THE JOURNAL OF FINANCE • VOL. XLI, NO. 3 • JULY 1986

Returns and Risks of U.S. Bank Foreign Currency Activities

THEOHARRY GRAMMATIKOS, ANTHONY SAUNDERS and ITZHAK SWARY*

ABSTRACT

In this paper the risks and returns on U.S. banks' foreign currency positions are analyzed in a portfolio setting when both exchange rate and foreign interest rate risks are present. It is shown that U.S. banks could achieve considerable reductions in risk by optimally selecting their foreign currency positions. Actual foreign currency portfolio returns generated from expected exchange rate changes and exchange rate surprises were positive on average but those generated from interest rate surprises were negative. Although the total portfolio returns were positive, on a risk-adjusted basis bank return performance was relatively poor. Nevertheless, despite this relatively poor performance, the risk of ruin or failure for a "representative bank" from foreign currency activities was found to be approximately zero when judged in comparison to the capital funds available to large money center banks to cushion such losses.

FOREIGN CURRENCY TRADING and investment activities are assuming greater importance in the overall on- and off-balance sheet activities of U.S. commercial banks. For example, in April 1983, 119 banks in the U.S. had foreign currency trading operations, up from 90 in March 1980, with a total volume traded of $702 billion compared to $491 billion in March 1980.

General concerns by regulators regarding these foreign currency activities have mounted since the failures of the Franklin National Bank and Bankhaus (ID) Herstatt in 1974. Both failures were either directly or indirectly attributed to losses incurred on foreign currency transactions (see, for example, Rose [12]). As a result, bank regulators have been paying greater attention to monitoring these activities, especially with regard to their possible impact on bank capital adequacy. This monitoring includes provisions for increased disclosure of losses on foreign currency positions in the recently passed International Lending Supervision Act [5][1] and the development of a data base that requires each bank with a foreign exchange position of $10 million or more to report the details of that position to the Treasury every month.

The risks emanating from the foreign currency activities of commercial banks can be divided into two types: (i) exchange rate risk(s), and (ii) foreign interest rate risk(s). Exchange rate risk occurs whenever a bank has a positive (or negative) net asset position in a particular foreign currency and there is an unexpected change in exchange rates. If foreign currency assets are greater (smaller) than liabilities, an appreciation (depreciation) in the foreign currency

* University of Wisconsin-Madison, New York University and Hebrew University, respectively.

[1] Specifically Sections 904 and 907 of that Act.

vis-à-vis the dollar generates capital gains (losses) either on paper or realized. However, even if a bank's assets and liabilities in a foreign currency are matched in size (i.e., its net asset position is zero) it may still be exposed to foreign interest rate risk; elsewhere this has been called seemingly hedged speculation (see Rodriguez and Carter [11], pp. 109–110). Foreign interest rate risk arises whenever a bank mismatches the durations (or maturities) of its foreign currency assets and liabilities. If the average duration of its foreign currency assets is greater (smaller) than its liabilities, then an unexpected upward parallel shift in the term structure of foreign interest rates will reduce (increase) the bank's net interest earnings.

Given that U.S. banks do hold exposed net positions and appear to mismatch the durations of foreign assets and liabilities (see below), the objective of this paper is to evaluate the overall return performance and risk exposure resulting from their foreign currency activities. Previous studies in this area have been concerned primarily with the forecasting ability of U.S. commercial banks in taking speculative or open foreign currency positions in individual currencies (see Fieleke [4] and Irmler [6]). However, to date, no study has sought to evaluate the returns and risks of U.S. banks' foreign currency positions in the face of: (a) both exchange rate and foreign interest rate risks, and (b) a portfolio rather than single currency context. Specifically, with respect to (b), even if we find that a foreign currency position taken in one currency is risky, the overall exposure of the bank may be lower than apparent if the bank simultaneously holds positions in many foreign currencies, and exchange rate and interest rate changes are not perfectly (positively) correlated across countries.

The foreign currency positions taken by U.S. banks are briefly described in Section I. In Section II a model is developed that generates the ex ante returns and risks on each currency position, and portfolio of currency positions, in the face of both exchange rate and foreign interest rate risks. Section III presents the data and the properties of the variables. In Section IV estimates of ex ante risk exposure are derived and risk minimizing foreign currency portfolios are estimated and compared to the estimated risk of actual portfolios selected by U.S. banks. In Section V estimates of ex ante and ex post returns are presented and a performance index derived. Finally, the implications of the risk exposure for the solvency of U.S. banks and the overall conclusions are presented in Section VI.

I. The Foreign Currency Positions of U.S. Banks

The average monthly net positions taken by U.S. banks (as reported in the U.S. *Treasury Bulletin*) in five major currencies (the Canadian dollar, British pound, German mark, Swiss franc and Japanese yen) are presented in Table I, for the years 1976–1981.[2]

As can be seen, the total net asset position in each currency can be decomposed into a net balance sheet position (assets minus liabilities) and a net forward

[2] The Treasury stopped publishing this data in the *Treasury Bulletin* at the end of 1981.

Table I

U.S. Bank Foreign Currency Positions, 1976–81[a]

Year	Balance Sheet Net Positions	Forward Contracts Net Positions	Total Net Asset Positions	Std. Deviation of Net Asset Positions
Canadian dollar				
1976	251.58	−158.50	93.08	57.76
1977	481.42	−523.42	−42.00	57.55
1978	716.33	−726.67	−10.33	112.99
1979	1006.75	−973.17	33.58	134.04
1980	1426.67	−1457.67	−31.00	61.38
1981	1664.18	−1770.64	−106.45	228.32
British pound				
1976	−20.58	−3.67	−24.25	47.60
1977	−3.25	50.08	46.83	41.34
1978	33.58	−139.17	−105.58	44.60
1979	182.50	−288.08	−105.58	79.67
1980	392.17	−512.33	−120.17	172.73
1981	1011.27	−1152.91	−141.64	33.19
German mark				
1976	5530.17	−4087.67	1442.50	386.54
1977	4133.17	−3283.50	849.67	1274.10
1978	3200.75	−2465.58	735.17	242.13
1979	3111.92	−2485.50	626.42	400.46
1980	6065.25	−5639.50	425.75	281.72
1981	9738.09	−8536.00	1202.09	695.12
Swiss franc				
1976	2970.83	−2891.58	79.25	300.82
1977	2853.17	−2545.08	308.08	222.56
1978	2353.25	−2230.67	122.58	157.08
1979	3188.83	−3180.83	8.00	215.47
1980	3777.25	−4018.83	?41.58	204.07
1981	3872.18	−3674.64	197.55	1211.18
Japanese yen				
1976	484,313.58	−399,324.83	84,988.75	67,838.16
1977	441,204.00	−367,453.17	73,750.83	11,448.39
1978	519,648.58	−456,716.50	62,932.08	43,589.16
1979	477,877.00	−438,067.00	39,810.00	22,420.49
1980	485,465.17	−460,916.33	24,548.83	13,389.23
1981	649,175.37	−575,768.45	73,406.91	131,266.98

[a] Average of monthly amounts (amounts in millions).

contract position (forward contracts bought minus forward constracts sold). The net balance sheet positions are shown in the first column and net forward contract positions in the second. It is apparent from these figures that banks generally have been net long in foreign balance sheet assets and net short in forward contracts, so that these exposures have often worked to offset each other, thereby reducing total net exposure. Nevertheless, total net exposure levels often have been quite large.

In addition to information on total exposure of U.S. banks in different currencies, the Treasury also provides a breakdown of the maturity composition of

Table II

German Mark Maturity Positions in January 1981
(millions of marks)

End of Month	Maturity	Worldwide						
		Balance Sheet Items			Foreign Exchange Contracts			Net Overall Position
		Assets	Liabilities	Net	Bought	Sold	Net	
January 1981	Demand/spot	9,996	13,728	−3,728	41,072	40,612	460	−3,272
	3 days–1 month	17,490	16,399	1,091	34,331	37,453	−3,122	−2,031
	Over 1 mo.–3 months	19,373	16,022	3,351	53,870	55,430	−1,560	1,791
	Over 3 mos.–6 months	10,002	8,270	1,732	42,999	44,970	−1,971	−239
	Over 6 mos.–1 year	4,103	2,833	1,270	18,267	19,536	−1,269	1
	Over 1 yr.	10,774	6,468	4,306	3,805	4,072	−267	4,039
	Total of all maturities	71,738	63,720	8,018	194,344	202,073	−7,729	289

foreign currency assets, liabilities and forward contracts for each month. A representative example of this maturity breakdown is shown in Table II for the German mark in January 1981.

This detailed breakdown indicates that the positions taken by banks in each maturity were often quite different. In Table II, for example, banks were net short in spot marks (−DM 3,272 million) but net long in marks with maturities over 1 year (DM 4,039 million).

Thus, the evidence from the Treasury data suggests that, historically, (a) banks have imperfectly hedged their overall or total asset positions in individual foreign currencies, exposing them to exchange rate risk and, (b) they have imperfectly matched the maturities of their foreign currency positions, exposing them to interest rate risk.

II. The Expected Returns and Risks on Bank Foreign Currency Positions

The bank is assumed to calculate portfolio duration according to the well known Macauley formula [10] (also see Bierwag and Kaufman [2]). Given a preselected (or initial) net asset position, NP_0, in a foreign currency (say German marks), a mismatch of asset and liability durations, $[d_L L_0 - d_A A_0]$ (where d_L, d_A are duration parameters defined below), and a beginning period level of German rates, r_0, the expected change in the end of period wealth, $E(\Delta \tilde{W})$, will depend on the expected change in the \$/DM exchange rate, $E(\Delta \tilde{X}/X_0)$, and the expected rate of change in the (German) interest rate, $E(\Delta \tilde{r}/1 + r_0)$, over that period. Thus, the bank's one period expected or ex ante dollar return from holding an exposed position in any single currency will be

$$E(\Delta \tilde{W}) = NP_0(1 + r_0)X_0\left[1 + \frac{E(\Delta \tilde{X})}{X_0}\right] + [d_L L_0 - d_A A_0]X_0 \frac{E(\Delta \tilde{r})}{1 + r_0} - NP_0 X_0 \quad (1)$$

where:

$\Delta\tilde{W}$ = the stochastic change in the (U.S. $) value of bank wealth
NP_0 = the net asset position (for all maturities) in foreign currency at the beginning of the time period
r_0 = the Euro-currency interest rate at the beginning of the period
$\Delta\tilde{r}/(1 + r_0)$ = the rate of change in the interest rate over the period
X_0 = the dollar/foreign currency exchange rate at the beginning of the period
$\Delta\tilde{X}/X_0$ = the change in the exchange rate over the period
d_L = the duration of foreign currency liabilities
d_A = the duration of foreign currency assets
L_0 = aggregate foreign currency liabilities at the beginning of the period
A_0 = aggregate foreign currency assets at the beginning of the period.

We can also calculate the ex ante or expected risk of the position taken in any individual foreign currency. Here risk is measured by the ex ante variance (or standard deviation) of the change in wealth. Thus,

$$\mathrm{Var}(\Delta\tilde{W}) = [NP_0(1 + r_0)X_0]^2\mathrm{Var}\left(\frac{\Delta\tilde{X}}{X_0}\right) + [d_L L_0 - d_A A_0]^2 X_0^2 \frac{\mathrm{Var}(\Delta\tilde{r})}{(1 + r_0)^2}$$
$$+ 2[NP_0(1 + r_0)X_0][d_L L_0 - d_A A_0]X_0\mathrm{Cov}\left(\frac{\Delta\tilde{X}}{X_0}, \frac{\Delta\tilde{r}}{1 + r_0}\right) \quad (2)$$

However, equations (1) and (2) merely reflect a bank's exposure in a single currency. As noted in the introduction it is quite possible that diversification by the bank into many currencies, which themselves have heterogeneous asset-liability durations, will actually work to reduce overall risk exposure. This will be especially true if exchange rate and foreign interest rate changes have relatively low positive or negative correlations.

In a j–currency world, $j = 1, \ldots, n$, the overall or portfolio return and risk can be calculated as follows:

Let

$$NP_0^j(1 + r_0^j)X_0^j = K_1^j = \text{Net asset position in the } j\text{'th currency}$$

and

$$[d_L^j L_0^j - d_A^j A_0^j]X_0^j = K_2^j = \text{Net duration position in the } j\text{'th currency.}$$

Then form the following vectors:

$$Y = [K_1^1, \ldots, K_1^n, K_2^1, \ldots, K_2^n]$$

where Y is a $1 \times 2n$ vector of exposure positions, and

$$Z = \left[\left(\frac{r_0^1}{1 + r_0^1} + \frac{\Delta\tilde{X}^1}{X_0^1}\right), \ldots, \left(\frac{r_0^n}{1 + r_0^n} + \frac{\Delta\tilde{X}^n}{X_0^n}\right), \frac{\Delta\tilde{r}^1}{1 + r_0^1}, \ldots, \frac{\Delta\tilde{r}^n}{1 + r_0^n}\right]$$

where Z is a $1 \times 2n$ vector of returns. Finally, let

$$M = \frac{1}{T}(Z - \bar{Z})(Z - \bar{Z})'$$

where M is a $(2n \times 2n)$ variance-covariance matrix of exchange rate changes and interest rate changes, and T is the sample period over which M is estimated. Then,

$$E(\Delta\tilde{W}) = YE(Z') \tag{3}$$

and

$$\text{Var}(\Delta\tilde{W}) = YMY' \tag{4}$$

III. Data and Properties of Variables

Data used to calculate net asset positions and durations in five foreign currencies (the Canadian dollar, the British pound, the German mark, the Swiss franc and the Japanese yen) from December, 1975 through November, 1981 were obtained from the Treasury's *Monthly Bulletin*. Three-month Euro-currency rates and foreign currency exchange rates were derived from the Harris Bank's weekly data base.

To calculate the durations of foreign asset and liability portfolios, it was assumed that all payments (principal plus interest) on a foreign currency asset or liability were made at maturity (see Dufey and Giddy [3]). Further, since duration is measured in units of time, 3 months was chosen as a numeraire. Finally, the *Treasury Bulletin* publishes only maturity "ranges" for foreign currency assets and liabilities. As a result, it was assumed that all assets (or liabilities) matured at the earliest date given in the maturity range.[3]

The variance-covariance matrix among the weekly changes in the five spot exchange rates ($\Delta\tilde{X}/X_0$) and Euro-currency rates ($\Delta\tilde{r}/1 + r_0$) was then estimated for the whole sample period (12/75–11/81) and two equal subperiods (12/75–11/78 and 12/78–11/81). It was apparent that a number of negative correlations existed among exchange rate changes and interest rate changes in all three periods. For example, 23 out of 40 correlations for the whole sample period were negative with 18 significant at the 5% level or less. Further, most of the negative correlations were among exchange rate and interest rate changes, as would be predicted by a partial equilibrium version of the interest rate parity theorem (IRPT) (see Fieleke [4]).[4] It was also apparent that these negative correlations were generally higher in the second subperiod (12/78–11/81) compared to the first (12/75–11/78). Thus, while the standard deviations of $\Delta\tilde{X}/X_0$ and $\Delta\tilde{r}/(1 + r_0)$ were generally larger in the second subperiod, there appear to have been opportunities for significant currency risk diversification.

[3] However, this assumption will underestimate the true duration mismatch and bias downwards the estimate of foreign interest rate exposure.

[4] That is, given values for $r_\$$ and F, where F is the one-period forward exchange rate and $r_\$$ is the U.S. dollar interest rate, the IRPT implies $(F - X_0)/X_0 = (r_\$ - r_0)/(1 + r_0)$, so that an increase in $r_\$$ implies a decrease in X_0.

To examine the underlying stability of the exchange rate-interest rate variance-covariance matrices a Chi-squared test of the null hypothesis that the matrix in the first subperiod (12/75–11/78) was equal to the matrix in the second subperiod (12/78–11/81) was conducted. The Chi-squared test value was 421.02, which rejected the null hypothesis of equality at the 5% level. Moreover, successive six-month variance-covariance matrices were also estimated and the null hypothesis of matrix equality was rejected. Because of this instability a rolling forward method of revising expectations, as to the underlying relationship among the $\Delta\tilde{X}/X_0$ and $\Delta\tilde{r}/(1 + r_0)$ variables, was employed in evaluating the ex ante foreign currency risk exposure of banks over the 6/76–11/81 period.[5]

IV. Risk Performance

As discussed above, foreign currency risk is measured by the ex ante variance of returns (or standard deviation) on the foreign currency portfolio, i.e., $\text{Var}(\Delta\tilde{W}) = YMY'$ where, Y is a 1×10 vector of actual net foreign currency asset positions and foreign currency durations adopted by U.S. banks and M is a 10×10 ex ante variance-covariance matrix among $\Delta\tilde{X}/X_0$ and $\Delta\tilde{r}/(1 + r_0)$. It is assumed that at the beginning of each period banks selected their net foreign currency asset and duration positions based on a forecast of M estimated from information on exchange rate and interest rate changes over the previous 26 weeks. Given the monthly vector, Y, calculated from the *Treasury Bulletin* and the estimates of M, the ex ante standard deviation of returns, $\sqrt{\text{Var}(\Delta\tilde{W})}$, can be calculated for each month of the sample period. These monthly standard deviations measured in millions of U.S. dollars, are plotted in Figure 1 for the period 6/76–11/81.[6]

As can be seen, for the period from June 1976 through the beginning of 1981 there has been a general increase in the risk exposure of bank foreign currency portfolios. The risk exposure declined in the third quarter of 1981 but started to increase again during the fourth quarter of 1981.

Given that some risk exposure may be optimal or even unavoidable, due to the cost of hedging or incomplete markets in foreign currency and interest rate futures, in this section we next look at the suboptimization (in terms of risk) of the actual net asset and duration positions chosen by U.S. banks from a portfolio perspective. To do this, banks' actual foreign currency positions, and the risks associated with those positions, were used as the relevant measures for comparison.

To estimate the relative degree of suboptimization in a portfolio context, two experiments were carried out. The first, which follows theoretical work by Levi [8], lets all foreign currency portfolio (net asset and net duration) positions *except one* be taken as given, i.e., as published in the *Treasury Bulletin*, but allows one position to take on a value which minimizes the ex ante risk of foreign currency portfolio returns (subject to the constraint of $n - 1$ fixed positions). It

[5] Elsewhere, using U.S. stocks, Johnson and Shannon [7] have shown that revising portfolio weights on the basis of new information generates higher risk-adjusted portfolio returns than a strategy of choosing fixed portfolio weights based on an initial variance-covariance matrix.

[6] The first 26 week period (12/75–5/76) was used to provide an initial estimate of the matrix, M.

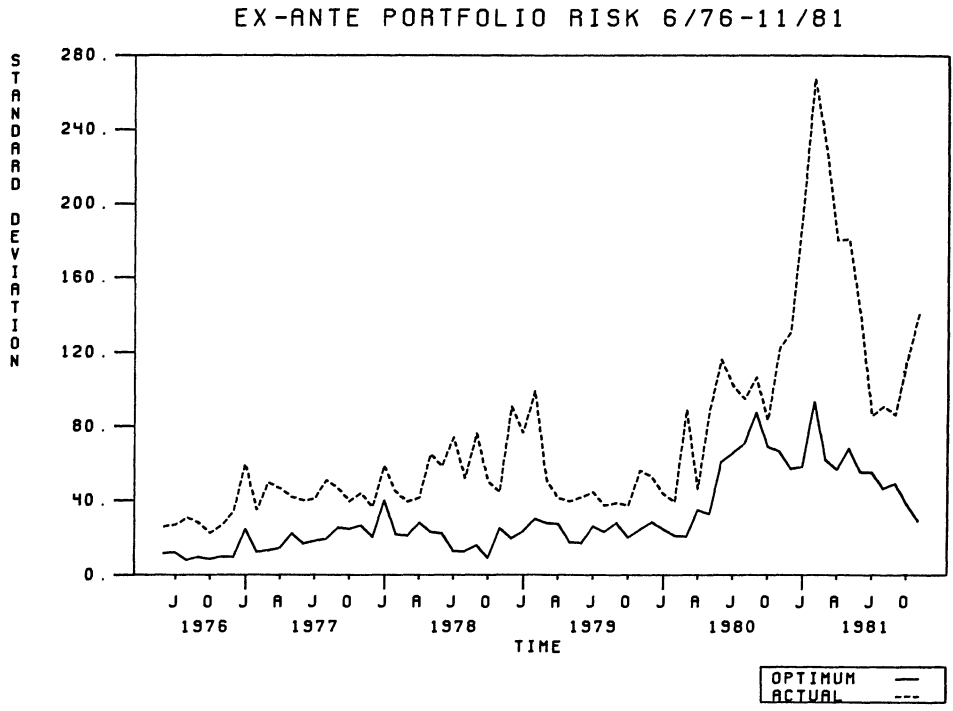

Figure 1. Actual and Optimal Risk of Foreign Currency Operations.

can be shown that the risk minimizing value of the free variable is simply the negative of the weighted sum of the regression slopes of the free variable on the fixed variables, where the weights are the fixed exposure positions. The potential risk reducing power of allowing this position to be variable can then be determined by comparing the standard deviation of the actual portfolio in each month, i.e., when all Y's are predetermined, with the standard deviation derived when one position is allowed to take an optimal value and $n - 1$ are fixed.

The average proportional reductions in risk when each foreign currency net asset position was successively chosen as the free variable were 2.78%, 11.17%, 13.9%, 13.11%, and 11.61% for the Canadian dollar, pound, mark, franc and yen, respectively. The corresponding average reductions in risk when each foreign currency duration was optimized were 5.41%, 30.50%, 18.07%, 9.00% and 6.87%. Thus, the Levi test suggests that for the Canadian dollar, pound and mark, U.S. banks were more exposed to foreign interest rate rather than exchange rate risk while the reverse was true for the franc and the yen.

The second experiment allows all portfolio (net asset and duration) positions to take on an optimal value so as to minimize the risk of the entire portfolio for a given expected return. Thus, for each month the efficient frontier was constructed from historical data over the previous 26 weeks and the risk minimizing portfolio was derived that yielded the same expected return as the actual portfolio chosen by U.S. banks. The standard deviations of these risk minimizing portfolios (scaled up to the actual total portfolio position) are shown in Figure 1. As expected, much higher risk reductions were possible if all positions were chosen

optimally compared to the Levi method. The lowest proportional risk reduction was 17% (October, 1980) while the highest was 83% (July, 1978). The average risk reduction was 54.62%, suggesting that banks on average could have reduced their risk exposure by half if they had chosen their foreign currency net asset and duration positions in an optimal fashion.

V. Return Performance

From equations (1) and (3) the ex ante dollar return on a bank's foreign currency portfolio will depend on assumptions made regarding the stochastic processes underlying the time series behavior of $\Delta\tilde{X}/X_0$ and $\Delta\tilde{r}/(1 + r_0)$. From equation (1) we have:

$$E(\Delta\tilde{W}) = NP_0(1 + r_0)X_0\left[1 + \frac{E(\Delta\tilde{X})}{X_0}\right] + [d_L L_0 - d_A A_0]X_0 \frac{E(\Delta\tilde{r})}{1 + r_0} - NP_0X_0$$

If it is assumed that the bank decision maker believes:[7]

$$\frac{E(\Delta\tilde{X})}{X_0} = \frac{r_\$ - r_0}{1 + r_0} \quad \text{and} \quad \frac{E(\Delta\tilde{r})}{1 + r_0} = 0$$

then,

$$E(\Delta\tilde{W}) = NP_0X_0r_\$ \tag{5}$$

where $r_\$$ is the U.S. dollar interest rate. That is, a bank's ex ante return will be the U.S. dollar return (cost) on the foreign currency net asset (liability) position. It can also be shown that the actual or ex post return is equal to the expected return (5) plus a term for surprises in exchange rate changes and another term for foreign interest rate surprises.

$$\Delta\tilde{W} = \underbrace{NP_0X_0r_\$}_{\substack{\text{(Expected}\\ \text{Return)}}} + \underbrace{NP_0X_0\left[r_0 - r_\$ + (1 + r_0)\frac{\Delta\tilde{X}}{X_0}\right]}_{\substack{\text{(Gain or Loss Due to}\\ \text{Exchange Rate Surprises)}}} + \underbrace{[d_L L_0 - d_A A_0]X_0 \frac{\Delta\tilde{r}}{1 + r_0}}_{\substack{\text{(Gain or Loss Due to}\\ \text{Interest Rate Surprises)}}} \tag{6}$$

Table III presents the monthly portfolio actual or ex post dollar returns in millions of U.S. dollars over the period 12/76–11/81. Panel A shows the actual monthly dollar returns for each of the five currencies and for the total portfolio. U.S. banks obtained positive returns from their exposure in the mark, franc and yen while they received negative returns from their exposure in the Canadian dollar and the pound. Notice also that despite the extremely high coefficients of

[7] That is, it is assumed that IRPT holds and that the foreign interest rate term structures are expected to remain unchanged.

Table III

Ex Post Monthly Portfolio Returns in Millions of U.S. Dollars: 12/75–11/81

A. Decomposition According to Foreign Currency Exposure

Foreign Currency	Mean	Standard Deviation	Coefficient[a] of Variation
Can. dollar	−0.625	6.970	11.15
Pound	−0.411	26.899	65.45
Mark	4.597	20.932	4.55
Franc	0.897	7.385	8.23
Yen	2.404	8.966	3.73
Total	6.862	35.048	5.11

B. Decomposition According to Type of Return

Return Due to	Mean	Standard Deviation	Coefficient[a] of Variation
Expected Exchange Rate Changes	3.862	6.721	1.74
Exchange Rate Surprises	6.016	18.550	3.08
Interest Rate Surprises	−2.795	29.825	10.67
Total	6.862	35.048	5.11

[a] Absolute value.

variation of returns for the Canadian dollar, the pound and the franc, the coefficient of variation for the total portfolio return was much lower as should be expected from portfolio theory. The cause of this was the generally low correlations between individual ex post currency returns over the sample period. In particular, the largest positive correlation was between the Canadian dollar and the mark (+.31) and the largest negative correlation between the pound and the mark (−.29).

To gain further insights into the underlying causes of the ex post variability of returns, total monthly ex post foreign currency portfolio returns were next decomposed into the three components of equation (6). As can be seen from Panel B of Table III, banks enjoyed on average positive returns from both the expected exchange rate changes (3.862) and the exchange rate surprises (6.016). As a matter of fact, exchange rate surprises may not have been actual "surprises" for U.S. banks since on average they obtained dollar returns almost twice as high from these "surprises" over what would be expected according to the IRPT. This finding suggests that U.S. banks may have outperformed the IRPT as far as forecasting exchange rates is concerned. On the other hand, interest rate surprises generated a negative (on average) dollar return (−2.795) indicating that they did not fare as well in forecasting changes in foreign interest rates. It might also be noted that the coefficient of variation of returns from the interest rate surprises (10.67) was much larger than that for exchange rate surprises (3.08).

Finally, as a measure of overall foreign currency portfolio performance, risk-adjusted (or standardized) returns on the total currency portfolio were calculated for both ex ante and ex post returns (see Sharpe [14]). Standardized ex ante returns and standardized ex post returns are defined respectively as ex ante returns in period t (see (5)) divided by the ex ante standard deviation calculated as in Section IV, and ex post returns in period t (see (6)) divided by the ex post standard deviation.[8]

In general, the ex ante performance index was very close to zero over most of the sample period. Indeed, in no month were ex ante risk-adjusted returns significantly different from zero at the 5% level. The ex post performance index was far more variable but even in this case it was possible to identify only one standardized return that was significantly different from zero (December, 1977).

VI. Conclusions and Implications

As has become apparent from Sections IV and V, returns on U.S. banks' foreign currency positions over the 1976–81 period have often been small relative to the underlying risks involved.[9] This is so even if risk is measured in a portfolio context. The Treasury and bank regulators (the Federal Reserve, FDIC, Comptroller of the Currency) have at various times expressed concern that taking active foreign currency positions may endanger the overall safety and soundness of the banking system (most recently in the International Lending Supervision Act of 1983). It is natural to ask how exposed banks are to failure in the face of foreign currency portfolio risk.[10] Using the capital positions (C) of the 15 largest money center banks and annualized estimates of the ex ante standard deviation of returns, the probability of ruin (α) can be calculated as $Z(\alpha) = \frac{-C - E(\Delta\tilde{W})}{\sigma_{\Delta\tilde{W}}}$ (see Roy [13]).[11] In all years examined (1978–81), C was significantly greater than $\sigma_{\Delta\tilde{W}}$.[12] Indeed, it was not possible to reject the hypothesis that α was zero in each year of our sample.

Nevertheless, this type of calculation does not incorporate possible indirect routes to capital impairment. For example, the announcement of foreign exchange losses, even if small relative to capital could lead to a confidence problem among

[8] Note that ex post variance was calculated using weekly exchange rate and interest rate changes over month t and the preceding 5 months, whereas ex ante variance was calculated over the 6 months preceding t.

[9] However, it should be noted that the data employed in this study fail to include the fees that banks might generate from foreign currency activities. For example, in 1981 and 1982 non-interest earnings from foreign currency activities supplied over 10% of total non-interest income of Bank of America, Chase Manhattan, Citibank and Morgan Guaranty, among others.

[10] To the extent that foreign currency risks are less than perfectly (positively) correlated with the risks of other bank activities, our estimate of the risk of failure will be biased upwards.

[11] Using Moody's annual reports, the fifteen banks were: Bank of Boston Corp., Bank America Corp., Bankers Trust N.Y. Corp., Chase Manhattan Corp., Chemical N.Y. Corp., Citicorp, Continental Illinois Corp., First Chicago Corp., Irving Bank Corp., Manufacturers Hanover Corp., Marine Midland Bank Inc., Mellon National Corp., J. P. Morgan and Co. Inc., NBD Bancorp, and Security Pacific Corp.

[12] Calculations for 1976 and 1977 were not performed due to problems in determining primary capital figures for certain banks.

large depositors, leading to a withdrawal of funds both from the bank concerned as well as other banks or an increase in risk premiums impounded in the cost of funds. These types of contagion effects among banks have been documented elsewhere by Aharony and Swary [1] among others.[13] Moreover, considerations of default or country risk have been ignored. Finally, the calculations are based on aggregate positions of U.S. banks relative to aggregate capital, thereby reflecting the risk to the average or "representative bank." Individual banks (or outliers) that are in financial distress may have incentives to take excessive risks through foreign currency market speculation in a gamble to return to solvency. There is some evidence that this strategy lay behind Franklin National's foreign currency operations in 1973–74 (see Rose [12]). Using the disaggregated positions of individual U.S. banks (if available) might provide greater insights into the riskiness of foreign currency operations.

[13] The effect of adverse information on depositors' confidence has been amply demonstrated in the recent (May 1984) runs on Continental Illinois and Manufacturers Hanover banks.

REFERENCES

1. J. Aharony and I. Swary. "Contagion Effects of Bank Failures: Evidence from Capital Markets." *Journal of Business* 56 (July 1983), 305–322.
2. G. O. Bierwag and G. G. Kaufman. "Coping With the Risk of Interest Rate Fluctuations." *Journal of Business* 50 (July 1977), 364–370.
3. G. Dufey and I. H. Giddy. *The International Money Market.* Englewood Cliffs: Prentice-Hall, 1978.
4. N. S. Fieleke. "Foreign Currency Positioning by U.S. Firms: Some New Evidence." *Review of Economics and Statistics* 63 (February 1981), 35–42.
5. International Lending Supervision Act, PL 98-181, November 30, 1983.
6. E. W. Irmler. "Further Evidence on Foreign Currency Positioning by U.S. Banks." Office of the Comptroller of the Currency Working Paper No. 8, 1982.
7. K. H. Johnson and D. S. Shannon. "A Note on Diversification and the Reduction of Dispersion." *Journal of Financial Economics* 1 (December 1974), 365–372.
8. M. D. Levi. "Underutilization of Forward Markets or Rational Behavior." *Journal of Finance* 34 (September 1979), 1013–1016.
9. H. Levy. "Optimal Portfolio of Foreign Currencies with Borrowing and Lending." *Journal of Money, Credit and Banking* 13 (August 1981), 325–341.
10. F. R. Macauley. *Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields, and Stock Prices in the United States since 1856.* New York: Columbia University Press for the National Bureau of Economic Research, 1938.
11. R. M. Rodriguez and E. E. Carter. *International Financial Management.* Englewood Cliffs: Prentice-Hall, 1976.
12. S. Rose. "What Really Went Wrong at Franklin National." *Fortune* (October 1974).
13. A. D. Roy. "Safety-First and the Holding of Assets." *Econometrica* (1952), 431–449.
14. W. F. Sharpe. "Mutual Fund Performance." *Journal of Business* 39 (January 1966), 119–138.

DISCUSSION

JAMES A. BRICKLEY*: Grammatikos, Saunders and Swary examine U.S. bank exposure to interest rate and exchange rate risk from foreign currency operations. They conclude that U.S. banks are not choosing optimal foreign currency port-

* University of Utah.