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Exposure determines proper currency hedge

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The increasing overseas exposure of large pension funds requires formulating a policy on currency hedging and deciding on implementation steps.

Opinions on the appropriate hedge are unusually widely divergent, ranging from no hedge at all to fully hedged, since currency hedging is a "free lunch."

The argument for hedging is that the volatility of a foreign asset's value to a U.S. investor is reduced without sacrificing any long-term expected return. It is assumed that taking on currency risk does not provide a risk premium because there is no way a U.S. investor investing abroad and a foreigner investing in the United States can earn a currency risk premium simultaneously. In addition, data indicate currency fluctuations do not necessarily wash out over time, so the volatility is not just temporary. Also, the cost of currency hedging is fairly low.

The argument against hedging is that the benefit from diversification provided by currency exposure outweighs the benefit from reduced volatility on that segment of the portfolio. In other words, hedging foreign assets increases the assets' correlation to domestic markets. At relatively low levels of currency exposure, the lower correlation associated with not

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Table 1

$$\begin{aligned} \text{Total variance} = & \text{variance domestic assets} \times \text{domestic assets}^2 \\ & + \text{variance international assets} \times \text{international assets}^2 \\ & + 2 \times \text{correlation factor} \times \text{domestic assets} \times \text{international assets} \\ & \times \text{standard deviation domestic returns} \\ & \times \text{standard deviation international returns} \end{aligned}$$

Table 2

$$\text{Currency hedge position} = \frac{176 \times \text{international} - 15 \times \text{domestic}}{203 \times \text{international}}$$

Table 3

International allocation (%)	Domestic allocation (%)	Optimal currency hedge (%)*
5	95	0
8	92	2
10	90	7
12	88	22
15	85	45
20	80	57
25	75	65
30	70	69
40	60	75
50	50	79

* As a percentage of international allocation.

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hedging ought to outweigh the higher volatility. In addition, currency provides an excellent hedge against domestic inflation, thus hedging inflation-driven pension fund liabilities. Finally, currency hedging requires a significant liquid reserve, which entails an implicit opportunity cost.

Let us approach the question of

what is the appropriate hedge strategy by starting with the formula for aggregating variance (risk, volatility) of two assets — in this case, domestic and international equities.

Looking at this formula (see Table 1), it is clear that at low levels of exposure to international assets, the variance of the inter-

national assets component will have a small weight relative to the covariance factor of the domestic and international assets because the first is weighted by the square of the international assets whereas the second is weighted by the product of domestic and international assets. This observation supports the diversification argument.

The purpose of this paper is to resolve or arbitrate this difference in opinion by providing a formula that any fund sponsor or manager can use to determine the optimal hedge level that will minimize risk. This formula does not depend on the degree of risk aversion. It is assumed there is no long-term expected return from currency exposure and that transaction costs are insignificant.

The first step is to provide a generalized formula others can use by plugging in their volatility and correlation assumptions. The second step is to enter parameters reducing and greatly simplifying the equation. Finally, a table is constructed that indicates the optimal hedge portion at various levels of international exposure.

Going back to the original formula, one can further generalize the international segment by letting one portion (H) be currency hedged and the remainder (1-H) be unhedged. This creates three variance terms for the domestic, international hedged and international unhedged, and three covariance terms for each possible combination of two asset classes. The term H appears in five of the six terms (the exception is domestic variance) in the first and second power.

To minimize total variance using the portion with currency hedging, H, as the independent variable, we can take the first derivative of this equation with respect to H and set it to equal zero.

Note that this is a special case of the traditional risk/return asset allocation model. The important difference is that currency expo-

sure is assumed not to have any impact on long-term returns. Therefore, we are able to focus on the horizontal risk axis (and strive to be as far to the left as possible) and completely ignore the vertical expected returns axis.

Setting the first derivative to equal zero; isolating the currency hedge portion, H; and concentrating the products of domestic and international we get a factor that precisely indicates the correct amount of currency to hedge as a function of the domestic and international allocations, the variance of the domestic and international assets as well as the covariance between the domestic and international assets.

By using our own figures based on annual data for the Standard & Poor's 500 Stock Index and the Morgan Stanley Capital International Europe Australia Far East Index from 1973 through 1991, we can reduce this equation to something very manageable and workable.

- Volatility of international equities unhedged equals 24.2;
- Volatility of international equities with a currency hedge equals 20.9;
- Volatility of domestic equities unhedged equals 17.9;
- Correlation of domestic and international equities unhedged equals 0.57;
- Correlation of domestic and international equities with a currency hedge equals 0.7; and
- Correlation of international equities with and without a currency hedge equals 0.81.

Using the simple formula in Table 2, we can construct a table indicating the optimal portion of currency exposure to be hedged to minimize risk as a function of allocation to international, shown in Table 3.

At very low international allocations, extra currency exposure actually reduces risk because of improved diversification. At allocations between 10% and 15%, the required hedge surges from 7% to

45% of international assets. This confirms the general consensus that at a 15% international exposure, a sponsor should address the currency question. At this level, overseas assets become significant and their high volatility has a noticeable impact on the portfolio, so some hedging is desirable.

At an international exposure of 25% of assets, the optimal hedge plateaus at 65% and climbs gradually to 79% at 50% investment abroad. It is reasonable to expect that at high allocations of foreign assets, more than half would be hedged because at that level of exposure, the higher volatility of the unhedged assets dominates the correlation component. Nevertheless, it doesn't make sense to hedge 100% because there is always an element of diversification to be gained from leaving a portion unhedged. One might think of hedged international and unhedged international as two asset classes albeit with a high correlation to each other.

Important work in determining the optimal currency hedge was done by Stephen Nesbitt, presented in an article in the March-April 1991 issue of the Financial Analysts Journal. Mr. Nesbitt provides a chart as a guideline rather than a formula plotting currency hedge and international allocation at various levels of transaction costs.

Our results are quite different from those indicated in the chart for zero transaction costs. This could be attributed to a different allocation within the international segment or to different parameter inputs.

In terms of the original dispute we set out to resolve, to fully hedge currency exposure or not at all, our verdict is like Solomon's — cut smack in the middle of the two opposing camps. A hedge is not necessary below a 10% international exposure, but at a 15% to 25% allocation or more, a substantial hedge is desirable. A full hedge is never necessary. ■