Foreign Exchange Risk: Relevance and Management

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Few senior corporate managers profess even a limited understanding of foreign exchange exposure management. This article offers a description of foreign exchange risk and the characteristics and costs of risk hedging alternatives. Because the costs of protection from exchange market fluctuations are company-specific, the cost differentials explain why some managers hedge extensively while others choose to bear the risk.

It is no surprise that the concern of corporate management with foreign exchange risk has recently intensified. With the acceptance of floating exchange rates and the continuing increase in cross-border investment and trade flows, today's economic environment stands in stark contrast to the relatively tranquil economic background of the 1960s. In fact, with the continuing integration of the world economy, multinational and trading firms are no longer alone in their exposure to exchange risk; firms with sales and sourcing totally limited to the domestic market are exposed to shifts in the competitive environment caused by changes in foreign exchange rates.

These forces have contributed to the increased importance of foreign exchange risk in the world of the corporate manager. Understanding the relevance and characteristics of the risk is a prerequisite for risk measurement and management. The study of exchange risk also provides insights into the character of a close cousin – inflation risk.

This paper summarizes recent work on the nature of foreign exchange risk exposure and considers the reasons why exchange risk is a matter of high level concern for some firms and not others. A related comparison is made between firms which adopt an active hedging policy and firms which rarely contract for forward foreign exchange. Finally, the article offers a description of the cost of forward exchange hedging. Some, often ignored, implicit costs of hedging are considered and decision rules for optimal forward hedging are described.

EXPOSURE TO FOREIGN EXCHANGE RISK

The turbulence in the foreign exchange markets which began in the late 1960s was reflected in a universal concern about the effect of the new volatility on world trade and investment. The basis for this concern was the recognition that fluctuating exchange rates would increase the risk of operations for firms which invested across currencies.

While there is general agreement that changes in foreign exchange rates should affect the 'value' of a corporation, there has been little consensus on the relevant 'value' which is at risk.

In 1976 the US accounting profession published a new set of guidelines, Statement Number 8, for the translation of financial statements from one currency to another. This mandate defined those foreign balance sheet accounts to be translated at current exchange rates; these accounts are considered 'at risk' because their US dollar value changes when foreign exchange rates change.

In response to the new rules a flurry of articles appeared in both the academic and managerial literature. These papers are largely critical of the guidelines adopted by the Financial Accounting Standard Board in their Statement Number 8; however, few of these critics agree on an alternative measure of exposure.

A competing approach to measuring the riskiness induced by fluctuating exchange rates is described in a small but growing body of literature.[1] The common thread is that accounting value is considered irrelevant. The assumed objective of management is maximization of economic or market value; this value is at risk to the extent that it fluctuates in response to foreign exchange rate fluctuations. In this context *foreign exchange exposure is the sensitivity of economic value to changes in current and forecast exchange rates*. It is measured as the coefficient between variability in economic value and variability in exchange rates.

The economic approach takes advantage of the fact that many foreign cash flows are 'naturally hedged' because many prices are determined in a

world market. For such flows home currency returns are invariant with respect to changes in exchange rate expectations because foreign currency devaluation is immediately offset by an inflationary increase in the foreign currency cash flow. For such flows, exposure – the coefficient of exchange rate variability – is zero.

Other corporate cash flows are on the opposite end of the spectrum. Nominal assets and liabilities such as claims to accounts receivable or liabilities to foreign banks or bondholders are fixed in foreign currency terms. Cash flows arising from these assets and liabilities are totally exposed – the coefficient on exchange rate variability is unity.

Of course, many types of cash flows fall between the two extremes; they are neither fully exposed nor completely 'naturally' hedged. The degree of effective exposure is determined by aspects of the economic and competitive environment and characteristics of the firm's business and management.

The papers cited (see Ref. 1) build to an attempt at describing these determinants of exposure. The net exposure of the home country value of the firm's foreign cash flows can be seen as a weighted average of the coefficients relevant to each disaggregated segment of the cash flow stream. The overall coefficient adjusts a nominal cash flow by the degree to which it is financially or 'naturally' hedged; the product of the nominal cash flow and the exposure coefficient is equivalent to a fully exposed foreign currency cash flow.

FOREIGN EXCHANGE RISK

Foreign exchange risk is the possibility of changes in the value of the firm which arises from the potential for changes in foreign exchange rates. This risk is a product of two components: exposure – the sensitivity of the dollar value to exchange rate changes; and the variability of exchange rates themselves.

A firm which holds a DM2 500 000 receivable as part of a $20 million portfolio of assets may serve as an example. At an exchange rate of $0.400/DM the receivable is worth $1 million – 5% of the value of the firm's assets. If the firm has issued no DM liabilities, the receivable is totally exposed because its value in DM is fixed; the dollar value of the

receivable will vary directly with the exchange rate. If the deutschmark revalues by 10% to $0.44/DM, the dollar value of the receivable increases by 10% to $1.1 million; likewise, the dollar value of the receivable declines by 10% with a 10% deutschmark devaluation. The full $1 million value of the receivable is totally exposed because this amount varies to the full extent of the exchange rate variation.

Foreign exchange *risk* reflects both the exposure and the range of potential exchange rate variability. In the example, the DM/$ exchange rate varied by 10% on either side of its initial value. This variation acted on a fully exposed DM2 500 000 asset to produce swings in net worth of $100 000. The potential for gains and losses of this magnitude is foreign exchange risk.

MANAGEMENT RESPONSE TO EXCHANGE RISK

The Importance of the Problem

Appropriate strategies for exchange risk management must recognize the relevance of exchange risk to a particular firm's investors. In particular, exchange risk should not affect management strategy when it does not affect or concern investors.

One source of investor indifference to exchange risk may be the range of hedging and investment options available on personal account. In a perfect and complete capital market, investors can costlessly hedge or diversify foreign exchange risk on personal account. For example, an investor might own shares in a firm which is long DM and offset the risk by purchasing shares in a firm with a short DM position. Alternatively, the investor could denominate his/her personal debt in DM or could hedge the long DM position by selling DM in the forward foreign exchange market at the appropriate maturity. Clearly such an investor will place no value on management activity designed to reduce exchange risk.

In some cases the corporate manager might also appropriately ignore exchange risk in less complete capital markets. The structure of the firm's investment portfolio may itself reduce or eliminate the

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investor's exchange risk. Risk is eliminated for investors in a firm whose internal operations tend to balance long and short currency positions. Also investors in firms with a broad diversity of international interests are relatively protected; for these firms' gains in one currency tend to be offset by losses in another currency. Investment returns would appear quite stable with respect to changes in any single exchange rate.

For most firms, however, either capital markets are sufficiently imperfect or internal diversification sufficiently limited as to leave the value of the firms somewhat dependent on the *level* of exchange risk. As a result, foreign exchange risk is a factor in financial management. The exchange risk of investment and financing alternatives must be evaluated and hedging instruments become useful tools for value maximization.

The Costs of Solutions

Foreign currency debt is probably the most frequently used instrument for reducing or eliminating foreign exchange risk. Local debt acts as a hedge because it offsets an asset exposure. In the example above, the DM2 500 000 exposure would be completely hedged by a bank loan in the same amount. (To be precise, the perfect hedge requires a borrowing of DM2 500 000 *less* interest.) The firm would simply exchange the proceeds of the loan for dollars in the spot foreign exchange market and repay the loan with the proceeds of the maturing receivable.

One of the attractions of a hedge with local currency debt is that it is often costless. The difference between the interest rate paid on the loan and the interest rate earned on the repatriated cash often closely approximates the loss on foreign exchange which is predicted for the maturing receivable. As a result, the local debt provides a means for assuming a fixed cost in lieu of a highly uncertain cost with the same expected value. In fact the binding constraint to the more active use of local currency debt is more often availability than cost.

Similarly the forward foreign exchange market may be an important arena for corporate exchange risk reduction. Forward contracts, like foreign currency debt, hedge currency risk by acting as an offset. Returning to the example, a forward sale of DM2 500 000 would offer a complete hedge of the DM receivable. No cash, except a small margin, changes hands at the time of the sale. Instead gains or losses are realized at the contract's maturity.

Table 1 demonstrates the value of a forward hedge. In this example we assume that the forward exchange rate at the time of sale equals the spot exchange rate, $0.40/DM. The expected value of the receivable is $1 million and the expected value of the forward foreign exchange contract is zero.

The offset advantage is exercised when the spot exchange rate prevailing at the maturity of the

Table 1

Price of DM at collection date	Value in $US		
	$0.36	$0.40	$0.44
Receivable			
Value of receivable	$0.9 million	$1 million	$1.1 million
Gain (lose on receivable	($0.1 million)		$0.1 million
Forward contract – forward sale of DM2.5 million $0.40/DM			
Gain (loss) per DM sold	$0.04	0	($0.04)
Gain (loss) on forward contract	$0.1 million	0	($0.1 million)
Net gain (loss)	0	0	0
Net value of receivable and forward contract	$1 million	$1 million	$1 million

receivable and forward contracts differs from the initial contract rate. For example, when the actual rate is $0.36 at maturity, the decline in the value of the receivable is offset by an equivalent gain on the forward contract. At maturity the gain would be realized as a cash payment through the bank or broker handling the transaction. Similarly, an appreciation in the value of the DM to $0.44 would generate a cash loss on the forward contract of $0.1 million exactly offsetting the gain on the receivable.

Like foreign currency debt, forward contracts are often appropriately priced. (The evidence is not complete on this point, though there is no persuasive evidence of a strong bias which would imply excess forward hedging costs.) However, availability is often limited, particularly in more exotic or highly volatile currencies. Further, available forward contract maturities which exceed a year or two are quite rare. Still one would expect active use of the available forward markets for the hedging of corporate foreign exchange risk. In addition, corporate demand for the risk sharing mechanism should generate expansion of the public forward market into the currencies and maturities currently available only on a privately brokered basis. Instead, the observed reality contradicts these expectations. Forward foreign exchange hedges are used far less frequently than might be expected and market extensions are opening very slowly. One explanation for this behavior requires a closer look at foreign exchange risk and at the nature of forward exchange contracts.

FORWARD FOREIGN EXCHANGE – SOME HIDDEN RISKS

In the example a forward sale of deutschmarks was used to hedge a deutschmark denominated asset – an account receivable. The example showed that

the combination of contracts insulated the firm from changes in foreign exchange rates. The example relied, however, on an important and not always valid assumption about the account receivable. This assumption was that the deutschmark value of the receivable was fixed, invariant with respect to exchange rates.

The invariance of the foreign currency value of assets may be reasonably assumed for some assets such as investment in cash and marketable securities. It may even reasonably describe the risk attached to some accounts receivable. However, these assets frequently embody some risk of maturity and default.

When the maturity and amounts of assets are uncertain they cannot be perfectly hedged by forward foreign exchange sales. In fact, the attempt to hedge may, in some cases, increase foreign exchange risk above the level of the unhedged asset. The degree of hidden risk depends on characteristics of the underlying asset or cash flow as well as characteristics of the currency behavior and implied forward contract price behavior. To explore these characteristics consider the objective: minimize the valuability of the dollar equivalent of the foreign currency cash flow. This dollar equivalent is the sum of the value of the flow itself and the value of any coincident forward exchange hedge.

$$\bar{C}^{\$} = \bar{S} \times \bar{C}^{F} + \bar{G} \qquad (1)$$

where $\bar{C}^{\$}$ = the expected future cash flow in dollars; $\bar{S}$ = the expected future rate of exchange between dollars and the foreign currency F; $\bar{C}^{F}$ = the expected future cash flow in foreign currency F; $\bar{G}$ = the expected future gain on the forward foreign exchange contract.

The expected gain on the forward foreign exchange contract can be described as a function of expectations about the exchange rate at maturity, and the contracted forward rate and amount.

$$\bar{G} = (F - \bar{S})C^{*} \qquad (2)$$

where F = the contracted forward foreign exchange rate; C^{*} = the contracted sale amount of currency F. This relationship defines the example above; a gain of \$0.1 million on the foreign exchange contract is the product of a profit of \$0.04 per DM sold forward and the forward sale amount of DM2 500 000.

These relationships, considered jointly, demonstrate the nature of the forward contract more clearly. The seller of forward foreign exchange simply contracts to a future exchange of the dollar equivalent (at that point in time) of the foreign cash flow, $\bar{S}C^{*}$, for a dollar equivalent determined at the time of contract, FC^{*}. The seller 'locks in' the value, F, at the forward rate of exchange.

$$\bar{C}^{\$} = \bar{S}\bar{C}^{F} - \bar{S}C^{*} + FC^{*} \qquad (3)$$

Returning to the objective of minimizing variance, note that the variance of the future cash flow,

$\bar{C}^{\$}$, is a function of the variances of the operating cash flow, the variance of the dollar equivalent of the forward foreign currency sale and the covariance between the two. (The variance of the fixed term FC^{*}, is zero.)

$$\text{Var } \bar{C}^{\$} = \text{var}\,(\bar{S} \times \bar{C}^{F}) + \text{Var}\,(\bar{S}C^{*})$$
$$- 2\,\text{Cov}\,(\bar{S} \times \bar{C}^{F}, \bar{S}C^{*}) \quad (4)$$

Clearly, the overall variance depends only on the variability of two components, the covariance between exchange rates and cash flows, and the variance of exchange rates. The covariance between rates and cash flows determines the first term in Eqn (4), the variability of the dollar equivalent of the operating flow. Low variability assets are characterized as those for which future foreign currency values tend to rise with currency devaluation and fall with currency revaluation. The future cash flows represented by investments in productive capacity in a monopolistic industry and in an unrestricted economic environment might serve as an example of such flows.

The second term in Eqn (4) depends simply on the variance of future exchange rates. This variance is reflected in the second term, $\bar{S}C^{*}$, since the foreign currency sale amount, C^{*}, is fixed at the time of contract.

The third term in Eqn (4), the covariance term, also depends on the covariance between the foreign currency flow and the exchange rate. In summary, there are two fundamental determinants of variance. One is the variance of exchange rates; the other is the covariance between rates and cash flows.

The hedging effect of forward contracts is illustrated by assuming that the foreign currency value of the operating cash flow, $\bar{C}^{F}$, is fixed. Assume further that this value is hedged by selling forward an equivalent amount of foreign currency.

$$\bar{C}^{F} = C^{*} \qquad (5)$$

where $\bar{C}^{F}$ = a future cash flow denominated foreign currency f; amount known with certainty. With these assumptions that the foreign cash flow is riskless and completely hedged, the covariance term equals twice the own variance and the variance of the dollar equivalent is zero.

$$\text{Var } \bar{C}^{\$} = \text{Var}\,(\bar{S}\bar{C}^{F}) + \text{Var}\,(\bar{S}C^{*})$$
$$- 2\,\text{Cov}\,(\bar{S}\bar{C}^{F}, \bar{S}C^{*}) = 0 \quad (6)$$

The 'hidden risk' in the use of forward contracts arises when there is uncertainty about either the timing or the amount of the foreign cash flow. This uncertainty introduces a forward contract risk – the risk that the maturing cash flow will not match the forward contract requirements at maturity. *Since the gain or loss on the forward contract is a cash requirement, the firm may unexpectedly realize a cash shortage or surplus.*

The risk is that the firm will realize a loss (gain)

on the underlying asset coincident with a loss (gain) on the forward foreign exchange contract intended as cover. Clearly the net risk depends on the likelihood of the joint occurrence of these events. In specific, risk is relatively higher in covering an operating cash flow whose foreign currency value declines with a currency revaluation or increases with a devaluation. For such flows, the decrease (increase) in the value of the flow would be reinforced by a revaluation loss (devaluation gain) on the forward contract. In fact, this magnification effect can actually cause the variance of the hedged cash flow to exceed the variance of an unhedged cash flow.

Consider again Eqn (4) which describes the total variance of the hedged cash flow. This variance exceeds the variance of the unhedged cash flow, $\text{Var}(\bar{S}\bar{C}^F)$ by the difference between two terms.

$$\text{Var } \bar{C}^S - \text{Var }(\bar{S}\bar{C}^F) = \text{Var }(\bar{S}C^*) - 2 \text{ Cov }(\bar{S}\bar{C}^F, \bar{S}C^*) \tag{7}$$

This formulation emphasizes those cash flow characteristics which reduce or reverse the risk reduction value of forward contract hedges. The larger the variance of the exchange rate – the volatility of the currency – the larger the variability in the value of the forward contract. This increases the risk of forward cover because a default on an account receivable would leave the firm exposed to relatively large gains and losses on the forward contract. As a result, forward hedging in a volatile currency may actually increase the firm's overall risk.

The second important cash flow characteristic, as mentioned above and emphasized here, is the specific covariance of the exchange rate and the foreign currency cash flow. This covariance determines the general covariance term shown above, the covariance of the dollar equivalent of the operating cash flow with the dollar equivalent of the forward contract sale.

The relationship between the more general covariance and the more specific covariance is complex, but can be demonstrated graphically (Fig. 1). At a low covariance the overall variance of the unhedged cash flow exceeds that of the hedged; the hedge is effective because the foreign currency cash
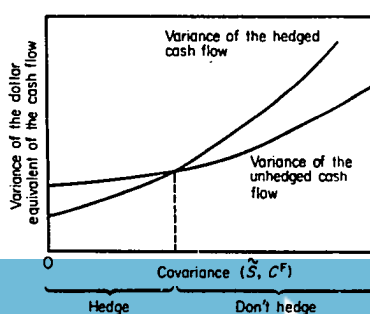
flow is likely to mature as scheduled to meet cash demands for the forward contract. In contrast, at relatively high covariances the hedged cash flow is actually riskier than the unhedged; in these cases there is a strong likelihood that the debtor will default when the currency revalues. The break-even covariance is easily derived from the formula given above, (Eqn 7).

Economists familiar with classical Balance of Trade adjustment theory can comfortably predict the types of assets for which forward cover effectively reduces the cash flow variability. A foreign currency revaluation tends to increase the world price of the country's exports and to reduce the price of non-traded goods within the country. The fortunes of firms or cash flows tied to these tendencies would fluctuate accordingly. For example, the cash flows from operations for a firm supplying import-competing goods would fall as customers switched to lower priced imports. Such a firm, as well as its suppliers, would be likely to increase rather than reduce risk by hedging a long position in the forward market.

IMPLICATIONS FOR FORWARD MARKET EXPANSION

The presence of the hidden risks to forward hedging is consistent with the market behavior discussed above. There it was recognized that firms generally utilized forward hedges less than might be expected. Further, public markets have not extended into the longer maturities or volatile currencies in spite of expected corporate demand for risk reduction in these areas.

The apparent underutilization of forward markets by corporations is consistent with the presence of hidden risks to forward hedges. The foreign currency values of most firms' cash flows are sensitive to exchange rate changes; a reluctance to hedge can be explained by the concomitant risk that the exposed cash flow may not materialize to offset forward contract gains or losses.

The absence of active forward markets for longer maturities is also consistent with hidden risk. One basic component of hidden risk – uncertainty about the timing and maturity of foreign cash flows – must increase as the maturity lengthens. In addition, the second component, variability of exchange rate expectations, may be larger for expectations about more distant maturities. Together these increase the hidden risk of 'long date forwards' and reduce the attractiveness of such hedges.

In short, the reality is consistent with the nature of forward cover. The absence of hedging demand may be due to the presence of greater exchange rate volatility at longer terms as well as greater business risk or greater sensitivity of foreign currency flows to exchange rates at greater maturities.

Figure 1

Using similar reasoning we can also explain a reluctance to hedge cash flows denominated in highly volatile currencies. Gains or losses on forward contracts are relatively high for highly volatile currencies; the consequences of covering uncertain cash flows are consequently greater. Again, we can explain some reluctance to hedge.

IMPLICATIONS FOR CORPORATE FOREIGN EXCHANGE EXPOSURE MANAGEMENT

The net effect of forward contracts on corporate risk depends on several characteristics of the firm and the markets. As described in the introductory sections of this paper, management must first determine the degree of cash flow exposure to exchange rate changes.

Two important elements affect the degree of economic exposure and must be considered when exposure is measured. One concern is the extent to which each cash flow is naturally hedged because its price or value is basically set in the world market. For example, the cash flows of a mining and minerals extraction company may be naturally hedged because foreign currency values adjust to a price set in pounds sterling or US dollars. The second element is the relative weights of naturally hedged, partially hedged and fully exposed cash flows in the aggregate.

The next step is to consider the relevance of this exposure or risk. Exposure management activities should be relatively less valuable when the firm's investors have access to relatively well-developed capital markets. Conversely, risk reduction by the firm's management may increase the value of the corporation when the investors are individually unable to hedge or diversify, or when the risk of exposure causes the managers of operations or marketing to make sub-optimal decisions.

The relevant exposure can then be offset by local currency borrowing. The issues here include availability and cost. Local debt provides costless foreign exchange cover when the costs of foreign currency debt differ from borrowing costs in other currencies

by the expected change in exchange rates. Unfortunately, local markets for debt are seldom so efficient and costs are high or availability is frequently limited. Another complication may be the desire to maintain local currency borrowings at a specific level in the interests of local political concerns or public relations.

Having identified residual foreign exchange exposure, forward foreign exchange hedges are a risk-reducing option. Such alternatives must be closely examined for several important characteristics:

(1) The business risk of the exposed cash flow should be low; that is, the probability of default on assets should be small.
(2) The probability of default should be relatively unrelated to local business conditions – especially the state of the foreign exchange market. This condition will most often be violated for firms trading in export, import, or trade-competing industries.
(3) The foreign currency should be relatively stable so that the fluctuation of profits/losses on forward contracts is relatively low.
(4) Forward contracts should be fairly priced – reflecting economic fundamentals. Conditions for fair pricing include active forward market trading, large numbers of market participants and limited governmental interference in the market.

In summary, good candidates for forward cover include assets with relatively low business risk and of relatively short maturity. Flows denominated in more stable currencies are more easily hedged since the value of the hedge itself will be fairly stable. Finally, flows which are closely tied to the foreign trade sectors of the local economy may best be left unhedged. For these flows hedging in the forward market may increase rather than reduce corporate risk.

Acknowledgement

NOTES AND REFERENCES

1. The work which emphasizes economic value as an objective function traces back to a paper by Heckerman, see Ref. 2. He offers a theoretical definition of exposure which emphasizes the importance of the macroeconomic relationship between prices and exchange rates in determining the real terms of trade and real profits; both input and output quantities are held constant. Shapiro (Ref. 3) extended this approach to recognize variable input and output quantities by defining the elasticities of quantities and real profits with respect to changes in the real terms of trade. Levi (Ref. 4) generalized Shapiro's model and added the financial effects of exchange rate changes to derive an optimal hedging strategy. Finally, Hekman (Ref. 5) integrated these factors into a corporate financial framework which recognizes future expectations, the value of forward contracts, and capital markets' valuation; Hekman (Ref. 6) described a simple method for measuring economic exposure. Rodriguez (Ref. 7) described the implications of this approach for hedging and financing decisions.

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