million pesos (after costs) in each of the next 5 years as a result of exporting products to Mexico that are denominated in Mexican pesos.

The salvage value of Kanab's Canadian subsidiary and Zion's Mexican subsidiary will be zero in 5 years. The spot rate of the Canadian dollar is $.60 while the spot rate of the Mexican peso is $.10. Assume the Canadian dollar could appreciate or depreciate against the U.S. dollar by about 8 percent in any given year, while the Mexican peso could appreciate or depreciate against the U.S. dollar by about 12 percent in any given year. Which company is subject to a higher degree of translation exposure? Explain.

35. Cross-Currency Relationships The Hong Kong dollar (HK$) is presently pegged to the U.S. dollar and is expected to remain pegged. Some Hong Kong firms export products to Australia that are denominated in Australian dollars and have no other business in Australia. The exports are not hedged. The Australian dollar is presently worth .50 U.S. dollars, but you expect that it will be worth .45 U.S. dollars by the end of the year. Based on your expectations, will the Hong Kong exporters be affected favorably or unfavorably? Briefly explain.

36. Interpreting Economic Exposure Spratt Co. (a U.S. firm) attempts to determine its economic exposure to movements in the British pound by applying regression analysis to data over the last 36 quarters:

$$SP = b_0 + b_1 e + \mu$$

where SP represents the percentage change in Spratt's stock price per quarter, e represents the percentage change in the pound value per quarter, and μ is an error term. Based on the analysis, the b_0 coefficient is zero and the b_1 coefficient is $-.4$ and is statistically significant. Assume that interest rate parity exists. Today, the spot rate of the pound is $1.80, the 90-day British interest rate is 3 percent, and the 90-day U.S. interest rate is 2 percent. Assume that the 90-day forward rate is expected to be an accurate forecast of the future spot rate. Do you expect that Spratt's value will be favorably affected, unfavorably affected, or not affected by its economic exposure over the next quarter? Explain.

37. Assessing Translation Exposure Assume the euro's spot rate is presently equal to $1.00. All of the following firms are based in New York and are the same size. While these firms concentrate on business in the United States, their entire foreign operations for this quarter are provided here.

Company A expects its exports to cause cash inflows of 9 million euros and imports to cause cash outflows equal to 3 million euros.

Company B has a subsidiary in Portugal that expects revenue of 5 million euros and has expenses of 1 million euros.

Company C expects exports to cause cash inflows of 9 million euros and imports to cause cash outflows of 3 million euros, and will repay the balance of an existing loan equal to 2 million euros.

Company D expects zero exports and imports to cause cash outflows of 11 million euros.

Company E will repay the balance of an existing loan equal to 9 million euros. Which of the five companies described here has the highest degree of translation exposure?

38. Exchange Rates and Market Share Minnesota Co. is a U.S. firm that exports computer parts to Japan. Its main competition is from firms that are based in Japan, which invoice their products in yen. Minnesota's exports are invoiced in U.S. dollars. The prices charged by Minnesota and its competitors will not change during the next year. Will Minnesota's revenue increase, decrease, or be unaffected if the spot rate of the yen appreciates over the next year? Briefly explain.

39. Exchange Rates and Market Share Harz Co. (a U.S. firm) has an arrangement with a Chinese company in which it purchases products from them every week at the prevailing spot rate, and then sells the products in the United States invoiced in dollars. All of its competition is from U.S. firms that have no international business. The prices charged by Harz and its competitors will not change over the next year. Will the net cash flows generated by Harz increase, decrease, or be unaffected if the Chinese yuan depreciates over the next year? Briefly explain.

40. IFE and Exposure Assume that Maine Co. (a U.S. firm) measures its economic exposure to movements in the British pound by applying regression analysis to data over the last 36 quarters:

$$SP = b_0 + b_1 e + \mu$$

where SP represents the percentage change in Maine's stock price per quarter, e represents the percentage change in the British pound value per quarter, and μ is an error term. Based on the analysis, the b_0 coefficient is estimated to be zero and the b_1 coefficient is estimated to be 0.3 and is statistically significant. Maine Co. believes that the movement in the value of the pound over the next quarter will be mostly driven by the international Fisher effect. The prevailing quarterly interest rate in the United Kingdom is lower than the prevailing quarterly interest rate in the United States. Would you expect that Maine's value to be favorably affected, unfavorably affected, or not affected by the pound's movement over the next quarter? Explain.

41. PPP and Exposure Layton Co. (a U.S. firm) attempts to determine its economic exposure to movements in the Japanese yen by applying regression analysis to data over the last 36 quarters:

$$SP = b_0 + b_1 e + \mu$$

where SP represents the percentage change in Layton's stock price per quarter, e represents the percentage change in the yen value per quarter, and μ is an error term. Based on the analysis, the b_0 coefficient is zero and the b_1 coefficient is 0.4 and is statistically significant. Layton believes that the inflation differential has a major effect on the value of the yen (based on purchasing power parity). The inflation in Japan is expected to rise substantially while the U.S. inflation will remain at a low level. Would you expect that Layton's value to be favorably affected, unfavorably

affected, or not affected by its economic exposure over the next quarter? Explain.

42. Exposure to Cash Flows Lance Co. is a U.S. company that has exposure to the Swiss franc (SF) and Danish krone (DK). It has net inflows of SF100 million and net outflows of DK500 million. The present exchange rate of the SF is about $.80 while the present exchange rate of the DK is $.10. Lance Co. has not hedged these positions. The SF and DK are highly correlated in their movements against the dollar. Explain whether Lance will be favorably or adversely affected if the dollar strengthens against foreign currencies over time.

43. Assessing Transaction Exposure Zebra Co. is a U.S. firm that obtains products from a U.S. supplier and then exports them to Canadian firms. Its exports are denominated in U.S. dollars. Its main competitor is a local company in Canada that sells similar products denominated in Canadian dollars. Is Zebra subject to transaction exposure? Briefly explain.

44. Assessing Translation Exposure Quartz Co. has its entire operations in Miami, Florida, and is an exporter of products to eurozone countries. All of its earnings are derived from its exports. The exports are denominated in euros. Reed Co. (of the United States) is about the same size as Quartz Co. and generates about the same amount of earnings in a typical year. It has a subsidiary in Germany that typically generates about 40 percent of its total earnings. All earnings are reinvested in Germany and therefore not remitted. The rest of Reed's business is in the United States. Which company has a higher degree of translation exposure? Briefly explain.

45. Estimating Value at Risk Yazoo, Inc., is a U.S. firm that has substantial international business in Japan and has cash inflows in Japanese yen. The spot rate of the yen today is $.01. The yen exchange rate was $.008 three months ago, $.0085 two months ago, and $.009 1 month ago. Yazoo uses today's spot rate of the yen as its forecast of the spot rate in 1 month. However, it wants to determine the maximum expected percentage decline in the value of the Japanese yen in 1 month based on the value-at-risk (VaR) method and a 95 percent probability. Use the exchange rate information provided to derive the maximum expected decline in the yen over the next month.

46. Assessing Exposure to Net Cash Flows Reese Co. will pay 1 million British pounds for materials imported from the United Kingdom in 1 month. Reese Co. sells some goods to Poland and will receive 3 million zloty (the Polish currency) for those goods in 1 month. The spot rate of the pound is $1.50, while the spot rate of the zloty is about $.30. Assume that the pound and zloty are both expected to depreciate substantially against the dollar over the next month and by the same degree (percentage). Will this have a favorable effect, unfavorable effect, or no effect on Reese Co. over the next year? Explain.

47. Impact of Translation Exposure on Stock Valuation Spencer Co. is a U.S. firm that has a large subsidiary in Singapore that generates a large amount of earnings. Spencer's stock is commonly valued at about 16 times its reported earnings per share. The earnings generated by the Singapore subsidiary in this period are the same as in the previous period. The Singapore dollar has depreciated substantially against the U.S. dollar during this period. None of the earnings generated by the Singapore subsidiary in this period will be remitted to the U.S. parent at this time. How will the stock price of Spencer Co. be affected (if at all) when the earnings are reported at the end of this period? Explain.

48. Assessing Translation Exposure Milwaukee Co. has an Australian subsidiary that earned 40 million Australian dollars (A$) this year. Little Rock Co. has an Australian subsidiary that earned A$30 million this year. The subsidiary of Milwaukee plans to reinvest its earnings in Australia while the subsidiary of Little Rock Co. plans to remit its earnings to the U.S. parent. Cincinnati Co. does not have an Australian subsidiary but it received revenue of A$50 million this year from exporting to Australia. All three companies have the same total revenue and total earnings levels (when considering their U.S. business as well), and are the same size, and do not have any other international business. Which company is subject to the highest degree of translation exposure? Briefly explain.

49. Measuring Economic Exposure Bag Company of the U.S. has a business of offering cruises along the coast of Argentina that are solely for American tourists. The company charges American tourists in U.S. dollars, but all of its expenses such as payments to its employees are in Argentine pesos. You want to measure Bag's economic exposure to movements in the peso by applying regression analysis to data over the last 60 quarters:

$$SP = b_0 + b_1 e + \mu$$

where SP represents the percentage change in Bag's stock price per quarter, e represents the percentage change in the Argentine peso's value per quarter, μ is an error term, while b_0 and b_1 are regression coefficients. Do you think the expected sign of the b_1 coefficient in the model

would be positive and significant, negative and significant, or zero (not significant)? Briefly 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 *International Financial Management* text companion website. Go to www.cengagebrain.com (students) or www.cengage.com/login (instructors) and search using **ISBN 9781133947837**.

BLADES, INC. CASE

Assessment of Exchange Rate Exposure

Blades, Inc., is currently exporting roller blades to Thailand and importing certain components needed to manufacture roller blades from that country. Under a fixed contractual agreement, Blades' primary customer in Thailand has committed itself to purchase 180,000 pairs of roller blades annually at a fixed price of 4,594 Thai baht (THB) per pair. Blades is importing rubber and plastic components from various suppliers in Thailand at a cost of approximately THB2,871 per pair, although the exact price (in baht) depends on current market prices. Blades imports materials sufficient to manufacture 72,000 pairs of roller blades from Thailand each year. The decision to import materials from Thailand was reached because rubber and plastic components needed to manufacture Blades' products are inexpensive, yet of high quality, in Thailand.

Blades has also conducted business with a Japanese supplier in the past. Although Blades' analysis indicates that the Japanese components are of a lower quality than the Thai components, Blades has occasionally imported components from Japan when the prices were low enough. Currently, Ben Holt, Blades' chief financial officer (CFO), is considering importing components from Japan more frequently. Specifically, he would like to reduce Blades' baht exposure by taking advantage of the recently high correlation between the baht and the yen. Since Blades has net inflows denominated in baht and would have outflows denominated in yen, its net transaction exposure would be reduced if these two currencies were highly correlated. If Blades decides to import components from Japan, it would probably import materials sufficient to manufacture 1,700 pairs of roller blades annually at a price of 7,440 yen per pair.

Holt is also contemplating further expansion into foreign countries. Although he would eventually like to establish a subsidiary or acquire an existing business overseas, his immediate focus is on increasing Blades' foreign sales. Holt's primary reason for this plan is that the profit margin from Blades' imports and exports exceeds 25 percent, while the profit margin from Blades' domestic production is below 15 percent. Consequently, he believes that further foreign expansion will be beneficial to the company's future.

Though Blades' current exporting and importing practices have been profitable, Holt is contemplating extending Blades' trade relationships to countries in different regions of the world. One reason for this decision is that various Thai roller blade manufacturers have recently established subsidiaries in the United States. Furthermore, various Thai roller blade manufacturers have recently targeted the U.S. market by advertising their products over the Internet. As a result of this increased competition from Thailand, Blades is uncertain whether its primary customer in Thailand will renew the current commitment to purchase a fixed number of roller blades annually. The current agreement will terminate in three years. Another reason for engaging in transactions with other, non-Asian countries is that the Thai baht has depreciated substantially recently, which has somewhat reduced Blades' profit margins. The sale of roller blades to other countries with more stable currencies may increase Blades' profit margins.

While Blades will continue exporting to Thailand under the current agreement for the next 2 years, it may also export roller blades to Jogs, Ltd., a British retailer. Preliminary negotiations indicate that Jogs would be willing to commit itself to purchase 200,000 pairs of Speedos, Blades' primary product, for a fixed price of £80 per pair.

Holt is aware that further expansion would increase Blades' exposure to exchange rate fluctuations, but he believes that Blades can supplement its profit margins by expanding. He is vaguely familiar with the different types of exchange rate exposure but has asked you, a financial analyst at Blades, Inc., to help him assess how the contemplated changes would affect Blades' financial position. Among other concerns, Holt is aware that recent economic problems in the region have had an

effect on Thailand and on other Asian countries. Although the correlation between Asian currencies such as the Japanese yen and the Thai baht is generally not very high and very unstable, these recent problems have increased the correlation among most Asian currencies. In contrast, the correlation between the British pound and the Asian currencies is quite low.

To aid you in your analysis, Holt has provided you with the following data:

CURRENCY	EXPECTED EXCHANGE RATE	RANGE OF POSSIBLE EXCHANGE RATES
British pound	$1.50	$1.47 to $1.53
Japanese yen	$ .0083	$.0079 to $.0087
Thai baht	$ .024	$.020 to $.028

Holt has asked you to answer the following questions:

1. What type(s) of exposure (transaction, economic, or translation exposure) is Blades subject to? Why?
2. Using a spreadsheet, conduct a consolidated net cash flow assessment of Blades, Inc., and estimate the range of net inflows and outflows for Blades for the coming year. Assume that Blades enters into the agreement with Jogs, Ltd.
3. If Blades does not enter into the agreement with the British firm and continues to export to Thailand and import from Thailand and Japan, do you think the increased correlations between the Japanese yen and the Thai baht will increase or reduce Blades' transaction exposure?
4. Do you think Blades should import components from Japan to reduce its net transaction exposure in the long run? Why or why not?
5. Assuming Blades enters into the agreement with Jogs, Ltd., how will its overall transaction exposure be affected?
6. Given that Thai roller blade manufacturers located in Thailand have begun targeting the U.S. roller blade market, how do you think Blades' U.S. sales were affected by the depreciation of the Thai baht? How do you think its exports to Thailand and its imports from Thailand and Japan were affected by the depreciation?

Small Business Dilemma

Assessment of Exchange Rate Exposure by the Sports Exports Company

At the current time, the Sports Exports Company is willing to receive payments in British pounds for the monthly exports it sends to the United Kingdom. Although all of its receivables are denominated in pounds, it has no payables in pounds or in any other foreign currency. Jim Logan, owner of the Sports Exports Company, wants to assess his firm's exposure to exchange rate risk.

1. Would you describe the exposure of the Sports Exports Company to exchange rate risk as transaction exposure? Economic exposure? Translation exposure?
2. Logan is considering a change in the pricing policy in which the importer must pay in dollars so that Logan will not have to worry about converting pounds to dollars every month. If implemented, would this policy eliminate the transaction exposure of the Sports Exports Company? Would it eliminate Sports Exports' economic exposure? Explain.
3. If Logan decides to implement the policy described in the previous question, how would the Sports Exports Company be affected (if at all) by appreciation of the pound? By depreciation of the pound? Would these effects on Sports Exports differ if Logan retained his original policy of pricing the exports in British pounds?

Internet/Excel Exercises

1. Go to www.oanda.com and obtain the direct exchange rate of the Canadian dollar and euro at the beginning of each of the last 7 years.

a. Assume you received C$2 million in earnings from your Canadian subsidiary at the beginning of each year over the last 7 years. Multiply this amount by the direct exchange rate of the Canadian dollar at the beginning of each year to determine how many U.S. dollars you received. Determine the percentage change in the dollar cash flows received from one year to the next. Determine the standard deviation of these percentage changes. This measures the volatility of movements in

the dollar earnings resulting from your Canadian business over time.

b. Now assume that you also received 1 million euros at the beginning of each year from your German subsidiary. Repeat the same process for the euro to measure the volatility of movements in the dollar cash flows resulting from your German business over time. Are the movements in dollar cash flows more volatile for the Canadian business or the German business?

c. Now consider the dollar cash flows you received from the Canadian subsidiary and the German subsidiary combined. That is, add the dollar cash flows received from both businesses for each year. Repeat the process to measure the volatility of movements in the dollar cash flows resulting from both businesses over time. Compare the volatility in the dollar cash flows of the portfolio to the volatility in cash flows resulting from the German business. Does it appear that diversification of businesses across two countries results in more stable cash flows than the business in Germany? Explain.

d. Compare the volatility in the dollar cash flows of the portfolio to the volatility in cash flows resulting from the Canadian business. Does it appear that diversification of businesses across two countries results in more stable cash flow movements than the business in Canada? Explain.

2. The following website contains annual reports of many MNCs: www.annualreportservice.com. Review the annual report of your choice. Look for any comments in the report that describe the MNC's transaction exposure, economic exposure, or translation exposure. Summarize the MNC's exposure based on the comments in the annual report.

Online Articles with Real-World Examples

Find a recent article online that describes an actual international finance application or a real world example about a specific MNC's actions that reinforces one or more of the concepts covered in this chapter.

If your class has an online component, your professor may ask you to post your summary there and provide the Web link of the article so that other students can access it. If your class is live, your professor may ask you to summarize your application in class. Your professor may assign specific students to complete this assignment for this chapter or may allow any students to do the assignment on a volunteer basis.

For recent online articles and real-world examples applied to this chapter, consider using the following search terms (and include the current year as a search term to ensure that the online articles are recent).

1. company AND exchange rate effects
2. Inc. AND exchange rate effects
3. company AND currency effects
4. Inc. AND currency effects
5. exposure to currency effects
6. exposure to exchange rate effects
7. exchange rate volatility
8. currency volatility
9. [name of an MNC] AND exchange rate effects
10. [name of an MNC] AND currency exposure

11
Managing Transaction Exposure

CHAPTER OBJECTIVES

The specific objectives of this chapter are to:

- compare the techniques commonly used to hedge payables,
- compare the techniques commonly used to hedge receivables,
- describe limitations of hedging, and
- suggest other methods of reducing exchange rate risk when hedging techniques are not available.

Transaction exposure exists when there are contractual transactions that cause a multinational corporation to either need or receive a specified amount of a foreign currency at a specified time in the future. The dollar value of payables could easily increase by 10 percent or more within a month. The dollar value of receivables could easily decline by 10 percent or more within a month, which might completely eliminate the profit margin on the sale of the product. For this reason, most MNCs may consider the hedging of contractual transactions denominated in foreign currencies. By managing transaction exposure, financial managers may increase the MNC's future cash flows, or at least reduce the uncertainty surrounding the MNC's cash flows, and thereby enhance the value of the MNC.

11-1 Policies for Hedging Transaction Exposure

An MNC's policy for hedging transaction exposure depends in part on its management's degree of risk aversion. An MNC may choose to hedge most of its transaction exposure or to hedge selectively.

11-1a Hedging Most of the Exposure

Some MNCs hedge most of their exposure so that their value is not strongly influenced by exchange rates. Multinational corporations that hedge most of their exposure do not necessarily expect that hedging will always be beneficial. In fact, they might even use some hedges that will likely result in slightly worse outcomes than no hedges at all, just to avoid the possibility of a major adverse movement in exchange rates. Hedging most of the transaction exposure allows MNCs to more accurately forecast future cash flows (in their home currency) so that they can make better decisions regarding the amount of financing they will need.

11-1b Selective Hedging

Many MNCs use selective hedging, in which they consider each type of transaction separately. Multinational corporations that are well diversified across many countries may forgo hedging their exposure except in rare circumstances. They might believe that a diversified set of exposures will limit the actual impact that exchange rates will have on their cash flows during any period.

WEB

www.ibm.com/us
The Web sites of various MNCs provide financial statements such as annual reports that disclose the use of financial derivatives for the purpose of hedging interest rate risk and foreign exchange rate risk.

Some MNCs, such as Black & Decker, Eastman Kodak, and Merck, hedge transactions when they believe that it will improve their expected cash flows. The following quotations from annual reports illustrate the strategy of selective hedging.

We do not comprehensively hedge the exposure to currency rate risk, although we may choose to selectively hedge exposure to foreign currency rate risk.

—ConocoPhillips

Decisions regarding whether or not to hedge a given commitment are made on a case-by-case basis by taking into consideration the amount and duration of the exposure, market volatility, and economic trends.

—DuPont Co.

We selectively hedge the potential effect of the foreign currency fluctuations related to operating activities.

—General Mills Co.

When an MNC considers hedging transaction exposure, it must first assess the extent of its transaction exposure (as discussed in the previous chapter). Next, it must consider the various techniques to hedge this exposure so that it can decide which hedging technique is optimal and whether to hedge its transaction exposure. This chapter explains the process by which an MNC identifies the optimal hedging technique for a particular transaction and determines whether or not to hedge that transaction.

11-2 Hedging Exposure to Payables

An MNC may decide to hedge part or all of its known payables transactions as a way of insulating itself from possible appreciation of the currency. It may select from the following hedging techniques to hedge its payables:

- forward or futures hedge,
- money market hedge, and
- currency option hedge.

Before selecting a hedging technique, MNCs normally compare the cash flows that would be expected when using each technique. The selection of the optimal hedging technique can vary over time as the relative advantages of the various techniques change. Each technique is discussed in turn, with examples provided.

11-2a Forward or Futures Hedge on Payables

Forward contracts and futures contracts allow an MNC to lock in a specific exchange rate at which it can purchase a specific currency, thereby hedging payables denominated in that currency. A forward contract is negotiated between the firm and a financial institution such as a commercial bank, so it can be tailored to meet the firm's specific needs. The contract will specify:

- the currency that the firm will pay,
- the currency that the firm will receive,
- the amount of currency to be received by the firm,
- the rate at which the MNC will exchange currencies (the "forward" rate), and
- the future date at which the exchange of currencies will occur.

EXAMPLE Coleman Co. is a U.S.-based MNC that will need 100,000 euros in one year. It could obtain a forward contract to purchase the euros one year from now. The one-year forward rate is $1.20, the same rate as currency futures contracts on euros. If Coleman purchases euros one year forward, its dollar cost in one year is:

$$\text{Cost in \$} = \text{Payables} \times \text{Forward rate}$$
$$= 100{,}000 \text{ euros} \times \$1.20$$
$$= \$120{,}000$$

●

WEB

www.bankofcanada.ca/en/rates/exchange.html

Forward rates for the euro, British pound, Canadian dollar, and Japanese yen for 1-month, 3-month, 6-month, and 12-month maturities. These forward rates indicate the exchange rates at which positions in these currencies can be hedged for specific time periods.

The same process would apply if futures contracts were used instead of forward contracts. The futures rate is normally close to the forward rate, so the main difference is that futures contracts are standardized and can be purchased on an exchange whereas the forward contract is negotiated between the MNC and a commercial bank.

Forward contracts are frequently used by large corporations that desire to hedge. DuPont Co. and Merck & Co. often have the equivalent of $300 million to $500 million in forward contracts at any one time to cover transaction exposure; Union Carbide has more than $100 million in forward contracts.

11-2b Money Market Hedge on Payables

A money market hedge on payables involves taking a money market position to cover a future payables position. If a firm has excess cash, then it can create a simplified money market hedge. However, many MNCs prefer to hedge payables without using their cash balances. A money market hedge can still be used in this situation, but it requires two money market positions: (1) borrowed funds in the home currency; and (2) a short-term investment in the foreign currency.

EXAMPLE If Coleman Co. needs 100,000 euros in one year, then it could convert dollars to euros and deposit the euros in a bank today. Assuming that it could earn 5 percent on this deposit, it would need to establish a deposit of 95,238 euros in order to have 100,000 euros in one year:

$$\text{Deposit amount to hedge payables} = \frac{100{,}000 \text{ euros}}{1 + .05} = 95{,}238 \text{ euros}$$

Assuming a spot rate today of $1.18, the dollars needed to make the deposit today can be estimated as

$$\text{Deposit amount in dollars} = 95{,}238 \text{ euros} / \$1.18 = \$112{,}381$$

Assuming that Coleman can borrow dollars at an interest rate of 8 percent, it would borrow the funds needed to make the deposit and then, at the end of the year, repay the loan:

$$\text{Dollar amount of loan repayment} = \$112{,}381 \times (1 + .08) = \$121{,}371$$

●

Money Market Hedge versus Forward Hedge Should an MNC implement a forward contract hedge or a money market hedge? Since the results of both hedges are known beforehand, the firm can implement the one that is more feasible. If interest rate parity (IRP) holds and there are no transaction costs, then the money market hedge will yield the same results as the forward hedge. This is because the forward premium on the forward rate reflects the interest rate differential between the two currencies. The hedging of future payables with a forward purchase is therefore similar to borrowing at the home interest rate and investing at the foreign interest rate.

11-2c Call Option Hedge on Payables

A currency call option provides the right to buy a specified amount of a particular currency at a specified price (called the *strike price*, or *exercise price*) within a given period of time. Yet unlike a futures or forward contract, the currency call option does not obligate its owner to buy the currency at that price. The MNC has the flexibility to let the

option expire and obtain the currency at the existing spot rate when payables are due. However, a firm must assess whether the advantages of a currency option hedge are worth the price (premium) paid for it. Details on currency options are provided in Chapter 5. The following discussion illustrates how they can be used in hedging.

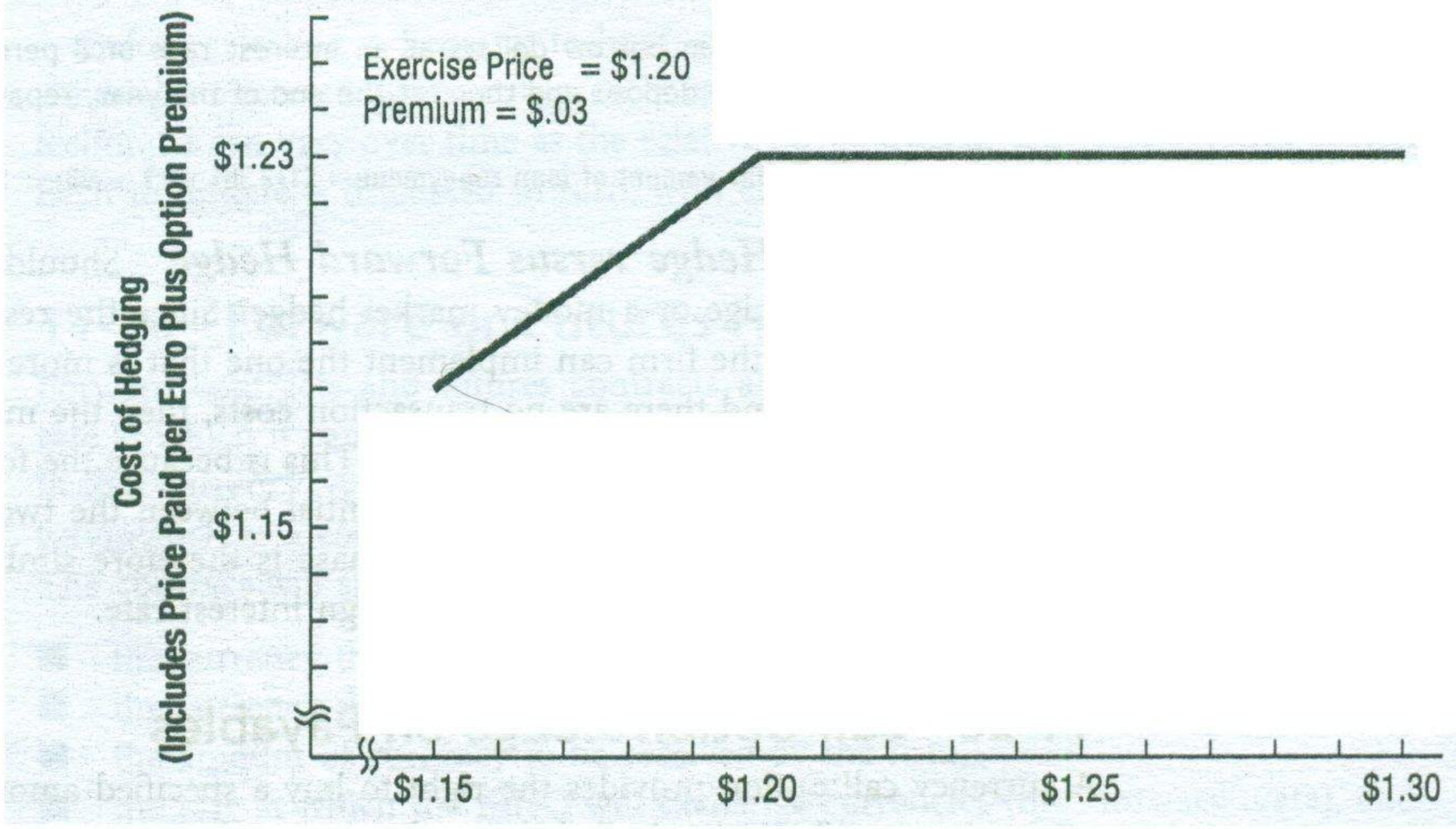
Cost of Call Options Based on a Contingency Graph The cost of hedging with call options is not known with certainty at the time that the options are purchased. It is determined once the payables are due and the spot rate at that time is known. The cost of hedging includes the price paid for the currency as well as the premium paid for the call option. If the spot rate of the currency when payables are due is less than the exercise price, then the MNC would let the option expire because it could purchase the currency in the foreign exchange market at the spot rate. If the spot rate is either equal to or greater than the exercise price, the MNC would exercise the option and pay the exercise price for the currency.

An MNC can develop a contingency graph that determines the cost of hedging with call options for each of several possible spot rates when payables are due. This procedure is especially useful when a MNC would like to assess the cost of hedging for a wide range of possible spot rate outcomes.

EXAMPLE Recall that Coleman Co. considers hedging its payables of 100,000 euros in one year. It could purchase call options on 100,000 euros so that it can hedge its payables. Assume that the call options have an exercise price of $1.20, a premium of $.03, and an expiration date of one year from now (when the payables are due). Coleman can create a contingency graph for the call option hedge, as shown in Exhibit 11.1. The horizontal axis shows several possible spot rates of the euro that could occur at the time payables are due, while the vertical axis shows the cost of hedging per euro for each of those possible spot rates.

If the spot rate at the time the payables are due is less than the exercise price of $1.20, then Coleman would not exercise the call option and so the cost of hedging would be equal to the spot

Exhibit 11.1 Contingency Graph for Hedging Payables with Call Options



rate at that time plus the premium paid for the call option. For example, if the spot rate was $1.16 when payables were due, Coleman would pay that spot rate along with the $.03 premium per unit.

At any spot rate that is *not* less than the exercise price of $1.20, Coleman would exercise the call option; in this case, the cost of hedging would be equal to the price paid per euro ($1.20) plus the premium ($.03 per euro) paid for the call option. Thus, the cost of hedging is $1.23 if the spot rate when the payables are due exceeds the exercise price of $1.20. ●

Exhibit 11.1 illustrates the advantages and disadvantages of a call option for hedging payables. The advantages are that it provides an effective hedge and allows the MNC to let the option expire if the spot rate at the time payables are due is lower than the exercise price. Of course, the main disadvantage of the call option is that a premium must be paid for it.

To compare hedging with a call option and hedging with a forward contract, recall from a previous example that Coleman Co. could purchase a forward contract on euros for $1.20. This would result in a hedging cost of $1.20 per euro, regardless of the spot rate at the time payables are due, because a forward contract (unlike a call option) creates an irrevocable obligation to execute. This could be plotted on the Exhibit 11.1 contingency graph as a horizontal line beginning at the $1.20 point on the vertical axis and extending straight across for all possible spot rates. In general, hedging with a forward contract costs less than with currency call options if the spot rate is relatively high when payables are due; the reverse is true if the spot rate is relatively low at the time payables are due.

Cost of Call Options Based on Currency Forecasts Although the contingency graph can determine the cost of hedging for various possible spot rates when payables are due, it does not incorporate an MNC's currency forecasts. Thus, it does not necessarily lead the MNC to a clear decision about whether to hedge with currency options. An MNC may wish to incorporate its own forecasts of the spot rate at the time payables are due so that it can estimate more accurately the cost of hedging with call options.

EXAMPLE Recall that Coleman Co. considers hedging its payables of 100,000 euros with a call option that has an exercise price of $1.20, a premium of $.03, and an expiration date of one year from now. Suppose that Coleman's forecast for the spot rate of the euro at the time payables are due is as follows:

- $1.16 (20 percent probability),
- $1.22 (70 percent probability),
- $1.24 (10 percent probability).

The effect of each of these scenarios on Coleman's cost of payables is shown in Exhibit 11.2. Columns 1 and 2 simply identify the scenario to be analyzed. Column 3 shows the premium per unit paid on the option, which is the same regardless of the spot rate prevailing when payables are due.

Exhibit 11.2 Using Currency Call Options to Hedge Euro Payables (exercise price = $1.20, premium = $.03)

(1)	(2)	(3)	(4)	(5) = (4) + (3)	(6)
SCENARIO	SPOT RATE WHEN PAYABLES ARE DUE	PREMIUM PER UNIT PAID ON CALL OPTIONS	AMOUNT PAID PER UNIT WHEN OWNING CALL OPTIONS	TOTAL AMOUNT PAID PER UNIT (INCLUDING THE PREMIUM) WHEN OWNING CALL OPTIONS	$ AMOUNT PAID FOR 100,000 EUROS WHEN OWNING CALL OPTIONS
1	$1.16	$.03	$1.16	$1.19	$119,000
2	1.22	.03	1.20	1.23	123,000
3	1.24	.03	1.20	1.23	123,000

Column 4 shows the amount that Coleman would pay per euro for the payables under each scenario, assuming that it owned call options. If Scenario 1 occurs, Coleman will let the options expire and purchase euros in the spot market for $1.16 each.

If Scenario 2 or 3 occurs, Coleman will exercise the options (purchasing euros for $1.20 per unit) and then use the euros to make its payment. Column 5, which is the sum of columns 3 and 4, shows the amount paid per unit when the $.03 premium paid on the call option is included. Column 6 converts column 5 into a total dollar cost based on the 100,000 euros hedged. ●

Consideration of Alternative Call Options Several different types of call options may be available, with different exercise prices and premiums for a given currency and expiration date. The trade-off is that an MNC must either pay a higher premium for a call option with a lower exercise price or accept a higher exercise price on an option with a lower premium. The call option perceived to be most desirable for hedging a particular payables position will be analyzed (as explained in the preceding example) so that it can be compared with the other hedging techniques.

11-2d Comparison of Techniques to Hedge Payables

The methods of hedging payables are summarized in Exhibit 11.3, which also illustrates how the cost of each technique was measured for Coleman Co. (based on the previous examples). Note that the cost of the forward hedge or money market hedge can be determined with certainty whereas the currency call option hedge has different outcomes depending on the future spot rate at the time payables are due.

Exhibit 11.3 Comparison of Hedging Alternatives for Coleman Co.

Forward Hedge

Purchase euros (€) one year forward.

$$\begin{aligned}\text{Dollars needed in 1 year} &= \text{payables in €} \times \text{forward rate of euro}\\ &= 100{,}000 \text{ euros} \times \$1.20\\ &= \$120{,}000\end{aligned}$$

Money Market Hedge

Borrow $, convert to €, invest €, repay $ loan in one year.

$$\begin{aligned}\text{Amount in € to be invested} &= \frac{€100{,}000}{1 + .05}\\ &= 95.238 \text{ euros}\\ \text{Amount in \$ needed to convert into € for deposit} &= €95{,}238 \times \$1.18\\ &= \$112{,}381\\ \text{Interest and principal owed on \$ loan after 1 year} &= \$112{,}381 \times (1 + .08)\\ &= \$121{,}371\end{aligned}$$

Call Option

Purchase call option. (The following computations assume that the option is to be exercised on the day euros are needed, or not at all; exercise price = $1.20, premium = $.03.)

POSSIBLE SPOT RATE IN 1 YEAR	PREMIUM PER UNIT PAID FOR OPTION	EXERCISE OPTION?	TOTAL PRICE (INCLUDING OPTION PREMIUM) PAID PER UNIT	TOTAL PRICE PAID FOR 100,000 EUROS	PROBABILITY
$1.16	$.03	No	$1.19	$119,000	20%
1.22	.03	Yes	1.23	123,000	70
1.24	.03	Yes	1.23	123,000	10

Optimal Technique for Hedging Payables An MNC can select the optimal technique for hedging payables by following these steps. First, since the futures and forward hedge are similar, the MNC need only consider which of these two techniques it prefers. Second, when comparing the forward (or futures) hedge to the money market hedge, the MNC can easily determine which hedge is more desirable because the cost of each hedge can be determined with certainty. Once that comparison is completed, the MNC can assess the feasibility of the currency call option hedge. The distribution of the estimated cash outflows resulting from the currency call option hedge can be identified by estimating its expected value and then determining the likelihood that the currency call option hedge will be less costly than an alternative hedging technique.

EXAMPLE Recall that Coleman Co. needs to hedge payables of 100,000 euros. Coleman's costs of different hedging techniques can be compared to determine which technique is optimal for hedging the payables. Exhibit 11.4 provides a graphic comparison of the cost of hedging resulting from using different techniques (which were determined in the previous examples in this chapter). For Coleman, the forward hedge is preferable to the money market hedge because it results in a lower cost of hedging payables.

The cost of the call option hedge is described by a probability distribution because it depends on the exchange rate at the time that payables are due. The expected value of the cost if using the currency call option hedge is

$$\text{Expected value of cost} = (\$119{,}000 \times 20\%) + (\$123{,}000 \times 80\%)$$
$$= \$122{,}200$$

The probability of the future spot rate being $1.22 (70 percent) and the probability of its being $1.24 (10 percent) are combined in the calculation because they result in the same cost. The expected value of the cost when hedging with call options exceeds the cost of the forward rate hedge.

Comparing the distribution of the cost of hedging with call options to the cost of the forward hedge shows that there is only a 20 percent chance that the currency call option hedge will be cheaper than the forward hedge; there is an 80 percent chance that it will be more expensive. Overall, then, the forward hedge is the optimal hedge. ●

The optimal technique to hedge payables may vary over time depending on the prevailing forward rate, interest rates, call option premium, and the forecast of the future spot rate at the time payables are due.

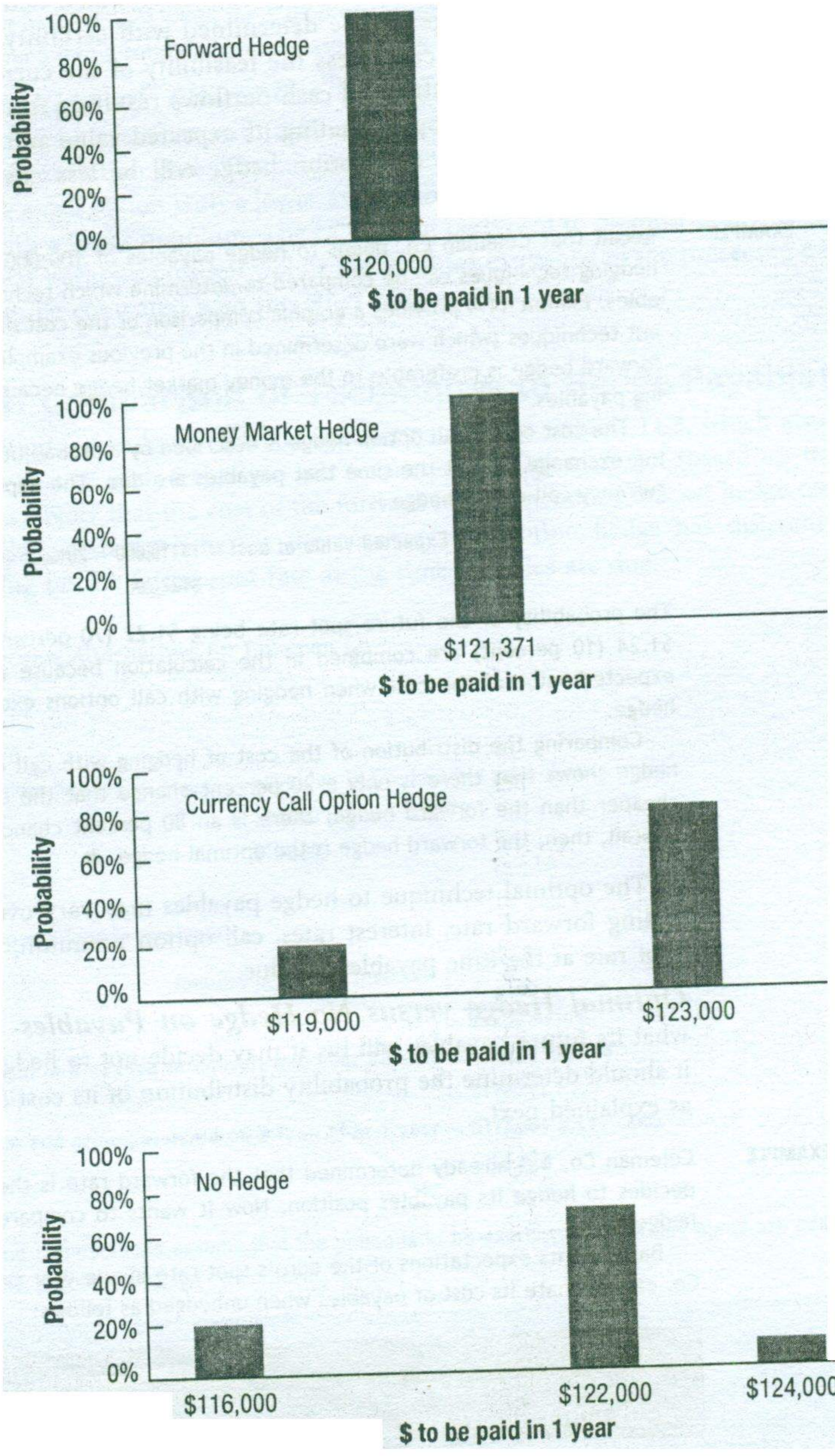
Optimal Hedge versus No Hedge on Payables Even when an MNC knows what its future payables will be, it may decide not to hedge in some cases. In that event it should determine the probability distribution of its cost of payables when not hedging, as explained next.

EXAMPLE Coleman Co. has already determined that the forward rate is the optimal hedging technique if it decides to hedge its payables position. Now it wants to compare the forward hedge to using no hedge at all.

Based on its expectations of the euro's spot rate in one year (as described previously), Coleman Co. can estimate its cost of payables when unhedged as follows:

POSSIBLE SPOT RATE OF EURO IN 1 YEAR	DOLLAR PAYMENTS WHEN NOT HEDGING = 100,000 EUROS × POSSIBLE SPOT RATE	PROBABILITY
$1.16	$116,000	20%
$1.22	$122,000	70%
$1.24	$124,000	10%

Exhibit 11.4 Graphic Comparison of Techniques to Hedge Payables



This probability distribution of costs when not hedging is shown in the bottom graph of Exhibit 11.4 and can be compared to the cost of the forward hedge in that exhibit.

The expected value of the payables when not hedging is now estimated as

$$\begin{aligned}\text{Expected value of payables} &= (\$116{,}000 \times 20\%) + (\$122{,}000 \times 70\%) - (\$124{,}000 \times 10\%) \\ &= \$121{,}000\end{aligned}$$

This expected value is $1,000 more than if Coleman uses a forward hedge. In addition, the probability distribution suggests an 80 percent probability that the cost of the payables when unhedged will exceed the cost of hedging with a forward contract. Therefore, Coleman decides to hedge its payables position with a forward contract.

For contractual transactions involving future payments, if the known cash outflows from hedging are equal to the expected cash outflows from not hedging then an MNC will usually hedge. The cash outflows when not hedging the payables are uncertain and could be higher than expected. Most MNCs are unwilling to forgo hedging of their payables unless they are confident that the expected cash outflows from not hedging will be lower than the known cash outflows from hedging. ●

11-2e Evaluating the Hedge Decision

MNCs can evaluate past hedging decisions by estimating the real cost of hedging payables, which is measured as follows:

$$\text{RCH}_p = \text{Cost of hedging payables} - \text{Cost of payables if not hedged}$$

After the payables transaction has occurred, an MNC may assess the outcome of its decision to hedge.

EXAMPLE Recall that Coleman Co. decided to hedge its payables with a forward contract, resulting in a dollar cost of $120,000. Suppose that, on the day that it makes its payment (one year after it hedged its payables), the spot rate of the euro is $1.18. Notice that this spot rate is different from all of the three possible spot rates that Coleman Co. predicted. This is not unusual, since it is difficult to predict the spot rate even when allowing for a distribution of possible outcomes. If Coleman Co. had not hedged, its cost of the payables would have been $118,000 (computed as 100,000 euros × $1.18). Thus, Coleman's real cost of hedging is

$$\begin{aligned}\text{RCH}_p &= \text{Cost of hedging payables} - \text{Cost of payables if not hedged} \\ &= \$120{,}000 - \$118{,}000 \\ &= \$2{,}000\end{aligned}$$

In this example, Coleman's cost of hedging payables turned out to be $2,000 more than if it had not hedged. However, Coleman is not necessarily disappointed in its decision to hedge. That decision allowed it to know exactly how many dollars it would need to cover its payables position and insulated the payment from adverse movements in the euro. ●

11-3 Hedging Exposure to Receivables

An MNC may decide to hedge part or all of its receivables transactions denominated in foreign currencies so that it is insulated from the possible depreciation of those currencies. It can apply the same techniques available for hedging payables to hedge receivables. The application of each hedging technique to receivables is discussed next.

11-3a Forward or Futures Hedge on Receivables

Forward contracts and futures contracts allow an MNC to lock in a specific exchange rate at which it can sell a specific currency, thereby enabling it to hedge receivables denominated in a foreign currency.

EXAMPLE Viner Co. is a U.S.-based MNC that will receive 200,000 Swiss francs (SF) in six months. It could obtain a forward contract to sell SF200,000 in six months. The six-month forward rate is $.71, the same rate as currency futures contracts on Swiss francs. If Viner sells Swiss francs six months forward, it can estimate the amount of dollars to be received in 6 months as follows:

$$\begin{aligned}\text{Cash inflow in \$} &= \text{Receivables} \times \text{Forward rate}\\ &= \text{SF200,000} \times \$.71\\ &= \$142,000\end{aligned}$$

●

The same process would apply if futures contracts were used instead of forward contracts. The futures rate is normally close to the forward rate, so the main difference is that a futures contracts would be standardized and sold on an exchange whereas a forward contract would be negotiated between the MNC and a commercial bank.

11-3b Money Market Hedge on Receivables

A money market hedge on receivables involves borrowing the currency that will be received and then using the receivables to pay off the loan.

EXAMPLE Recall that Viner Co. will receive SF200,000 in six months. Assume that it can borrow funds denominated in Swiss francs at a rate of 3 percent over a 6-month period. The amount that it should borrow so that it can use all of its receivables to repay the entire loan in six months is

$$\begin{aligned}\text{Amount to borrow} &= \text{SF200,000}/(1 + .03)\\ &= \text{SF194,175}\end{aligned}$$

If Viner Co. obtains a six-month loan of SF194,175 from a bank, then it will owe the bank SF200,000 in six months. It can use its receivables to repay the loan. The funds that it borrowed can be converted to dollars and used to support existing operations. ●

If the MNC does not need any short-term funds to support existing operations, it can still obtain a loan as just explained, convert the funds to dollars, and invest the dollars in the money market.

EXAMPLE If Viner Co. does not need any funds to support existing operations, then it can convert the Swiss francs that it borrowed into dollars. Suppose the spot exchange rate is presently $.70. When Viner Co. converts the Swiss francs, it will receive:

$$\text{Amount of dollars received from loan} = \text{SF194,175} \times \$.70 = \$135,922$$

These dollars can then be invested in the money market. Assume that Viner Co. can earn 2 percent interest over a six-month period. In six months, the investment will be worth

$$\$135,922 \times 1.02 = \$138,640$$

Thus, if Viner Co. uses a money market hedge, its receivables will be worth $138,640 in six months. ●

11-3c Put Option Hedge on Receivables

A put option allows an MNC to sell a specific amount of currency at a specified exercise price by a specified expiration date. An MNC can purchase a put option on the currency denominating its receivables and thus lock in the minimum amount that it would receive when converting the receivables into its home currency. However, the put option differs from a forward or futures contract in that it is an option, not an obligation. If the currency denominating the receivables is higher than the exercise price at the time of expiration, then the MNC can let the put option expire and can sell the currency in the foreign exchange market at the prevailing spot rate. The MNC must also consider the premium that it must pay for the put option.

Cost of Put Options Based on Contingency Graph The cost of hedging with put options is not known with certainty at the time they are purchased; it is determined once the receivables are due and the spot rate at that time is known. An estimate of the cash to be received from a put option hedge is the estimated cash received from selling the currency minus the premium paid for the put option. If the spot rate of the currency when receivables arrive is lower than the exercise price, then the MNC would exercise the option and receive the exercise price when selling the currency. If the spot rate at that time is equal to or higher than the exercise price, the MNC would let the option expire and would sell the currency at the spot rate in the foreign exchange market.

An MNC can develop a contingency graph that determines the cash received from hedging with put options depending on each of several possible spot rates when receivables arrive. Such graphs are useful for MNCs that would like to estimate the cash received from hedging based on a wide range of possible spot rate outcomes.

EXAMPLE

Recall that Viner Co. considers hedging its receivables of SF200,000 in 6 months. It could do this by purchasing put options on SF200,000. Assume that the put options have an exercise price of $.70, a premium of $.02, and an expiration date of six months from now (when the receivables arrive). Viner can create a contingency graph for the put option hedge, as in Exhibit 11.5. The horizontal axis shows several possible values of the Swiss franc spot rate prevailing when Viner's receivables arrive, while the vertical axis shows the cash to be received from the put option hedge based on each of those possible spot rates.

At any spot rate less than or equal to the exercise price of $.70, Viner Co. would exercise the put option, selling the Swiss francs at the exercise price of $.70. After subtracting the $.02 premium per unit, Viner would receive $.68 per unit from selling the francs. At any spot rate more than the exercise price, Viner would let the put option expire and simply sell the francs at the spot rate in the foreign exchange market. For example, if the spot rate were $.75 when receivables were due then Viner would sell the Swiss francs at that rate; it would receive $.73 after subtracting the $.02 premium per unit. ●

Exhibit 11.5 Contingency Graph for Hedging Receivables with Put Options

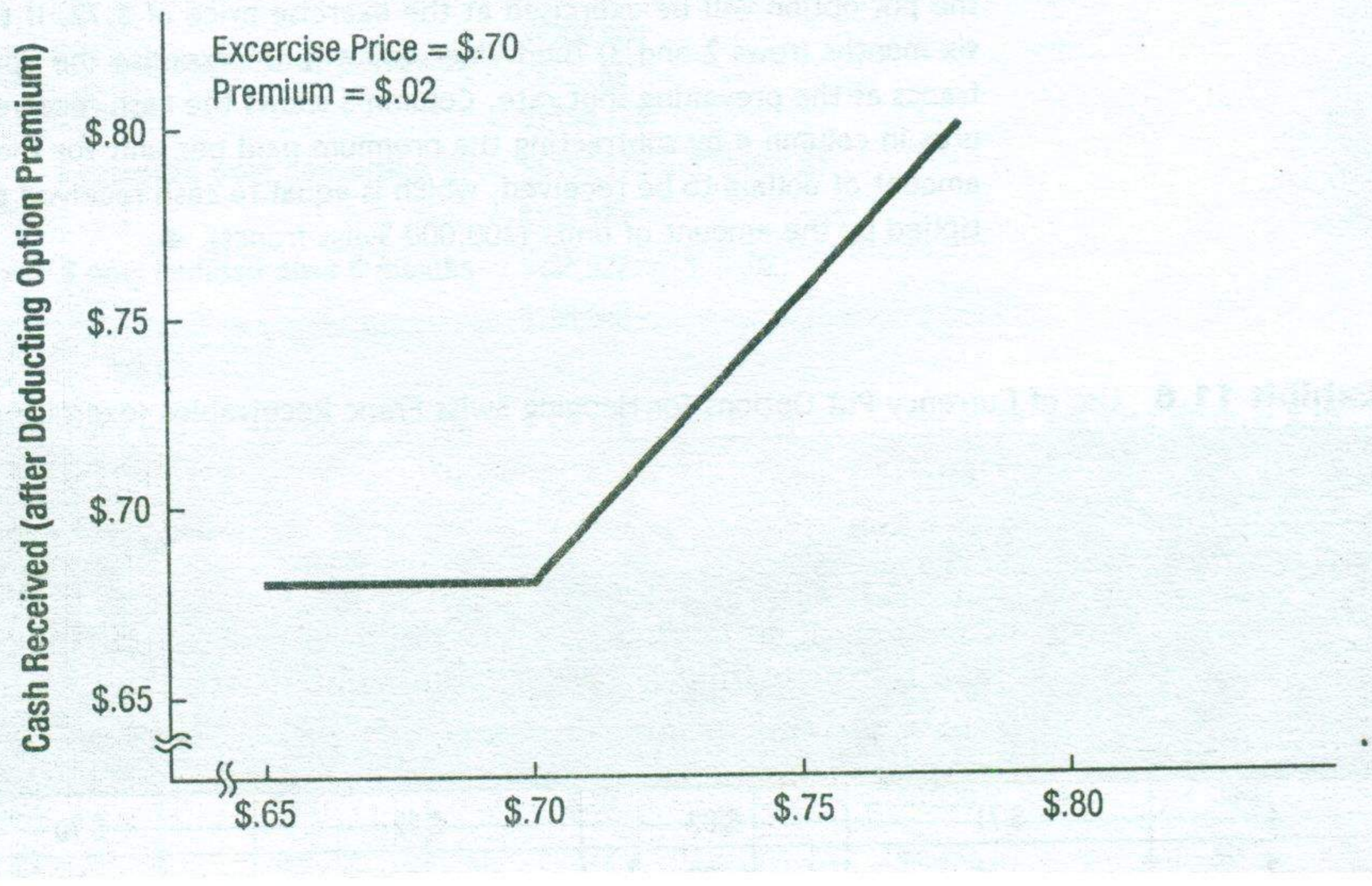


Exhibit 11.5 illustrates the advantages and disadvantages of a put option for hedging receivables. The advantage is that the put option provides hedges effectively while allowing the MNC to let the option expire if its exercise price is less than the spot rate. However, the put option's obvious disadvantage is that a premium must be paid for it.

Recall from a previous example that Viner Co. could sell a forward contract on Swiss francs for $.71; this would allow it to receive $.71 per Swiss franc regardless of the spot rate at the time receivables arrive. This action could be plotted on the contingency graph of Exhibit 11.5 as a horizontal line that starts at the $.71 point on the vertical axis and extends straight across for all possible spot rates. In general, the forward rate hedge will provide a larger amount of cash than the put option hedge if the spot rate is relatively low when the Swiss francs are received.

Cost of Put Options Based on Currency Forecasts The contingency graph can determine the cash to be received from hedging based on various possible spot rates when receivables will arrive, but it does not consider an MNC's currency forecasts. Hence this graph need not lead the MNC to a clear decision about whether to hedge receivables with currency put options. Therefore, an MNC may wish to incorporate its own forecasts of the spot rate when estimating the dollar cash inflows to be received when hedging with put options.

EXAMPLE Viner Co. considers purchasing a put option contract on Swiss francs; the option has an exercise price of $.72 and a premium of $.02. The company has developed the following probability distribution for the spot rate of the Swiss franc in six months:

- $.71 (30 percent probability),
- $.74 (40 percent probability),
- $.76 (30 percent probability).

The expected dollar cash flows to be received from purchasing a put option on Swiss francs are shown in Exhibit 11.6. The second column lists the possible spot rates that may (according to Viner's projections) occur in six months; the third column gives the option premium, which remains the same regardless of the future spot rate. The fourth column shows the amount to be received per unit as a result of owning the put options. If the future spot rate is $.71 (first row of the exhibit), the put option will be exercised at the exercise price of $.72. If the spot rate is more than $.72 in six months (rows 2 and 3) then Viner Co. will not exercise the option; instead it will sell the Swiss francs at the prevailing spot rate. Column 5 shows the cash received per unit, which adjusts the figures in column 4 by subtracting the premium paid per unit for the put option. Column 6 shows the amount of dollars to be received, which is equal to cash received per unit (shown in column 5) multiplied by the amount of units (200,000 Swiss francs). ●

Exhibit 11.6 Use of Currency Put Options for Hedging Swiss Franc Receivables (exercise price = $.72; premium = $.02)

(1) SCENARIO	(2) SPOT RATE WHEN PAYMENT ON RECEIVABLES IS RECEIVED	(3) PREMIUM PER UNIT ON PUT OPTIONS	(4) AMOUNT RECEIVED PER UNIT WHEN OWNING PUT OPTIONS	(5) = (4) − (3) NET AMOUNT RECEIVED PER UNIT (AFTER ACCOUNTING FOR PREMIUM PAID)	(6) DOLLAR AMOUNT RECEIVED FROM HEDGING SF200,000 RECEIVABLES WITH PUT OPTIONS
1	$.71	$.02	$.72	$.70	$140,000
2	.74	.02	.74	.72	144,000
3	.76	.02	.76	.74	148,000

Consideration of Alternative Put Options Several different types of put options may be available that feature different exercise prices and premiums for a given currency and expiration date. An MNC can obtain a put option with a higher exercise price, but the premium will also be higher. Alternatively, it can select a put option with a lower premium but also a lower exercise price. The put option selected as most desirable for hedging a particular receivables position would be analyzed (as explained previously) and then compared to other hedging techniques.

11-3d Comparison of Techniques for Hedging Receivables

The techniques that can be used to hedge receivables are summarized in Exhibit 11.7, with an illustration of how the cash inflow from each hedging technique was measured for Viner Co. (based on previous examples).

Optimal Technique for Hedging Receivables The optimal technique to hedge receivables may vary over time depending on the specific quotations, such as the forward rate quoted on a forward contract, the interest rates quoted on a money market loan, and the premium quoted on a put option. The optimal technique for hedging a specific future receivables position can be determined by comparing the cash to be received among the hedging techniques. Just as in the case of hedging payables, the MNC first considers either the futures or forward hedge according to its preferences. For our example, the forward hedge is considered. Second, it is again easy to compare the forward (or

Exhibit 11.7 Comparison of Hedging Alternatives for Viner Co.

Forward Hedge

Sell Swiss francs six months forward.

$$\text{Dollars to be received in 6 months} = \text{receivables in SF} \times \text{forward rate of SF}$$
$$= \text{SF200,000} \times \$.71$$
$$= \$142{,}000$$

Money Market Hedge

Borrow SF, convert to $, invest $, use receivables to pay off loan in six months.

$$\text{Amount in SF borrowed} = \frac{\text{SF200,000}}{1 + .03}$$
$$= \text{SF194,175}$$
$$\text{\$ received from converting SF} = \text{SF194,175} \times \$.70 \text{ per SF}$$
$$= \$135{,}922$$
$$\text{\$ accumulated after 6 months} = \$135{,}922 \times (1 + .02)$$
$$= \$138{,}640$$

Put Option Hedge

Purchase put option. (Assume the options will be exercised on the day SF are to be received, or not at all; exercise price = $.72, premium = $.02.)

POSSIBLE SPOT RATE IN 6 MONTHS	PREMIUM PER UNIT PAID FOR OPTION	EXERCISE OPTION?	RECEIVED PER UNIT (AFTER ACCOUNTING FOR THE PREMIUM)	TOTAL DOLLARS RECEIVED FROM CONVERTING SF200,000	PROBABILITY
.71	$.02	Yes	$.70	$140,000	30%
.74	.02	No	.72	144,000	40
.76	.02	No	.74	148,000	30

futures) hedge and the money market hedge because the cash to be received from either type can be determined with certainty.

Once that comparison is completed, the MNC can assess the feasibility of the currency put option hedge. Since the amount of cash to be received from the currency put option depends on the spot rate prevailing when receivables arrive, this amount is best described by a probability distribution. That distribution of cash to be received when hedging with put options can be derived by estimating the expected value and then determining the likelihood of the currency put option hedge resulting in more cash than an alternative method of hedging.

EXAMPLE When attempting to hedge receivables of SF200,000, Viner Co. can compare the cash to be received as the result of applying different hedging techniques in order to determine which one is optimal. Exhibit 11.8 gives a graphic summary of the cash to be received from each hedging technique based on the previous examples for Viner Co. In this example, the forward hedge is better than the money market hedge because it will generate more cash.

The graph for the put option hedge confirms that the cash to be received is a function of the exchange rate at the time that receivables are due. The expected value of the cash to be received from the put option hedge is

$$\begin{aligned}\text{Expected value of cash to be received} &= (\$140{,}000 \times 30\%) \\ &\quad + (\$144{,}000 \times 40\%) \\ &\quad + (\$148{,}000 \times 30\%) \\ &= \$144{,}000\end{aligned}$$

The expected value of the cash to be received when hedging with put options exceeds the cash amount that would be received from the forward rate hedge.

According to the comparison in Exhibit 11.8 between the distribution of cash to be received from the put option to the certain cash from the forward hedge, there is a 30 percent chance that the currency put option hedge will result in less cash than the forward hedge; there is also a 70 percent chance that the put option hedge will result in more cash than the forward hedge. Consequently, Viner Co. decides that the optimal hedge is the one using put options. ●

Optimal Hedge versus No Hedge on Receivables An MNC may know what its future receivables will be yet still decide not to hedge. In that case, the MNC needs to determine the probability distribution of its revenue from receivables when not hedging. This determination is illustrated in the following example.

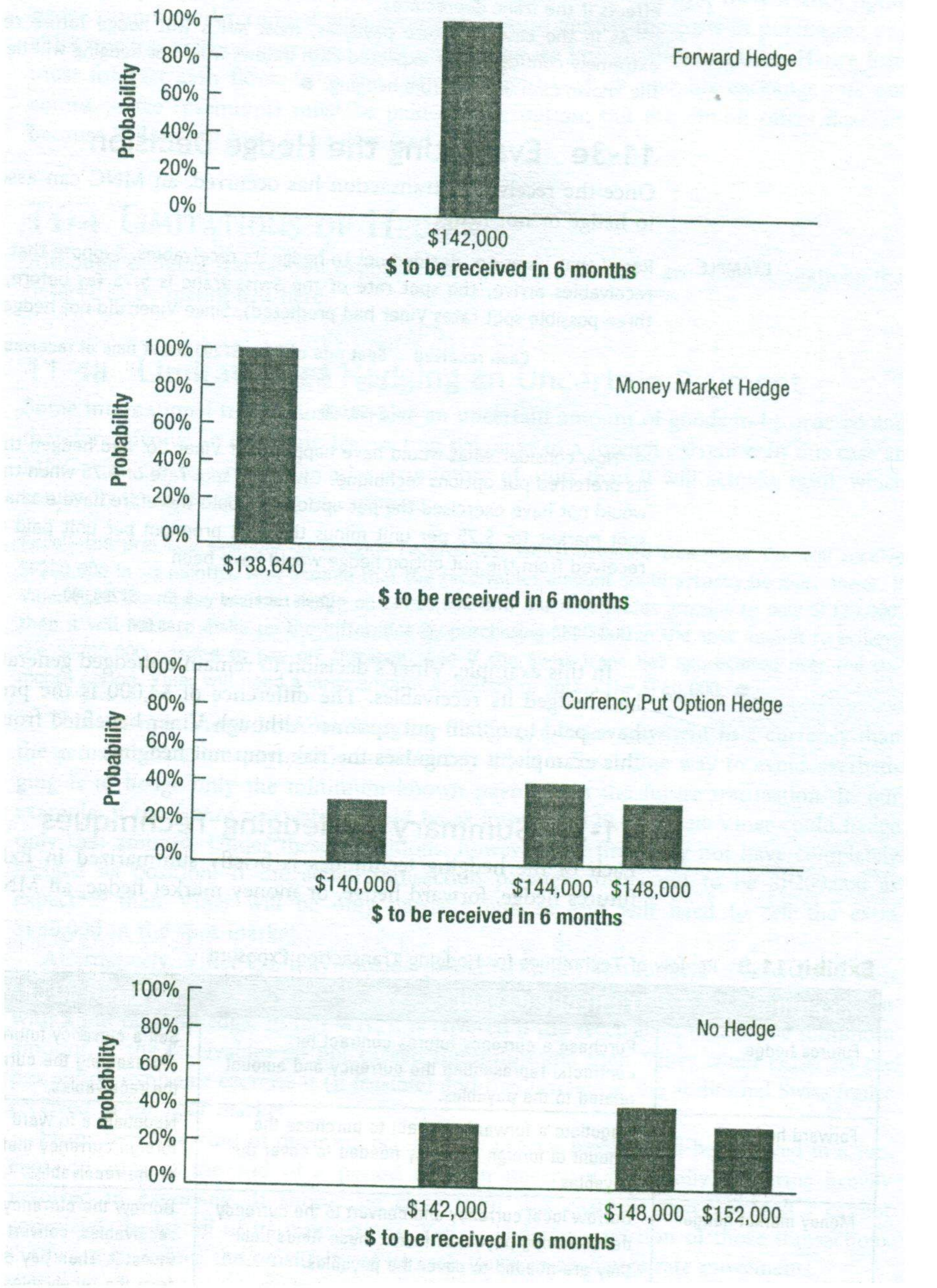
EXAMPLE Viner Co. has already established that the put option hedge is the optimal technique for hedging its receivables position, so now it wants to compare using that hedge to using no hedge. Given its expectations of the Swiss franc's spot rate in one year, the company can estimate the cash to be received (if it remains unhedged) as follows:

POSSIBLE SPOT RATE OF SWISS FRANC IN 1 YEAR	DOLLAR PAYMENTS WHEN NOT HEDGING = SF200,000 × POSSIBLE SPOT RATE	PROBABILITY
$.71	$142,000	30%
$.74	$148,000	40%
$.76	$152,000	30%

The expected value of cash that Viner will receive when not hedging is estimated as

$$\begin{aligned}\text{Expected value of cash to be received} &= (\$142{,}000 \times 30\%) \\ &\quad + (\$148{,}000 \times 40\%) \\ &\quad + (\$152{,}000 \times 30\%) \\ &= \$147{,}400\end{aligned}$$

Exhibit 11.8 Graph Comparison of Techniques to Hedge Receivables



When comparing this expected value to the expected value of cash that Viner Co. would receive from its put option hedge ($144,000), Viner decides to remain unhedged. That decision reflects the company's hope of benefitting from appreciation in the Swiss franc against the U.S. dollar over the next six months as well as its willingness to accept the trade-off: being susceptible to adverse effects if the franc depreciates.

As in the case of future payables, most MNCs will hedge future receivables unless they are extremely confident that expected cash inflows from not hedging will be (significantly) higher than the known cash inflows from hedging. ●

11-3e Evaluating the Hedge Decision

Once the receivables transaction has occurred, an MNC can assess its previous decision to hedge or not hedge.

EXAMPLE

Recall that Viner Co. decided not to hedge its receivables. Suppose that six months later, when the receivables arrive, the spot rate of the Swiss franc is $.75 (as before, this rate differs from the three possible spot rates Viner had predicted). Since Viner did not hedge, it receives

$$\begin{aligned}\text{Cash received} &= \text{Spot rate of SF} \times \text{SF200,000 at time of receivables transaction}\\ &= \$.75 \times \text{SF200,000}\\ &= \$150{,}000\end{aligned}$$

Now consider what would have happened if Viner Co. had hedged the receivables position using its preferred put options technique. Given the spot rate of $.75 when the receivables arrived, Viner would not have exercised the put option. It would therefore have exchanged the Swiss francs in the spot market for $.75 per unit minus the $.02 premium per unit paid for the put option. Its cash received from the put option hedge would have been

$$\begin{aligned}\text{Cash received} &= \$.73 \times \text{SF200,000}\\ &= \$146{,}000\end{aligned}$$

●

In this example, Viner's decision to remain unhedged generated $4,000 more than if it had hedged its receivables. The difference of $4,000 is the premium that Viner would have paid to obtain put options. Although Viner benefited from remaining unhedged in this example, it recognizes the risk from not hedging.

11-3f Summary of Hedging Techniques

Each of the hedging techniques is briefly summarized in Exhibit 11.9. When using a futures hedge, forward hedge, or money market hedge, an MNC can estimate the funds

Exhibit 11.9 Review of Techniques for Hedging Transaction Exposure

TECHNIQUE	TO HEDGE PAYABLES	TO HEDGE RECEIVABLES
Futures hedge	Purchase a currency futures contract (or contracts) representing the currency and amount related to the payables.	Sell a currency futures contract (or contracts) representing the currency and amount related to the receivables.
Forward hedge	Negotiate a forward contract to purchase the amount of foreign currency needed to cover the payables.	Negotiate a forward contract to sell the amount of foreign currency that will be received as a result of the receivables.
Money market hedge	Borrow local currency and convert to the currency denominating payables. Invest these funds until they are needed to cover the payables.	Borrow the currency denominating the receivables, convert it to the local currency, and invest it. Then pay off the loan with cash inflows from the receivables.
Currency option hedge	Purchase a currency call option (or options) representing the currency and amount related to the payables.	Purchase a currency put option (or options) representing the currency and amount related to the receivables.

(denominated in its home currency) that it will need for future payables or the funds that it will receive after converting foreign currency receivables. The outcome is certain, so the firm can compare the costs or revenue and determine which of these hedging techniques is appropriate. In contrast, the cash flow associated with the currency option hedge cannot be determined with certainty because neither the costs of purchasing payables nor the revenue generated from receivables are known ahead of time. Hence firms must forecast cash flows from the option hedge based on possible exchange rate outcomes. A fee (premium) must be paid for the option, but the option offers flexibility because it does not have to be exercised.

11-4 Limitations of Hedging

Although hedging transaction exposure can be effective, there are some limitations that deserve to be mentioned here.

11-4a Limitation of Hedging an Uncertain Payment

Some international transactions involve an uncertain amount of goods to be ordered and therefore involve an uncertain transaction payment in a foreign currency. In this case an MNC may create a hedge for a larger number of units than it will actually need, which results in the opposite form of exposure.

EXAMPLE Recall the previous example on hedging receivables, which assumed that Viner Co. will receive SF200,000 in six months. Now assume that the receivables amount could actually be much lower. If Viner uses the money market hedge on SF200,000 and the receivables amount to only SF120,000, then it will have to make up the difference by purchasing SF80,000 in the spot market to achieve the SF200,000 needed to pay off the loan. And if the Swiss franc has appreciated over the six-month period, Viner will need a large amount in dollars to obtain the SF80,000. ●

This example shows how **overhedging** (hedging a larger payment in a currency than the actual transaction payment) can adversely affect a firm. One way to avoid overhedging is to hedge only the minimum known payment in the future transaction. In our example, if the future receivables could be as low as SF120,000 then Viner could hedge only that amount. Under these conditions, however, the firm may not have completely hedged its position. If the actual transaction payment turns out to be SF200,000 as expected, then Viner will be only partially hedged and will need to sell the extra SF80,000 in the spot market.

Alternatively, Viner Co. may consider hedging the minimum level of receivables with a money market hedge and hedging the additional amount of receivables that may occur with a put option hedge. In this way, it is covered if the receivables exceed the minimum amount. If the receivables do not exceed the minimum, then Viner could either let the put option expire or exercise it (if feasible) and then exchange the additional Swiss francs received in the spot market.

Firms face this kind of dilemma because the precise payment to be received in a foreign currency at the end of a period is often uncertain, especially for firms heavily involved in exporting. It should be clear from this example that an MNCs cannot completely hedge all of its transactions. Yet by hedging a portion of those transactions the firm can reduce the sensitivity of its cash flows to exchange rate movements.

11-4b Limitation of Repeated Short-Term Hedging

The repeated hedging of near-term transactions has limited effectiveness in the long run.

EXAMPLE Winthrop Co. is a U.S. firm that specializes in importing a single large shipment of CD players each year and then selling the units to retail stores throughout the year. Assume that today's exchange rate of the Japanese yen (¥) is $.005 and that the CD players are worth ¥60,000, or $300. The forward rate of the yen generally exhibits a premium of 2 percent. Exhibit 11.10 shows the yen–dollar exchange rate to be paid by the importer over time. As the spot rate changes, the forward rate will often change by a similar amount. Thus, if the spot rate increases by 10 percent over the year, then the forward rate may increase by about the same amount; in that case, the importer will pay 10 percent more for next year's shipment (assuming no change in the yen price quoted by the Japanese exporter). The use of a one-year forward contract when the yen is strong would be preferable to no hedge in this case, but it could not eliminate increases in prices paid by the importer each year. Therefore, the use of short-term hedging techniques does not completely insulate a firm from exchange rate exposure, even if the hedges are used repeatedly over time. ●

Hedging techniques that are applied over longer-term periods can more effectively insulate the firm from exchange rate risk in the long run. That is, Winthrop Co. could, at time 0, create a hedge for shipments to arrive at the end of each of the next several years. The forward rate for each hedge would be based on today's spot rate, as shown in Exhibit 11.11. If the yen is appreciating, then such a strategy would save a substantial amount of money.

This strategy is limited, however, in that the amount of yen to be hedged further into the future is more uncertain because the shipment size will depend on economic conditions or other factors at that time. If a recession occurs then Winthrop Co. may reduce the number of CD players ordered, but the amount in yen to be received by the importer is dictated by the forward contract created previously. The manufacturer may go bankrupt or simply experience stockouts, but in any case Winthrop Co. remains obligated to purchase the yen.

Long-Term Hedging as a Solution Despite the limitations of long-term hedging just described, some MNCs (including Procter & Gamble and Walt Disney Company)

Exhibit 11.10 Repeated Hedging of Foreign Payables When the Foreign Currency Is Appreciating

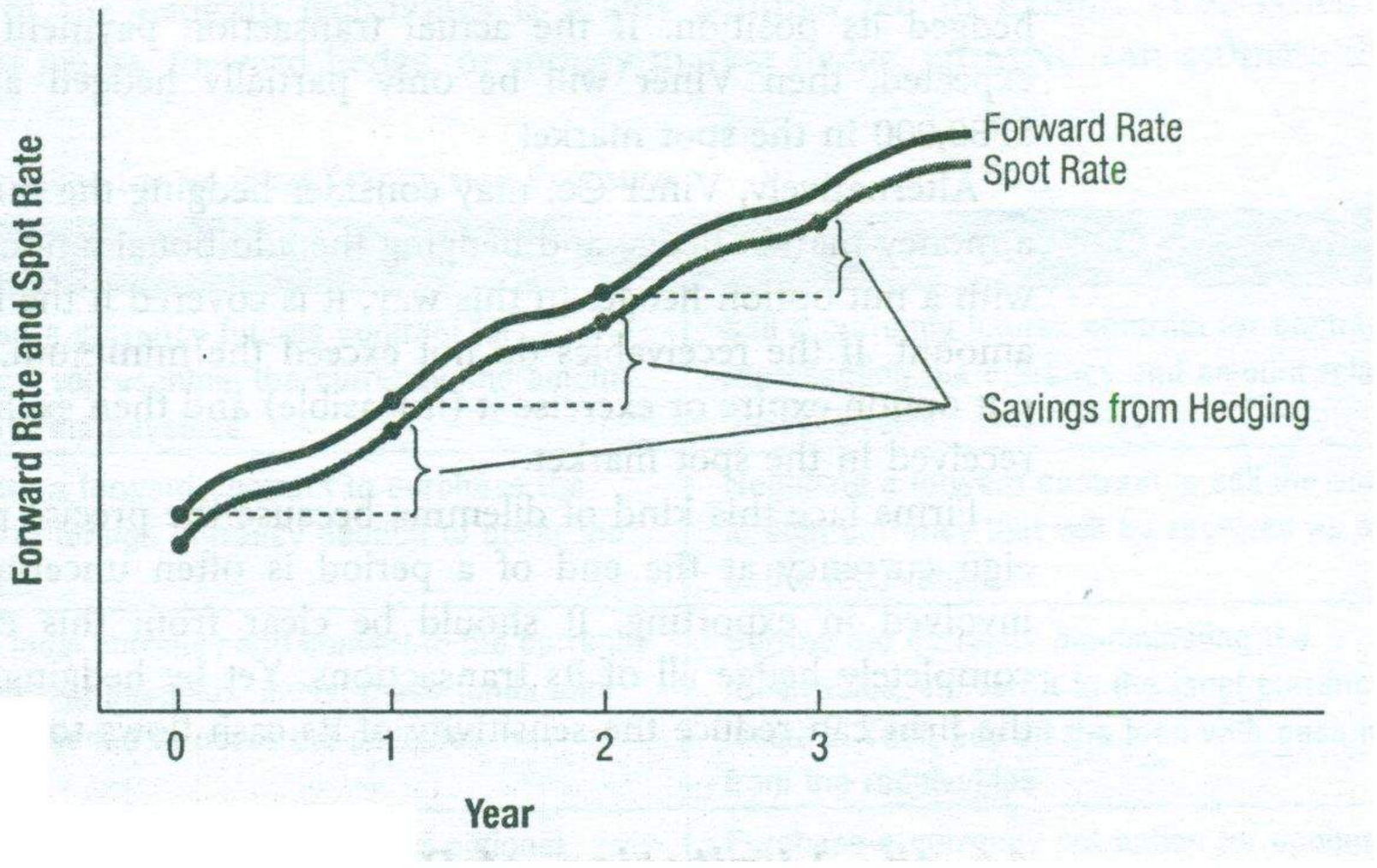
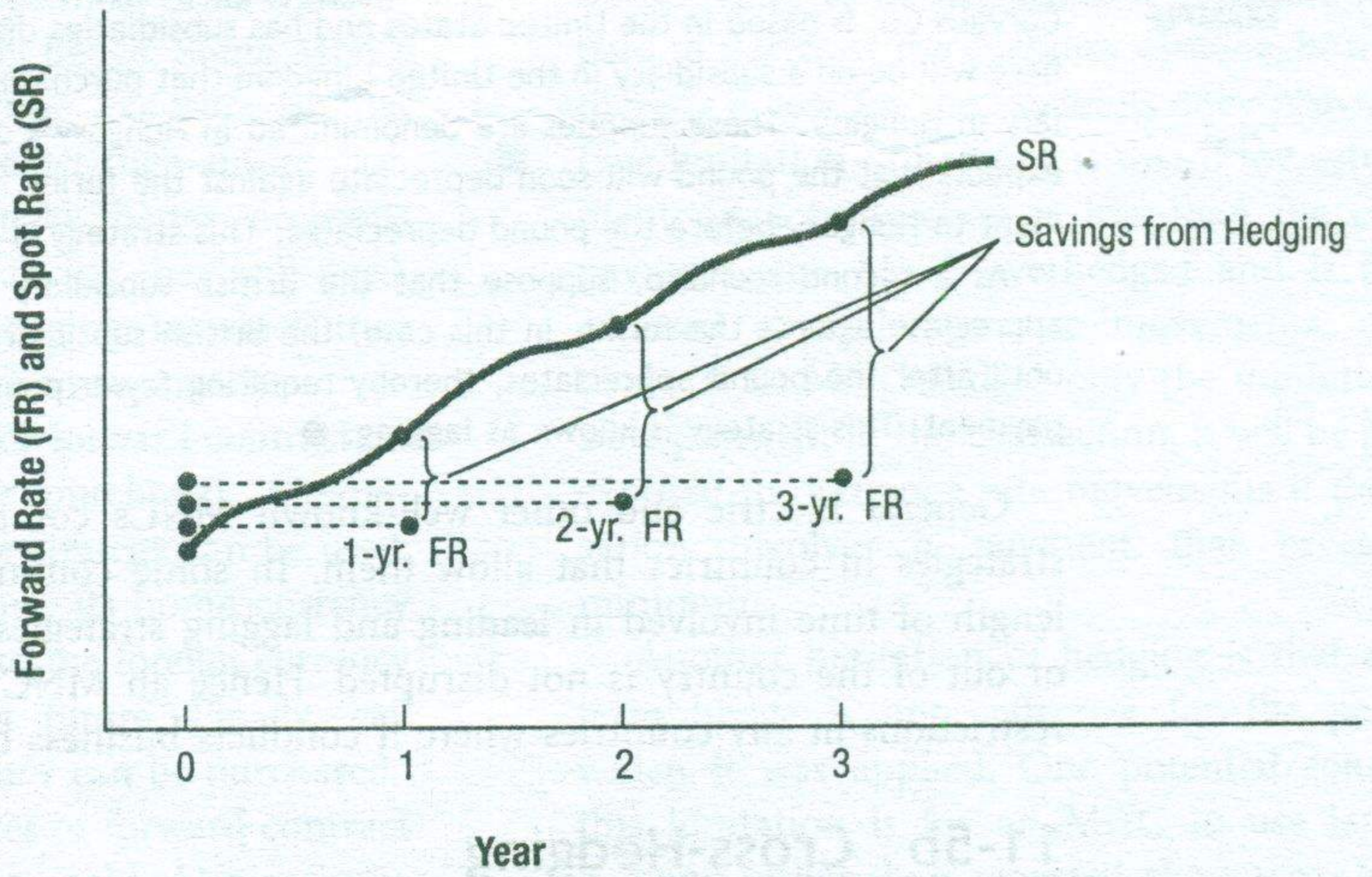


Exhibit 11.11 Long-Term Hedging of Payables When the Foreign Currency Is Appreciating



view it as a way to overcome the limitations of repeated short-term hedging. These firms commonly use long-term forward contracts to hedge long-term transaction exposure. Some banks offer forward contracts for up to 5 years or 10 years on some commonly traded currencies. Because the bank is forced to trust that the firm will fulfill its long-term obligation specified in the forward contract, only the most creditworthy bank customers are considered.

Another alternative to repeated short-term hedging is a **parallel loan** (or "back-to-back loan"), which involves an exchange of currencies between two parties with a promise to re-exchange currencies at a specified exchange rate on a future date. This long-term hedging technique involves two currency swaps: one at the inception of the loan contract and another swap at the specified future date. The arrangement is interpreted by accountants as a loan and so is recorded on financial statements; it is covered in more detail in Chapter 18.

Although the methods discussed here are usually preferable to repeated short-term hedging, they could cause an MNC to be overhedged if the long-term transaction exposure turns out to be less than expected. Therefore, these solutions are most effective when the MNC has a long-term contract with a client firm that guarantees the long-term transaction exposure.

11-5 Alternative Hedging Techniques

When a perfect hedge is not available (or is too expensive) to eliminate transaction exposure, the firm should consider methods that can at least reduce exposure. Such methods include

- leading and lagging,
- cross-hedging, and
- currency diversification.

Each method is discussed in turn.

11-5a Leading and Lagging

Leading and lagging strategies involve adjusting the timing of a payment request or disbursement to reflect expectations about future currency movements.

EXAMPLE

Corvalis Co. is based in the United States and has subsidiaries dispersed around the world. The focus here will be on a subsidiary in the United Kingdom that purchases some of its supplies from a subsidiary in Hungary. These supplies are denominated in Hungary's currency (the forint). If Corvalis Co. expects that the pound will soon depreciate against the forint, it may attempt to expedite its payment to Hungary before the pound depreciates. This strategy is referred to as **leading.**

As a second scenario, suppose that the British subsidiary expects that the pound will soon appreciate against the forint. In this case, the British subsidiary may attempt to stall its payment until after the pound appreciates, thereby requiring fewer pounds to obtain the forint needed for payment. This strategy is known as **lagging.** ●

General Electric and other well-known MNCs commonly use leading and lagging strategies in countries that allow them. In some countries, the government limits the length of time involved in leading and lagging strategies so that the flow of funds into or out of the country is not disrupted. Hence an MNC must be aware of government restrictions in any countries where it conducts business before using these strategies.

11-5b Cross-Hedging

Cross-hedging is a common method of reducing transaction exposure when the currency cannot be hedged.

EXAMPLE

Greeley Co., a U.S. firm, has payables in zloty (Poland's currency) 90 days from now. Because it is worried that the zloty may appreciate against the U.S. dollar, the company may want to hedge this position. If forward contracts and other hedging techniques are not available for the zloty, then Greeley may consider cross-hedging.

The first step is to identify a currency that can be hedged and that also is highly correlated with the zloty. Greeley observes that the euro has recently been moving in tandem with the zloty and decides to set up a 90-day forward contract on the euro. If the movements in the zloty and euro continue to be highly correlated (that is, if the two currencies continue to move in the same similar direction and to a similar extent), then the exchange rate between them should be fairly stable over time. The next step is for Greeley to purchase euros 90 days forward, which enables the company to exchange euros for the zloty when zloty are required for payment. ●

This type of hedge is sometimes referred to as a *proxy hedge* because the hedged position is in a currency that serves as a proxy for the currency in which the MNC is exposed. The effectiveness of this strategy depends on the degree to which the two currencies are positively correlated: the greater is the positive correlation, the more effective will be the cross-hedging strategy.

11-5c Currency Diversification

A third method for reducing transaction exposure is **currency diversification**, which can limit the potential effect of any single currency's movements on the value of an MNC. Some MNCs such as The Coca-Cola Co., PepsiCo, and Altria, claim that their exposure to exchange rate movements is significantly reduced because they diversify their business among numerous countries.

The dollar value of future inflows in foreign currencies will be more stable if the foreign currencies received are *not* highly correlated. The reason is that lower (positive or negative) correlations can reduce variability in the dollar value of all foreign currency inflows. When foreign currencies are highly correlated with each other, diversifying among them is not an effective way to reduce risk. If one of the currencies substantially depreciated then, given their strong correlation, the others would likely do so as well.

SUMMARY

- An MNC may choose to hedge most of its transaction exposure or to selectively hedge. Some MNCs hedge most of their transaction exposure so that they can more accurately predict their future cash inflows or outflows and make better decisions regarding the amount of financing they will need. Many MNCs use selective hedging, in which they consider each type of transaction separately.
- To hedge payables, a futures or forward contract on the foreign currency can be purchased. Alternatively, a money market hedge strategy can be used; in this case, the MNC borrows its home currency and converts the proceeds into the foreign currency that will be needed in the future. Finally, call options on the foreign currency can be purchased.
- To hedge receivables, a futures or forward contract on the foreign currency can be sold. Alternatively, a money market hedge strategy can be used. In this case, the MNC borrows the foreign currency to be received and converts the funds into its home currency; the loan is to be repaid by the receivables. Finally, put options on the foreign currency can be purchased.
- The currency options hedge has an advantage over the other hedging techniques in that the options do not have to be exercised. A premium must be paid to purchase the currency options, however, so there is a cost for the flexibility they provide.
- One limitation of hedging is that if the actual payment on a transaction is less than the expected payment, the MNC overhedged and is partially exposed to exchange rate movements. Alternatively, if an MNC hedges only the minimum possible payment in the transaction, it will be partially exposed to exchange rate movements if the transaction involves a payment that exceeds the minimum.

  Another limitation of hedging is that a short-term hedge is only effective for the period in which it was applied. One potential solution to this limitation is for an MNC to use long-term hedging rather than repeated short-term hedging. This choice is more effective if the MNC can be sure that its transaction exposure will persist into the distant future.
- When hedging techniques like forward and currency option contracts are not available, there are still some methods of reducing transaction exposure, such as leading and lagging, cross-hedging, and currency diversification.

POINT COUNTER-POINT

Should an MNC Risk Overhedging?

Point Yes. MNCs have some "unanticipated" transactions that occur without any advance notice. They should attempt to forecast the net cash flows in each currency due to unanticipated transactions based on the previous net cash flows for that currency in a previous period. Even though it would be impossible to forecast the volume of these unanticipated transactions per day, it may be possible to forecast the volume on a monthly basis. For example, if an MNC has net cash flows between 3 million and 4 million Philippine pesos every month, it may presume that it will receive at least 3 million pesos in each of the next few months unless conditions change. Thus, it can hedge a position of 3 million in pesos by either selling that amount of pesos forward or buying put options on that amount of pesos. Any amount of net cash flows in excess of 3 million pesos will not be hedged, but at least the MNC was able to hedge the minimum expected net cash flows.

Counter-Point No. MNCs should not hedge unanticipated transactions. When they overhedge the expected net cash flows in a foreign currency, they are still exposed to exchange rate risk. If they sell more currency as a result of forward contracts than their net cash flows, they will be adversely affected by an increase in the value of the currency. Their initial reasons for hedging were to protect against the weakness of the currency, but the overhedging described here would cause a shift in their exposure. Overhedging does not insulate an MNC against exchange rate risk. It just changes the means by which the MNC is exposed.

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. Montclair Co., a U.S. firm, plans to use a money market hedge to hedge its payment of 3 million Australian dollars for Australian goods in 1 year. The U.S. interest rate is 7 percent, while the Australian interest rate is 12 percent. The spot rate of the Australian dollar is $.85, while the 1-year forward rate is $.81. Determine the amount of U.S. dollars needed in 1 year if a money market hedge is used.

2. Using the information in the previous question, would Montclair Co. be better off hedging the payables with a money market hedge or with a forward hedge?

3. Using the information about Montclair from the first question, explain the possible advantage of a currency option hedge over a money market hedge for Montclair Co. What is a possible disadvantage of the currency option hedge?

4. Sanibel Co. purchases British goods (denominated in pounds) every month. It negotiates a 1-month forward contract at the beginning of every month to hedge its payables. Assume the British pound appreciates consistently over the next 5 years. Will Sanibel be affected? Explain.

5. Using the information from question 4, suggest how Sanibel Co. could more effectively insulate itself from the possible long-term appreciation of the British pound.

6. Hopkins Co. transported goods to Switzerland and will receive 2 million Swiss francs in 3 months. It believes the 3-month forward rate will be an accurate forecast of the future spot rate. The 3-month forward rate of the Swiss franc is $.68. A put option is available with an exercise price of $.69 and a premium of $.03. Would Hopkins prefer a put option hedge to no hedge? Explain.

QUESTIONS AND APPLICATIONS

1. Hedging in General Explain the relationship between this chapter on hedging and the previous chapter on measuring exposure.

2. Money Market Hedge on Receivables Assume that Stevens Point Co. has net receivables of 100,000 Singapore dollars in 90 days. The spot rate of the Singapore dollar is $.50, and the Singapore interest rate is 2 percent over 90 days. Suggest how the U.S. firm could implement a money market hedge. Be precise.

3. Money Market Hedge on Payables Assume that Hampshire Co. has net payables of 200,000 Mexican pesos in 180 days. The Mexican interest rate is 7 percent over 180 days, and the spot rate of the Mexican peso is $.10. Suggest how the U.S. firm could implement a money market hedge. Be precise.

4. Net Transaction Exposure Why should an MNC identify net exposure before hedging?

5. Hedging with Futures Explain how a U.S. corporation could hedge net receivables in euros with futures contracts. Explain how a U.S. corporation could hedge net payables in Japanese yen with futures contracts.

6. Hedging with Forward Contracts Explain how a U.S. corporation could hedge net receivables in Malaysian ringgit with a forward contract. Explain how a U.S. corporation could hedge payables in Canadian dollars with a forward contract.

7. Real Cost of Hedging Payables Assume that Loras Corp. imported goods from New Zealand and needs 100,000 New Zealand dollars 180 days from now. It is trying to determine whether to hedge this position. Loras has developed the following probability distribution for the New Zealand dollar:

POSSIBLE VALUE OF NEW ZEALAND DOLLAR IN 180 DAYS	PROBABILITY
$.40	5%
.45	10
.48	30
.50	30
.53	20
.55	5

The 180-day forward rate of the New Zealand dollar is $.52. The spot rate of the New Zealand dollar is $.49. Develop a table showing a feasibility analysis for hedging. That is, determine the possible differences between the costs of hedging versus no hedging. What is the probability that hedging will be more costly to the firm than not hedging? Determine the expected value of the additional cost of hedging.

8. Benefits of Hedging If hedging is expected to be more costly than not hedging, why would a firm even consider hedging?

9. Real Cost of Hedging Payables Assume that Suffolk Co. negotiated a forward contract to purchase 200,000 British pounds in 90 days. The 90-day forward rate was $1.40 per British pound. The pounds to be purchased were to be used to purchase British supplies. On the day the pounds were delivered in accordance with the forward contract, the spot rate of the British pound was $1.44. What was the real cost of hedging the payables for this U.S. firm?

10. Forward Hedge Decision Kayla Co. imports products from Mexico, and it will make payment in pesos in 90 days. Interest rate parity holds. The prevailing interest rate in Mexico is very high, which reflects the high expected inflation there. Kayla expects that the Mexican peso will depreciate over the next 90 days. Yet, it plans to hedge its payables with a 90-day forward contract. Why may Kayla believe that it will pay a smaller amount of dollars when hedging than if it remains unhedged?

11. Hedging on Payables Assume the following information:

90-day U.S. interest rate	4%
90-day Malaysian interest rate	3%
90-day forward rate of Malaysian ringgit	$.400
Spot rate of Malaysian ringgit	$.404

Assume that the Santa Barbara Co. in the United States will need 300,000 ringgit in 90 days. It wishes to hedge this payables position. Would it be better-off using a forward hedge or a money market hedge? Substantiate your answer with estimated costs for each type of hedge.

12. Hedging Decision on Receivables Assume the following information:

180-day U.S. interest rate	8%
180-day British interest rate	9%
180-day forward rate of British pound	$1.50
Spot rate of British pound	$1.48

Assume that Riverside Corp. from the United States will receive 400,000 pounds in 180 days. Would it be better-off using a forward hedge or a money market hedge? Substantiate your answer with estimated revenue for each type of hedge.

13. Currency Options Relate the use of currency options to hedging net payables and receivables. That is, when should currency puts be purchased, and when should currency calls be purchased? Why would Cleveland, Inc., consider hedging net payables or net receivables with currency options rather than forward contracts? What are the disadvantages of hedging with currency options as opposed to forward contracts?

14. Currency Options Can Brooklyn Co. determine whether currency options will be more or less expensive than a forward hedge when considering both hedging techniques to cover net payables in euros? Why or why not?

15. Long-Term Hedging How can a firm hedge long-term currency positions? Elaborate on each method.

16. Leading and Lagging Under what conditions would Zona Co.'s subsidiary consider using a leading strategy to reduce transaction exposure? Under what conditions would Zona Co.'s subsidiary consider using a lagging strategy to reduce transaction exposure?

17. Cross-Hedging Explain how a firm can use cross-hedging to reduce transaction exposure.

18. Currency Diversification Explain how a firm can use currency diversification to reduce transaction exposure.

19. Hedging with Put Options As treasurer of Tucson Corp. (a U.S. exporter to New Zealand), you must decide how to hedge (if at all) future receivables of 250,000 New Zealand dollars 90 days from now. Put options are available for a premium

of $.03 per unit and an exercise price of $.49 per New Zealand dollar. The forecasted spot rate of the NZ$ in 90 days follows:

FUTURE SPOT RATE	PROBABILITY
$.44	.30%
.40	50
.38	20

Given that you hedge your position with options, create a probability distribution for U.S. dollars to be received in 90 days.

20. Forward Hedge Would Oregon Co.'s real cost of hedging Australian dollar payables every 90 days have been positive, negative, or about zero on average over a period in which the dollar weakened consistently? What does this imply about the forward rate as an unbiased predictor of the future spot rate? Explain.

21. Implications of IRP for Hedging If interest rate parity exists, would a forward hedge be more favorable, the same as, or less favorable than a money market hedge on euro payables? Explain.

22. Real Cost of Hedging Would Montana Co.'s real cost of hedging Japanese yen receivables have been positive, negative, or about zero on average over a period in which the dollar weakened consistently? Explain.

23. Forward versus Options Hedge on Payables If you are a U.S. importer of Mexican goods and you believe that today's forward rate of the peso is a very accurate estimate of the future spot rate, do you think Mexican peso call options would be a more appropriate hedge than the forward hedge? Explain.

24. Forward versus Options Hedge on Receivables You are an exporter of goods to the United Kingdom, and you believe that today's forward rate of the British pound substantially underestimates the future spot rate. Company policy requires you to hedge your British pound receivables in some way. Would a forward hedge or a put option hedge be more appropriate? Explain.

25. Forward Hedging Explain how a Malaysian firm can use the forward market to hedge periodic purchases of U.S. goods denominated in U.S. dollars. Explain how a French firm can use forward contracts to hedge periodic sales of goods sold to the United States that are invoiced in dollars. Explain how a British firm can use the forward market to hedge periodic purchases of Japanese goods denominated in yen.

26. Continuous Hedging Cornell Co. purchases computer chips denominated in euros on a monthly basis from a Dutch supplier. To hedge its exchange rate risk, this U.S. firm negotiates a 3-month forward contract 3 months before the next order will arrive. In other words, Cornell is always covered for the next three monthly shipments. Because Cornell consistently hedges in this manner, it is not concerned with exchange rate movements. Is Cornell insulated from exchange rate movements? Explain.

27. Hedging Payables with Currency Options Malibu, Inc., is a U.S. company that imports British goods. It plans to use call options to hedge payables of 100,000 pounds in 90 days. Three call options are available that have an expiration date 90 days from now. Fill in the number of dollars needed to pay for the payables (including the option premium paid) for each option available under each possible scenario in the following table:

SCENARIO	SPOT RATE OF POUND 90 DAYS FROM NOW	EXERCISE PRICE = $1.74; PREMIUM = $.06	EXERCISE PRICE = $1.76; PREMIUM = $.05	EXERCISE PRICE = $1.79; PREMIUM = $.03
1	$1.65			
2	1.70			
3	1.75			
4	1.80			
5	1.85			

If each of the five scenarios had an equal probability of occurrence, which option would you choose? Explain.

28. Forward Hedging Wedco Technology of New Jersey exports plastics products to Europe. Wedco decided to price its exports in dollars. Telematics International, Inc. (of Florida), exports computer net work systems to the United Kingdom (denominated in British pounds) and other countries. Telematics decided to use hedging techniques such as forward contracts to hedge its exposure.

a. Does Wedco's strategy of pricing its materials for European customers in dollars avoid economic exposure? Explain.

b. Explain why the earnings of Telematics International, Inc., were affected by changes in the value of the pound. Why might Telematics leave its exposure unhedged sometimes?

29. The Long-Term Hedge Dilemma St. Louis, Inc., which relies on exporting, denominates its exports in pesos and receives pesos every month. It expects the peso to weaken over time. St. Louis recognizes the limitation of monthly hedging. It also recognizes that it could remove its transaction exposure by denominating its exports in dollars, but it would still be subject to economic exposure. The long-term hedging techniques are limited, and the firm does not know how many pesos it will receive in the future, so it would have difficulty even if a long-term hedging method were available. How can this business realistically reduce its exposure over the long term?

30. Long-Term Hedging Since Obisbo, Inc., conducts much business in Japan, it is likely to have cash flows in yen that will periodically be remitted by its Japanese subsidiary to the U.S. parent. What are the limitations of hedging these remittances 1 year in advance over each of the next 20 years? What are the limitations of creating a hedge today that will hedge these remittances over each of the next 20 years?

31. Hedging during a Crisis Describe how a crisis in Asia could reduce the cash flows of a U.S. firm that exports products (denominated in U.S. dollars) to Asian countries. How could a U.S. firm that exported products (denominated in U.S. dollars) to Asia and anticipates an Asian crisis before it began insulate itself from any currency effects while continuing to export to Asia?

Advanced Questions

32. Comparison of Techniques for Hedging Receivables

a. Assume that Carbondale Co. expects to receive S$500,000 in one year. The existing spot rate of the Singapore dollar is $.60. The 1-year forward rate of the Singapore dollar is $.62. Carbondale created a probability distribution for the future spot rate in 1 year as follows:

FUTURE SPOT RATE	PROBABILITY
$.61	20%
.63	50
.67	30

Assume that 1-year put options on Singapore dollars are available, with an exercise price of $.63 and a premium of $.04 per unit. One-year call options on Singapore dollars are available with an exercise price of $.60 and a premium of $.03 per unit. Assume the following money market rates:

	U.S.	SINGAPORE
Deposit rate	8%	5%
Borrowing rate	9	6

Given this information, determine whether a forward hedge, a money market hedge, or a currency options hedge would be most appropriate. Then compare the most appropriate hedge to an unhedged strategy, and decide whether Carbondale should hedge its receivables position.

b. Assume that Baton Rouge, Inc., expects to need S$1 million in 1 year. Using any relevant information in part (a) of this question, determine whether a forward hedge, a money market hedge, or a currency options hedge would be most appropriate. Then, compare the most appropriate hedge to an unhedged strategy, and decide whether Baton Rouge should hedge its payables position.

33. Techniques for Hedging Receivables

SMU Corp. has future receivables of 4 million New Zealand dollars (NZ$) in 1 year. It must decide whether to use options or a money market hedge to hedge this position. Use any of the following information to make the decision. Verify your answer by determining the estimate (or probability

distribution) of dollar revenue to be received in 1 year for each type of hedge.

Spot rate of NZ$	$.54
One-year call option	Exercise price = $.50; premium = $.07
One-year put option	Exercise price = $.52; premium = $.03

	U.S.	NEW ZEALAND
One-year deposit rate	9%	6%
One-year borrowing rate	11	8

	RATE	PROBABILITY
Forecasted spot rate of NZ$	$.50	20%
	.51	50
	.53	30

34. Exposure of U.S. Importers If you were a U.S. importer of products from Europe, explain whether a weak U.S. economy would cause you to hedge your payables (denominated in euros) due a few months later if you expected that the weak economy would cause a major reduction in U.S. interest rates.

35. Forward versus Option Hedge As treasurer of Tempe Corp., you are confronted with the following problem. Assume the 1-year forward rate of the British pound is $1.59. You plan to receive 1 million pounds in 1 year. A 1-year put option is available. It has an exercise price of $1.61. The spot rate as of today is $1.62, and the option premium is $.04 per unit. Your forecast of the percentage change in the spot rate was determined from the following regression model:

$$e_t = a_0 + a_1 DINF_{t-1} + a_2 DINT_t + \mu$$

where

e_t = percentage change in British pound value over period t
$DINF_{t-1}$ = differential in inflation between the United States and the United Kingdom in period $t-1$
$DINT_t$ = average differential between U.S. interest rate and British interest rate over period t
a_0, a_1, and a_2 = regression coefficients
μ = error term

The regression model was applied to historical annual data, and the regression coefficients were estimated as follows:

$$a_0 = 0.0$$
$$a_1 = 1.1$$
$$a_2 = 0.6$$

Assume last year's inflation rates were 3 percent for the United States and 8 percent for the United Kingdom. Also assume that the interest rate differential ($DINT_t$) is forecasted as follows for this year:

FORECAST OF $DINT_t$	PROBABILITY
1%	40%
2	50
3	10

Using any of the available information, should the treasurer choose the forward hedge or the put option hedge? Show your work.

36. Hedging Decision You believe that IRP presently exists. The nominal annual interest rate in Mexico is 14 percent. The nominal annual interest rate in the United States is 3 percent. You expect that annual inflation will be about 4 percent in Mexico and 5 percent in the United States. The spot rate of the Mexican peso is $.10. Put options on pesos are available with a 1-year expiration date, an exercise price of $.1008, and a premium of $.014 per unit.

You will receive 1 million pesos in 1 year.

a. Determine the expected amount of dollars that you will receive if you use a forward hedge.

b. Determine the expected amount of dollars that you will receive if you do not hedge and believe in purchasing power parity (PPP).

c. Determine the amount of dollars that you will expect to receive if you believe in PPP and use a currency put option hedge. Account for the premium you would pay on the put option.

37. Forecasting with IFE and Hedging Assume that Calumet Co. will receive 10 million pesos in 15 months. It does not have a relationship with a bank at this time and, therefore, cannot obtain a forward contract to hedge its receivables at this time. However, in 3 months, it will be able to obtain a 1-year (12-month) forward contract to hedge its receivables. Today the

3-month U.S. interest rate is 2 percent (not annualized), the 12-month U.S. interest rate is 8 percent, the 3-month Mexican peso interest rate is 5 percent (not annualized), and the 12-month peso interest rate is 20 percent.

Assume that interest rate parity exists. Assume the international Fisher effect exists. Assume that the existing interest rates are expected to remain constant over time. The spot rate of the Mexican peso today is $.10. Based on this information, estimate the amount of dollars that Calumet Co. will receive in 15 months.

38. Forecasting from Regression Analysis and Hedging You apply a regression model to annual data in which the annual percentage change in the British pound is the dependent variable, and INF (defined as annual U.S. inflation minus U.K. inflation) is the independent variable. Results of the regression analysis show an estimate of 0.0 for the intercept and +1.4 for the slope coefficient. You believe that your model will be useful to predict exchange rate movements in the future.

You expect that inflation in the United States will be 3 percent, versus 5 percent in the United Kingdom. There is an 80 percent chance of that scenario. However, you think that oil prices could rise, and if so, the annual U.S. inflation rate will be 8 percent instead of 3 percent (and the annual U.K. inflation will still be 5 percent). There is a 20 percent chance that this scenario will occur. You think that the inflation differential is the only variable that will affect the British pound's exchange rate over the next year. The spot rate of the pound as of today is $1.80. The annual interest rate in the United States is 6 percent versus an annual interest rate in the United Kingdom of 8 percent. Call options are available with an exercise price of $1.79, an expiration date of 1 year from today, and a premium of $.03 per unit.

Your firm in the United States expects to need 1 million pounds in 1 year to pay for imports. You can use any one of the following strategies to deal with the exchange rate risk:

a. Unhedged strategy

b. Money market hedge

c. Call option hedge

Estimate the dollar cash flows you will need as a result of using each strategy. If the estimate for a particular strategy involves a probability distribution, show the distribution. Which hedge is optimal?

39. Forecasting Cash Flows and Hedging Decision Virginia Co. has a subsidiary in Hong Kong and in Thailand. Assume that the Hong Kong dollar (HK$) is pegged at $.13 per Hong Kong dollar and it will remain pegged. The Thai baht fluctuates against the U.S. dollar and is presently worth $.03. Virginia Co. expects that during this year, the U.S. inflation rate will be 2 percent, the Thailand inflation rate will be 11 percent, while the Hong Kong inflation rate will be 3 percent. Virginia Co. expects that purchasing power parity will hold for any exchange rate that is not fixed (pegged). Virginia Co. will receive 10 million Thai baht and 10 million Hong Kong dollars at the end of 1 year from its subsidiaries.

a. Determine the expected amount of dollars to be received from the Thai subsidiary in 1 year when the baht receivables are converted to U.S. dollars.

b. The Hong Kong subsidiary will send HK$1 million to make a payment for supplies to the Thai subsidiary. Determine the expected amount of baht that will be received by the Thai subsidiary when the Hong Kong dollar receivables are converted to Thai baht.

c. Assume that interest rate parity exists. Also assume that the real 1-year interest rate in the United States is 10 percent, while the real interest rate in Thailand is 3.0 percent. Determine the expected amount of dollars to be received by Virginia Co. if it uses a 1-year forward contract today to hedge the receivables of 10 million baht that will arrive in 1 year.

40. Hedging Decision Indiana Co. expects to receive 5 million euros in 1 year from exports, and it wants to consider hedging its exchange rate risk. The spot rate of the euro as of today is $1.10. Interest rate parity exists. Indiana Co. uses the forward rate as a predictor of the future spot rate. The annual interest rate in the United States is 8 percent versus an annual interest rate of 5 percent in the eurozone. Put options on euros are available with an exercise price of $1.11, an expiration date of 1 year from today, and a premium of $.06 per unit. Estimate the dollar cash flows that Indiana Co. will receive as a result of using each of the following strategies:

a. unhedged strategy

b. money market hedge

c. call option hedge

Which hedge is optimal?

41. Overhedging Denver Co. is about to order supplies from Canada that are denominated in Canadian dollars (C$). It has no other transactions in Canada and will not have any other transactions in the future. The supplies will arrive in 1 year and payment is due at that time. There is only one supplier in Canada. Denver submits an order for three loads of supplies, which will be priced at C$3 million. Denver Co. purchases C$3 million 1 year forward, since it anticipates that the Canadian dollar will appreciate substantially over the year.

The existing spot rate is $.62, while the 1-year forward rate is $.64. The supplier is not sure if it will be able to provide the full order, so it only guarantees Denver Co. that it will ship one load of supplies. In this case, the supplies will be priced at C$1 million. Denver Co. will not know whether it will receive one load or three loads until the end of the year.

Determine Denver's total cash outflows in U.S. dollars under the scenario that the Canadian supplier only provides one load of supplies and that the spot rate of the Canadian dollar at the end of 1 year is $.59. Show your work.

42. Long-Term Hedging with Forward Contracts Tampa Co. will build airplanes and export them to Mexico for delivery in 3 years. The total payment to be received in 3 years for these exports is 900 million pesos. Today the peso's spot rate is $.10. The annual U.S. interest rate is 4 percent, regardless of the debt maturity. The annual interest rate in Mexico is 9 percent regardless of the debt maturity. Tampa plans to hedge its exposure with a forward contract that it will arrange today. Assume that interest rate parity exists. Determine the dollar amount that Tampa will receive in 3 years.

43. Timing the Hedge Red River Co. (a U.S. firm) purchases imports that have a price of 400,000 Singapore dollars, and it has to pay for the imports in 90 days. It will use a 90-day forward contract to cover its payables. Assume that interest rate parity exists. This morning, the spot rate of the Singapore dollar was $.50. At noon, the Federal Reserve reduced U.S. interest rates, while there was no change in interest rates in Singapore. The Fed's actions immediately increased the degree of uncertainty surrounding the value of the Singapore dollar over the next 3 months. The Singapore dollar's spot rate remained at $.50 throughout the day. Assume that the U.S. and Singapore interest rates were the same as of this morning. Also assume that the international Fisher effect holds. If Red River Co. purchased a currency call option contract at the money this morning to hedge its exposure, would its total U.S. dollar cash outflows be more than, less than, or the same as the total U.S. dollar cash outflows if it had negotiated a forward contract this morning? Explain.

44. Hedging with Forward versus Option Contracts Assume interest rate parity exists. Today, the 1-year interest rate in Canada is the same as the 1-year interest rate in the United States. Utah Co. uses the forward rate to forecast the future spot rate of the Canadian dollar that will exist in 1 year. It needs to purchase Canadian dollars in 1 year. Will the expected cost of its payables be lower if it hedges its payables with a 1-year forward contract on Canadian dollars or a 1-year at-the-money call option contract on Canadian dollars? Explain.

45. Hedging with a Bull Spread (See the chapter appendix.) Evar Imports, Inc., buys chocolate from Switzerland and resells it in the United States. It just purchased chocolate invoiced at SF62,500. Payment for the invoice is due in 30 days. Assume that the current exchange rate of the Swiss franc is $.74. Also assume that three call options for the franc are available. The first option has a strike price of $.74 and a premium of $.03; the second option has a strike price of $.77 and a premium of $.01; the third option has a strike price of $.80 and a premium of $.006. Evar Imports is concerned about a modest appreciation in the Swiss franc.

a. Describe how Evar Imports could construct a bull spread using the first two options. What is the cost of this hedge? When is this hedge most effective? When is it least effective?

b. Describe how Evar Imports could construct a bull spread using the first option and the third option. What is the cost of this hedge? When is this hedge most effective? When is it least effective?

c. Given your answers to parts (a) and (b), what is the trade-off involved in constructing a bull spread using call options with a higher exercise price?

46. Hedging with a Bear Spread (See the chapter appendix.) Marson, Inc., has some customers in Canada and frequently receives payments denominated in Canadian dollars (C$). The current spot rate for the Canadian dollar is $.75. Two call options on Canadian dollars are available. The first option has an exercise price of $.72 and a premium of $.03. The second option has an exercise price of $.74 and a premium of $.01. Marson, Inc., would like to use a bear spread to hedge a receivable position of C$50,000, which is due in a month. Marson is concerned that the Canadian dollar may depreciate to $.73 in 1 month.

a. Describe how Marson, Inc., could use a bear spread to hedge its position.

b. Assume the spot rate of the Canadian dollar in 1 month is $.73. Was the hedge effective?

47. Hedging with Straddles (See the chapter appendix.) Brooks, Inc., imports wood from Morocco. The Moroccan exporter invoices in Moroccan dirham. The current exchange rate of the dirham is $.10. Brooks just purchased wood for 2 million dirham and should pay for the wood in 3 months. It is also possible that Brooks will receive 4 million dirham in 3 months from the sale of refinished wood in Morocco. Brooks is currently in negotiations with a Moroccan importer about the refinished wood. If the negotiations are successful, Brooks will receive the 4 million dirham in 3 months for a net cash inflow of 2 million dirham. The following option information is available:

- Call option premium on Moroccan dirham = $.003.
- Put option premium on Moroccan dirham = $.002.
- Call and put option strike price = $.098.
- One option contract represents 500,000 dirham.

a. Describe how Brooks could use a straddle to hedge its possible positions in dirham.

b. Consider three scenarios. In the first scenario, the dirham's spot rate at option expiration is equal to the exercise price of $.098. In the second scenario, the dirham depreciates to $.08. In the third scenario, the dirham appreciates to $.11. For each scenario, consider both the case when the negotiations are successful and the case when the negotiations are not successful. Assess the effectiveness of the long straddle in each of these situations by comparing it to a strategy of using long call options to hedge.

48. Hedging with Straddles versus Strangles (See the chapter appendix.) Refer to the previous problem. Assume that Brooks believes the cost of a long straddle is too high. However, call options with an exercise price of $.105 and a premium of $.002 and put options with an exercise price of $.09 and a premium of $.001 are also available on Moroccan dirham. Describe how Brooks could use a long strangle to hedge its possible dirham positions. What is the trade-off involved in using a long strangle versus a long straddle to hedge the positions?

49. Comparison of Hedging Techniques You own a U.S. exporting firm and will receive 10 million Swiss francs in 1 year. Assume that interest parity exists. Assume zero transaction costs. Today, the 1-year interest rate in the United States is 7 percent, and the 1-year interest rate in Switzerland is 9 percent. You believe that today's spot rate of the Swiss franc (which is $.85) is the best predictor of the spot rate 1 year from now. You consider these alternatives:

- hedge with 1-year forward contract,
- hedge with a money market hedge,
- hedge with at-the-money put options on Swiss francs with a 1-year expiration date, or
- remain unhedged.

Which alternative will generate the highest expected amount of dollars? If multiple alternatives are tied for generating the highest expected amount of dollars, list each of them.

50. PPP and Hedging with Call Options Visor, Inc. (a U.S. firm), has agreed to purchase supplies from Argentina and will need 1 million Argentine pesos in 1 year. Interest rate parity presently exists. The annual interest rate in Argentina is 19 percent. The annual interest rate in the United States is 6 percent. You expect that annual inflation will be about 11 percent in Argentina and 4 percent in the United States. The spot rate of the Argentine peso is $.30. Call options on pesos are available with a 1-year expiration date, an exercise price of $.29, and a premium of $.03 per unit. Determine the expected amount of dollars that you will pay from hedging with call options (including the premium paid for the options) if you expect that the spot rate of the peso will change over the next year based on purchasing power parity (PPP).

51. Long-Term Forward Contracts Assume that interest rate parity exists. The annualized interest rate is presently 5 percent in the United States for any term to maturity and is 13 percent in Mexico for any term to maturity. Dokar Co. (a U.S. firm) has an agreement in which it will develop and export software to Mexico's government 2 years from now and will receive 20 million Mexican pesos in 2 years. The spot rate of the peso is $.10. Dokar uses a 2-year forward contract to hedge its receivables in 2 years. How many dollars will Dokar Co. receive in 2 years? Show your work.

52. Money Market versus Put Option Hedge Narto Co. (a U.S. firm) exports to Switzerland and expects to receive 500,000 Swiss francs in 1 year. The 1-year U.S. interest rate is 5 percent when investing funds and 7 percent when borrowing funds. The 1-year Swiss interest rate is 9 percent when investing funds and 11 percent when borrowing funds. The spot rate of the Swiss franc is $.80. Narto expects that the spot rate of

the Swiss franc will be $.75 in 1 year. There is a put option available on Swiss francs with an exercise price of $.79 and a premium of $.02.

a. Determine the amount of dollars that Narto Co. will receive at the end of 1 year if it implements a money market hedge.

b. Determine the amount of dollars that Narto Co. expects to receive at the end of 1 year (after accounting for the option premium) if it implements a put option hedge.

53. Forward versus Option Hedge Assume that interest rate parity exists. Today, the 1-year interest rate in Japan is the same as the 1-year interest rate in the United States. You use the international Fisher effect when forecasting how exchange rates will change over the next year. You will receive Japanese yen in 1 year. You can hedge receivables with a 1-year forward contract on Japanese yen or a 1-year at-the-money put option contract on Japanese yen. If you use a forward hedge, will your expected dollar cash flows in 1 year be higher than, lower than, or the same as if you had used put options? Explain.

54. Long-Term Hedging Rebel Co. (a U.S. firm) has a contract with the government of Spain and will receive payments of 10,000 euros in exchange for consulting services at the end of each of the next 10 years. The annualized interest rate in the United States is 6 percent regardless of the term to maturity. The annualized interest rate for the euro is 6 percent regardless of the term to maturity. Assume that you expect that the interest rates for the U.S. dollar and for the euro will be the same at any future time, regardless of the term to maturity. Assume that interest rate parity exists. Rebel considers two alternative strategies:

Strategy 1 It can use forward hedging 1 year in advance of the receivables, so that at the end of each year, it creates a new 1-year forward hedge for the receivables.

Strategy 2 It can establish a hedge today for all future receivables (a 1-year forward hedge for receivables in 1 year, a 2-year forward hedge for receivables in 2 years, and so on).

a. Assume that the euro depreciates consistently over the next 10 years. Will Strategy 1 result in higher, lower, or the same cash flows for Rebel Co. as Strategy 2?

b. Assume that the euro appreciates consistently over the next 10 years. Will Strategy 1 result in higher, lower, or the same cash flows for Rebel Co. as strategy 2?

55. Long-Term Hedging San Fran Co. imports products. It will pay 5 million Swiss francs for imports in 1 year. Mateo Co. will also pay 5 million Swiss francs for imports in 1 year. San Fran Co. and Mateo Co. will also need to pay 5 million Swiss francs for imports arriving in 2 years.

Today, Mateo Co. uses a 1-year forward contract to hedge its payables in 1 year. A year from today, it will use a 1-year forward contract to hedge the payables that it must pay 2 years from today.

Today, San Fran Co. uses a 1-year forward contract to hedge its payables due in 1 year. Today, it also uses a 2-year forward contract to hedge its payables in 2 years.

Interest rate parity exists and it will continue to exist in the future. The Swiss franc will consistently depreciate over the next 2 years.

Switzerland and the United States have similar interest rates, regardless of their maturity, and those rates will continue to be the same in the future.

Will the total expected dollar cash outflows that San Fran Co. will pay for its payables be higher than, lower than, or the same as the total expected dollar cash outflows that Mateo Co. will pay? Explain.

56. Comparison of Hedging Techniques Today, the spot rate of the euro is $1.20. The one-year forward rate is $1.16. A one-year call option on euros exists with a premium of $.04 per unit and an exercise price of $1.17. You think the spot rate is the best forecast of future spot rates. You will need to pay 10 million euros in one year. Determine whether a money market hedge or a call option hedge would be more appropriate to hedge your payables.

57. IRP, PPP, and the Hedging Decision The one-year U.S. interest rate is presently higher than the Japanese interest rate. Assume a real rate of interest of 0 percent in each country. Assume that interest rate parity exists. You believe in purchasing power parity (PPP). You have receivables of 10 million Japanese yen that you will definitely receive in one year. Should you hedge? Briefly explain.

58. Cross-Hedging Strategy Assume that the country of Dreeland has a currency (called the dree) that tends to move in tandem with the Chilean peso and is expected to continue to move in tandem with the Chilean peso in the future. Indianapolis Co., a U.S. firm, has a large amount of receivables denominated in dree. It expects that the dree will depreciate against the dollar over time. There are no derivatives available on

the dree. Indianapolis Co. considers the following strategies to reduce its exchange rate risk:

a. use a money market hedge in which it converts dollars into dree and maintains a deposit denominated in dree for one year,

b. use a forward contract to purchase Chilean pesos forward,

c. sell a put option hedge on Chilean pesos,

d. purchase a call option on Chilean pesos, and

e. use a forward contract in which it sells Chilean pesos forward.

Which strategy is most appropriate?

59. Estimating the Hedged Cost of Payables Grady Co. is a manufacturer of hockey equipment in Chicago, and it will need 3 million Swiss francs in one year to pay for imported supplies. The U.S. one-year interest rate is 2 percent Switzerland's one-year interest rate is 7 percent. The spot rate of the Swiss franc is $.90. The one-year forward rate of the Swiss franc is $.88. A one-year call option on Swiss franc exists with an exercise price of $.90 and a premium of $.03 per unit. As the Treasurer of Grady Co., you think the spot rate of the Swiss franc is the best forecast of the future spot rate of the Swiss franc.

a. If you use a money market hedge, determine the amount of dollars that you will pay for the payables.

b. If you use a call option hedge, determine the expected amount of dollars that you will pay for the payables (account for the option premium within your estimate).

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 *International Financial Management* text companion website. Go to www.cengagebrain.com (students) or www.cengage.com/login (instructors) and search using **ISBN 9781133947837**.

Blades, Inc. Case

Management of Transaction Exposure

Blades, Inc., has recently decided to expand its international trade relationship by exporting to the United Kingdom. Jogs, Ltd., a British retailer, has committed itself to the annual purchase of 200,000 pairs of Speedos, Blades' primary product, for a price of £80 per pair. The agreement is to last for 2 years, at which time it may be renewed by Blades and Jogs.

In addition to this new international trade relationship, Blades continues to export to Thailand. Its primary customer there, a retailer called Entertainment Products, is committed to the purchase of 180,000 pairs of Speedos annually for another three years at a fixed price of 4,594 Thai baht per pair. When the agreement terminates, it may be renewed by Blades and Entertainment Products.

Blades also incurs costs of goods sold denominated in Thai baht. It imports materials sufficient to manufacture 72,000 pairs of Speedos annually from Thailand. These imports are denominated in baht, and the price depends on current market prices for the rubber and plastic components imported.

Under the two export arrangements, Blades sells quarterly amounts of 50,000 and 45,000 pairs of Speedos to Jogs and Entertainment Products, respectively. Payment for these sales is made on the first of January, April, July, and October. The annual amounts are spread over quarters in order to avoid excessive inventories for the British and Thai retailers. Similarly, in order to avoid excessive inventories, Blades usually imports materials sufficient to manufacture 18,000 pairs of Speedos quarterly from Thailand. Although payment terms call for payment within 60 days of delivery, Blades generally pays for its Thai imports upon delivery on the first day of each quarter in order to maintain its trade relationships with the Thai suppliers. Blades feels that early payment is beneficial, as other customers of the Thai supplier pay for their purchases only when it is required.

Since Blades is relatively new to international trade, Ben Holt, Blades' chief financial officer, is concerned with the potential impact of exchange rate fluctuations on Blades' financial performance. Holt is vaguely familiar with various techniques available to hedge transaction exposure, but he is not certain whether one technique is superior to the others.

Holt would like to know more about forward, money market, and option hedges and has asked you, a financial analyst at Blades, to help him identify the hedging technique most appropriate for Blades.

Unfortunately, no options are available for Thailand, but British call and put options are available for £31,250 per option. Holt has gathered and provided you with the following information for Thailand and the United Kingdom:

	THAILAND	UNITED KINGDOM
Current spot rate	$.0230	$1.50
90-day forward rate	$.0215	$1.49
Put option premium	Not available	$.020 per unit
Put option exercise price	Not available	$1.47
Call option premium	Not available	$.015 per unit
Call option exercise price	Not available	$1.48
90-day borrowing rate (nonannualized)	4%	2%
90-day lending rate (nonannualized)	3.5%	1.8%

In addition to this information, Holt has informed you that the 90-day borrowing and lending rates in the United States are 2.3 and 2.1 percent, respectively, on a nonannualized basis. He has also identified the following probability distributions for the exchange rates of the British pound and the Thai baht in 90 days:

PROBABILITY	SPOT RATE FOR THE THAI BAHT IN 90 DAYS	SPOT RATE FOR THE BRITISH POUND IN 90 DAYS
5%	$1.45	$.0200
20	1.47	.0213
30	1.48	.0217
25	1.49	.0220
15	1.50	.0230
5	1.52	.0235

Blades' next sales to and purchases from Thailand will occur 1 quarter from now. If Blades decides to hedge, Holt will want to hedge the entire amount subject to exchange rate fluctuations, even if it requires overhedging (i.e., hedging more than the needed amount). Currently, Holt expects the imported components from Thailand to cost approximately 3,000 baht per pair of Speedos. Holt has asked you to answer the following questions for him:

1. Using a spreadsheet, compare the hedging alternatives for the Thai baht with a scenario under which Blades remains unhedged. Do you think Blades should hedge or remain unhedged? If Blades should hedge, which hedge is most appropriate?
2. Using a spreadsheet, compare the hedging alternatives for the British pound receivables with a scenario under which Blades remains unhedged. Do you think Blades should hedge or remain unhedged? Which hedge is the most appropriate for Blades?
3. In general, do you think it is easier for Blades to hedge its inflows or its outflows denominated in foreign currencies? Why?
4. Would any of the hedges you compared in question 2 for the British pounds to be received in 90 days require Blades to overhedge? Given Blades' exporting arrangements, do you think it is subject to overhedging with a money market hedge?
5. Could Blades modify the timing of the Thai imports in order to reduce its transaction exposure? What is the trade-off of such a modification?
6. Could Blades modify its payment practices for the Thai imports in order to reduce its transaction exposure? What is the trade-off of such a modification?
7. Given Blades' exporting agreements, are there any long-term hedging techniques Blades could benefit from? For this question only, assume that Blades incurs all of its costs in the United States.

Small Business Dilemma

Hedging Decisions by the Sports Exports Company

Jim Logan, owner of the Sports Exports Company, will be receiving about 10,000 British pounds about 1 month from now as payment for exports produced and sent by his firm. Logan is concerned about his exposure because he believes that there are two possible scenarios: (1) the pound will depreciate by 3 percent over the next month or (2) the pound will appreciate by 2 percent over the next month. There is a 70 percent chance that (1) will occur. There is a 30 percent chance that (2) will occur. Logan notices that the prevailing spot rate of the pound is $1.65, and the 1-month forward rate is about $1.645.

Logan can purchase a put option over the counter from a securities firm that has an exercise (strike) price of $1.645, a premium of $.025, and an expiration date of 1 month from now.

1. Determine the amount of dollars received by the Sports Exports Company if the receivables to be received in 1 month are not hedged under each of the two exchange rate scenarios.
2. Determine the amount of dollars received by the Sports Exports Company if a put option is used to hedge receivables in 1 month under each of the two exchange rate scenarios.
3. Determine the amount of dollars received by the Sports Exports Company if a forward hedge is used to hedge receivables in 1 month under each of the two exchange rate scenarios.
4. Summarize the results of dollars received based on an unhedged strategy, a put option strategy, and a forward hedge strategy. Select the strategy that you prefer based on the information provided.

Internet/Excel Exercises

1. The following website contains annual reports of many MNCs: www.annualreportservice.com. Review the annual report of your choice. Look for any comments in the report that describe the MNC's hedging of transaction exposure. Summarize the MNC's hedging of transaction exposure based on the comments in the annual report.

2. The following website provides exchange rate movements against the dollar over recent months: www.federalreserve.gov/releases. Based on the exposure of the MNC you assessed in question 1, determine whether the exchange rate movements of whatever currency (or currencies) it is exposed to moved in a favorable or unfavorable direction over the last few months.

Online Articles with Real-World Examples

Find a recent article online that describes an actual international finance application or a real-world example about a specific MNC's actions that reinforces one or more of the concepts covered in this chapter.

If your class has an online component, your professor may ask you to post your summary there and provide the Web link of the article so that other students can access it. If your class is live, your professor may ask you to summarize your application in class. Your professor may assign specific students to complete this assignment for this chapter or may allow any students to do the assignment on a volunteer basis.

For recent online articles and real-world examples applied to this chapter, consider using the following search terms (and include the current year as a search term to ensure that the online articles are recent).

1. company AND hedge
2. Inc. AND hedge
3. hedge AND currency
4. hedge AND exchange rate
5. forward contract AND hedge
6. currency futures AND hedge
7. money market AND hedge
8. currency option AND hedge
9. [name of an MNC] AND forward contract
10. company AND hedging policy

APPENDIX 11

Nontraditional Hedging Techniques

Although traditional hedging techniques were covered in the chapter, many other techniques may be appropriate for an MNC's particular situation. Some of these nontraditional techniques are described in this appendix.

Hedging with Currency Straddles

In reality, some MNCs do not know whether they will have net cash inflows or outflows as a result of their transactions in a specific currency over a particular period of time. A long straddle (purchase of a call option and put option with the same exercise price) is an effective tool to hedge under these conditions.

EXAMPLE

Houston Co. conducts business in Mexico and expects to need 4 million Mexican pesos (MXP) to cover specific expenses. If it is unable to renew a business deal with the Mexican government (its biggest customer), it will receive a total of MXP3 million in revenue in 1 month, which will result in net cash flows of −MXP1 million. If it is able to renew the business deal with the government, it will receive a total of MXP5 million, which will result in net cash flows of +MXP1 million. The prevailing spot rate of the Mexican peso is $.09. If Houston has excess pesos in 1 month, it will convert them to dollars. If Houston does not have enough pesos in 1 month, it will use dollars to obtain the amount that it needs. Houston would like to hedge its exchange rate risk, regardless of which scenario occurs.

Currently, call options for Mexican pesos with expiration dates in 1 month are available with an exercise price of $.09 and a premium of $.004 per peso. Put options for Mexican pesos with an expiration date of 1 month are available with an exercise price of $.09 and a premium of $.005 per peso. Options for Mexican pesos are denominated in 250,000 pesos per option contract.

Houston could hedge its possible position of having positive net cash flows of MXP1 million by purchasing put options. It would pay a premium of $5,000 (1,000,000 units × $.005). It could hedge its possible position of needing MXP1 million by purchasing call options. It would pay a premium of $4,000 (1,000,000 units × $.004). Assume that Houston constructs a straddle to hedge both possible outcomes and pays $9,000 for the call options and put options on pesos. Assume that Houston exercises the options in 1 month, if at all.

Consider the following scenarios that could occur one month from now.

1. If Houston has net cash flows of +MXP1 million and the peso's value is $.10, the company would let its put options expire and would convert its pesos to dollars in the spot market, receiving $100,000 (1,000,000 units × $.10) from this transaction. It would also exercise its call option by purchasing 1 million pesos at $.09 and selling them in the spot market for $.10.

This transaction would generate a gain of $10,000. Overall, Houston would receive $110,000, minus the $9,000 in premiums paid for the options.

2. If Houston has net cash flows of +MXP1 million and the peso depreciates to $.08, the company would exercise its put options and let the call options expire. Overall, Houston would receive $90,000 (1,000,000 units × $.09) from exercising the options minus the $9,000 in premiums paid for the options.
3. If Houston has net cash flows of +MXP1 million and the peso is $.09, the company would let its call and put options expire. It would receive $90,000 (1,000,000 × $.09) from selling pesos in the spot market minus the $9,000 in premiums paid for the options.
4. If Houston has net cash flows of −MXP1 million and the peso's value is $.10, the company would exercise its call options and let its put options expire. Overall, Houston would pay a total of $99,000, which consists of the $90,000 (1,000,000 × $.09) from exercising the call option plus the $9,000 in premiums paid for the options.
5. If Houston has net cash flows of −MXP1 million and the peso's value is $.08, the company would let its call options expire and buy pesos in the spot market. It would also buy 1 million pesos and then sell them by exercising its put options. This transaction would generate a gain of $10,000. Overall, Houston would pay a total of $79,000, which consists of the $80,000 paid to obtain the pesos it needs plus the $9,000 in premiums paid for the options minus the $10,000 gain generated from its put options.
6. If Houston has net cash flows of −MXP1 million and the peso's value is $.09, the company would let its call and put options expire. It would pay a total of $99,000, which consists of the $90,000 paid to obtain pesos and the $9,000 in premiums paid for the options. ●

Many other scenarios could also occur. A summary of possible scenarios, and the actions taken by Houston Co., is given in Exhibit 11A.1.

Hedging with Currency Strangles

In the hedging example just provided for Houston Co., consider that the expected value of the amount that Houston would pay or receive based on today's spot rate is $90,000 (MXP 1,000,000 × $.09). The option premiums paid for the options ($9,000) represent

Exhibit 11A.1 Possible Scenarios for Houston Co. When Hedging with a Straddle

PANEL A: HOUSTON HAS NET CASH FLOWS OF +MXP1,000,000 IN 1 MONTH	
MXP value > $.09 in one month	• Houston converts excess pesos to dollars in the spot market. • It lets the put options expire. • It exercises its call options and sells the pesos obtained from this transaction in the spot market; the proceeds recapture part of the premiums that were paid for the options.
MXP value < $.09 in one month	• Houston converts excess pesos to dollars at $.09 by exercising its put options. • It lets the call options expire.
MXP value = $.09 in one month	• Houston converts excess pesos to dollars in the spot market. • It lets its call options and put options expire.
PANEL B: HOUSTON HAS NET CASH FLOWS OF −MXP1,000,000 IN 1 MONTH	
MXP value > $.09 in one month	• Houston converts dollars to pesos by exercising its call options. • It lets the put options expire.
MXP value < $.09 in one month	• It lets the call options expire. • It buys pesos in the spot market and sells pesos obtained by exercising the put options; the proceeds recapture part of the premiums that were paid for the options.
MXP value = $.09 in one month	• Houston converts dollars to pesos in the spot market. • It lets its call and put options expire.

10 percent of that expected value. Thus, the straddle is an expensive means of hedging. The exercise price at which Houston hedged was equal to the spot rate ("at the money"). If Houston is willing to accept exposure to small exchange rate movements in the peso, it could reduce the premiums paid for the options. Specifically, it would use a *long strangle* by purchasing a call option and a put option that have different exercise prices. By purchasing a call option that has an exercise price higher than $.09 and a put option that has an exercise price lower than $.09, Houston can reduce the premiums it will pay on the options.

EXAMPLE Reconsider the example in which Houston Co. expects that it will have net cash flows of either +MXP1 million or −MXP1 million in 1 month. To reduce the premiums it pays for hedging with options, it can purchase options that are out of the money. Assume that it can obtain call options for Mexican pesos with an expiration date of 1 month, an exercise price of $.095, and a premium of $.002 per peso. It can also obtain put options for Mexican pesos with an expiration date of 1 month, an exercise price of $.085, and a premium of $.003 per peso.

Houston Co. could hedge its possible position of needing MXP1 million by purchasing call options. It would pay a premium of $2,000 (1,000,000 units × $.002). It could also hedge its possible position of having positive net cash flows of MXP1 million by purchasing put options. It would pay a premium of $3,000 (1,000,000 units × $.003). Overall, Houston would pay $5,000 for the call options and put options on pesos, which is substantially less than the $9,000 it would pay for the straddle in the previous example. However, the options do not offer protection until the spot rate deviates by more than $.005 from its existing level. If the spot rate remains within the range of the two exercise prices (from $.085 to $.095), Houston will not exercise either option.

This example of hedging with a strangle is a compromise between hedging with the straddle in the previous example and not hedging. For the range of possible spot rates between $.085 and $.095, there is no hedge. For scenarios in which the spot rate moves outside the range, Houston is hedged. It will have to pay no more than $.095 if it needs to obtain pesos and will be able to sell pesos for at least $.085 if it has pesos to sell. ●

Hedging with Currency Bull Spreads

In certain situations, MNCs can use currency bull spreads to hedge their cash outflows denominated in a foreign currency, as the following example illustrates.

EXAMPLE Peak, Inc., needs to order Canadian raw materials to use in its production process. The Canadian exporter typically invoices Peak in Canadian dollars. Assume that the current exchange rate for the Canadian dollar (C$) is $.73 and that Peak needs C$100,000 in 3 months. Two call options for Canadian dollars with expiration dates in 3 months and the following additional information are available:

- Call option 1 premium on Canadian dollars = $.015.
- Call option 2 premium on Canadian dollars = $.008.
- Call option 1 strike price = $.73.
- Call option 2 strike price = $.75.
- One option contract represents C$50,000.

To lock into a future price for the C$100,000, Peak could buy two option 1 contracts, paying 2 × C$50,000 × $.015 = $1,500. This would effectively lock in a maximum price of $.73 that Peak would pay in 3 months for a total maximum outflow of $74,500 (C$100,000 × $.73 + $1,500). If the spot price for Canadian dollars at option expiration is below $.73, Peak has the right to let the options expire and buy the C$100,000 in the open market for the lower price. Naturally, Peak would still have paid the $1,500 total premium in this case.

Historically, the Canadian dollar has been relatively stable against the U.S. dollar. If Peak believes that the Canadian dollar will appreciate in the next 3 months but is very unlikely to appreciate above the higher exercise price of $.75, it should consider constructing a bull spread to

hedge its Canadian dollar payables. To do so, Peak would purchase two option 1 contracts and write two option 2 contracts. The total cash outflow necessary to construct this bull spread is 2 × C$50,000 × ($.015 − $.008) = $700, since Peak would receive the premiums from writing the two option 2 contracts. Constructing the bull spread has reduced the cost of hedging by $800 ($1,500 − $700).

If the spot price of the Canadian dollar at option expiration is below the $.75 strike price, the bull spread will have provided an effective hedge. For example, if the spot price at option expiration is $.74, Peak will exercise the two option 1 contracts it purchased, for a total maximum outflow of $73,700 (C$100,000 × $.73 + $700). The buyer of the two option 2 contracts Peak wrote would let those options expire. If the Canadian dollar depreciates substantially below the lower strike price of $.73, the hedge will also be effective, as both options will expire worthless. Peak would purchase the Canadian dollars at the prevailing spot rate, having paid the difference in option premiums.

Now consider what will happen if the Canadian dollar appreciates above the higher exercise price of $.75 prior to option expiration. In this case, the bull spread will still reduce the total cash outflow and therefore provide a partial hedge. However, the hedge will be less effective.

As an illustration, assume the Canadian dollar appreciates to a spot price of $.80 in 3 months. Peak will still exercise the two option 1 contracts it purchased. However, the two option 2 contracts it wrote will also be exercised. Recall that this is a situation in which the maximum profit from the bull spread is realized, which is equal to the difference in exercise prices less the difference in the two premiums, or 2 × C$50,000 × ($.75 − $.73 − $.015 + $.008) = $1,300. Note that Peak must now purchase the C$100,000 it needs in the open market, since it needs to sell the Canadian dollars purchased by exercising the option 1 contracts to the buyer of the option 2 contracts it wrote. Therefore, Peak's total cash outflow in 3 months, when it needs the Canadian dollars, will be $78,700 (C$100,000 × $.80 − $1,300). Although Peak has successfully reduced its cash outflow in 3 months by $1,300, it would have fared much better by buying only two option 1 contracts to hedge its payables, which would have resulted in a maximum cash outflow of $74,500. Consequently, MNCs should use bull spreads to hedge only for relatively stable currencies that are not expected to appreciate drastically prior to option expiration. ●

Hedging with Currency Bear Spreads

In certain situations, MNCs can use currency bear spreads to hedge their receivables denominated in a foreign currency.

EXAMPLE Weber, Inc., has some Canadian customers. Weber typically bills these customers in Canadian dollars. Assume that the current exchange rate for the Canadian dollar (C$) is $.73 and that Weber expects to receive C$50,000 in 3 months. The following options for Canadian dollars are available.

- Call option 1 premium on Canadian dollars = $.015.
- Call option 2 premium on Canadian dollars = $.008.
- Call option 1 strike price = $.73.
- Call option 2 strike price = $.75.
- One option contract represents C$50,000.

If Weber believes the Canadian dollar will not depreciate much below the lower exercise price of $.75, it can construct a bear spread to hedge the receivable. Weber will buy call option 2 and write call option 1 to establish this bear spread. The total cash inflow resulting from this bear spread is C$50,000 × ($.015 − $.008) = $350. Constructing a bear spread will always result in a net cash inflow, since the spreader writes the call option with the lower exercise price and, therefore, the higher premium.

What will happen if the Canadian dollar appreciates above the higher exercise price of $.75 prior to option expiration? For example, assume that the spot rate for the Canadian dollar is $.80 at option expiration. In this case, the bear spread would result in a maximum loss of $.013 ($.75 − $.73 − $.015 + $.008) per Canadian dollar, for a total maximum loss of $650. However, Weber can now sell the receivables at the prevailing spot rate of $.80, netting $39,350 (C$50,000 × $.80 − $650).

Furthermore, while the maximum loss remains at $650 for the bear spread, Weber can benefit if the Canadian dollar appreciates even more.

The bear spread also provides an effective hedge if the spot price of the Canadian dollar at option expiration is above the lower strike price of $.73 but below the higher strike price of $.75. In this case, however, the benefit is reduced. For instance, if the spot price at option expiration is $.74, Weber will let option 2 expire. The buyer of option 1 will exercise it, and Weber will sell the receivables at the exercise price of $.73 to fulfill its obligation. This will result in a total cash inflow of $36,850 (C$50,000 × $.73 + $350) after including the net premium received from establishing the spread.

If the Canadian dollar depreciates below the lower strike price of $.73, Weber will realize the maximum gain from the bear spread but will have to sell the receivables at the low prevailing spot rate. For example, if the spot rate at option expiration is $.70, both options will expire worthless, but Weber will have received $350 from establishing the spread. If Weber sells the receivables at the spot rate, the net cash inflow will be $35,350 (C $50,000 × $.70 + $350). ●

In summary, MNCs should hedge receivables using bear spreads only for relatively stable currencies that are expected to depreciate modestly, but not drastically, prior to option expiration.

12 Managing Economic Exposure and Translation Exposure

CHAPTER OBJECTIVES

The specific objectives of this chapter are to:

- explain how an MNC's economic exposure can be hedged and
- explain how an MNC's translation exposure can be hedged.

As the previous chapter described, multinational corporations can manage the exposure of their international contractual transactions to exchange rate movements (referred to as transaction exposure) in various ways. Nevertheless, cash flows of MNCs may still be sensitive to exchange rate movements (economic exposure) even if anticipated international contractual transactions are hedged. Furthermore, the consolidated financial statements of MNCs may still be exposed to exchange rate movements (translation exposure). By managing economic exposure and translation exposure, financial managers may increase the value of their MNCs.

In general, it is more difficult to hedge economic or translation exposure than to hedge transaction exposure. The reasons are explained in this chapter.

12-1 Managing Economic Exposure

From a U.S. firm's perspective, transaction exposure represents only the exchange rate risk when converting net foreign cash inflows to U.S. dollars or when purchasing foreign currencies to send payments. Economic exposure represents any impact of exchange rate fluctuations on a firm's future cash flows. To illustrate the difference between transaction exposure and economic exposure, consider the following example.

EXAMPLE Facebook is commonly accessed by many customers outside of the United States. When it first established a credit system for users to make purchases online, it required that all payments be in U.S. dollars. Consequently, these transactions were not subject to transaction exposure. However, they were subject to economic exposure because it is more costly for European customers to make purchases online when the euro is weak, which could cause these customers to make fewer purchases and thus reduce Facebook's cash inflows. In 2012, Facebook revised its credit system so that its users could make purchases in their local currency. This is more desirable for many non-U.S. users, but it means that Facebook is directly exposed to exchange rate movements. If the euro weakens, Facebook is adversely affected because the euros it receives are converted into fewer dollars. Whether Facebook requires payment in dollars or allows payment in the foreign currency, these transactions are subject to economic exposure, because a change in the value of the foreign currencies could affect the dollar cash inflows that Facebook receives. ●

Any U.S.-based MNC could require that all transactions be in dollars to avoid transaction exposure. But that does not eliminate its economic exposure. Thus, MNCs cannot focus just on hedging their foreign currency payables or receivables but must also

attempt to determine how all their cash flows will be affected by possible exchange rate movements.

EXAMPLE

Nike's economic exposure comes in various forms. First, it is subject to transaction exposure because of its numerous purchase and sale transactions in foreign currencies, and this transaction exposure is a subset of economic exposure. Second, any remitted earnings from foreign subsidiaries to the U.S. parent also reflect transaction exposure and therefore reflect economic exposure. Third, a change in exchange rates that affects the demand for shoes at other athletic shoe companies (such as Adidas) can indirectly affect the demand for Nike's athletic shoes. Even if Nike could eliminate its transaction exposure, it cannot perfectly hedge its remaining economic exposure; it is difficult to determine exactly how a specific exchange rate movement will affect the demand for a competitor's athletic shoes and, therefore, how it will indirectly affect the demand for Nike's shoes. ●

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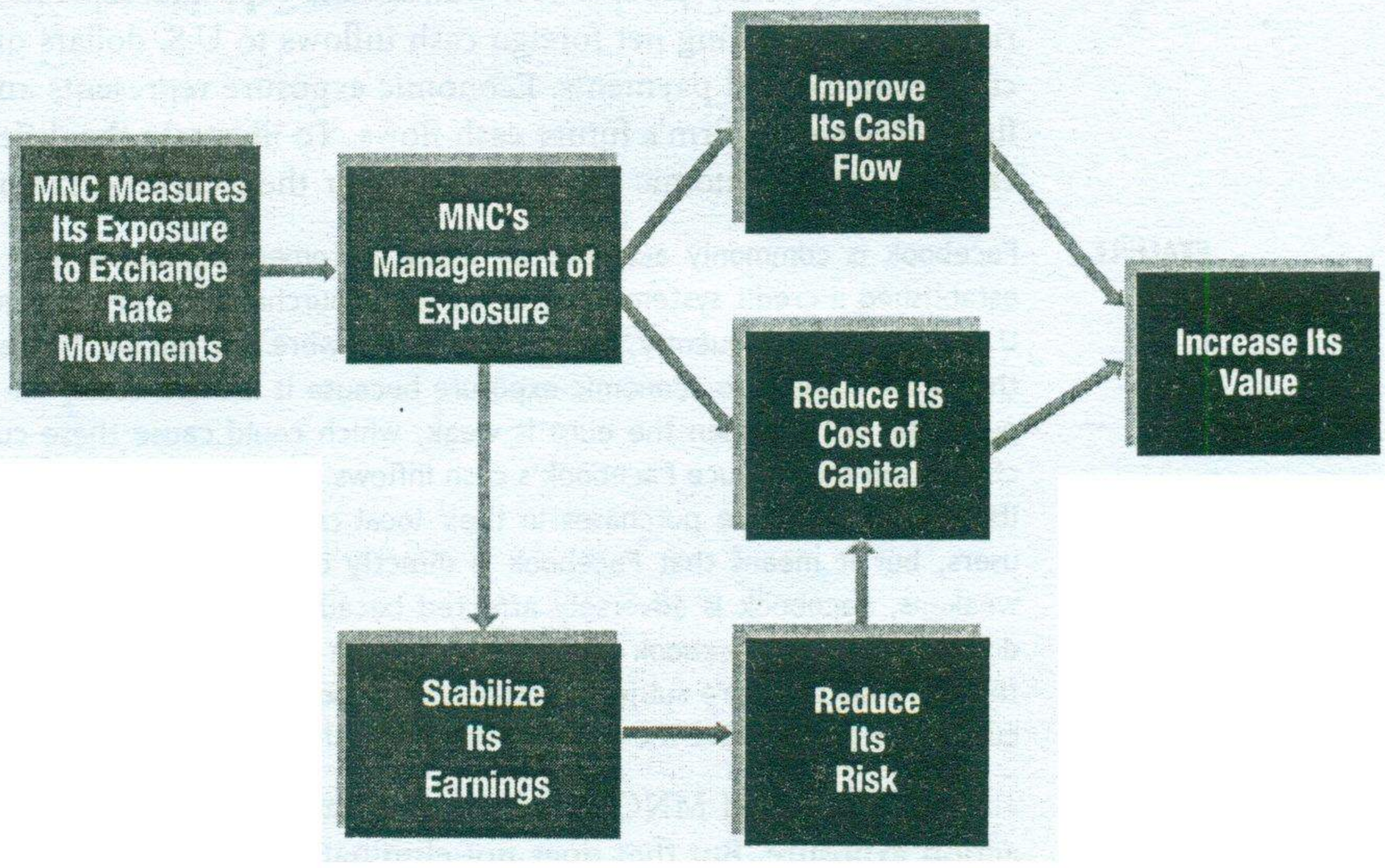
An example of an MNC's Web site. The Web sites of various MNCs make available financial statements such as annual reports that describe the use of financial derivatives to hedge interest rate risk and exchange rate risk.

The following comments in PepsiCo's annual report summarize the dilemma faced by many MNCs that assess economic exposure.

> *The economic impact of currency exchange rates on us is complex because such changes are often linked to variability in real growth, inflation, interest rates, governmental actions, and other factors. These changes, if material, can cause us to adjust our financing and operating strategies.*
>
> *—PepsiCo*

The means by which an MNC's management of its exposure to exchange rate movements can increase its value are summarized in Exhibit 12.1. First, it may be able to increase its cash inflows or reduce its cash outflows by properly managing its exposure. Second, it may be able to reduce its financing costs, which lowers its cost of capital. Third, it may be able to stabilize its earnings, which can reduce its risk and therefore reduce its cost of capital.

Exhibit 12.1 How Managing Exposure Can Increase an MNC's Value



12-1a Assessing Economic Exposure

An MNC must determine how it is subject to economic exposure before it can manage its economic exposure. It must measure its exposure to each currency in terms of its cash inflows and cash outflows. Information for each subsidiary can be used to derive estimates.

EXAMPLE Recall from Chapter 10 that Madison Co. is subject to economic exposure. Madison can assess its economic exposure to exchange rate movements by determining the sensitivity of its expenses and revenue to various possible exchange rate scenarios. Exhibit 12.2 reproduces Madison's revenue and expense information from Exhibit 10.12. Madison's sales in the United States are not sensitive to exchange rate scenarios. Canadian sales are expected to be C$4 million, but the dollar amount received from these sales will depend on the scenario. The cost of materials purchased in the United States is assumed to be $50 million and insensitive to exchange rate movements. The cost of materials purchased in Canada is assumed to be C$200 million. The U.S. dollar amount of this cost varies with the exchange rate scenario. ●

EXAMPLE The interest owed to U.S. banks is insensitive to the exchange rate scenario, but the projected amount of dollars needed to pay interest on existing Canadian loans varies with the exchange rate scenario.

Exhibit 12.2 enables Madison to assess how its cash flows before taxes will be affected by different exchange rate movements. A stronger Canadian dollar increases Madison's dollar revenue earned from Canadian sales. However, it also increases Madison's cost of materials purchased from Canada and the dollar amount needed to pay interest on loans from Canadian banks. The higher expenses more than offset the higher revenue in this scenario. Thus, the amount of Madison's cash flows before taxes is inversely related to the strength of the Canadian dollar.

If the Canadian dollar strengthens consistently over the long run, Madison's expenses likely will rise at a higher rate than its U.S. dollar revenue. Consequently, Madison may wish to revise its operations in a manner that either increases Canadian sales or reduces orders of Canadian materials. These actions would allow some offsetting of cash flows and therefore reduce its economic exposure, as explained next. ●

Exhibit 12.2 Original Impact of Possible Exchange Rates on Cash Flows of Madison Co. (in millions)

	EXCHANGE RATE SCENARIO		
	C$1 = $.75	C$1 = $.80	C$1 = .85
Sales			
(1) U.S. sales	$320.00	$320.00	$320.00
(2) Canadian sales	C$4 = 3.00	C$4 = 3.20	C$4 = 3.40
(3) Total sales in U.S. $	$323.00	$323.20	$323.40
Cost of Materials and Operating Expenses			
(4) U.S. cost of materials	$ 50.00	$ 50.00	$ 50.00
(5) Canadian cost of materials	C$200 = 150.00	C$200 = 160.00	C$200 = 170.00
(6) Total cost of materials in U.S. $	$200.00	$210.00	$220.00
(7) Operating expenses	$ 60.00	$ 60.00	$ 60.00
Interest Expenses			
(8) U.S. interest expenses	$ 3	$ 3	$ 3
(9) Canadian interest expenses	C$10 = 7.5	C$10 = 8	C$10 = 8.50
(10) Total interest expenses in U.S. $	$ 10.5	$ 11	$ 11.50
Cash flows in U.S. $ before taxes	$ 52.50	$ 42.20	$ 31.90

12-1b Restructuring to Reduce Economic Exposure

MNCs may restructure their operations to reduce their economic exposure. The restructuring involves shifting the sources of costs or revenue to other locations in order to match cash inflows and outflows in foreign currencies.

EXAMPLE

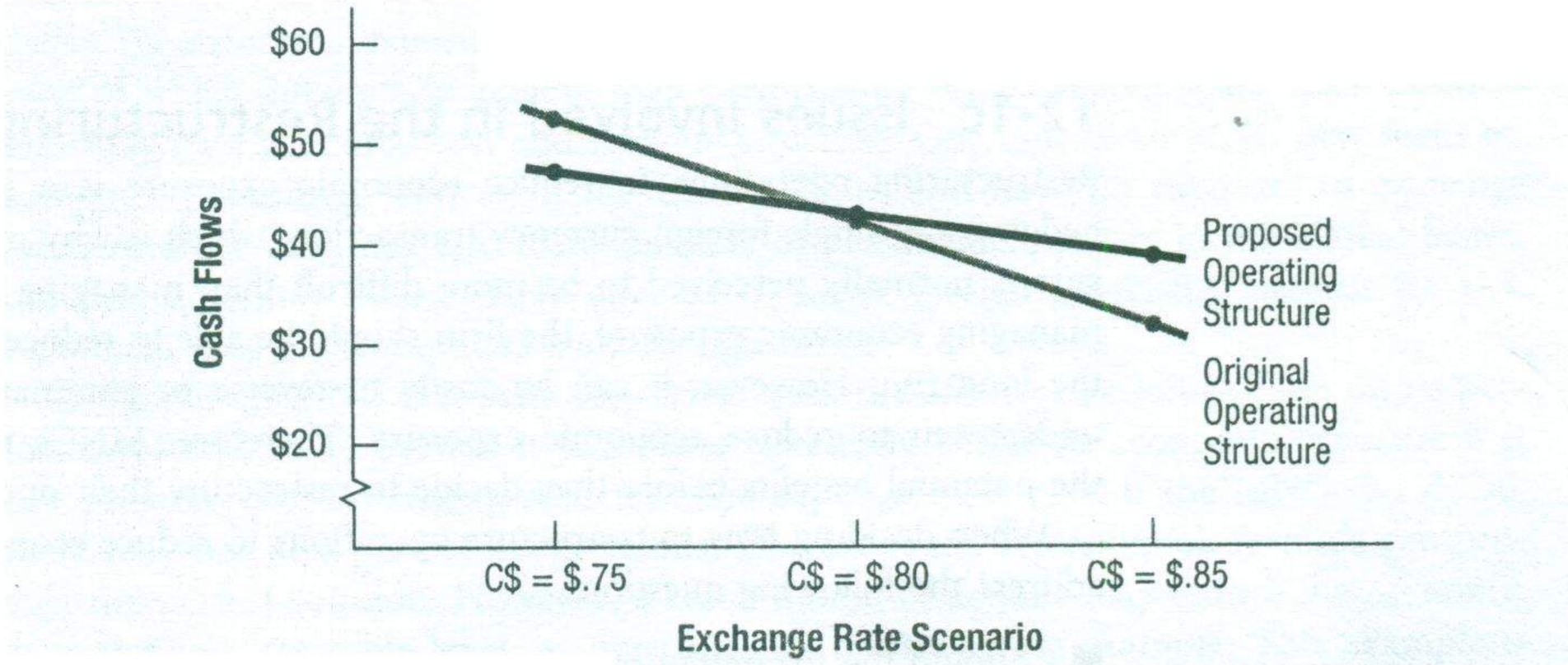
Reconsider the previous example of Madison Co., which has more cash outflows than cash inflows in Canadian dollars. Madison could create more balance by increasing Canadian sales. It believes that it can achieve Canadian sales of C$20 million if it spends $2 million more on advertising (which is part of Madison's operating expenses). The increased sales will also require an additional expenditure of $10 million on materials from U.S. suppliers. In addition, it plans to reduce its reliance on Canadian suppliers and increase its reliance on U.S. suppliers. Madison anticipates that this strategy will reduce the cost of materials from Canadian suppliers by C$100 million and increase the cost of materials from U.S. suppliers by $80 million (not including the $10 million increase resulting from increased sales to the Canadian market). Furthermore, it plans to borrow additional funds in the United States and retire some existing loans from Canadian banks. The result will be an additional interest expense of $4 million to U.S. banks and a reduction of C$5 million owed to Canadian banks. Exhibit 12.3 shows the anticipated impact of these strategies on Madison's cash flows. For each of the three exchange rate scenarios, the initial projections are in the left column and the revised projections (as a result of the proposed strategy) are in the right column.

Note first the projected total sales increase in response to Madison's plan to penetrate the Canadian market (see row 2). Second, the U.S. cost of materials is now $90 million higher as a result of the $10 million increase to accommodate increased Canadian sales and the $80 million increase due to the shift from Canadian suppliers to U.S. suppliers (see row 4). The Canadian cost of materials decreases from C$200 million to C$100 million as a result of this shift (see row 5). The revised operating expenses of $62 million include the $2 million increase in advertising expenses necessary to penetrate the Canadian market (see row 7). The interest expenses are

Exhibit 12.3 Impact of Possible Exchange Rate Movements on Earnings under Two Alternative Operational Structures (millions of currency units)

	EXCHANGE RATE SCENARIO C$ = $.75		EXCHANGE RATE SCENARIO C$ = $.80		EXCHANGE RATE SCENARIO C$ = $.85	
	ORIGINAL OPERATIONAL STRUCTURE	*PROPOSED OPERATIONAL STRUCTURE*	ORIGINAL OPERATIONAL STRUCTURE	*PROPOSED OPERATIONAL STRUCTURE*	ORIGINAL OPERATIONAL STRUCTURE	*PROPOSED OPERATIONAL STRUCTURE*
Sales						
(1) U.S. sales	$320.0	$320.0	$320.0	$320.0	$320.0	$320.0
(2) Canadian sales	C$4 = 3.0	C$20 = 15.00	C$4 = 3.20	C$20 = 16	C$4 = 3.40	C$20 = 17.00
(3) Total sales in U.S. $	$323.0	$335.00	$323.20	$336.00	$323.40	$337.00
Cost of Materials and Operating Expenses						
(4) U.S. cost of materials	$ 50.0	$140.00	$ 50.00	$140	$ 50.00	$140.00
(5) Canadian cost of materials	C$200 = 150.0	C$100 = 75.00	C$200 = 160.00	C$100 = 80	C$200 = 170.00	C$100 = 85.00
(6) Total cost of materials in U.S. $	$200.0	$215.00	$210.00	$220	$220.00	$225.00
(7) Operating expenses	$ 60	$ 62	$ 60	$ 62	$ 60	$ 62
Interest Expenses						
(8) U.S. interest expenses	$ 3.0	$ 7.00	$ 3.00	$ 7.00	$ 3.00	$ 7.00
(9) Canadian interest expenses	C$10 = 7.5	C$ = 3.75	C$10 = 8.00	C$5 = 4	C$5 = 8.50	C$ = 4.25
(10) Total interest expenses in U.S. $	$ 10.5	$ 10.75	$ 11.00	$ 11	$ 11.50	$ 11.25
(11) Cash flows in US. $ before taxes	$ 52.5	$ 47.25	$ 42.20	$ 43	$ 31.90	$ 38.75

Exhibit 12.4 Economic Exposure Based on the Original and Proposed Operating Structures



revised because of the increased loans from the U.S. banks and reduced loans from Canadian banks (see rows 8 and 9).

If Madison increases its Canadian dollar inflows and reduces its Canadian dollar outflows as proposed, then its revenue and expenses will be affected by movements of the Canadian dollar in a similar manner. Thus, its performance will be less susceptible to movements in the Canadian dollar. Exhibit 12.4 illustrates the sensitivity of Madison's earnings before taxes to the three exchange rate scenarios (derived from Exhibit 12.3). The reduced sensitivity of Madison's proposed restructured operations to exchange rate movements is obvious. ●

The way a firm restructures its operations to reduce economic exposure to exchange rate risk depends on the form of exposure. For Madison Co., future expenses are more sensitive than future revenue to the possible values of a foreign currency. Therefore, the company can reduce its economic exposure by increasing the sensitivity of revenue and reducing the sensitivity of expenses to exchange rate movements. However, firms that have a greater level of exchange rate–sensitive revenue than expenses would reduce their economic exposure by decreasing the level of exchange rate–sensitive revenue or by increasing the level of exchange rate–sensitive expenses.

Expediting the Analysis with Computer Spreadsheets Determining the sensitivity of cash flows (ignoring tax effects) to alternative exchange rate scenarios can be expedited by using a computer to create a spreadsheet similar to Exhibit 12.3. By revising the input to reflect various possible restructurings, the analyst can determine how each operational structure would affect the firm's economic exposure. For example, Madison Co. may also consider the expected impact from adjusting Canadian sales by various amounts and/or reducing Canadian expenses by various amounts.

EXAMPLE Recall that Madison Co. assessed one alternative operational structure in which it increased Canadian sales by C$16 million, reduced its purchases of Canadian materials by C$100 million, and reduced its interest owed to Canadian banks by C$5 million. By using a computerized spreadsheet, Madison can easily assess the impact of alternative strategies, such as increasing Canadian sales by

other amounts and/or reducing the Canadian expenses by other amounts. This provides Madison with more information about its economic exposure under various operational structures and enables it to devise the operational structure that will reduce its economic exposure to the degree desired. ●

12-1c Issues Involved in the Restructuring Decision

Restructuring operations to reduce economic exposure is a more complex task than hedging any single foreign currency transaction, which is why managing economic exposure is normally perceived to be more difficult than managing transaction exposure. By managing economic exposure, the firm should be able to reduce economic exposure over the long run. However, it can be costly to reverse or eliminate restructuring that was undertaken to reduce economic exposure. Therefore, MNCs must be confident about the potential benefits before they decide to restructure their operations.

When deciding how to restructure operations to reduce economic exposure, one must address the following questions.

- Should the firm attempt to increase or reduce sales in new or existing foreign markets?
- Should the firm increase or reduce its dependency on foreign suppliers?
- Should the firm establish or eliminate production facilities in foreign markets?
- Should the firm increase or reduce its level of debt denominated in foreign currencies?

The first question relates to foreign cash inflows and the remaining ones to foreign cash outflows. Some of the more common solutions to balancing a foreign currency's inflows and outflows are summarized in Exhibit 12.5. Any restructuring of operations that can reduce the periodic difference between a foreign currency's inflows and outflows can reduce the firm's economic exposure to that currency's movements.

MNCs that have production and marketing facilities in various countries may be able to reduce any adverse impact of economic exposure by shifting the allocation of their operations.

EXAMPLE Deland Co. manufactures products in the United States, Japan, and Mexico and sells these products (denominated in the currency where they are produced) to several countries. If the Japanese yen strengthens against many currencies, then Deland may boost production in Mexico while expecting a decline in demand for the Japanese subsidiary's products. By following this strategy, however, Deland may have to forgo economies of scale that could be achieved if it concentrated production at one subsidiary while other subsidiaries focused on warehousing and distribution. ●

Exhibit 12.5 Restructuring Operations to Balance the Impact of Currency Movements on Cash Inflows and Outflows

TYPE OF OPERATION	RECOMMENDED ACTION WHEN A FOREIGN CURRENCY HAS A GREATER IMPACT ON CASH INFLOWS	RECOMMENDED ACTION WHEN A FOREIGN CURRENCY HAS A GREATER IMPACT ON CASH OUTFLOWS
Sales in foreign currency units	Reduce foreign sales	Increase foreign sales
Reliance on foreign supplies	Increase foreign supply orders	Reduce foreign supply orders
Proportion of debt structure representing foreign debt	Restructure debt to increase debt payments in foreign currency	Restructure debt to reduce debt payments in foreign currency

12-2 A Case of Hedging Economic Exposure

In reality, most MNCs are not able to reduce their economic exposure as easily as Madison Co. in the earlier example. First, an MNC's economic exposure may not be so obvious. An analysis of the income statement for an entire MNC may not necessarily detect its economic exposure. The MNC may be composed of various business units, each of which attempts to achieve high performance for its shareholders. Each business unit may have a unique cost and revenue structure. One unit of an MNC may focus on computer consulting services in the United States and have no exposure to exchange rates. Another unit may also focus on sales of personal computers in the United States, but this unit may be adversely affected by weak foreign currencies because its U.S. customers may buy computers from foreign firms.

Although an MNC is mostly concerned with the effect of exchange rates on its performance and value overall, it can more effectively hedge its economic exposure if it can pinpoint the underlying source of the exposure. Yet even if the MNC can do so, there may not be a perfect hedge against that exposure. No textbook formula can provide the perfect solution. However, a combination of actions may reduce the economic exposure to a tolerable level, as illustrated in the following example. This example is more difficult than the previous example of Madison Co., but it may be more realistic for many MNCs.

12-2a Savor Co.'s Dilemma

Savor Co., a U.S. firm, is primarily concerned with its exposure to the euro. It wants to pinpoint the source of that exposure so that it can determine how to hedge it. Savor has three units that conduct some business in Europe. Because each unit has established a wide variety of business arrangements, it is not obvious whether all three units have a similar exposure. Each unit tends to be independent of the others, and the managers of each unit are compensated according to that unit's performance. Savor may want to hedge its economic exposure, but it must first determine whether it is exposed and the source of the exposure.

Assessment of Economic Exposure Because the exact nature of its economic exposure to the euro is not obvious, Savor attempts to assess the relationship between the euro's movements and each unit's cash flows over the last nine quarters. A firm may want to use more data, but nine quarters are sufficient to illustrate the point. The cash flows and movements in the euro are shown in Exhibit 12.6. First, Savor applies regression analysis (as discussed in the previous chapter) to determine whether the percentage change in its total cash flow (PCF, shown in column 5) is related to the percentage change in the euro's value (PCE, shown in column 6) over time:

$$PCF_t = a_0 + a_1(PCE_t) + \mu_t$$

Regression analysis derives the values of the constant a_0 and the slope coefficient a_1. The slope coefficient represents the sensitivity of PCF_t to movements in the euro. According to this analysis, the slope coefficient is positive and statistically significant, which implies that the cash flows are positively related to the percentage changes in the euro. That is, a negative change in the euro adversely affects Savor's total cash flows. The R^2 statistic is .31, which suggests that 31 percent of the variation in Savor's cash flows can be explained by movements in the euro. The evidence presented so far strongly suggests that Savor is exposed to exchange rate movements of the euro but does not pinpoint the source of that exposure.

Exhibit 12.6 Assessment of Savor Co.'s Cash Flows and the Euro's Movements

(1) QUARTER	(2) % CHANGE IN UNIT A'S CASH FLOWS	(3) % CHANGE IN UNIT B'S CASH FLOWS	(4) % CHANGE IN UNIT C'S CASH FLOWS	(5) % CHANGE IN TOTAL CASH FLOWS	(6) % CHANGE IN VALUE OF THE EURO
1	–3	2	1	0	2
2	0	1	3	4	5
3	6	–6	–1	–1	–3
4	–1	1	–1	–1	0
5	–4	0	–1	–5	–2
6	–1	–2	–2	–5	–5
7	1	–3	3	1	4
8	–3	2	1	0	2
9	4	–1	0	3	–4

Assessment of Each Unit's Exposure To determine the source of the exposure, Savor applies the regression model separately to each individual unit's cash flows. The results are shown here (apply the regression analysis yourself as an exercise):

UNIT	SLOPE COEFFICIENT
A	Not significant
B	Not significant
C	Coefficient = .45, which is statistically significant (R^2 = .80)

These results suggest that the cash flows of Units A and B are not subject to economic exposure. However, Unit C is subject to economic exposure. Approximately 80 percent of Unit C's cash flows can be explained by movements in the value of the euro over time. The regression coefficient indicates that, for a 1 percent decrease in the value of the euro, the unit's cash flows will decline by about .45 percent. Exhibit 12.6, confirms the strong relationship between the euro's movements and Unit C's cash flows.

Identifying the Source of the Unit's Exposure Now that Savor has determined that one unit is the cause of the exposure, it can pinpoint the characteristics of that unit that cause the exposure. Savor believes that the key components that affect Unit C's cash flows are income statement items such as its U.S. revenue, its cost of goods sold, and its operating expenses. This unit conducts all of its production in the United States.

Savor first determines the value of each income statement item that affected the unit's cash flows in each of the last nine quarters. It then applies regression analysis to determine the relationship between the percentage change in the euro and each income statement item over those quarters. Assume that it finds:

- a significant positive relationship between Unit C's revenue and the euro's value,
- no relationship between the unit's cost of goods sold and the euro's value,
- no relationship between the unit's operating expenses and the euro's value.

These results suggest that, when the euro weakens, the unit's revenue from U.S. customers declines substantially. Savor's U.S. customers shift their demand to foreign competitors when the euro weakens and they can obtain imports at a low price. Thus, the company's economic exposure could be due to foreign competition. A firm's economic

exposure is not always obvious, however, and regression analysis may detect exposure that was not suspected by the firm or its individual units. Furthermore, regression analysis can be used to provide a more precise estimate of the degree of economic exposure, which can be useful when deciding how to manage the exposure.

12-2b Possible Strategies for Hedging Economic Exposure

Now that Savor has identified the source of its economic exposure, it can develop a strategy to reduce that exposure. In general, Savor Co. wants to restructure its business such that it can benefit when the euro weakens in order to offset the adverse effects of a weak euro on its revenue.

Pricing Policy Savor recognizes that there will be periods in the future when the euro will depreciate against the dollar. Under these conditions, Unit C may attempt to be more competitive by reducing its prices. If the euro's value declines by 10 percent and this reduces the prices that U.S. customers pay for the foreign products by 10 percent, then Unit C can attempt to remain competitive by discounting its prices by 10 percent. Although this strategy can retain market share, the lower prices will result in less revenue and thus reduced cash flows. Therefore, this strategy does not completely eliminate Savor's economic exposure. Nevertheless, this strategy may still be feasible, especially if the unit can charge relatively high prices in periods when the euro is strong and U.S. customers have to pay higher prices for European products. In essence, the strategy might allow the unit to generate abnormally high cash flows in a strong-euro period to offset the abnormally low cash flows in a weak-euro period. The adverse effect during a weak-euro period will still occur, however. Given the limitations of this strategy, other strategies should be considered.

Hedging with Forward Contracts Savor's Unit C could sell euros forward for the period in which it wants to hedge against the adverse effects of the weak euro. Using a forward contract has definite limitations, however. Because the economic exposure is likely to continue indefinitely, the use of a forward contract in the manner described here hedges only for the period of the contract. It does not serve as a continuous long-term hedge against economic exposure. Savor Co. could attempt to sell many forward contracts on euros for different maturities far into the future in order to establish a long-term hedge of its future revenue. However, it does not know what its revenue in euros will be in future periods, especially in the distant future.

Purchasing Foreign Supplies Another possibility is for the unit to purchase all of its materials in Europe, a strategy that would reduce its costs (and enhance its cash flows) during a weak-euro period and thereby offset the adverse effects of the weak euro. However, the cost of buying European materials may be higher than the cost of buying local materials, especially when transportation expenses are considered. Savor Co. does not want to use this method to hedge if it will significantly increase its operating expenses.

Financing with Foreign Funds The unit could also reduce its economic exposure by financing a portion of its business with loans in euros. It could convert the loan proceeds to dollars and use the dollars to support its business. It will need to make periodic loan repayments in euros. If the euro weakens, the unit will need fewer dollars to cover the loan repayments. This favorable effect can partially offset the adverse effect of a weak euro on the unit's revenue. If the euro strengthens, the unit will need more dollars to cover the loan repayments, but this adverse effect will be offset by the favorable effect of the strong euro on the unit's revenue. This type of hedge is more effective than the pricing hedge because it can offset the adverse effects of a weak euro in the same period

(whereas the pricing policy attempts to make up for lost cash flows once the euro strengthens).

This strategy also has some limitations. First, the strategy makes sense only if Savor needs some debt financing. It should not borrow funds just for the sake of hedging its economic exposure. Second, Savor might not desire this strategy when the euro has a very high interest rate. Although borrowing in euros can reduce the company's economic exposure, it may not be willing to enact the hedge at a cost of higher interest expenses than it would pay in the United States.

Third, this strategy is unlikely to create a perfect hedge against Savor's economic exposure. Even if the company needs debt financing and the interest rate charged on the foreign loan is low, Savor must attempt to determine the amount of debt financing that will hedge its economic exposure. The amount of foreign debt financing necessary to fully hedge the exposure may exceed the amount of funding that Savor needs.

Revising Operations of Other Units Given the limitations of hedging Unit C's economic exposure by adjusting the unit's operations, Savor may consider modifying the operations of another unit in a manner that will offset the exposure of Unit C. However, this strategy may require changes in another unit that might not benefit that unit. For example, assume that Unit C could partially hedge its economic exposure by borrowing euros (as explained previously) but that it does not need to borrow as much as would be necessary to fully offset its economic exposure. Savor's top management may suggest that Units A and B also obtain their financing in euros, so that the MNC's overall economic exposure is hedged. Thus, a weak euro would still adversely affect Unit C because the adverse effect on its revenue would not be fully offset by the favorable effect on its financing (debt repayments). But if the other units have borrowed euros as well, then the combined favorable effects on financing for Savor overall could offset the adverse effects on Unit C.

However, Units A and B will not necessarily desire to finance their operations in euros. Recall that these units are not subject to economic exposure. Also recall that the managers of each unit are compensated according to the performance of that unit. By agreeing to finance in euros, Units A and B could become exposed to movements in the euro. If the euro strengthens, their cost of financing increases. So by helping to offset the exposure of Unit C, Units A and B could experience weaker performance and their managers would receive less compensation.

A solution is still possible if Savor's top managers who are not affiliated with any unit can remove the hedging activity from the compensation formula for the units' managers. That is, top management could instruct Units A and B to borrow funds in euros, but could reward the managers of those units based on an assessment of the units' performance that *excludes* the effect of the euro on financing costs. Unit managers would then be more willing to engage in a strategy that increases their economic exposure while reducing Savor's.

12-2c Savor's Hedging Strategy

In summary, Savor's initial analysis of its units determined that only Unit C was highly subject to economic exposure. Unit C could attempt to use a pricing policy that would maintain market share when the euro weakens, but this strategy would not eliminate the economic exposure because its cash flows would still be adversely affected. Borrowing euros can be an effective strategy to hedge Unit C's exposure, but it does not need to borrow the amount of funds necessary to offset its exposure. The optimal solution for Savor Co. is to instruct its other units to do their financing in euros as well. This strategy effectively increases their exposure but in the opposite manner of Unit C's exposure, so that the MNC's economic exposure overall is reduced. The units' managers should be

willing to cooperate if their compensation is not reduced as a result of increasing the exposure of their individual units.

12-2d Limitations of Savor's Hedging Strategy

Even if Savor Co. is able to achieve the hedge just described, the hedge will still not be perfect. The impact of the euro's movements on Savor's cash outflows needed to repay the loans is known with certainty, but the impact of the euro's movements on Savor's cash inflows (revenue) is uncertain and can change over time. If the amount of foreign competition increases, the sensitivity of Unit C's cash flows to exchange rates would also increase. To hedge this increased exposure, it would need to borrow a larger amount of euros. An MNC's economic exposure can change over time in response to shifts in foreign competition or other global conditions, so it must continually assess and manage that exposure.

12-3 Hedging Exposure to Fixed Assets

Up to this point, the focus has been on how economic exposure can affect periodic cash flows. The effects may extend beyond periodic cash flows, however. When an MNC has fixed assets (such as buildings or machinery) in a foreign country, the dollar cash flows to be received from the ultimate sale of these assets are subject to exchange rate risk.

EXAMPLE

Wagner Co., a U.S. firm, pursued a six-year project in Russia. It purchased a manufacturing plant from the Russian government six years ago for 500 million rubles. Since the ruble was worth $.16 at the time of the investment, Wagner needed $80 million to purchase the plant. The Russian government guaranteed that it would repurchase the plant for 500 million rubles in six years when the project was completed. At that time, however, the ruble was worth only $.034, so Wagner received only $17 million (computed as 500 million × $.034) from selling the plant. Even though the price of the plant in rubles at the time of the sale was the same as the price at the time of the purchase, the sales price of the plant in dollars at the time of the sale was about 79 percent less than the purchase price. ●

A sale of fixed assets can be hedged by selling the currency forward in a long-term forward contract. However, long-term forward contracts may not be available for currencies in emerging markets. An alternative solution is to create a liability in that currency that matches the expected value of the assets at the time in the future when they may be sold. In essence, the sale of the fixed assets generates a foreign currency cash inflow that can be used to pay off the liability that is denominated in the same currency.

EXAMPLE

In the previous example, Wagner could have financed part of its investment in the Russian manufacturing plant by borrowing rubles from a local bank, with the loan structured to have zero interest payments and a lump-sum repayment value equal to the expected sales price set for the date when Wagner expected to sell the plant. Thus, the loan could have been structured to have a lump-sum repayment value of 500 million rubles in six years. ●

The limitations of hedging a sale of fixed assets are that an MNC does not necessarily know (1) the date when it will sell the assets or (2) the price in local currency at which it will sell them. Consequently, it is unable to create a liability that perfectly matches the date and amount of the sale of the fixed assets. Nevertheless, these limitations should not prevent a firm from hedging.

EXAMPLE

Even if the Russian government would not guarantee a purchase price of the plant, Wagner Co. could create a liability that reflects the earliest possible sales date and the lowest expected sales price. If the sales date turns out to be later than the earliest possible sales date, Wagner might be

able to extend its loan period to match the sales date. In this way, it can still rely on the funding from the loan to support operations in Russia until the assets are sold. By structuring the lump-sum loan repayment to match the minimum sales price, Wagner will not be perfectly hedged if the fixed assets turn out to be worth more than the minimum expected amount. Even so, Wagner would at least have reduced its exposure by offsetting a portion of the fixed assets with a liability in the same currency. ●

12-4 Managing Translation Exposure

Translation exposure occurs when an MNC translates each subsidiary's financial data to its home currency for consolidated financial statements. Even if translation exposure does not affect cash flows, it is a concern of many MNCs because it can reduce an MNC's consolidated earnings and thereby cause a decline in its stock price.

EXAMPLE

Columbus Co. is a U.S.-based MNC with a subsidiary in the United Kingdom. The subsidiary typically accounts for about half of the total revenue and earnings generated by Columbus. In the last three quarters, the value of the British pound declined, and the reported dollar level of earnings attributable to the British subsidiary was weak simply because of the relatively low rate at which the British earnings were translated into U.S. dollars. During this period, the stock price of Columbus declined because of the decline in consolidated earnings. The high-level managers and the board were criticized in the media for poor performance, even though the only reason for the poor performance was the translation effect on earnings. The employee compensation levels are tied to consolidated earnings and therefore were low this year because of the translation effect. Consequently, Columbus decided that it would attempt to hedge translation exposure in the future. ●

12-4a Hedging with Forward Contracts

Multinational corporations can use forward contracts or futures contracts to hedge translation exposure. Specifically, they can sell the currency forward that their foreign subsidiaries receive as earnings. In this way, they create a cash outflow in the currency to offset the earnings received in that currency.

EXAMPLE

Recall that Columbus Co. has one subsidiary based in the United Kingdom. While there is no foreseeable transaction exposure in the near future from the future earnings (since the pounds will remain in the United Kingdom), Columbus is vulnerable to translation exposure. The subsidiary forecasts that its earnings next year will be £20 million. To hedge its translation exposure, Columbus can implement a forward hedge on the expected earnings by selling £20 million one year forward. Assume the forward rate at that time is $1.60, the same as the spot rate. At the end of the year, Columbus can buy £20 million at the spot rate and fulfill its forward contract obligation to sell £20 million. If the pound depreciates during the fiscal year, then Columbus will be able to purchase pounds at the end of the fiscal year to fulfill the forward contract at a cheaper rate than it can sell them ($1.60 per pound). Thus, it will have generated a gain from its forward hedge position that can offset the translation loss.

If the pound depreciates such that the average weighted exchange rate is $1.50 over the year, the subsidiary's earnings will be translated as follows:

$$\begin{aligned}\text{Translated earnings} &= \text{Subsidiary earnings} \,/\, \text{Weighted average exchange rate} \\ &= \text{20 million pounds} \times \$1.50 \\ &= \$30 \text{ million}\end{aligned}$$

If the exchange rate had not declined over the year, the translated amount of earnings would have been $32 million (computed as 20 million pounds × $1.60), so the exchange rate movements caused the reported earnings to be reduced by $2 million.

However, there is a gain from the forward contract because the spot rate declined over the year. If we assume that the spot rate is worth $1.50 at the end of the year, then the gain on the forward contract would be:

$$\begin{aligned}\text{Gain on forward contract} &= (\text{Amount received from forward sale}) \\ &\quad -(\text{Amount paid to fulfill forward contract obligation}) \\ &= (\text{20 million pounds} \times \$1.60) - (\text{20 million pounds} \times \$1.50) \\ &= \$32 \text{ million} - \$30 \text{ million} \\ &= \$2 \text{ million}\end{aligned}$$

In reality, a perfect offsetting effect is unlikely. However, when there is a relatively large reduction in the weighted average exchange rate, there will likely be a large reduction in the spot rate over that same period. Consequently, the larger the adverse translation effect, the larger the gain on the forward contract. Thus, the forward contract is normally effective in hedging a portion of the translation exposure.

12-4b Limitations of Hedging Translation Exposure

There are four limitations in hedging translation exposure.

Inaccurate Earnings Forecasts A subsidiary's earnings in a future period are uncertain. In the previous example involving Columbus, Inc., British earnings were projected to be £20 million. If the actual earnings turned out to be much higher and if the pound weakened during the year, then the translation loss would likely exceed the gain generated from the forward contract strategy.

Inadequate Forward Contracts for Some Currencies A second limitation is that forward contracts are not available for all currencies. Thus, an MNC with subsidiaries in some smaller countries may not be able to obtain forward contracts for the currencies of concern.

Accounting Distortions A third limitation is that the forward rate gain or loss reflects the difference between the forward rate and the future spot rate, whereas the translation gain or loss is caused by the change in the average exchange rate over the period in which the earnings are generated. In addition, the translation losses are not tax deductible, whereas gains on forward contracts used to hedge translation exposure are taxed.

Increased Transaction Exposure The fourth and most critical limitation with using a forward contract to hedge translation exposure is that doing so may increase the MNC's transaction exposure. For example, consider a situation in which the subsidiary's currency appreciates during the fiscal year, resulting in a translation gain. If the MNC enacts a hedge strategy at the start of the fiscal year, this strategy will generate a transaction loss that will somewhat offset the translation gain.

Some MNCs may not be comfortable with this offsetting effect. The translation gain is simply a paper gain; that is, the reported dollar value of earnings is higher simply because of the subsidiary currency's appreciation. However, if the subsidiary reinvests the earnings then the parent does not receive any more income due to this appreciation. The MNC's net cash flow is not affected. In contrast, the loss resulting from a hedge strategy is a true loss; that is, the net cash flow to the parent will be reduced owing to this loss. Thus, in this situation, the MNC reduces its translation exposure at the expense of increasing its transaction exposure.

SUMMARY

- Economic exposure can be managed by balancing the sensitivity of revenue and expenses to exchange rate fluctuations. To accomplish this, however, the firm must first recognize how its revenue and expenses are affected by exchange rate fluctuations. For some firms, revenue is more susceptible. These firms are most concerned that their home currency will appreciate against foreign currencies since the unfavorable effects on revenue will more than offset the favorable effects on expenses. Conversely, firms whose expenses are more sensitive to exchange rates than their revenue are most concerned that their home currency will depreciate against foreign currencies. When firms reduce their economic exposure, they reduce not only these unfavorable effects but also the favorable effects if the home currency value moves in the opposite direction.
- Translation exposure can be reduced by selling forward the foreign currency used to measure a subsidiary's income. If the foreign currency depreciates against the home currency, the adverse impact on the consolidated income statement can be offset by the gain on the forward sale in that currency. If the foreign currency appreciates over the time period of concern, there will be a loss on the forward sale that is offset by a favorable effect on the reported consolidated earnings. However, many MNCs would not be satisfied with a "paper gain" that offsets a "cash loss."

POINT COUNTER-POINT

Can an MNC Reduce the Impact of Translation Exposure by Communicating?

Point Yes. Investors commonly use earnings to derive an MNC's expected future cash flows. Investors do not necessarily recognize how an MNC's translation exposure could distort their estimates of the MNC's future cash flows. Therefore, the MNC could clearly communicate in its annual report and elsewhere how the earnings were affected by translation gains and losses in any period. If investors have this information, they will not overreact to earnings changes that are primarily attributed to translation exposure.

Counter-Point No. Investors focus on the bottom line and should ignore any communication regarding the translation exposure. Moreover, they may believe that translation exposure should be accounted for anyway. If foreign earnings are reduced because of a weak currency, the earnings may continue to be weak if the currency remains weak.

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. Salem Exporting Co. purchases chemicals from U.S. sources and uses them to make pharmaceutical products that are exported to Canadian hospitals. Salem prices its products in Canadian dollars and is concerned about the possibility of the long-term depreciation of the Canadian dollar against the U.S. dollar. It periodically hedges its exposure with short-term forward contracts, but this does not insulate against the possible trend of continuing Canadian dollar depreciation. How could Salem offset some of its exposure resulting from its export business?
2. Using the information in question 1, give a possible disadvantage of offsetting exchange rate exposure from the export business.
3. Coastal Corp. is a U.S. firm with a subsidiary in the United Kingdom. It expects that the pound will depreciate this year. Explain Coastal's translation exposure. How could Coastal hedge its translation exposure?
4. Everhart Co. has substantial translation exposure in European subsidiaries. The treasurer of Everhart Co. suggests that the translation effects are not relevant because the earnings generated by the European subsidiaries are not being remitted to the U.S. parent but are simply being reinvested in Europe. Nevertheless, the vice president of finance of Everhart Co. is concerned about translation exposure because the stock price is highly dependent on the consolidated earnings, which are dependent on the exchange rates at which the earnings are translated. Who is correct?

5. Lincolnshire Co. exports 80 percent of its total production of goods in New Mexico to Latin American countries. Kalafa Co. sells all the goods it produces in the United States, but it has a subsidiary in Spain that usually generates about 20 percent of its total earnings. Compare the translation exposure of these two U.S. firms.

Questions and Applications

1. Reducing Economic Exposure Colorado, Inc., is a U.S.-based MNC that obtains 10 percent of its supplies from European manufacturers. Sixty percent of its revenues are due to exports to Europe, where its product is invoiced in euros. Explain how Colorado can attempt to reduce its economic exposure to exchange rate fluctuations in the euro.

2. Reducing Economic Exposure UVA Co. is a U.S.-based MNC that obtains 40 percent of its foreign supplies from Thailand. It also borrows Thailand's currency (the baht) from Thai banks and converts the baht to dollars to support U.S. operations. It currently receives about 10 percent of its revenue from Thai customers. Its sales to Thai customers are denominated in baht. Explain how UVA Co. can reduce its economic exposure to exchange rate fluctuations.

3. Reducing Economic Exposure Albany Corp. is a U.S.-based MNC that has a large government contract with Australia. The contract will continue for several years and generate more than half of Albany's total sales volume. The Australian government pays Albany in Australian dollars. About 10 percent of Albany's operating expenses are in Australian dollars; all other expenses are in U.S. dollars. Explain how Albany Corp. can reduce its economic exposure to exchange rate fluctuations.

4. Trade-offs When Reducing Economic Exposure When an MNC restructures its operations to reduce its economic exposure, it may sometimes forgo economies of scale. Explain.

5. Exchange Rate Effects on Earnings Explain how a U.S.-based MNC's consolidated earnings are affected when foreign currencies depreciate.

6. Hedging Translation Exposure Explain how a firm can hedge its translation exposure.

7. Limitations of Hedging Translation Exposure Bartunek Co. is a U.S.-based MNC that has European subsidiaries and wants to hedge its translation exposure to fluctuations in the euro's value. Explain some limitations when it hedges translation exposure.

8. Effective Hedging of Translation Exposure Would a more established MNC or a less established MNC be better able to effectively hedge its given level of translation exposure? Why?

9. Comparing Degrees of Economic Exposure Carlton Co. and Palmer, Inc., are U.S.-based MNCs with subsidiaries in Mexico that distribute medical supplies (produced in the United States) to customers throughout Latin America. Both subsidiaries purchase the products at cost and sell the products at 90 percent markup. The other operating costs of the subsidiaries are very low. Carlton Co. has a research and development center in the United States that focuses on improving its medical technology. Palmer, Inc., has a similar center based in Mexico. Each firm subsidizes its respective research and development center on an annual basis. Which firm is subject to a higher degree of economic exposure? Explain.

10. Comparing Degrees of Translation Exposure Nelson Co. is a U.S. firm with annual export sales to Singapore of about S$800 million. Its main competitor is Mez Co., also based in the United States, with a subsidiary in Singapore that generates about S$800 million in annual sales. Any earnings generated by the subsidiary are reinvested to support its operations. Based on the information provided, which firm is subject to a higher degree of translation exposure? Explain.

Advanced Questions

11. Managing Economic Exposure St. Paul Co. does business in the United States and New Zealand. In attempting to assess its economic exposure, it compiled the following information.

a. St. Paul's U.S. sales are somewhat affected by the value of the New Zealand dollar (NZ$) because it faces competition from New Zealand exporters. It forecasts the U.S. sales based on the following three exchange rate scenarios:

EXCHANGE RATE OF NEW ZEALAND DOLLARS	REVENUE FROM U.S. BUSINESS (IN MILLIONS)
NZ$ = $.48	$100
NZ$ = .50	105
NZ$ = .54	110

b. Its New Zealand dollar revenues on sales to New Zealand invoiced in New Zealand dollars are expected to be NZ$600 million.

c. Its anticipated cost of materials is estimated at $200 million from the purchase of U.S. materials and NZ$100 million from the purchase of New Zealand materials.

d. Fixed operating expenses are estimated at $30 million.

e. Variable operating expenses are estimated at 20 percent of total sales (after including New Zealand sales, translated to a dollar amount).

f. Interest expense is estimated at $20 million on existing U.S. loans, and the company has no existing New Zealand loans.

Forecast net cash flows for St. Paul Co. under each of the three exchange rate scenarios. Explain how St. Paul's net cash flows are affected by possible exchange rate movements. Explain how it can restructure its operations to reduce the sensitivity of its net cash flows to exchange rate movements without reducing its volume of business in New Zealand.

12. Assessing Economic Exposure Alaska, Inc., plans to create and finance a subsidiary in Mexico that produces computer components at a low cost and exports them to other countries. It has no other international business. The subsidiary will produce computers and export them to Caribbean islands and will invoice the products in U.S. dollars. The values of the currencies in the islands are expected to remain very stable against the dollar. The subsidiary will pay wages, rent, and other operating costs in Mexican pesos. The subsidiary will remit earnings monthly to the parent.

a. Would Alaska's cash flows be favorably or unfavorably affected if the Mexican peso depreciates over time?

b. Assume that Alaska considers partial financing of this subsidiary with peso loans from Mexican banks instead of providing all the financing with its own funds. Would this alternative form of financing increase, decrease, or have no effect on the degree to which Alaska is exposed to exchange rate movements of the peso?

13. Hedging Continual Exposure Clearlake, Inc., produces its products in its factory in Texas and exports most of the products to Mexico each month. The exports are denominated in pesos. Clearlake recognizes that hedging on a monthly basis does not really protect against long-term movements in exchange rates. It also recognizes that it could eliminate its transaction exposure by denominating the exports in dollars, but that it still would have economic exposure (because Mexican consumers would reduce demand if the peso weakened). Clearlake does not know how many pesos it will receive in the future, so it would have difficulty even if a long-term hedging method were available. How can Clearlake realistically deal with this dilemma and reduce its exposure over the long term? (There is no perfect solution, but in the real world, there rarely are perfect solutions.)

14. Sources of Supplies and Exposure to Exchange Rate Risk Laguna Co. (a U.S. firm) will be receiving 4 million British pounds in 1 year. It will need to make a payment of 3 million Polish zloty in 1 year. It has no other exchange rate risk at this time. However, it needs to buy supplies and can purchase them from Switzerland, Hong Kong, Canada, or Ecuador. Another alternative is that it could also purchase one-fourth of the supplies from each of the four countries mentioned in the previous sentence.

The supplies will be invoiced in the currency of the country from which they are imported. Laguna Co. believes that none of the sources of the imports would provide a clear cost advantage. As of today, the dollar cost of these supplies would be about $6 million regardless of the source that will provide the supplies.

The spot rates today are as follows:

British pound = $1.80
Swiss franc = $.60
Polish zloty = $.30
Hong Kong dollar = $.14
Canadian dollar = $.60

The movements of the pound and the Swiss franc and the Polish zloty against the dollar are highly correlated. The Hong Kong dollar is tied to the U.S. dollar, and you expect that it will continue to be tied to the dollar. The movements in the value of the Canadian dollar against the U.S. dollar are not correlated with the movements of the other currencies. Ecuador uses the U.S. dollar as its local currency.

Which alternative should Laguna Co. select in order to minimize its overall exchange rate risk?

15. Minimizing Exposure Lola Co. (a U.S. firm) expects to receive 10 million euros in 1 year. It does not plan to hedge this transaction with a forward contract

or other hedging techniques. This is its only international business, and it is not exposed to any other form of exchange rate risk. Lola Co. plans to purchase materials for future operations, and it will send its payment for these materials in 1 year. The value of the materials to be purchased is about equal to the expected value of the receivables. Lola Co. can purchase the materials from Switzerland, Hong Kong, Canada, or the United States. Another alternative is that it could also purchase one-fourth of the materials from each of the four countries mentioned in the previous sentence. The supplies will be invoiced in the currency of the country from which they are imported.

The movements of the euro and the Swiss franc against the dollar are highly correlated and will continue to be highly correlated. The Hong Kong dollar is tied to the U.S. dollar and you expect that it will continue to be tied to the dollar. The movements in the value of Canadian dollar against the U.S. dollar are independent of (not correlated with) the movements of other currencies against the U.S. dollar.

Lola Co. believes that none of the sources of the imports would provide a clear cost advantage.

Which alternative should Lola Co. select for obtaining supplies that will minimize its overall exchange rate risk?

16. Financing to Reduce Exchange Rate Exposure Nashville Co. presently incurs costs of about 12 million Australian dollars (A$) per year due to research and development expenses in Australia. It sells the products that are designed each year, and all of products sold each year would be invoiced in U.S. dollars. Nashville anticipates revenue of about $20 million per year and about half of the revenue would be from sales to customers in Australia. An Australian dollar is presently valued at $1 (1 U.S. dollar), but it fluctuates a lot over time. Nashville Co. is planning a new project in which it will expand its sales to other regions within the United States and the sales will be invoiced in dollars. Nashville can finance this project with a 5-year loan by (1) borrowing only Australian dollars, or (2) borrowing only U.S. dollars, or (3) borrowing one-half of the funds from each of these sources. The 5-year interest rates on an Australian dollar loan and U.S. dollar loan are the same.

a. If Nashville wants to use the form of financing that will reduce its exposure to exchange rate risk the most, what is the optimal form of financing? Briefly explain (this means that one or two sentences should be sufficient if your explanation is clear).

b. Now assume that Nashville expects that the Australian dollar will appreciate over time. Suppose the company wants to maximize its expected net present value of this project and is not concerned about its exposure to exchange rate risk. Under these conditions, which financing alternative is most appropriate? Briefly 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 *International Financial Management* text companion website. Go to www.cengagebrain.com (students) or www.cengage.com/login (instructors) and search using **ISBN 9781133947837.**

Blades, Inc. Case

Assessment of Economic Exposure

Blades, Inc., has been exporting to Thailand since its decision to supplement its declining U.S. sales by exporting there. Furthermore, Blades has recently begun exporting to a retailer in the United Kingdom. The suppliers of the components needed by Blades for roller blade production (such as rubber and plastic) are located in the United States and Thailand. Blades decided to use Thai suppliers for rubber and plastic components needed to manufacture roller blades because of cost and quality considerations. All of Blades' exports and imports are denominated in the respective foreign currency; for example, Blades pays for the Thai imports in baht.

The decision to export to Thailand was supported by the fact that Thailand had been one of the world's fastest growing economies in recent years. Furthermore, Blades found an importer in Thailand that was willing to commit itself to the annual purchase of 180,000 pairs of Blades' Speedos, which are among the highest quality roller blades in the world. The commitment began last year and will last another 2 years, at

which time it may be renewed by the two parties. Due to this commitment, Blades is selling its roller blades for 4,594 baht per pair (approximately $100 at current exchange rates) instead of the usual $120 per pair. Although this price represents a substantial discount from the regular price for a pair of Speedo blades, it still constitutes a considerable markup above cost. Because importers in other Asian countries were not willing to make this type of commitment, this was a decisive factor in the choice of Thailand for exporting purposes. Although Ben Holt, Blades' chief financial officer (CFO), believes the sports product market in Asia has very high future growth potential, Blades has recently begun exporting to Jogs, Ltd., a British retailer. Jogs has committed itself to purchase 200,000 pairs of Speedos annually for a fixed price of £80 per pair.

For the coming year, Blades expects to import rubber and plastic components from Thailand sufficient to manufacture 80,000 pairs of Speedos at a cost of approximately 3,000 baht per pair of Speedos.

You, as Blades' financial analyst, have told Holt that recent events in Asia have fundamentally affected the economic condition of Asian countries, including Thailand. For example, you have pointed out that the high level of consumer spending on leisure products such as roller blades has declined considerably. Thus, the Thai retailer may not renew its commitment with Blades in 2 years. Furthermore, you are worried that the current economic conditions in Thailand may lead to a substantial depreciation of the Thai baht, which would affect Blades negatively.

Despite recent developments, however, Holt remains optimistic; he is convinced that Southeast Asia will exhibit high potential for growth when the impact of recent events in Asia subsides. Consequently, Holt has no doubt that the Thai customer will renew its commitment for another 3 years when the current agreement terminates. In your opinion, Holt is not considering all of the factors that might directly or indirectly affect Blades. Moreover, you are worried that he is ignoring Blades' future in Thailand even if the Thai importer renews its commitment for another 3 years. In fact, you believe that a renewal of the existing agreement with the Thai customer may affect Blades negatively due to the high level of inflation in Thailand.

Since Holt is interested in your opinion and wants to assess Blades' economic exposure in Thailand, he has asked you to conduct an analysis of the impact of the value of the baht on next year's earnings to assess Blades' economic exposure. You have gathered the following information:

- Blades has forecasted sales in the United States of 520,000 pairs of Speedos at regular prices; exports to Thailand of 180,000 pairs of Speedos for 4,594 baht a pair; and exports to the United Kingdom of 200,000 pairs of Speedos for £80 per pair.
- Cost of goods sold for 80,000 pairs of Speedos are incurred in Thailand; the remainder is incurred in the United States, where the cost of goods sold per pair of Speedos runs approximately $70.
- Fixed costs are $2 million, and variable operating expenses other than costs of goods sold represent approximately 11 percent of U.S. sales. All fixed and variable operating expenses other than cost of goods sold are incurred in the United States.
- Recent events in Asia have increased the uncertainty regarding certain Asian currencies considerably, making it extremely difficult to forecast the value of the baht at which the Thai revenues will be converted. The current spot rate of the baht is $.022, and the current spot rate of the pound is $1.50. You have created three scenarios and derived an expected value on average for the upcoming year based on each scenario (see the following table):

SCENARIO	EFFECT ON THE AVERAGE VALUE OF BAHT	AVERAGE VALUE OF BAHT	AVERAGE VALUE OF POUND
1	No change	$.0220	$1.530
2	Depreciate by 5%	.0209	1.485
3	Depreciate by 10%	.0198	1.500

- Blades currently has no debt in its capital structure. However, it may borrow funds in Thailand if it establishes a subsidiary in the country.

Holt has asked you to answer the following questions:

1. How will Blades be negatively affected by the high level of inflation in Thailand if the Thai customer renews its commitment for another 3 years?

2. Holt believes that the Thai importer will renew its commitment in 2 years. Do you think his assessment is

correct? Why or why not? Also, assume that the Thai economy returns to the high growth level that existed prior to the recent unfavorable economic events. Under this assumption, how likely is it that the Thai importer will renew its commitment in 2 years?

3. For each of the three possible values of the Thai baht and the British pound, use a spreadsheet to estimate cash flows for the next year. Briefly comment on the level of Blades' economic exposure. Ignore possible tax effects.

4. Now repeat your analysis in question 3 but assume that the British pound and the Thai baht are perfectly correlated. For example, if the baht depreciates by 5 percent, the pound will also depreciate by 5 percent. Under this assumption, is Blades subject to a greater degree of economic exposure? Why or why not?

5. Based on your answers to the previous three questions, what actions could Blades take to reduce its level of economic exposure to Thailand?

Small Business Dilemma

Hedging the Sports Exports Company's Economic Exposure to Exchange Rate Risk

Jim Logan, owner of the Sports Exports Company, remains concerned about his exposure to exchange rate risk. Even if he hedges his transactions from 1 month to another, he recognizes that a long-term trend of depreciation in the British pound could have a severe impact on his firm. He believes that he must continue to focus on the British market for selling his footballs.

However, Logan plans to consider various ways in which he can reduce his economic exposure. At the current time, he obtains material from a local manufacturer and uses a machine to produce the footballs, which are then exported. He still uses his garage as a place of production and would like to continue using his garage to maintain low operating expenses.

1. How could Logan adjust his operations to reduce his economic exposure? What is a possible disadvantage of such an adjustment?
2. Offer another solution to hedging the economic exposure in the long run as Logan's business grows. What are the disadvantages of this solution?

Internet/Excel Exercises

1. Review an annual report of an MNC of your choice. Many MNCs provide their annual report on their websites. Look for any comments that relate to the MNC's economic or translation exposure. Does it appear that the MNC hedges its economic exposure or translation exposure? If so, what methods does it use to hedge its exposure?
2. Go to finance.yahoo.com and insert the ticker symbol IBM (or use a different MNC if you wish) in the stock quotations box. Then scroll down and click on Historical Prices. Set the date range so that you can access data for least the last 20 quarters. Obtain the stock price of IBM at the beginning of the last 20 quarters and insert the data on your electronic spreadsheet. Compute the percentage change in the stock price of IBM from one quarter to the next. Then go to www.oanda.com/convert/fxhistory and obtain direct exchange rates of the Canadian dollar and the euro that match up with the stock price data. Run a regression analysis with the quarterly percentage change in IBM's stock price as the dependent variable and the quarterly change in the Canadian dollar's value as the independent variable. (Appendix C explains how Excel can be used to run regression analysis.) Does it appear that IBM's stock price is affected by changes in the value of the Canadian dollar? If so, what is the direction of the relationship? Is the relationship strong? (Check the R-squared statistic.) Based on this relationship, do you think IBM should attempt to hedge its economic exposure to movements in the Canadian dollar?
3. Repeat the process using the euro in place of the Canadian dollar. Does it appear that IBM's stock price is affected by changes in the value of the euro? If so, what is the direction of the relationship? Is the relationship strong? (Check the *R*-squared statistic.) Based on this relationship, do you think IBM should attempt to hedge its economic exposure to movements in the euro?

Online Articles with Real-World Examples

Find a recent article online that describes an actual international finance application or a real-world example about a specific MNC's actions that reinforces one or more of the concepts covered in this chapter.

If your class has an online component, your professor may ask you to post your summary there and provide the Web link of the article so that other students can access it. If your class is live, your professor may ask you to summarize your application in class. Your professor may assign specific students to complete this assignment for this chapter or may allow any students to do the assignment on a volunteer basis.

For recent online articles and real-world examples applied to this chapter, consider using the following search terms (and include the current year as a search term to ensure that the online articles are recent).

1. hedge AND [name of an MNC]
2. hedge AND exchange rate effects
3. hedge AND currency effects
4. exposure AND exchange rate
5. exposure AND currency
6. hedge AND translation exposure
7. hedge AND translation effect
8. forward contract AND translation
9. managing translation exposure
10. reducing translation exposure

PART 3 INTEGRATIVE PROBLEM

Exchange Risk Management

Vogl Co. is a U.S. firm conducting a financial plan for the next year. It has no foreign subsidiaries, but more than half of its sales are from exports. Its foreign cash inflows to be received from exporting and cash outflows to be paid for imported supplies over the next year are shown in the following table:

CURRENCY	TOTAL INFLOW	TOTAL OUTFLOW
Canadian dollar (C$)	C$32,000,000	C$32,000,000
New Zealand dollar (NZ$)	NZ$5,000,000	NZ$1,000,000
Mexican peso (MXP)	MXP11,000,000	MXP10,000
Singapore dollar (S$)	S$4,000,000	S$8,000,000

The spot rates and 1-year forward rates as of today are shown below:

CURRENCY	SPOT RATE	ONE-YEAR FORWARD RATE
C$	$.90	$.93
NZ$	.60	.59
MXP	.18	.15
S$	.65	.64

Questions

1. Based on the information provided, determine Vogl's net exposure to each foreign currency in dollars.
2. Assume that today's spot rate is used as a forecast of the future spot rate 1 year from now. The New Zealand dollar, Mexican peso, and Singapore dollar are expected to move in tandem against the U.S. dollar over the next year. The Canadian dollar's movements are expected to be unrelated to movements of the other currencies. Since exchange rates are difficult to predict, the forecasted net dollar cash flows per currency may be inaccurate. Do you anticipate any offsetting exchange rate effects from whatever exchange movements do occur? Explain.
3. Given the forecast of the Canadian dollar along with the forward rate of the Canadian dollar, what is the expected increase or decrease in dollar cash flows that

would result from hedging the net cash flows in Canadian dollars? Would you hedge the Canadian dollar position?

4. Assume that the Canadian dollar net inflows may range from C$20 million to C$40 million over the next year. Explain the risk of hedging C$30 million in net inflows. How can Vogl Co. avoid such a risk? Is there any tradeoff resulting from your strategy to avoid that risk?

5. Vogl Co. recognizes that its year-to-year hedging strategy hedges the risk only over a given year and does not insulate it from long-term trends in the Canadian dollar's value. It has considered establishing a subsidiary in Canada. The goods would be sent from the United States to the Canadian subsidiary and distributed by the subsidiary. The proceeds received would be reinvested by the Canadian subsidiary in Canada. In this way, Vogl Co. would not have to convert Canadian dollars to U.S. dollars each year. Has Vogl eliminated its exposure to exchange rate risk by using this strategy? Explain.