INTERNATIONAL JOURNAL OF BUSINESS, 2(2), 1997 ISSN:1083-4346

Transaction Exposure, Forward Foreign Exchange Contracts And Exchange Rate Risk

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This paper shows that, for an American multinational corporation that faces transaction exposure, forward foreign exchange market hedges have the ability to lower foreign exchange risk if there is long-term exposure in Pounds, Deutsche Marks, Swiss Francs, and Japanese Yen. While this result also holds for short-term exposure in Pounds, for the other three currencies there are short time periods in which exchange rate risk is not significantly reduced by hedging.

I. INTRODUCTION

In this paper, evidence is presented to support the hypothesis that, for transaction exposure in Pounds, Deutsche Marks, Swiss Francs, and Japanese Yen, hedging using forward contracts reduces exchange rate risk significantly. The reduction in risk is especially apparent if the exposure continues for a long time period. For short-term transaction exposure in Pounds, risk reduction is observed for all time periods studied. However, there are some time periods in which risk reduction is not observed if there is short-term exposure in Deutsche Marks, Japanese Yen, and Swiss Francs.

Whether or not hedging results in risk reduction has been the focus of recent debate. Portfolio theory implies that, given well-diversified investors, corporate hedging does not benefit shareholders by reducing the firm's cost of capital. In the international context, those who favor currency hedging believe that it lowers portfolio risk and that the cost of hedging is minimal. Perold and Schulman [7] propose the so-called "free lunch hypothesis"; that, on average, currency hedging gives substantial risk reduction at no loss of expected return. In fact, they argue that U.S. investors reduce the risk of their portfolios more by hedging than they do by diversifying abroad, in an unhedged fashion, in the first place. Glen and Jorion [3] found that inclusion of forward contracts results in statistically significant improvements in the performance of unconditional portfolios containing bonds. For an investor who diversifies internationally, Black [1] derived a formula for the optimal hedge ratio that suggests that foreign equities should be hedged, hedging equities across different countries should be equal, and hedging should be less than one hundred percent.[1] Those who are opposed to currency hedging argue that it does not reduce risk sufficiently to justify its cost. In fact, some opponents contend that currency exposure helps to diversify a portfolio and that to hedge this exposure might increase the risk rather than reduce it. Other opponents argue that, over the long run, swings in currency values cancel each other out and, hence, currency exposure does not introduce significant risk for

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long-term investors. This is corroborated by the findings in Froot [2] who shows that hedges reduce portfolio return variance at short horizons but not at long horizons. At horizons of several years, complete hedging actually increases the return variance of many portfolios.

Corporate finance theory indicates that hedging can increase firm value by reducing expected taxes, expected costs of financial distress, or other agency costs. The use of off-balance-sheet hedging instruments has been increasing at a striking pace (e.g., Treasury bond futures volume on the Chicago Board of Trade grew from 32 thousand contracts in 1977 to 75 million contracts in 1990). Nance et. al. [5] find that 104 firms out of a sample of 169 firms used hedging instruments in 1986. Firms that hedge face more convex tax functions, have less coverage of fixed claims, are larger, have more growth options in their investment opportunity set, and employ fewer hedging substitutes. Wilford [9] shows that, for some firms, using modern portfolio management techniques to manage corporate risks can prove advantageous.

While there is substantial literature on hedging portfolios, relatively little empirical work has focused on the hedging of the different kinds of exposures that are faced by a multinational corporation.[2] This paper investigates whether hedging transaction exposure is beneficial from the point of view of an American manager who faces transaction exposure in Pounds, Deutsche Marks, Swiss Francs, and Japanese Yen.

The rest of the paper is organized as follows. In section 1 the testable hypothesis is developed and the estimable equation is derived. Section 2 discusses the data. This section also reports and interprets regression results. Conclusions are in section 3.

II. THE HYPOTHESIS AND THE ESTIMABLE EQUATION

Consider an exporter that has sold merchandise on credit at time t and is expecting payment of one unit of foreign exchange at time t+1. The exporter has two alternatives:

(a) Remain unhedged. In this case, the exporter will receive $\$S_{t+1}$, the spot exchange rate at time t+1, quoted as the number of dollars per unit of foreign exchange. This is equivalent to investing $1/(1+i^*)$ units of foreign exchange at time t, where i^* is the foreign interest rate, which at time t is worth $\$S_t/(1+i^*)$, where S_t is the spot exchange rate at time t. Thus, the opportunity cost of receiving $\$S_{t+1}$ at t+1 is $\$S_t(1+i)/(1+i^*)$, where i is the domestic interest rate. Then, the log of the real return from the unhedged position can be written as

$$X_t = \ln(S_{t+1})-\ln(S_t)-(i-i^*)-[\ln(CPI_{t+1})-\ln(CPI_t)], \quad (1)$$

where CPI_{t+1} and CPI_t are the domestic consumer price index in time t+1 and t, respectively.

(b) Hedge using the forward foreign exchange market. In this case, the exporter locks into a forward contract to deliver one unit of the foreign currency and

receive, at time t+1, $\$F_{t+1}$, the forward rate at time t for the delivery of one unit of foreign currency at time t+1. Using the logic in (a) above the log of the real return of the hedged position is

$$H_t = \ln(F_{t+1})-\ln(S_t)-(i-i^*)-[\ln(CPI_{t+1})-\ln(CPI_t)] \quad (2)$$

The purpose of this paper is to test for the equality of the return variances of the hedged and the unhedged positions. A statistical technique suggested by Nothaft et. al. [6], which is designed to test for the effectiveness of hedging, is used.[3] In the context of this paper, this technique is implemented in the following steps:

(i) Regress X_t on constant and save the residuals called $U_{X,t}$. This is the input to calculate the return variance of the unhedged position.
(ii) Regress X_t on H_t and save the residuals called $U_{H,t}$. This is the input to calculate the return variance from the hedged position.
(iii) Construct two transformation variables, $Z_{1,t}= U_{H,t}+U_{X,t}$ and $Z_{2,t}= U_{H,t}-U_{X,t}$.

As explained in Nothaft et. al. [6], the transformation establishes the relationship that $Cov(Z_{1,t},Z_{2,t})=Var(U_{H,t})-Var(U_{X,t})$. The test of $Cov(Z_{1,t},Z_{2,t})=0$ is equivalent to the test of the equality of $Var(U_{H,t})$ and $Var(U_{X,t})$. In order to test for $Cov(Z_{1,t},Z_{2,t})=0$ regress $Z_{1,t}$ on $Z_{2,t}$ using ordinary least squares

$$Z_{1,t}= \beta_0+\beta_1 Z_{2,t}+\varepsilon_t. \quad (3)$$

In eq. (3), if $\beta_1= Cov(Z_{1,t},Z_{2,t})/Var(Z_{1,t})=0$, then this implies that $Cov(Z_{1,t},Z_{2,t})= 0$ and $Var(U_{H,t})=Var(U_{X,t})$. This rationale leads to a test of significance of β_1 by the *t*-test. If β_1 is not significantly different from zero, then the return variances of the hedged and the unhedged positions are equal. If β_1 is greater (less) than zero, then the return variance of the hedged position is greater (less) than the return variance of the unhedged position. Thus, if β_1 is statistically less than zero, the hedged position is better than remaining unhedged.

III. DATA AND REGRESSION RESULTS

Spot and forward rates for Pounds, Deutsche Marks, Swiss Francs and Japanese Yen from 1977 to 1992 are used in this study. These are obtained from various issues of *The Wall Street Journal*. The U.S. prime interest rate is used for i, and the respective prime interest rate for each country is used for i^*. The U.S. consumer price index for all commodities is used as the deflator for the calculation of real returns. For each currency, the transformation variables $Z_{1,t}$ and $Z_{2,t}$ are first constructed using steps (i) (ii) and (iii) outlined in the previous section. Equation (3) is then estimated, first with observations for the entire sample period and then using observations from 15 quarters at a time. Results from the entire sample and sub-samples are used to make inferences on the efficacy of hedging in the long run and in a relatively shorter period of time, respectively.

The *t*-statistics, along with the p-values, for the null hypothesis of $\beta_1=0$

against the alternative of $\beta_1 \neq 0$ from the estimation of eq. (3) for US$/UK Pound, US$/DM, US$/SF, and US$/Yen appear in Table 1.

Table 1
Regression Results From the Estimation of eq. (3) Using $/£, $/DM, $/SF and $/Yen Spot and Forward Rates

Transformation variables $Z_{1,t}$ and $Z_{2,t}$ are first constructed. Then, $Z_{1,t}$ is regressed on $Z_{2,t}$ using ordinary least squares:

$$Z_{1,t} = \beta_0 + \beta_1 Z_{2,t} + \varepsilon_t$$

This is equation (3). The *t*-statistics, along with the p-values, for the null hypothesis of $\beta_1 = 0$ against the alternative of $\beta_1 \neq 0$ for $/£, $/DM, $/SF and $/Yen are reported in the table. The results in Panel A use quarterly data for the entire sample period (1977-1992). Results in Panels B through E use quarterly data for 15 quarters at a time.

t-Statistics (p-value)

	$/£	$/DM	$/SF	$/Yen
Panel A	-4.066 (0.000)	-4.456 (0.000)	-3.845 (0.000)	-5.219 (0.000)
Panel B	-3.077 (0.009)	-1.728 (0.108)	-1.144 (0.273)	-1.865 (0.085)
Panel C	-2.078 (0.058)	-1.212 (0.247)	-1.236 (0.238)	-1.182 (0.258)
Panel D	-2.010 (0.066)	-2.159 (0.050)	-2.029 (0.063)	-2.586 (0.023)
Panel E	-3.427 (0.004)	-3.322 (0.005)	-3.156 (0.007)	-4.927 (0.000)

The *t*-statistics in Panel A are obtained using data from the entire sample period while results in panels B through E are obtained using sub-sample data for 15 quarters each. Results from Panel A indicate that β_1 is significantly less than zero for all the four currencies. This implies that, in the long run, there is strong evidence that the variance of the hedged position is lower than the unhedged position for all four currencies. Results from the remaining panels indicate that hedging in the Pound Sterling market reduces variability also in a relatively shorter period. However, in the $/DM, $/SF, and the $/Yen markets there are periods in which hedging using the forward market does not reduce variability significantly if the transaction exposure is for a relatively short-time period of time.

The findings of this paper are in sharp contrast to results obtained by Froot [2] in the context of portfolio investment. He shows that hedges reduce portfolio return variance at short horizons but not at long horizons. Results in this paper suggest that the risk of *long-term* transaction exposure in all the foreign currencies

considered could be lowered by forward market hedges whereas for some currencies hedging is not always useful if the exposure is for a relatively shorter period.

IV. CONCLUSION

This paper examines whether or not hedging using the forward foreign exchange market lowers exchange rate risk significantly for transaction exposure in Pounds, Deutsche Marks, Swiss Francs, and Japanese Yen. Using a methodology that has been proposed by Nothaft et. al. [6] strong evidence is presented to support the hypothesis that hedging lowers exchange rate risk significantly in all the four markets if the exposure is for a relatively long time period. For shorter term exposure, while this result also holds for exposure in Pounds, there are periods when exchange rate risk is not lowered if there is short-term exposure in Deutsche Marks, Swiss Francs, or Japanese Yen.

NOTES

1. There are many other papers in the literature that derive "optimal" hedging policies (see, e.g., Kritzman [4])
2. Schooley and White [8] consider using forward contracts, futures, puts, and calls to hedge translation exposure.
3. I am indebted to an anonymous referee for suggesting this technique. See Nothaft et. al. [6] for the rationale for using this technique to test for hedging effectiveness.

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