#69

November 1975

FOREIGN EXCHANGE OPERATIONS OF U.S. BANKS

by

Robert C. Bradshaw*

FOREIGN EXCHANGE OPERATIONS OF U.S. BANKS

by

Robert C. Bradshaw*

In recent months the Federal Reserve Board and other bank regulatory agencies have been giving special consideration to supervisory or regulatory reforms that might be implemented to limit banks' exposure to foreign exchange losses. This paper reviews the nature of certain of the risks associated with bank's foreign exchange operations and discusses, in general terms, some of what the Federal Reserve has learned in a recent survey of the procedures employed by U.S. banks to monitor and limit their exposure in foreign exchange operations.

Relatively recent events have drawn special attention to this particular area of banks' operations. For one thing, the widespread adoption of floating exchange rates has increased the range of potential losses (or gains) on a given size open net position in foreign currencies.[1/] In addition, the highly publicized foreign-exchange-related losses of Franklin National Bank and the I.D. Herstatt Bank in Germany, among others, have raised both official and private concern that sizable exchange losses at one or more U.S. banks could pose a threat to the solvency of those banks, might erode public confidence in the banking system as a whole, and could disrupt the functioning of foreign exchange markets. (It is worth noting that a recent tabulation of banks' publicized

---

*/ The views expressed herein are solely those of the author and do not necessarily represent the views of the Federal Reserve System. This paper was presented at the Eleventh Annual Conference on Bank Structure and Competition at the Federal Reserve Bank of Chicago, held on May 1 and 2, 1975, and will be published by the Federal Reserve Bank of Chicago later in 1975.

foreign-exchange-related losses from the beginning of 1974 to date shows publicized, extraordinary losses of U.S. and foreign banks totaling nearly $1 billion. However, only about $65 million of this total was incurred by U.S. banks, about two-thirds of which represents Franklin's losses. The publicized losses recently incurred by other U.S. banks (most of which were connected with the Herstatt failure) were relatively small in relation to the equity capital and earnings of these banks and did not pose a serious threat to their solvency).

Certain of the risks that banks are (or may be) exposed to in their foreign exchange operations are essentially unavoidable (in one degree or another) if a bank is to deal very extensively in foreign exchange; other risks are taken at the bank's discretion or may be incurred via a breakdown in a bank's internal controls. Aside from fraud, or other possible violations of a bank's internal controls, there are three broad types of exposure to losses in foreign exchange operations: (1) open net position exposure; (2) maturity gap exposure; and (3) customer exposure. The first two are types of market risks and the latter is essentially a credit risk.

1. Open Net Position Exposure

This is probably the most widely understood (but, perhaps, not the most important) type of exposure in foreign exchange dealings. Table 1 (page 16) serves to illustrate what is meant by open net position exposure and to distinguish between open net position exposure and maturity gap exposure. The table is a highly simplified, hypothetical representation

of the ingredients of a bank's foreign exchange position. (Listed below the table, with lower case letters corresponding to the footnoted data in the table, is a set of hypothetical operations by the bank that could have generated this data.)

In this example, the bank's open net position in German marks (the only foreign currency considered in the example) is a long net position of $10 million equivalent -- given by the vertical summation of Column 9, or by the horizontal summation of the totals in columns 3 and 6. The bank has an overall long net position in German marks because its German mark denominated general ledger assets plus its outstanding exchange contracts to receive German marks exceed, by $10 million equivalent, the sum of its mark denominated liabilities and contracts to deliver marks. An open net position, as defined here, is independent of the maturity distribution of the various foreign currency assets, liabilities and exchange contracts on the books of the bank. (The bank's maturity gap exposure, discussed below, does relate to this maturity distribution.)

In this example, if the U.S. dollar price of the German mark were to appreciate by 10 percent in spot and forward markets, the bank would make a profit of $1 million (or, 10 percent of its long net position in marks). The value of its mark denominated assets and buy contracts, totaling $180 million, would increase by $18 million, but the value of its mark liabilities and sell contracts would increase by $17 million -- for a net gain of $1 million.

Thus, open net position exposure in a given currency means exposure to changes in the market value of an economic unit's net

commitments to receive or deliver balances in that currency, independent of the maturity distribution or the gross size of the various assets, liabilities and exchange contracts making up any given net position.

The following general observations are intended to offer some notion of the procedures employed by many U.S. banks in limiting their open net position exposure.

a. Most banks set close of business net position limits on a currency by currency basis for each office of the bank that conducts foreign exchange operations. For example, the London office of a U.S. bank might be told that its open net position -- short or long -- in German marks is not to exceed $20 million equivalent as of the close of business on any given day. Other larger or smaller limits would be set for various other currencies.

b. In some cases, local regulations may dictate an office's maximum open net position in a currency; this is true in London where the Bank of England sets limits on open sterling positions that may be held by any bank authorized to deal in foreign exchange in the United Kingdom.

c. A banks' net position limits usually are not equal for all the currencies in which it deals. Net position limits ordinarily are the largest for a dozen or so actively traded currencies (the Canadian dollar, various European currencies and the Japanese yen). The relative size of limits on different currencies tends to reflect factors such as the volume of commercial business in a currency, the geographical location of a bank's offices and, in general, the bank's attitudes about the risks involved in

taking open positions in a particular currency (as influenced by such factors as political stability in the country of issue of the currency and the historical variability of the currency's exchange rate).

d. Some banks do not set net position limits on a currency by currency basis. Limits are set on the sum of open net positions that may be taken by each office of the bank, usually specifying the currencies in which open positions are permitted, but without setting explicit currency by currency limits.

e. Many banks utilize what may be referred to as a "dominant limit" on an office's open net positions -- a limit on the total of open positions (whether short or long) in all currencies that is less than the sum of the office's individual currency limits. This practice gives greater flexibility to traders (allows traders to work within broader individual currency limits) without raising the bank's potential exposure in all foreign currencies taken together. Banks using "dominant limits" of this type may reasonably set larger individual currency limits than might otherwise be prudent.

f. It is difficult to make meaningful empirical observations about the relative degree of exposure to open net position losses that various U.S. banks permit themselves. A bank's ability to suffer losses without posing a threat to its solvency, or to public confidence in the bank even with no immediate threat of insolvency, will depend upon a variety of factors such as the size of the bank's capital, its earnings on other operations, and (of no small importance) the bank's reputation

among the public and other banks. The Board's staff has attempted to make some rough comparisons among U.S. banks, based upon the total of a bank's open net position limits in a group of actively traded currencies in relation to its equity capital. (In cases where a bank has a so-called "dominant limit" on its open net positions, that limit, rather than the sum of individual currency limits, enters this ratio.) Presently available information indicates that this ratio (of aggregate position limits to equity capital) is in the 10 to 20 percent range for most major money center banks, and is generally under 10 percent for most other banks that have foreign exchange operations of any appreciable size.

It is noteworthy that the self-imposed limits established by the U.S. banks for which we have such information are, in most instances, more conservative than the regulatory limits recently established by the German authorities for their banks. Under the German regulations the sum of a bank's open net positions (independent of whether these net positions are short or long) in all non-DM currencies is not to exceed 30 percent of capital.

When considering the exposure associated with the size of a bank's aggregate position limits, one should recognize that a bank would rarely, if ever, fully utilize its limits in all currencies (or even most major currencies) at the same time. Furthermore, the maximum percentage loss that a bank might suffer on an open position as a consequence of

exchange rates moving counter to the bank's expectations is far less than 100 percent -- perhaps more on the order of 10 to 20 percent. To illustrate, if a bank had aggregate limits totaling 20 percent of capital (which is above average) and was utilizing 50 percent of the total of these limits (which is also above the average) and it lost as much as 20 percent on all of its open net positions (which is rather unlikely) its losses would amount to only 2 percent of capital.

2. Maturity Gap Exposure

The essential point to be made in connection with maturity gap exposure is that the risk associated with mismatched maturities in a bank's foreign currency forward position is essentially the same as the risk associated with mismatching of maturities in money market operations (e.g., borrowing "short" to lend "long," or vice versa). If a bank engages in an exchange market swap operation, e.g., selling German marks one month forward against a two-month forward purchase of equivalent value, it does not alter its net open position in marks -- but it does incur maturity gap exposure. The profit or loss realized on a swap operation in a given currency will be determined by subsequent changes in the term structure of forward premiums (or discounts) on the currency involved. In the absence of impediments to covered arbitrage flows between credit market instruments of different currency denomination, the structure of forward premiums (or discounts) on one currency in terms of another will be determined by interest rate differentials between credit market instruments denominated in the currencies in

question.[2/] Thus, unless capital controls or other impediments to arbitrage distort "normal" market relationships, the profit or loss on an exchange market swap operation will be determined by subsequent changes in interest rate differentials as between the currencies involved in the swap operation.

The data in Table 2 (page 17) serve to illustrate the determinants of the profit or loss on a maturity gap position created by an exchange market swap operation. Part A of Table 2 shows levels of German mark forward rates (labeled F) and percent per annum premiums on the mark (labeled ϕ) consistent with a spot DM rate of 40 U.S. cents and various assumed differentials between "the" Euro-dollar interest rate and "the" Euro-DM interest rate. For simplicity we assume a constant spot DM exchange rate and assume that interest rates in both Euro-currency markets are invariant with respect to maturity (i.e., yield curves are "flat", at least in the maturities considered here). The implied levels of forward rates and forward percent per annum premiums are calculated from the equations noted in Part A of the table.

As noted above, the profit or loss on a forward swap operation will be determined by subsequent changes in the structure of forward premiums or discounts on a currency, which, in turn, will be determined by subsequent changes in interest rate differentials as between the currencies involved in the swap operation -- in the absence of any distortions to "normal" market relationships. Assume, for example, that Euro-dollar and Euro-DM interest rates are presently 9 percent and 4 percent, respectively, and that a bank expects that within one month's time Euro-DM interest rates will fall to 2 percent. Accordingly, the bank expects that within one month the forward premium on the DM will

rise to about 7 percent from its current level of about 5 percent -- which implies an increase in all forward rates relative to the spot rate, and an increase in the spread between any given pair of forward rates.

Given the bank's expectations, it could attempt to profit in a variety of ways, two of which are illustrated below. Let us say, for example, that the bank opens up a maturity gap (but does not alter its net position) by doing a swap involving a one-month forward sale of marks matched by an equivalent two-month forward purchase of marks. Part B of Table 2 illustrates the profit the bank would make if its expectations were realized. The gap position is opened up by selling one-month DM at 40.166 cents per mark and buying an equivalent amount of two-month DM at 40.331 cents per mark. One month later (if, again, its expectations are realized) the bank could take a profit by doing a reverse swap to close its gap position -- in this case buying spot DM at 40 cents (to make delivery on its maturing one-month forward sale contract) and selling one-month forward DM at the new one-month DM rate of 40.233. As noted in Part B of the table the bank would make a net profit of about .068 cents per mark (or about $1,700 if the bank had initially done a $1 million equivalent swap operation). A change in the mark's spot rate in the interim would not have materially affected the bank's profit so long as its interest rate expectations were realized. (If, for example, the spot rate declined, the bank would have made a larger profit as it covered its original one month sale contract by buying spot; but it would have taken a

commensurately greater loss in closing out its remaining forward contract.) If the interest rate differential did not change, the bank would break even; if the differential (Euro-dollar rates minus Euro-DM rates) declined, rather than increasing, the bank would have lost money on its gap position.

It was stated earlier that the essential point to be made in connection with maturity gap exposure is that the risk is essentially the same as the risk associated with mismatching of maturities in money market operations. To illustrate, if the bank faced the same expected and actual interest rate developments, it could have engaged in an analogous money market operation in which it would initially borrow one-month Euro-DM at 4 percent, lend two-month Euro-DM at 4 percent (here we disregard the bid-ask spread in Euro-currency borrowing and lending) and then, one month later, refinance its Euro-DM liability at the new, lower Euro-DM rate of 2 percent. The bank would break even (disregarding bid-ask markup) in the first month but profit at a 2 percent annual rate in the second month. Its profit on this money market operation is almost exactly the same profit it would make in doing the previously illustrated exchange market swap operation based on the same interest rate expectations.[3/]

Thus, in the above examples, the market risk associated with opening up a foreign exchange gap position by selling one-month forward DM against an equivalent two-month forward purchase is essentially the same as the risk associated with opening up a maturity gap position in a money market operation by borrowing one-month Euro-DM to finance a two-month Euro-DM loan. Both operations constitute a bet on future changes in interest rates; either operation would have the same effect on the bank's net position as viewed over time in Column 9 of Table 1. These risks are so similar that many banks make no distinction between the two types of operations in limiting their maturity gap exposure.

Some banks have no formal limits on their maturity gap exposure, but most have explicit currency by currency limits for each office of the bank. The following types of limits are illustrative of the limits used by many U.S. banks.

a. The simplest form of explicit limit on maturity gap exposure has the effect of setting a maximum length of time between the settlement dates on the opposing buy and sell contracts involved in a swap. A conservative bank might not permit settlement dates on opposing contracts to diverge by more than 15 days; a less conservative bank might permit six months or more. This type of limit reflects the fact that the potential gain (and, thus, the potential loss) on a swap operation increases in proportion to the spread between the maturities on the contracts involved in the swap operation.[4/]

b. A common approach to maturity gap control (at least among larger banks) involves dividing the future into time intervals (as illustrated in Table 1) and setting limits indicating the maximum net long or short position in a currency that may exist in any future interval of time. (Many banks use monthly or half-monthly intervals.) This type of limit does not distinguish between, say, a swap of one month against two months and a swap of one month against 12 months -- although the latter would ordinarily involve a greater potential gain or loss. In many cases, however, banks that use this type of limit also have limits to constrain the spread between opposing maturity dates.

c. A variation on the maturity gap limits just described involves also setting "cumulative limits" on open net positions over

time. For example, a bank might set limits on net positions taken in future monthly intervals, but also set limits on cumulative open positions three months out, six months out and so on. The cumulative limit for three-months out would restrict the cumulative value of net positions in the first three-month period to something less than the open net position permitted in any single future month. For example, if the gap limits for individual months were $20 million equivalent each, short or long, the cumulative limit for three months out might be $10 million equivalent. In this case the bank's traders would have to manage their positions so that for the next three months taken together the bank would not be short or long in the currency in question by more than $10 million equivalent -- although a short or long position of as much as $20 million equivalent in any single month would be permitted. This approach can restrict the trader from, say, using all of his gap limits for individual months to load up "near" months with short positions taken against long positions in more distant months -- it restricts the extent to which the trader can do swaps involving widely divergent maturities on the opposing buy and sell contracts in a swap.

d. A few banks use a rather unique method of controlling maturity gap exposure that involves the calculation of what one bank refers to as its "weighted average exposure," this weighted average value being the variable subject to control. "Weighted average exposure", as calculated by one bank, is determined by recording net short or long positions in each currency in future half-monthly intervals; multiplying each half-monthly position by a weight starting

with one and increasing by one in each successive half-monthly interval (e.g., the weights would range from one to 24 if the most distant forward contract in a position would mature one year hence); the sum of these weighted net positions (subtracting short weighted net positions from long weighted net positions) is then divided by 24 to arrive at "weighted average exposure". In general, this approach gives greater weight to exposure involving swaps with more distant maturities between the opposing contracts (e.g., a swap involving a one-month forward sale against a six-month forward purchase would, because of the consecutively increasing weights, use up more of a trader's allowable "weighted average exposure" than a swap of equal contract value involving a one-month forward sale against a two-month forward purchase).

3. Customer Exposure

Customer exposure may be less interesting from an analytical point of view than other areas of foreign exchange exposure, but it is also probably one of the most important and difficult to control areas of exposure in foreign exchange dealing. The Herstatt-related losses of several U.S. banks last summer is a good example of customer-related risk in foreign exchange operations.

Customer limits set by banks generally take the form of a limit on the gross value of foreign exchange contracts that a bank will have outstanding with a given individual or institution, although some banks limit the net of buy and sell contracts with a particular customer. Such limits are often supplemented by limits on gross or net settlements coming due on a single day.

The fact that customer limits are established is recognition of two types of customer-related risks inherent in foreign exchange contracts. One type, frequently referred to as a "10 to 20 percent risk", involves the possibility that the other party to an exchange contract will, in effect, cancel the contract (due to insolvency or some other reason); this unanticipated elimination of a contract from the bank's previous position suddenly alters the bank's net position exposure and may result in a loss (or gain) for the bank, depending upon how exchange rates have moved since the time the contract was written. The term "10 to 20 percent risk" comes from the expectation that exchange rates would be unlikely to have moved against the bank by more than about 10 to 20 percent. The other type of customer-related risk, so-called "100-percent risk", involves the possibility that, on the day of settlement of a contract, the other party to the contract might fail to deliver counterpart funds after the bank makes delivery -- as happened when Herstatt's payments suddenly ceased. Under such circumstances the net loss may not be 100 percent, because some part of the initially uncollected funds may be recovered in subsequent legal action.

Customer risk in foreign exchange dealing is basically a form of credit risk. Accordingly, banks' customer limits are established in light of the same sorts of criteria that a bank would evaluate in establishing a credit line for a given bank or non-bank customer. Foreign exchange customer limits would in most cases be some multiple of a customer's ordinary credit line in that customer default on a foreign exchange contract would most likely result in "10 to 20 percent" exposure, rather than a 100 percent loss.

Concluding Remarks

When considering the potential effectiveness of measures employed by banks to limit their exposure to the various risks associated with foreign exchange operations, one should not lose sight of the critical importance of a bank's audit and other internal control procedures for insuring compliance with its self-imposed exposure limits. None of these limits can effectively constrain a bank's exposure to foreign exchange losses if internal controls are ineffective. The basic function of a good internal control system is to keep management accurately informed of the various foreign currency commitments made on behalf of the bank by its foreign exchange traders and money market operations personnel.

Unauthorized trading apparently was the principal source of Franklin's foreign-exchange-related losses and the root cause of the large foreign exchange losses experienced recently by several foreign banks. Just as no bank can effectively limit its foreign exchange exposure without good internal controls, no program instituted by regulatory authorities to reduce the risk of occurrence of major foreign-exchange-related losses can expect much success unless it addresses itself to maintaining and improving the quality of banks' internal control systems.

Table 1

Hypothetical Foreign Currency Position Data: German Marks (DM)
Date: April 30, 1975

(millions of U.S. dollars equivalent)

Maturity	General Ledger Accounts (1) Assets	(2) Liabilities	(3)=(1)-(2) Net	Foreign Exchange Contracts (4) Bought	(5) Sold	(6)=(4)-(5) Net	Consolidation (7) = (1)+(4)	(8) = (2)+(5)	(9) = (3)+(6)
to 30 days	5[a]	--	5	75[b]	80[b] 20[e]	(25)	80	100	(20)
31-60 days	--	--	--	20[e]	--	20	20	--	20
61-90 days	--	15[f]	(15)	10[g]	--	10	10	15	(5)
91-120 days	15[f]	--	15	--	--	--	15	--	15
121-150 days	30[d]	--	30	--	30[d]	(30)	30	30	--
151-180 days	--	--	--	25[c]	25[c]	--	25	25	--
over 180 days	--	--	--	--	--	--	--	--	--
Totals	50	15	35	130	155	(25)	180	170	10

Hypothetical origins of the above foreign currency position data:

a) DM demand balances totaling $5 million equivalent are held at German banks as working balances.
b) Spot contracts to buy DM total $75 million equivalent; those to sell DM total $80 million equivalent.
c) Forward purchase contracts of 151-180 day maturity, totaling $25 million equivalent, are matched by forward sales contracts of comparable maturity and equal value.
d) Euro-DM deposit balances totaling $30 million equivalent and of 121-150 day maturity are covered by DM forward sales contracts of comparable maturity and equal value.
e) In a "swap" operation, $20 million equivalent of DM was sold 30 days forward against a 60 day forward purchase of equal value.
f) In a money market operation, a 120-day, $15 million equivalent Euro-DM loan was funded with a 90-day Euro-DM deposit liability.
g) Ten million dollars equivalent of 90-day forward marks was purchased outright.

Table 2

Calcuation of the Profit or Loss on a Hypothetical Swap Operation in Dollars Against German Marks (DM)

A. Levels of forward DM exchange rates (F) and percent per annum forward premiums (ϕ) on the DM implied by alternative interest rate assumptions:

	Values of F and ϕ for different interest rate assumptions					
	R$ - RF (9% - 4% = 5%)		R$ - RF (9% - 2% = 7%)		R$ - RF (8% - 5% = 3%)	
Maturity of Fwds.	F	ϕ	F	ϕ	F	ϕ
1 month	40.166	4.98%	40.233	6.99%	40.100	2.99%
2 months	40.331	4.97%	40.465	6.98%	40.198	2.98%
3 months	40.495	4.95%	40.697	6.97%	40.296	2.96%

Where: a) the spot rate is assumed to remain constant at 40.0 U.S. cents per DM;

b) R$ = "the" Euro-dollar interest rate, RF = "the" Euro-DM interest rate, (and, for simplicity, it is assumed that interest rates are invariant with respect to maturity in both money markets);

c) the values of F and ϕ are calculated from

$$F = \frac{(1/f + R\$)}{(1/f + RF)} \cdot S \quad \text{and} \quad \phi = 1/f \cdot \left(\frac{F-S}{S}\right) \cdot 100,$$

Where, in addition, S = the spot DM exchange rate and f = the fraction of one year represented by the forward maturity in question (i.e., for a one month forward, f = 1/12).

B. Profit on a Swap Operation

	swap opening gap position	swap (1 month later) eliminating gap position
Interest Rate Assumptions:	R$ - RF = 9% - 4%	R$ - RF = 9% - 2%
Transactions: (at implied forward rates)	a) sell 1 mo. DM at 40.166 b) buy 2 mo. DM at 40.331	a) buy spot DM at 40.000 b) sell 1 mo. DM at 40.233

Profit margin = (40.166 - 40.000) + (40.233 - 40.331) = .166 - .098 = .068

FOOTNOTES:

1/ Although the percentage size of revaluations (upward or downward) of various currencies under fixed exchange rates was generally greater than the percentage amount by which an exchange rate might be expected to change in a short period of time under floating rates, sophisticated currency position managers were unlikely to be caught on the "wrong side" of the market when revaluations occurred and at most times were exposed only to exchange rate movements within narrow official limits.

2/ If credit market instruments of equal maturity but different currency denomination are perceived as being less than perfect substitutes even when exchange rate risk is eliminated by forward covering, forward premiums or discounts in a given maturity may deviate from "interest parity" (i.e., from levels that would equalize covered rates of return). Moreover, a variety of credit market instruments are usually available in any given currency and maturity, so that it is often unclear which among many interest rate differentials is relevant to the determination of forward premiums or discounts. As a general rule, however, the levels of percent per annum forward premiums or discounts on major currencies are very close to those implied by interest rate differentials in "external" money markets where impediments to covered interest arbitrage are at a minimum (e.g., the three-month percent per annum premium or discount on the German mark is virtually always within a few basis points of the premium or discount implied by the differential between Euro-dollar and Euro-DM interest rates of three-month maturity). For purposes of this discussion, references to interest rate differentials mean differentials appearing in Euro-currency markets for the currencies in question.

3/ In this example, the profit on a $1 million equivalent money market operation would be approximately $1,667 (or, 1/12 of 2 percent times $1 million). The profit on the swap operation would be exactly the same as that on the money market operation if interest rate differentials changed immediately after the bank engaged in the swap that opened the gap position and the bank then immediately closed out the gap position at the new set of forward rates.

4/ Although the reference here (and at several points in the text that follows) is to "swaps," these various types of maturity gap limits would ordinarily apply with equal force to maturity mismatching in a foreign currency money market operation.