Efficient market implications for foreign exchange exposure management

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EFFICIENT MARKET IMPLICATIONS FOR FOREIGN EXCHANGE EXPOSURE MANAGEMENT

BY

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1 INTRODUCTION

The assets and liabilities of international companies, by definition, are held, and their income stream achieved, in a variety of currencies. Changes in the exchange rates of these foreign currencies may adversely affect the reported profits and the nominal net worth of the company. With the advent of general free floating exchange rates (March 19, 1973), foreign exchange exposure management has taken an ever increasingly important share of the international company's daily financial management.

2 DEFINITION OF EXPOSURE

Foreign exchange exposure management begins with the definition and identification of the international firm's exchange exposure. The end-of-period dollar value of an exposure in any foreign currency equals the product of two uncertain (random) variables, *i.e.*, the amount of the foreign currency exposure and its exchange rate. If $\tilde{X}$ denotes the uncertain amount of the foreign currency exposure and $\tilde{s}$ the uncertain exchange rate, both valued at end-of-period, then the end-of-period dollar value of the foreign currency exposure, $\tilde{V}$, is equal to $\tilde{X}(\tilde{s}) \cdot \tilde{s}$, or $\tilde{V} = \tilde{X}(\tilde{s}) \cdot \tilde{s}$. Notice that the amount of foreign currency exposure is itself an implicit function of the exchange rate, *i.e.*, $\tilde{X} = \tilde{X}(\tilde{s})$, since changes in the rate of exchange might affect future cash flows in the foreign currency.

3 EFFICIENCY OF FOREIGN EXCHANGE MARKETS

Research by Giddy and Dufey (1975), Giddy (1976), Fieleke (1975), and Frenkel and Levich (1975) has presented evidence supporting the hypothesis of efficiency

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of the foreign exchange market. Only the weak form of the efficient market hypothesis has been tested,[1] *i.e.*, that current foreign exchange rates fully reflect the information implied by the historical sequence of exchange rates. Hence, successive changes in exchange rates are independent of the sequence of past changes in exchange rates.

Giddy and Dufey then argue that the advent of floating exchange rates has reduced to zero the usefulness of any attempt to forecast exchange rate changes. Their assertion is based on the theory of efficient markets which, when applied to the foreign exchange market under freely fluctuating exchange rates, suggests that the present price properly reflects all available information. As in the case of stock market prices, traders and speculators cannot do consistently better than 'the market' in predicting exchange rates. Exchange rates react to new information in an immediate and unbiased fashion, and the assumption is often made that new information arrives randomly, so that exchange rates fluctuate randomly. However, I do not believe that the actual system of managed float corresponds to a system in which exchange rates fluctuate fully randomly.[2]

Governmental authorities still occasionally intervene to assure an orderly market behaviour. The most important international agreement in this context is the 'snake' agreement that is still followed by Germany, Belgium, the Netherlands, Luxembourg and Denmark. In some countries, the domestic interest rate for borrowers may be implicitly subsidized. Thus monetary authorities may influence the interest rate structure.

However, the market reacts extremely quickly to new information available to the public. In other words, potential gains in the foreign exchange markets are immediately arbitraged away. This means that exchange markets are highly efficient in eliminating unexploited profit opportunities – one cannot consistently outsmart the foreign exchange market.

4 THE FORWARD RATE AS FORECAST FOR THE FUTURE SPOT RATE

Under normal market conditions the forward rate has to be considered as the best available forecast of the future spot exchange rate. In times of abnormal disturbance, however, national authorities may intervene directly in the for-

1 In addition to the weak form there also exists a semi-strong and a strong form of efficient market hypothesis. The semi-strong form asserts that all public information is fully reflected in prices (exchange rates). The strong form maintains that not only public information but all information is fully reflected in the prices.

2 There is an important difference in emphasis between the efficient market theory and the random walk. The random walk theory focusses on whether price changes are random, while the efficient market theory concentrates on the amount of information already reflected in the current prices.

ward market through forward purchases of their own currencies in order to prevent the forward discounts from widening too much, sometimes in addition to restrictions on interest arbitrage of speculation.

The forward exchange rate is determined by supply and demand for future currencies. The forward premium or discount is, in fact, a reflection of expectations on the future spot rate. Consequently, if expectations are correct then the forward rate will not be biased; if they are incorrect the forward rate will differ from the future spot rate but only in the short run. For example, if an individual expects that the spot rate in the next period (say 3 months from now) will be lower (higher) than the actual 3 months forward rate, he will have an incentive to sell (purchase) forward exchange and, if his expectations are realized, he will make a per-unit profit equal to the difference between the forward and the expected spot rate. The result of these actions in the market is to move the price of forward exchange toward the expected future spot rate. Since, in the absence of exchange controls, the forward market is highly competitive and rational, speculative funds will continue to enter the market until the price of forward approaches the expected future price of the foreign exchange when these forward contracts come due. Consequently, as suggested by C. Hekman (1975), the forward exchange rate contains the best prediction of price changes for the contract period as it contains all the information available to the public at any point in time. More precisely, the best estimate of the future spot rate is the current forward rate for contracts maturing on that future date. For example, the best prediction of the rate in one month, three months or one year is the forward rate for contracts maturing in one month, three months or one year. So we can draw the conclusion that the forward market provides a viable alternative to risk-averse traders.

We expect the forward exchange rate to be a more accurate predictor the more freely speculators are allowed to enter and exit the market and the more readily available is the relevant information to the public.

5 COST OF HEDGING UNDER THE EFFICIENT MARKET THEOREM

In general, the cost of hedging in the forward market or through the money markets ought to be defined as the difference between the value one would receive at the end of the period if one did not hedge and the amount that would be received if one did hedge. The cost of hedging in the forward market is, therefore, the difference between the future spot rate and current forward rate plus any transactions cost associated with the forward contract. Since at the time of the decision, the future spot rate is uncertain, the costs of hedging in this way are, in part, uncertain. The expected costs of hedging in this manner are the expected value of the difference between the (known) future spot rate plus the known transactions cost.

If the current forward rate is an unbiased estimate of the future spot rate, the expected costs of hedging in the forward market is just the transactions cost associated with the forward transaction. Similarly, the costs of hedging through the money markets are the difference between the interest rate differential in the two currencies and the spread between the current and future spot rate of the foreign currency plus any transaction costs.

Since the future spot rate is uncertain, the costs of this type of hedging are uncertain as well. The expected costs of hedging in the money market are the transactions cost plus the difference between the interest rate differential and the expected value of the difference between the current and future spot rates. If the interest differential is equal to the difference between the current spot rate and the current futures rate, as it most often is, and if the futures rate is an unbiased estimate of the future spot rate, however, the expected cost of hedging through the money markets is only the transactions cost involved.

Assuming efficient foreign currency markets and ignoring transactions costs, the cost of a hedge is zero, since either way, with or without hedging, you end up with the same expected return.[3] In other words, the company has to take a foreign exchange loss (or profit), whether it engages in hedging activities or not. The expected foreign exchange loss (or profit) corresponds to the difference between the foreign currency portfolio valued at the current spot rates and at the expected spot rates at the end of the planning horizon. This argument is not followed by most businessmen, since they mistakenly define costs of hedging as the difference between spot and forward exchange rates (discount or premium).

As an example, suppose outstanding Italian Lira receivables are covered by selling the IL forward at a 10% discount. The company is sure to collect the receivables at the forward rate; this implies a 10% exchange loss. However, if the company chooses not to cover these IL receipts, it will nevertheless face a loss whose expected value is 10%, since the forward rate is an unbiased predictor of the future spot rate under the assumption of efficient foreign exchange markets and zero transaction costs.

Similarly, hedging in the money market consists of borrowing the foreign currency (borrowing US dollars), converting these funds into US dollars (the foreign currency), and investing them in the money market for the same period as the original loan agreement. The cost of hedging in the money market is essentially equal to the interest rate differential between the borrowing and the investment rates, adjusted for the two currencies involved, plus transaction costs

3 This statement should be understood in an ex ante sense. 'Efficient market conditions rule out unexploited profits' does not imply that ex post foreign exchange transactions can never be profitable. Rather it implies that, ex ante, the market participants behave in such a way as to eliminate all expected profit opportunities.

incurred. Again, for most currencies the expected value of the cost of hedging in the money market is equal to the transaction costs involved (in an ex ante sense), as the Interest Rate Parity theorem[4] holds.

In efficient markets, both types of hedging should produce similar results at the same costs, because interest rates and forward and spot exchange rates are determined simultaneously. Money and foreign exchange markets respond continuously to one another to achieve equilibrium. The costs of hedging, assuming efficiency in foreign exchange markets, result in pure transaction costs. These costs of transaction in foreign exchange markets are composed of three elements:

1. Brokerage or service fees charged by the foreign exchange dealers (*i.e.*, the ask-bid spread), or in case of borrowing, compensating balance requirements represent an indirect service fee.
2. Information costs, *i.e.*, all expenses incurred of being informed, such as subscription fees for services as Predex, Reuter-reports, foreign exchange counseling, *etc.*
3. Administrative costs, *i.e.*, the time cost of the executive(s) in charge of exposure management, the cost of executing hedging transactions such as telephone and telex costs, visits with bankers, *etc.*

6 IMPLICATIONS FOR HEDGING STRATEGY

It was stated earlier in this article that the company's exposure in any currency is a function of two uncertain variables: the amount of exposure and its exchange rate. We make the assumption that the amount of exposure in every foreign currency can be approached as a known variable by adding transaction exposure (*i.e.* forecasted cash flows of the company reflecting the impact of changes in exchange rates upon these financial flows) to the translation or accounting exposure of the company. In other words, one should define the amount of exposure as the forecasted accounting value of the firm (taking into account the impact of exchange rate changes on some balance sheet items) at the end of the planning period. Under this workable assumption, foreign exchange exposure management concentrates on the protection of the dollar value of the company's foreign currency assets and liabilities against the adverse impact of changes in the exchange rates.

After the international company has consolidated the foreign exchange exposure of all subsidiaries and netted out assets and liabilities per currency, its net

4 The Interest Rate Parity theorem (also called the Fisher effect in an open economy) states that the interest rate differential of similar assets denominated in different currencies equals the difference between the forward and spot exchange rate. For an excellent survey article see Officer and Willett (1970).

exposure will consist of long/short positions in various currencies. This set of foreign currency positions constitutes the currency portfolio of the company. We introduce the following simple notation to illustrate the basic formulation of the hedging problem:

X_i = exposure in currency i, $i = 1, 2, \ldots, n$.
$s_{o,i}$ = spot exchange rate for currency i.
$o^{s_{1,i}}$ = forward exchange rate for currency i.
$\tilde{s}_{1,i}$ = future spot exchange rate for currency i.
Δ = transaction costs (assumed to be equal for all currencies).
h_i = amount of exposure in currency i hedged.
$\tilde{V}$ = value of the foreign exchange portfolio at the end of the planning period.

For reasons of simplicity, we limit hedging to the forward market. The value of the foreign currency portfolio at the end of the planning period as a function of the amounts hedged can then be represented as:

$$\tilde{V}(h) = \sum_{i=1}^{N} X_i \tilde{s}_{1,i} + \sum_{i=1}^{N} h_i (o^{s_{1,i}} - \tilde{s}_{1,i} - \Delta \cdot s_{o,i}) \tag{1}$$

or,

$$\tilde{V}(h) = \sum_{i=1}^{N} h_i o^{s_{1,i}} + \sum_{i=1}^{N} (X_i - h_i)\tilde{s}_{1,i} - \sum_{i=1}^{N} \Delta \cdot h_i \cdot s_{o,i} \tag{1 bis}$$

The expected value of the foreign exchange portfolio at the end of the period is then:

$$\bar{V}(h) = \sum_{i=1}^{N} h_i o^{s_{1,i}} + \sum_{i=1}^{N} (X_i - h_i)\bar{s}_{1,i} - \Delta \cdot \sum_{i=1}^{N} h_i \cdot s_{o,i} \tag{2}$$

or,

$$\bar{V}(h) = \sum_{i=1}^{N} h_i (o^{s_{1,i}} - \Delta \cdot s_{o,i}) + \sum_{i=1}^{N} (X_i - h_i)\bar{s}_{1,i} \tag{2 bis}$$

The variance of the currency portfolio is:

$$\check{V}(h) = \sum_{i=1}^{N} \sum_{j=1}^{N} (X_i - h_i)(X_j - h_j)\, Cov\,(\tilde{s}_{1,i}, \tilde{s}_{1,j}) \tag{3}$$

Under the hypothesis of efficient foreign exchange markets, the validity of the

Purchasing Power Parity theorem[5] in the form of regular sales price adjustments, may take care of the company's uncertainty with respect to the mean value of its foreign currency portfolio. However, there remains an uncertainty problem to the company, *i.e.*, the variation of the value of the portfolio around its mean.

The objective of foreign exchange management is defined as the minimization of exchange risk to the company, *i.e.*, to minimize the variance of the company's foreign currency portfolio subject to the costs incurred by hedging. Hedging reduces variance caused by exchange rate changes but entails costs to the company. The maximum expected value and variance of the currency portfolio corresponds to zero hedging. For increased amounts of hedging and hence for larger reductions in expected value due to the incurred hedging costs, the variance of the portfolio decreases and will finally become zero when all initially exposed currency positions are fully hedged. The expected maximum hedging costs are:

$$\sum_{i=1}^{N} h_i(\bar{s}_{1,i} - o^{s_{1,i}} + \Delta \cdot s_{o,i}), \text{ with } h_i = X_i \text{ for all } i.$$

Or, the expected value of the fully hedged (*i.e.*, zero variance) foreign currency portfolio is then:

$$\sum_{i=1}^{N} X_i \bar{s}_{1,i} - h_i(\bar{s}_{1,i} - o^{s_{1,i}} + \Delta \cdot s_{o,i}), \text{ with } h_i = X_i \text{ for all } i \tag{4}$$

For different amounts of hedging costs, a quadrate programming model can find us the related values of $\bar{V}$ and $\check{V}$, *i.e.* tracing out an 'efficient frontier' between the variance of the company's currency portfolio and the expected value of this portfolio at the end of the planning period. The money manager can choose a combination of $\bar{V}$ and $\check{V}$ in dealing with the hedging decision, *i.e.*, in making the trade-off between hedging costs and reduction in portfolio variance. The diagram below illustrates the expected value-variance relationship for different amounts of hedging costs.

As has been stated above, costs of hedging under the hypothesis of efficient foreign exchange markets correspond to the transaction costs incurred. There are no direct estimates of the cost of transactions in the foreign exchange or money market. This makes it extremely hard, if not impossible, to make an accurate

5 The Purchasing Power Parity (PPP) theorem addresses itself to the relation between the domestic price level and the equilibrium foreign exchange rate. The theorem states that changes in relative prices equals the experienced changes in exchange rates. For an excellent discussion of PPP, we refer the reader to Balassa (1964), Holmes (1967), Officer (1976) and Dornbusch, Jaffe, *et al.* (1978). For tests of the theory see Aliber and Stickney (1975) and Gaillot (1970).

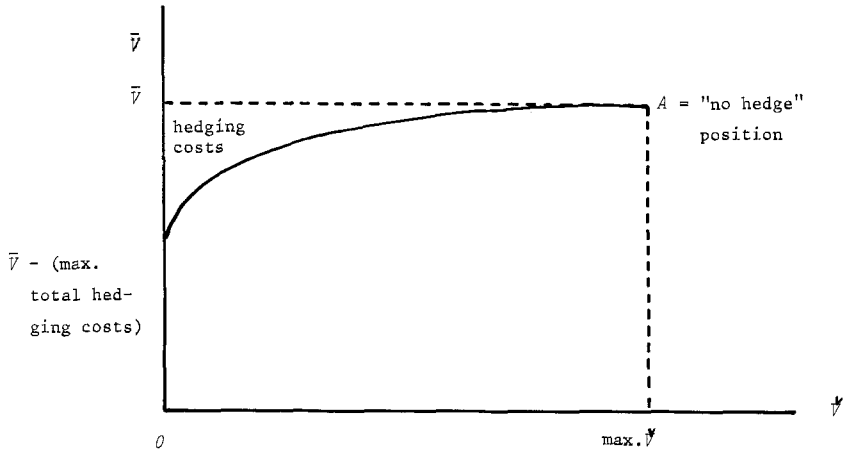

Figure 1 – Expected value-variance relationship.

estimate of transaction costs. Fortunately, some research in this area has lately been done by Frenkel and Levich (1977). They use data on triangular arbitrage as procedure for the estimation of the cost of foreign exchange transactions. Triangular arbitrage is supposed to keep the cross-exchange rates consistent. As an example, consider the exchange rate between the US dollar ($) and the DM, and the exchange rates between the $ and the SF, and between the SF and the DM. In the absence of transaction costs, consistency of equilibrium in the exchange markets requires that for any particular maturity:

$$\left[\frac{\$}{DM}\right] = \left[\frac{\$}{SF}\right] \cdot \left[\frac{SF}{DM}\right] \tag{5}$$

Equation (5) indicates that the dollar price of one DM should equal the product of the price of one SF in terms of $ and the price of one DM in terms of SF.

The discrepancy between both sides of equation (5) is used as an estimate of total transaction costs in the market for foreign exchange. The estimate of the cost of transactions in (90-day) forward exchange rates was 0.5%.[6] This is for the current managed float period (*i.e.* post-1973). In comparison with the 1968–69 period of tranquil fixed parities, Frenkel and Levich found that costs of transactions in foreign exchange have risen six to ten times higher.

6 In practice transaction costs will differ slightly, especially for the less traded currencies, as larger brokerage fees will be charged by foreign exchange dealers.

Taking into account the low cost of hedging and exploiting the statistical relationship between the currencies in the foreign exchange portfolio (*i.e.* the correlation or co-movement between them) one can substantially reduce the foreign exchange risk to the company at relatively low hedging costs. This explains the flat portion of the $\bar{V} - \check{V}$ relationship in Figure 1. The efficient market hypothesis implies that when hedging costs are measured correctly, *i.e.* the sum of transaction costs and the difference between the forward rate and one's forecast of the future spot rate, one can substantially reduce the variance of the company's foreign exchange portfolio at low cost. The principal implication for a hedging strategy is that hedging should be used much more extensively than is the common practice.

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Summary

EFFICIENT MARKET IMPLICATIONS FOR FOREIGN EXCHANGE EXPOSURE MANAGEMENT

Under the hypothesis of efficient foreign exchange markets, the validity of the Purchasing Power Parity theorem may take care of the company's uncertainty with respect to the mean value of its foreign currency portfolio. The remaining uncertainty, *i.e.* the variance of the value of the foreign currency portfolio around its mean, can be reduced by hedging. Assuming efficient markets, the expected cost of hedging is equal to the transaction costs incurred. Taking into account the low cost of hedging, one can substantially reduce the foreign exchange risk at a relatively low cost. Hedging should be used more extensively than is common practice.