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A Sectoral Analysis

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Exchange Rate Risk and U.S. Trade: A Sectoral Analysis 16

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Foreign exchange rates have been highly volatile since the currencies of the major industrial countries began floating in 1973. According to empirical evidence, this volatility and the attendant exchange rate risk reduced the volume of U.S. trade during the 1974-84 period. The reductions were modest on the whole, but there were relatively large effects on some sectors of the economy.

Federal Reserve Open Market Techniques

By Howard L. Roth

Open market operations are the Federal Reserve's primary monetary policy instrument for promoting noninflationary economic growth and other policy goals. Through open market operations—the buying and selling of U.S. government securities—the Federal Reserve influences interest rates and the supply of money and credit. Changes in financial conditions lead in turn to movements in economic activity and the general level of prices in the economy.

In conducting open market operations, the Federal Reserve uses a number of different techniques, ranging from outright transactions with U.S. government security dealers to self-reversing transactions with foreign central banks. The particular technique used depends, among other things, on the Federal Reserve's operating procedures and changes in factors other than open market operations that affect reserve availability.

Howard Roth is an economist at the Federal Reserve Bank of Kansas City. Richard Roberts, a research associate at the bank, assisted in the preparation of the article.

This article describes the different techniques that are used in conducting open market operations and identifies some changes that have occurred in recent years in their relative importance. The first section provides background material on the role open market operations play in the conduct of monetary policy. The open market operating techniques are described in the second section, while the third section examines the changes that have occurred in the usage of these techniques in recent years.

Open market operations and monetary policy

Open market operations by the Federal Reserve lead initially to changes in the supply of reserves that depository financial institutions have available to meet their reserve requirements. Changes in reserves—which are held either as deposits at Federal Reserve banks or as vault cash—lead in turn to changes in interest rates and the supply of money and credit. For example, when reserves

increase, depository institutions are able to increase their loans and investments, and thereby increase the deposit accounts held by borrowers. The attendant rise in the supply of money and credit tends, in turn, to be accompanied by a decline in interest rates. Alternatively, a reduction in reserves leads to a decline in money and credit and upward pressure on interest rates.

The linkage between open market operations and reserves is made clear by the accounting transaction that occurs when the Federal Reserve pays for the securities it buys or is paid for securities it sells. When the Federal Reserve buys securities, it pays for them by crediting the reserve accounts held at the Federal Reserve by the sellers' depository institutions.[1] The sellers' accounts at depository institutions, in turn, are credited. Conversely, sales of securities by the Federal Reserve are handled through debits to depository institutions' reserve accounts at the Federal Reserve. Thus, when the Federal Reserve purchases securities, reserves increase; and when the Federal Reserve sells securities, reserves decline.

The Federal Reserve's portfolio of securities is one of several sources of reserves, as shown in Table 1. Other sources include Federal Reserve loans to depository institutions and Federal Reserve float. Table 1 also shows how the total source of reserves can be used. In general, sources of reserves can be used three ways: they can be used as reserves, be used by the public as currency, or be used to increase other nonreserve liabilities of the Federal Reserve.[2]

[1] The Federal Reserve engages in security transactions with about three dozen large securities dealers. About a third of the dealers are departments in large money center banks. To buy or sell securities from a bank, the Federal Reserve simply credits or debits the bank's reserve account.

[2] The Federal Reserve capital accounts and the Treasury's monetary net worth make up the remaining uses.

As indicated in Table 1, total sources of reserves equal total uses of reserves.[3] Also, as the table shows, reserves equal total sources minus the uses other than reserves. The following reserve equation is similarly constructed and provides a breakdown of sources and nonreserve uses of reserves along the lines of Table 1.

Reserves = Securities + Loans
+ Float + Other Sources
− Currency in Circulation
− Treasury Deposits
− Foreign and Other Deposits
− Other Uses.

The sources and uses on the right hand side of the equation are more generally referred to as factors affecting reserves. The most important factor is the Federal Reserve's portfolio of securities. Loans to depository institutions are also a factor affecting reserves because reserves increase when the Federal Reserve credits the accounts of borrowing institutions for the amounts of their loans. Float—cash items in the process of collection minus deferred availability cash items—arises when the scheduled credit-deferral period on a check presented to the Federal Reserve for collection elapses before the Federal Reserve can collect

[3] Table 1 is a condensed version of a table published weekly in Federal Reserve publication H.4.1, "Factors Affecting Reserve Balances of Depository Institutions and Condition Statement of Federal Reserve Banks," and monthly as Table 1.11 in the *Federal Reserve Bulletin*. The consolidated balance sheet of the 12 Federal Reserve banks is published in the *Federal Reserve Bulletin* every month as Table 1.18. Information about the Treasury's monetary accounts is printed in the *Treasury Bulletin*.

For a description of the items appearing in these tables, see *The Federal Reserve System: Purposes and Functions*, Board of Governors of the Federal Reserve System, Washington, D.C., 1984, *Statfacts: Understanding Federal Reserve Statistical Reports*, Federal Reserve Bank of New York, November 1981, or any of a number of undergraduate money and banking textbooks.

TABLE 1
Sources and uses of reserves
November 20, 1985
(millions of dollars)*

Sources		
Federal Reserve portfolio of securities		180,341
Loans to depository institutions from the Federal Reserve		1,178
Float†		1,483
Other sources		47,122
Total sources		230,124
Uses		
Currency in circulation	191,471	
Minus vault cash used to satisfy reserve requirements	20,117	171,354
Treasury deposits		3,036
Foreign and other deposits held with Federal Reserve banks		800
Other uses		8,575
Total nonreserve uses		183,765
Reserves		46,359
Total uses		230,124

Source: *Federal Reserve Bulletin*, Tables 1.11 and 1.12, February 1986

*Biweekly averages of daily averages for two-week period ended November 20, 1985

†Cash items in the process of collection minus deferred availability cash items

from the depository institution on which the check was drawn. When this happens, both the presenting institution and the paying institution have credit for the funds, a development that adds reserves to the financial system until the Federal Reserve collects.

Another factor affecting reserves is currency in circulation, which consists of paper currency and coin held outside the Treasury and Federal Reserve banks. As the negative sign in the equation indicates, when currency in circulation increases, reserves of depository institutions decline. Deposits held with the Federal Reserve banks, other than reserve deposits, also affect reserves. These deposits include accounts that the Treasury, foreign central banks, and international institutions hold at Federal Reserve banks. The Treasury uses its account for depositing tax revenues and other receipts and for making expenditures. Foreign central banks and international institutions hold accounts at the Federal Reserve Bank of New York to facilitate international settlements. When the Treasury, foreign central banks, or international institutions transfer funds from domestic depository institutions to accounts at the Federal Reserve, reserves of depository institutions decline. Increases in these deposits are associated with decreases in reserves.

The factors affecting reserves can be divided into two categories—controllable and uncontrollable—according to whether the Federal Reserve has close control over them. The

only factor the Federal Reserve can control closely is its portfolio of securities. All of the other factors cannot be closely controlled.

Within this framework of factors affecting reserves, the Federal Reserve follows a three-step procedure in conducting monetary policy. The first step is to determine a target level of reserves consistent with the objectives of monetary policy.[4] The second step is to estimate the net change in reserves that will occur due to movements in uncontrollable factors. The third step is to undertake open market operations that increase or decrease security holdings enough to bring about the targeted level of reserves. Reserves are targeted over two-week maintenance periods that correspond to periods during which depository institutions are required to hold specified average levels of reserves.

A simplified example helps illustrate the three-step reserve-targeting procedure. Suppose the Federal Reserve determines that the target level of reserves for a reserve maintenance period is $41 billion. Also, suppose reserve projections show that when estimated developments of uncontrollable factors are taken into account, reserves would average $40 billion if the Federal Reserve took no action. In this case, therefore, the Federal Reserve would seek to supply depository institutions with an average of $1 billion in reserves by increasing its holdings of securities through open market operations. If, on the other hand, reserve projections showed reserves would exceed the targeted level, the Federal Reserve would absorb reserves by reducing its holdings of securities.

[4] More precisely, reserve targets are formulated in terms of nonborrowed reserves—reserves net of adjustment and seasonal borrowing by depository institutions.

Open market techniques

Open market operations are carried out by a unit in the Securities Department of the Federal Reserve Bank of New York.[5] This unit, known as the Desk, operates according to directives from the Federal Open Market Committee (FOMC).

The operations available to the Desk for managing reserves fall into two broad categories—outright or permanent transactions and temporary or self-reversing transactions. Buying, selling, or redeeming securities are outright transactions, while engaging in repurchase agreements (RP's) or engaging in matched sale purchase agreements (MSP's) are temporary transactions. With RP's, the Federal Reserve buys securities but agrees to sell them at a specified future date at a specified price.[6] Under MSP's, it sells securities but agrees to buy other securities at specified future dates and terms.

Outright transactions

The Desk uses outright transactions when it wants to provide or absorb reserves over relatively long time spans. Outright transactions typically are used when projections show a shortage or excess that is likely to persist longer than a single two-week maintenance period.

[5] Lucid descriptions of these operations are provided by Paul Meek, *U.S. Monetary Policy and Financial Markets*, Federal Reserve Bank of New York, 1982, and in *Open Market Operations*, Federal Reserve Bank of New York, 1985. See also William Melton, *Inside the Fed: Making Monetary Policy*, Dow Jones-Irwin, Homewood, Ill., 1985.

[6] The Federal Reserve's use of "RP" is opposite that of securities dealers. When the Federal Reserve says it is undertaking RP's, it is putting out money and taking in securities, thereby increasing reserves. When securities dealers undertake RP's, they are effectively borrowing money. The conventional definition of an RP, then, is a sale of securities with an agreement to repurchase the securities on a fixed date.

Long-lasting needs to add or drain reserves arise for a variety of reasons—to meet the needs of a growing economy, to offset long-lasting seasonal movements in uncontrolled factors, and to accommodate permanent changes in the demand for reserves.

A growing economy requires a growing money supply. Depository institutions must hold additional reserves to support growth in checkable and nonpersonal time deposits. And growth in currency in circulation must also be supported by additional reserves if reserve availability is to be maintained. Outright purchases supply the reserves needed for monetary expansion.

Seasonal movements in factors affecting reserves for more than a two-week maintenance period also may call for outright transactions. For example, currency in circulation rises before holidays as consumers prepare to make additional purchases, and then returns to more normal levels after the holidays. If not offset, the rise and fall of currency in circulation would first drain reserves from the financial system and then supply reserves. The seasonal pattern for the Christmas holiday season spans several weeks. By purchasing securities outright before Christmas and selling securities outright after Christmas, the Desk can offset much of the seasonal effect of currency in circulation on reserves.[7]

The Desk engages in outright transactions with U.S. government security dealers and with foreign central banks and other institutions that maintain accounts at the Federal Reserve Bank of New York. The Desk acts either as an intermediary between the foreign accounts and the securities market or deals directly with the foreign accounts in buying securities from them or selling securities to them. Foreign central banks and international institutions maintaining accounts at the Federal Reserve Bank of New York usually also hold accounts at domestic depository institutions. When the deposits of foreign institutions rise above the levels needed for ordinary transactions purposes, the surplus funds are normally invested in interest-earning assets. In many instances, foreign institutions ask a depository institution or a securities dealer to invest the funds in the securities market. In other instances, the institutions ask the Desk to invest the surplus funds. Depending on its perception of the need to add or drain reserves from the financial system, the Desk either invests the funds in the market or sells securities from its own account to absorb the funds.

The effects of outright transactions on reserves are illustrated in Table 2. Entry 1 shows the effect of an outright purchase of $1 billion in securities from a security dealer. The Federal Reserve's security portfolio (an asset of the Federal Reserve) is increased by $1 billion. The reserve account of the securities dealer's depository institution (a liability of the Federal Reserve and an asset of the depository institution) is correspondingly increased. The securities dealer's demand deposit at the financial institution (an asset of the securities dealer and a liability of the

[7] Recent changes in the long-run demand for reserves by depository institutions have been met with outright transactions. The Depository Institutions Deregulation and Monetary Control Act of 1980 mandated reserve requirements for nonmember banks and thrift institutions. The reserve requirement of these institutions has been phased in over six years. Demand for reserves by these institutions increases on the dates that their reserve requirements increase. The act also provided a schedule for reducing the reserve requirements of member banks. The phasing down, completed in 1984, reduced member banks' demand for reserves. Because they affected the demand for reserves, the phase-ups and phase-downs had to be accounted for in implementing policy. Since a phase-down permanently reduces demand for reserves, its effect on reserves is offset by an outright transaction reducing the supply of reserves. Similarly, a phase-up is offset by an outright purchase of securities.

TABLE 2

Reserve accounting

(billions of dollars)

	Federal Reserve				Depository Institutions			
(1)	Securities	+1	Reserves	+1	Reserves	+1	Demand deposits	+1
(1)								
(2)			Reserves	−1	Reserves	−1	Demand deposits	−1
(2)			Foreign deposits	+1				
(3)	Securities	−1	Foreign deposits	−1				
(3)								
(4)			Reserves	+1	Reserves	+1	Demand deposits	+1
(4)			Foreign deposits	−1				
(5)	Securities	+1	Reserves	+1	Reserves	+1	Demand deposits	+1
(6)	Securities	−1	Foreign deposits	−1				
(6)								
(7)			Reserves	+1	Reserves	+1	Demand deposits	+1
(7)			Foreign deposits	−1				
(8)	Securities	−1	Reserves	−1	Reserves	−1	Demand deposits	−1
(8)								

	Public				Foreign			
(1)	Demand deposits	+1						
(1)	Securities	−1						
(2)					Demand deposits	−1		
(2)					Deposit at FRB	+1		
(3)					Securities	+1		
(3)					Deposit at FRB	−1		
(4)	Securities	−1			Securities	+1		
(4)	Demand deposits	+1			Deposit at FRB	−1		
(5)	Demand deposits	+1	RP's	+1				
(6)					RRP's	+1		
(6)					Deposit at FRB	−1		
(7)			RP's	+1	RRP's	+1		
(7)	Demand deposits	+1			Deposit at FRB	−1		
(8)	Demand deposits	−1						
(8)	RRP's	+1						

depository institution) is increased. And the securities dealer's portfolio of securities (an asset of the securities dealer) is reduced. Thus, the outright purchase injects reserves into the financial system. Conversely, an outright sale drains reserves from the financial system, and the associated accounting entries are the reverse of those for an outright purchase.

The effects of outright transactions with foreign accounts are illustrated by entries 2 and 3 in Table 2. The illustration assumes that the Desk sells securities to a foreign account. To see the effect on reserves, it is useful to break the transaction into two components. One is the transfer of excess funds by the foreign institution from its account at a domestic depository institution to its account at the Federal Reserve Bank of New York. The other is the subsequent investment of these funds in securities from the Federal Reserve's portfolio. In entry 2 of Table 2, the foreign institution transfers funds from its account at a depository institution account to its account at the Federal Reserve, a transfer that drains reserves from the financial system. In entry 3, the Federal Reserve sells securities from its own account to the foreign account. The net effect of entries 2 and 3 is that securities are transferred from the Federal Reserve to foreign institutions, demand deposits of foreign institutions are reduced, and reserves are drained from the financial system. Conversely, when the Federal Reserve purchases securities offered for sale by foreign accounts, reserves are injected into the financial system.

When the Desk acts as agent for a foreign account in the securities markets, the level of total reserves in the financial system is not affected. When the Desk buys securities in the market for a foreign account, entry 2 is still appropriate but entry 3 is not. Instead, entry 4 records the investment of the funds in the market by the Federal Reserve acting as agent. When the seller of the securities deposits the check drawn on the foreign institution's account at the Federal Reserve Bank of New York, reserves (and demand deposits) increase to their original level. The net result of the two transactions shown in entries 2 and 4 is that the public has fewer securities and higher demand deposits while foreign institutions have lower demand deposits and fewer securities. Reserves are unchanged.

When the Federal Reserve redeems maturing securities held in its portfolio, the effect is to drain reserves in a similar manner as an outright sale of securities. The Desk redeems maturing securities by subscribing for a smaller amount of the issues offered in a Treasury or federal agency refunding than the Federal Reserve's current holdings of maturing issues. The accounting entries for a redemption are not shown in Table 2.

Temporary transactions

The Desk uses temporary transactions when it wants to provide or absorb reserves for relatively short time periods. Temporary transactions typically will be used when projections show a shortage or excess that is likely to persist no longer than a single two-week maintenance period.

Short-run needs to add or drain reserves typically arise from changes in uncontrollable factors. Temporary transactions are arranged to limit the effects on reserves of anticipated changes in uncontrollable factors and to offset the effects on reserves of unanticipated changes in these factors.

The Desk engages in two kinds of repurchase agreements and two kinds of matched sale-purchase transactions. System RP's are arranged for the account of the Federal Reserve Bank of New York. Customer-related

RP's are arranged for foreign and international institutions holding accounts at the Federal Reserve. MSP's in the market are between the Federal Reserve and securities dealers. The other kind of MSP is between the Federal Reserve and official foreign and international accounts.

The Desk makes available a daily investment facility in which foreign account funds are pooled. This arrangement allows the Desk either to invest the entire pool in the market in one transaction (customer-related RP's), to meet these investment needs from its own portfolio of securities (MSP's with the foreign investment pool), or to engage in a combination of the two. This pooling of foreign funds simplifies Desk operations and enables the Desk to serve the investment needs of more foreign accounts than it could otherwise.

The reserve effects of temporary transactions are also shown in Table 2. As entry 5 shows, the accounting for a System RP is similar to that for an outright purchase. One difference is that the securities dealer considers the transaction as having increased one of its liabilities, repurchase agreements. The securities dealer has borrowed funds from the Federal Reserve with an agreement to repay with interest on an agreed-on date, at most 15 days later. The other difference from an outright purchase is that the transaction is later reversed. Most often, the funds are loaned only overnight. In that case, reserves are increased for only one day. When the transaction is reversed, the accounting entries are reversed and reserves return to their original level.

Customer-related RP's and MSP's with the pool are alternative ways of investing the pool. The Desk does not consider MSP's with the pool a reserve management technique even though the MSP's drain reserves. Instead, when the Federal Reserve forecasts the level of reserves that will be available in the financial system, it assumes that the funds in the pool will be invested with the system as MSP's. That is, the pool is treated as an uncontrolled factor that regularly absorbs reserves, like currency in circulation.

The accounting entries for doing MSP's with the foreign pool are shown in entry 6 of

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The use of temporary transactions has changed signicantly in the past few years.

Table 2. Making MSP's with the pool does not offset the initial reserve drain when foreign and international accounts transfer their excess funds from depository institutions to the Federal Reserve Bank of New York. The net effect on reserves from lines 2 and 6 is a drain of reserves.

Because the prospective drain on reserves from doing MSP's with the pool is factored into reserve projections, customer-related RP's reduce the drain and increase reserves relative to the level that was projected. In this respect, both customer-related RP's and System RP's supply reserves to the financial system. However, like the outright purchase of securities for foreign or international account illustrated in entries 2 and 4, customer-related RP's have no net effect on reserves when the initial buildup of funds in foreign institutions' accounts at the Federal Reserve is taken into account. The accounting entries recording the investment of funds in the market are shown in entry 7. The foreign institution invests in reverse repurchase agreements (RRP's), an asset. The public, most likely a securities dealer, incurs an increase in RP's, a liability. There is no net effect on reserves when entries 2 and 7 are combined. The entries are reversed as the RP unwinds the next day.

Both System RP's and customer-related RP's increase reserves relative to reserve projections. The choice between the two depends largely on the magnitude of the reserve need that the Desk wants to meet. Customer-related RP's are limited by the amount of funds in the pool. System RP's can be used to meet larger reserve needs. Another consideration can be the duration of the reserve need. Reserve needs extending more than one day can be easily handled with multi-day System RP's. Designing a customer-related RP for this task would be difficult because the future size of the pool cannot be known precisely.

The accounting entries for a MSP in the market are given in entry 8 of Table 2. From the securities dealer's point of view, it has made a short-term loan to the Federal Reserve. The loan is recorded on the dealer's books as a debit to RRP's and a credit to demand deposits, another asset. When the MSP matures, the accounting entries are reversed. Thus, reserves are lower for the duration of the MSP and then return to their original level.

Use of the techniques

In conducting open market operations, the Desk relies more on temporary transactions than on outright transactions. The use of temporary transactions has changed significantly in the past few years. Their use declined sharply in 1980 and 1981, but has increased somewhat since 1981.

The dollar volume of total temporary transactions typically has been ten times the volume of total outright transactions. For example, temporary transactions totaled $310 billion in 1985, compared with $34 billion for outright transactions (Table 3). [8]

The reason for the much heavier use of temporary transactions is that uncontrolled factors are highly volatile in the short run. For example, while total reserves showed a net change of around $80 million a week in 1985, absolute week-to-week changes in uncontrolled factors averaged $1.4 billion during the year. To prevent this short-run variability in uncontrolled factors from leading to weekly variability in reserves, the Desk provided and absorbed reserves through temporary transactions.

The dollar volume of total temporary transactions dropped $63 billion in 1980, fell another $101 billion in 1981, and then increased $41 billion in 1982. From 1983 to 1985, total temporary transactions averaged almost precisely their 1982 level. Much of the pattern since 1979 can be attributed to changes in day-to-day operating procedures and changes in the variability of uncontrolled factors.

Changes in operating procedures contributed to the sharp drops in temporary transactions in 1980 and 1981.

Changes in operating procedures contributed to the sharp drops in temporary transactions in 1980 and 1981. Until October 1979, the Desk had used its reserve management techniques in day-to-day operations to hold the federal funds rate to a narrow band around a level thought to be consistent with the desired growth of money and credit. Heavy use of temporary transactions was required. Under the operating procedures instituted in October 1979, the Desk targeted nonborrowed reserves—reserves net of adjustment plus seasonal borrowing by

[8] The source of most of the dollar figures in Table 3 is a series of articles published yearly by the staff of the Federal Reserve Bank of New York, "Monetary Policy and Open Market Operations," *Quarterly Review*, Federal Reserve Bank of New York.

TABLE 3
Volume of open market operations
(billions of dollars)

	1978	1979	1980	1981	1982	1983	1984	1985
Outright transactions								
Purchases								
In market	15.0	7.1	8.5	8.8	10.5	10.7	14.1	17.1
From foreign accounts	9.9	14.1	4.4	8.4	9.4	11.8	9.7	9.4
Sales								
In market	0.2	2.3	2.8	2.6	1.5	0	1.1	1.5
To foreign accounts	13.7	5.6	4.5	4.1	7.1	3.4	7.6	2.7
Redemptions	2.3	3.0	3.5	1.9	3.2	2.8	8.0	3.7
Total outright	41.1	32.1	23.7	25.8	31.7	28.7	40.5	34.4
Temporary transactions								
Repurchase agreements								
System	221.5	185.5	167.2	110.9	179.1	124.0	144.8	156.4
Customer-related	47.3	53.0	64.3	79.5	89.1	159.9	126.7	116.7
Matched sale purchases in market	140.2	194.6	138.6	78.4	42.0	11.9	55.0	36.6
Total temporary	409.0	433.1	370.1	268.8	310.2	295.8	326.5	309.7

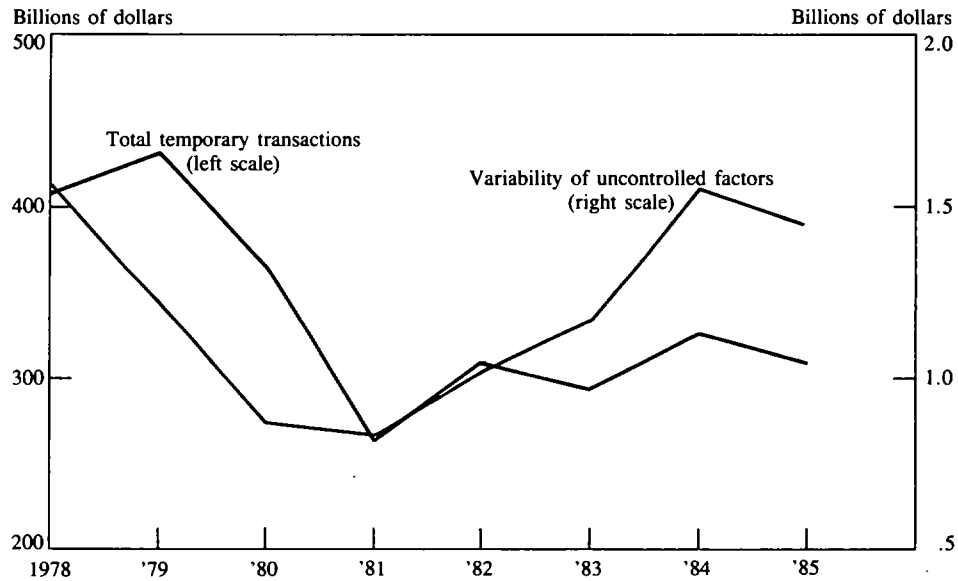
depository institutions from the Federal Reserve. Because the federal funds rate was allowed to vary over a much wider range, fewer temporary transactions were needed.[9]

Another change in operating procedures occurring in the fall of 1982 is consistent with the increased use of temporary transactions after 1981. The nonborrowed reserves operating procedure was modified in late 1982 when a breakdown in the relationship between M1 and economic activity forced the Federal Reserve to rely more on judgments of monetary and economic developments in deciding on the appropriate level of reserves in the financial system. The new procedure has been described as being between a nonborrowed reserves operating procedure and a federal funds operating procedure. As such, the use of temporary transactions might be expected to be more frequent than under the nonborrowed reserves procedure used from late 1979 to late 1982 but less frequent than under the federal funds rate procedure used until late 1979.

A decline in the variability of uncontrollable factors also contributed to the decline in the use of temporary transactions in 1980 and 1981. Chart 1 plots the dollar volume of total temporary transactions and the variability of total uncontrolled market factors for 1978 through 1985. Variability is measured by the average absolute week-to-week change in total uncontrolled market factors. Chart 1 shows that uncontrolled factors became less variable during the years that the use of temporary

[9] A study of the new operating procedures revealed that the number of market entries to conduct temporary transactions in the first year under the new operating procedures was about a third less than in the preceding year. See Fred J. Levin and Paul Meek, "Implementing the New Operating Procedures: The View from the Trading Desk," *New Monetary Control Procedures*, Federal Resere Staff Study, Vol. I, Board of Governors of the Federal Reserve System, February 1981. See also Neil G. Berkman, "Open Market Operations Under the New Monetary Policy," *New England Economic Review*, Federal Reserve Bank of Boston, March/April 1981, pp. 5-20.

CHART 1
Relationship between temporary transactions and the variability of uncontrolled factors



transactions was declining. The average absolute change declined from $1,202 million in 1979 to $850 million in 1981.

An upward movement in the variability of uncontrolled factors appears to be in part responsible for the increased use of temporary transactions after 1981. As shown by Chart 1, the variability of uncontrolled factors reached a low in 1981, then rose steadily from 1982 through 1984 before declining slightly in 1985.

An upward movement in the variability of uncontrolled factors appears to be in part responsible for the increased use of temporary transactions after 1981.

The factor contributing most to changes in variability in recent years has been Treasury deposits with the Federal Reserve. The variability of these deposits and their average level fell dramatically in 1979, remained low for three years, and then rose sharply in 1982 (Table 4). Since 1982, these deposits have been quite variable, although not as variable as they were in 1978.

The 1979-81 decline in the variability of Treasury deposits was due to changes in Treasury cash management techniques. In 1978, Congress authorized commercial banks to pay interest on tax and loan (T&L) accounts and charge the Treasury for services. The Treasury returned to a practice followed before 1967 of transferring funds from T&L accounts to Federal Reserve accounts only in anticipation of expenditures. In this way, the Treasury could maintain a fairly constant balance at the Federal Reserve, and the Treasury account at the

TABLE 4
Variability of uncontrolled factors affecting reserves held at Federal Reserve banks
(millions of dollars)

	Period							
	1978	1979	1980	1981	1982	1983	1984	1985
Uncontrolled factors providing reserves								
Loans	278	305	339	333	246	319	579	511
	(867)	(1,338)	(1,441)	(1,358)	(1,046)	(1,039)	(3,721)	(1,313)
Float	972	1,155	948	722	556	438	465	357
	(5,430)	(6,616)	(4,685)	(3,337)	(2,540)	(1,787)	(830)	(801)
Other sources*	226	284	248	286	283	235	347	323
Uncontrolled factors absorbing reserves								
Currency in circulation	471	522	573	649	737	741	818	828
Treasury deposits with the Federal Reserve	1,665	410	559	365	807	937	1,214	1,097
	(8,034)	(3,238)	(3,018)	(3,163)	(3,800)	(2,164)	(4,399)	(4,071)
Foreign and other deposits with the Federal Reserve	100	156	114	115	128	79	78	155
Other uses†	232	238	110	180	151	101	241	166

Note: Variability is measured as the mean absolute week-to-week change in the weekly averages of daily data for each factor indicated. The yearly average of weekly averages of daily data is shown in parentheses for selected factors.

*Includes other Federal Reserve assets, gold stock, the special drawing rights certificate account, and Treasury currency outstanding (lines 11 through 14 of Table 1.11 in the *Federal Reserve Bulletin*). For a description of these items, see "Statfacts: Understanding Federal Reserve Statistical Reports," Federal Reserve Bank of New York, November 1981.

†Includes other Federal Reserve liabilities and capital, service-related balances and adjustments, and Treasury cash (lines 21, 19, and 16, respectively, of Table 1.11 in the *Federal Reserve Bulletin*).

Federal Reserve became a much less variable factor affecting reserves.

The rise in the variability of Treasury deposits after 1981 has been due to a shortage of collateral to back T&L accounts. Funds in T&L accounts must be backed by U.S. securities owned by the commercial bank. When available collateral is depleted, additional receipts must be transferred to the Federal Reserve.

Float has also contributed to changes in the variability of uncontrolled factors. The variability of float declined substantially, beginning in 1980. The Federal Reserve has taken several steps to reduce float in recent years. The most significant step was to begin charging depository institutions for float in 1983. Float is, in effect, an extension of credit to depository institutions presenting checks. This credit was interest-free until 1985. Pricing of float and improvements in transporting and processing checks have led to the reduction of float indicated by the averages appearing in parentheses in Table 4.[10]

[10] The Federal Reserve has designed its credit deferral schedule so that presenting institutions generally receive credit no later than when the check clears. Thus, float is seldom negative, on

The variabilities of other uncontrolled factors have not changed dramatically. The variability of currency in circulation grew steadily over the period, about in line with growth in currency.[11] The variability of loans nearly doubled in 1984, primarily because of Continental Illinois' need to borrow heavily on an extended basis. Extended borrowing resulted in more variability of loans than normal again in 1985, although to a less extent than in 1984. The higher variability of loans is most likely temporary.

average, during a week. Because of this, the decline in the weekly average of float since 1978 has been accompanied by a decline in the variability of float.

[11] The variability of currency in circulation is partially predictable, making it less troublesome in formulating policy than if it were totally unpredictable.

Summary and conclusions

The Federal Reserve uses a number of techniques when conducting open market operations to control the supply of reserves available in the financial system. Open market operating techniques include outright and temporary transactions with U.S. government security dealers and foreign official institutions. Due to the need to prevent undue short-run variability in reserve availability, temporary transactions are used more heavily than outright transactions. In recent years, though, the use of temporary transactions has declined somewhat, due in part to a change in the Federal Reserve's operating procedures. Changes in the variability of factors affecting reserves other than open market operations have also affected the relative usage of temporary transactions.

Exchange Rate Risk and U.S. Trade: A Sectoral Analysis

By Keith E. Maskus

Foreign exchange rates have been highly volatile since the currencies of the major industrial countries were allowed to float in 1973. When fixed rates were abandoned, many observers thought exchange rate fluctuations would eventually dampen as market participants gained experience in flexibly priced currency markets. But oscillations in currency values have not declined and may have increased since 1980.[1]

Exchange rate volatility is a cause for concern if it impairs the smooth functioning of the world economy. Volatility can be detrimental in several ways. It can reduce the volume of international trade by creating uncertainty about the profits to be made from international transactions. Fluctuations in exchange rates also might restrict the international flow of capital by reducing both direct investment in foreign operating facilities and financial portfolio investment. Finally, exchange rate volatility might lead to higher prices for internationally traded goods by causing traders to add a risk premium to cover unanticipated exchange rate fluctuations.

In view of these potential problems, this article investigates the effects of exchange rate volatility on U.S. imports and exports during the 1974-84 period. The article first discusses theoretical relationships between exchange rate volatility and international trade and shows that, due to unpredictable fluctuations in real exchange rates, firms engaged in trade have faced exchange rate risk during the period of floating rates. The article then presents the results of an empirical investigation showing that this exchange rate risk had a modest negative effect on U.S. imports and exports during the 1974-84 period. The strength of this effect varied somewhat across sectors and trading partners.

[1] See Craig S. Hakkio, "Exchange Rate Volatility and Federal Reserve Policy," *Economic Review*, Federal Reserve Bank of Kansas City, July/August 1984, pp. 18-31.

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Foreign exchange risk and international trade

When exchange rate volatility cannot be predicted, it creates uncertainty about the magnitude of profits to be realized from international trade. This uncertainty is referred to as exchange rate uncertainty or exchange rate risk.

Nominal foreign exchange risk

Nominal exchange risk occurs when profits are uncertain due to unexpected changes in nominal exchange rates. For example, suppose a U.S. importing firm agrees to purchase commodities from Japan that cost one million yen, with payment due in three months. If the dollar unexpectedly depreciates relative to the yen over the three-month period, the dollar value of the purchase contract rises. This change imposes correspondingly higher costs on the importing firm, making its profits lower than anticipated. Alternatively, if the dollar unexpectedly appreciates, the change causes the importer's profits to exceed expectations. Exporting firms face corresponding uncertainty when their receipts are denominated in foreign currencies.

One way of limiting exposure to nominal exchange risk is by participating in the forward foreign exchange markets. Participants in forward exchange markets contract to buy or sell currencies in the future at currently specified exchange rates. The U.S. firm in the example above could agree to buy, in three months, the yen needed to settle its contract. The price of these future yen is called the forward exchange rate. Because the U.S. firm would know that rate with certainty, it might prefer to trade at the forward rate rather than wait to discover what the current, or spot, exchange rate would be in three months. By locking in a specified exchange rate at which it can settle the contract, the firm can use the forward market to reduce nominal exchange risk.

Forward markets do not ensure completely against nominal foreign exchange risk, however. One reason is that such insurance is costly. When future spot exchange rates are uncertain, those bearing the risk demand extra compensation, known as the risk premium, to provide currencies at guaranteed forward exchange rates. As a result, there is a wedge between the current forward and expected future spot rates that creates costs of hedging against foreign exchange risk. Available evidence suggests that these costs increase with the uncertainty of exchange rates.[2]

Exchange rate volatility is a cause for concern if it impairs the smooth functioning of the world economy.

Another reason forward markets do not ensure completely against nominal exchange risk is that international trade contracts vary in length. The longer protection from risk is needed, the less reliable the predictions of future spot exchange rates. Consequently, suppliers of foreign currencies may not be willing to make forward contracts of long maturities. For this reason, forward markets for contracts longer than one year have not developed fully.

Still another reason forward markets do not provide complete protection is that firms can cover only risks for contract amounts that are known with certainty, even in the short term. If future foreign currency-denominated

[2] See Jacob A. Frenkel and Richard M. Levich, "Transaction Costs and Interest Arbitrage: Tranquil Versus Turbulent Periods," *Journal of Political Economy*, December 1977, pp. 1209-1226.

receipts or expenditures are uncertain, forward markets are of little use in dealing with this uncertainty.

Real foreign exchange risk

Real foreign exchange risk occurs when profits are uncertain due to unexpected changes in the real exchange rate. Because the real exchange rate is the nominal rate adjusted for changes in the prices of traded goods and services, unexpected changes in the real rate depend on changes in both the nominal rate and in the prices of goods and services. For example, in the case of the U.S. firm importing from Japan, an unexpected depreciation of the dollar raises the dollar cost of importing Japanese commodities. But if the yen-denominated price charged by the Japanese suppliers falls over the same period and the dollar price received on the sale of imports in the United States rises, the effects of the dollar depreciation on the profits of the U.S. importer are mitigated. If prices move in the opposite direction, the effects of the dollar depreciation are magnified. Since profits are affected by both the nominal exchange rate and the prices of traded goods, it is real exchange risk that matters to the firm.[3]

Economic theory suggests that real exchange risk should be markedly less than nominal risk would indicate. This is because unanticipated changes in the nominal exchange rate should be accompanied by offsetting changes in price levels, at least for the aggregate economy in the long run. This assertion is based on the concept of purchasing power parity (PPP), a concept in which exchange rates and prices adjust to equalize the prices of traded goods in all countries. Empirical evidence suggests, however, that exchange rates can deviate substantially from PPP over the periods relevant for decisions made by firms.[4] Price changes often result from factors that are not directly related to exchange rates, such as weather problems, shifts in consumption behavior, or changes in macroeconomic policies. Therefore, price movements that reinforce the effects of exchange risk are as likely as offsetting ones.

Estimating exchange rate risk

To estimate the magnitude of real foreign exchange rate risk that firms engaged in international trade faced during the 1974-84 period, this study develops a straightforward but heretofore unused measure of risk. The measure has a nominal exchange rate risk component and a price risk component.

The nominal risk component, which attempts to measure unexpected changes in the nominal exchange rate, is based on the idea that the forward exchange rate represents the market's expectation of what the spot rate will be in the future. To the extent that the market predicts accurately, the current forward rate equals the actual spot rate observed later. The difference between the current forward rate and the future spot rate is due to inaccurate predictions. This gap is a measure of unex-

[3] Some authors argue that nominal exchange risk is more relevant than real exchange risk, at least for empirical work. See M. A. Akhtar and R. Spence Hilton, "Effects of Exchange Rate Uncertainty on German and U.S. Trade," *Quarterly Review*, Federal Reserve Bank of New York, Spring 1984, pp. 7-16.

[4] For a description of PPP, see Lawrence H. Officer, "The Purchasing Power Parity Theory of Exchange Rates: A Review Article," *Staff Papers*, International Monetary Fund, March 1976, pp. 1-61. For a description of its frequent failure to hold empirically, see Jacob A. Frenkel, "The Collapse of Purchasing Power Parity During the 1970s," *European Economic Review*, May 1981, pp. 145-165.

pected changes in the nominal exchange rate; that is, it measures nominal exchange rate risk. In this article, the gap is defined as the percentage difference between the daily average of the monthly spot rate and 90-day forward rate recorded three months earlier.[5]

Since profits are affected by both the nominal exchange rate and the prices of traded goods, it is real exchange risk that matters to the firm.

To measure the price risk component of real exchange rate risk, the article used a model to forecast inflation rates three months into the future for the United States and the four trading partners considered—Japan, the United Kingdom, Germany, and Canada. Inflation was forecast for the economies overall and for the specific tradeable goods sectors included in the analysis: agriculture, crude materials except fuels, manufactured goods classified chiefly by material, chemicals and related products, machinery, transport equipment, and miscellaneous manufactured goods. The differences between predicted inflation rates and actual inflation rates were then used as measures of unexpected price changes.

These price changes were then combined with the nominal exchange risk measures to develop overall and sectoral estimates of bilateral real exchange risk. Estimates were prepared quarterly for the overall real exchange rate from 1974:Q2 through 1984:Q4 and for each sector from 1975:Q3 through 1984:Q4. The real exchange risk variables effectively measure percentage changes in real spot exchange rates that were unexpected at the beginning of each quarter.[6]

Table 1 shows that real foreign exchange rate risk over the 1974-84 period was substantial, both for the U.S. economy as a whole and for the economy's major sectors. In the average quarter, the dollar unexpectedly fluctuated more than five percentage points in real terms relative to the yen, pound, and deutschemark. Unexpected changes in the real Canadian dollar-U.S. dollar rate were more modest, perhaps because the two economies are highly integrated.[7]

These average figures mask considerable variation in the actual quarter-to-quarter unanticipated changes, which sometimes reached as much as 20 percent of the real spot rate. Because even a 5 percent unexpected change in the exchange rate can markedly affect profits, real exchange rate risk was sizable during the 1974-84 period.

Estimating the impact of exchange rate risk on U.S. trade volume

This section presents the results of an empirical investigation to determine the extent that real exchange rate risk affected the volume of U.S. international trade during the 1974-84 period. The investigation focused on both total U.S. trade and trade conducted by major sectors of the U.S. economy.

[5] This is a common measure of nominal exchange risk. See Peter Hooper and Steven W. Kohlhagen, "The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade," *Journal of International Economics*, November 1978. Some argue for a measure based on formal econometric predictions, but these do not seem to provide better forecasts. See Richard Meese and Kenneth Rogoff, "Empirical Exchange Rate Models of the Seventies: Do They Fit Out-of-Sample?" *Journal of International Economics*, February 1983, pp. 3-24.

[6] The appendix provides a precise definition of the measure of real exchange rate risk.

[7] See Charles Freedman, "The Effect of U.S. Policies on Foreign Countries: The Case of Canada," *Monetary Policy Issues in the 1980s*, Federal Reserve Bank of Kansas City, 1982, pp. 97-118.

TABLE 1
Estimates of unexpected changes in quarterly U.S. real bilateral exchange rates as a percent of real spot rates

	Yen	Pounds	Deutsche-marks	Canadian Dollars
Total (1974:Q2-1984:Q4)	5.40	5.58	5.85	2.87
Agriculture (1975:Q3-1984:Q4)	5.50	6.99	5.78	2.44
Crude materials (1975:Q3-1984:Q4)	5.12	7.82	6.22	3.53
Manufactured goods classified chiefly by material (1975:Q3-1984:Q4)	4.92	5.16	5.36	2.45
Chemicals (1975:Q3-1984:Q4)	4.76	5.99	5.29	2.29
Machinery (1975:Q3-1984:Q4)	5.39	5.26	5.49	2.75
Transport equipment (1975:Q3-1984:Q4)	5.37	5.53	5.44	2.26
Miscellaneous manufactures (1975:Q3-1984:Q4)	5.44	5.24	5.55	2.36

Previous research

Previous empirical analyses have reached no firm conclusions on the importance of exchange rate risk for international trade. Studies of U.S. trade have typically shown little effect on aggregate trade volumes, although noticeable effects on the prices of traded goods have been found. Most of the studies have relied on measures of the variability of nominal exchange rates as proxies for exchange rate risk.[8] Two studies examined real exchange rate risk. Only one noted any significant effects on the aggregate volume of trade.[9] Both studies relied on measures of observed variability in the real exchange rate as measures of risk. Because these measures do not allow for predictable changes in real exchange rates, they are likely less accurate than the direct measures of unexpected changes used in this study. Moreover, no previous work has considered the effects of risk on U.S. sectoral trade.[10]

Sectoral focus

A sectoral focus is useful because exchange rate risk may affect industries differently, either because some industries are more exposed to risk than others or because industries react differently to a given level of exchange risk.

A number of factors affect an industry's exposure to risk. An important one is the extent to which the sector is open to interna-

[8] See especially Hooper and Kohlhagen, "The Effect of Exchange Rate Uncertainty on the Prices and Volume of International Trade," and Akhtar and Hilton, "Effects of Exchange Rate Uncertainty on German and U.S. Trade."

[9] Significant effects were found by David O. Cushman, "The Effects of Real Exchange Rate Risk on International Trade," *Journal of International Economics*, August 1983, pp. 45-64. See also "Exchange Rate Volatility and World Trade," Occasional Paper No. 28, International Monetary Fund, July 1984.

[10] The effects of reduced exchange risk associated with a discrete change in exchange rate regimes on Brazilian sectoral trade were studied by Donald V. Coes, "The Crawling Peg and Exchange Rate Uncertainty," in John Williamson, ed., *Exchange Rate Rules: The Theory, Performance, and Prospects of the Crawling Peg*, St. Martin's Press, New York, 1981, pp. 113-136.

tional trade as indicated by the proportion of costs generated through purchase of imports or the proportion of sales resulting from exports. Another determinant of exposure is the extent that trade contracts are denominated in foreign currencies. For example, there is no exposure to nominal exchange rate risk for U.S. firms if U.S. importers pay for purchases in dollars or if U.S. exporters receive payment in dollars. In these cases, though, the risk is merely shifted to foreigners.[11] Additional factors affecting exposure include the length of contracts and susceptibility to unexpected changes in the prices of goods.

Real foreign exchange rate risk over the 1974-84 period was substantial, both for the U.S. economy as a whole and for the economy's major sectors.

Industries may react to exposure differently for several reasons. One is because of differences in profitability. Highly profitable firms, for example, may be able to absorb risk without cutting back on trade. Since profitability is often related to concentration, highly concentrated industries may have a relatively low response to exchange rate risk. Also, industries with multinational operations may have a relatively low response because of their ability to diversify. Such industries may actually respond favorably to exchange rate risk if they can easily adjust their production and trade patterns across countries.[12] Other factors that may affect the response to risk exposure include the importance of internationally traded inputs to production, the ease of reducing domestic costs of importing and exporting, and the structure of trade restrictions.

Industries also may differ in their attitudes toward risk. Risk implies the possibility of unexpected gains as well as losses, so some firms may prefer to expose themselves to foreign exchange risk rather than limit their exposure. If such firms are important in an industry, an increase in exchange risk may be associated with an increase in international trade. In practice, this reaction is unlikely since few firms are "risk-lovers."

Overall empirical results

To isolate the impact of exchange rate risk on total and sectoral trade during the 1974-84 period, the empirical investigation for this article estimated equations that allow for the impact of all the factors that may have affected trade during the period. In addition to exchange rate risk, the equations allowed for the effects of real GNP, capacity utilization, labor costs, and the level of the exchange rate. Table 2 shows the general form of the equation used to estimate the volume of U.S. trade. Separate equations were estimated for total and sectoral U.S. exports to Japan, the United Kingdom, Germany, and Canada and imports from these countries. The sectors were agriculture, crude materials, manufactured goods classified chiefly by materials, chemicals, machinery, transport equipment, and

[11] Limited evidence suggests that there are some differences across manufacturing sectors in whether the currency denomination is that of the exporter or importer. See Stephen P. Magee, "U.S. Import Prices in the Currency-Contract Period," *Brookings Papers on Economic Activity*, 1974:1, pp. 117-164. For a detailed discussion of the effects of currency denomination on exchange risk, see Peter Hooper and Steven W. Kohlhagen, "The Effects of Exchange Rate Uncertainty on the Prices and Volume of International Trade," *Journal of International Economics*, November 1978, pp. 483-512.

[12] See Rachel McCulloch, "Unexpected Real Consequences of Floating Exchange Rates," *Princeton Essays in International Finance*, No. 153, August 1983.

TABLE 2
An equation for the volume of U.S. trade

$$Q = a_0 + a_1 y + a_2 CU + a_3 UC + a_4 UC^* + a_5 E + a_6 R + e$$

where Q = the real volume of U.S. bilateral exports or imports for specific sectors,

y = real GNP in the importing country,

CU = real sectoral capacity utilization in the importing country,

UC = real unit labor costs in the importing country,

UC* = real unit labor costs in the exporting country,

E = sectoral real exchange rate,

R = real exchange rate risk, and

e = error term.

miscellaneous manufacturing. A total of 64 equations were estimated.[13]

The results of the empirical investigations indicated, generally, that exchange rate risk tended to reduce U.S. international trade during the 1974-84 period. Of the 64 equations, 58 had a negative coefficient on the exchange rate risk variable, indicating a negative effect of risk on trade. Of the 58 negative effects, 26 were statistically significant.

While exchange rate risk tended to reduce trade, the size of the impact was fairly modest. For example, as discussed in detail below, of the 26 cases with statistically significant negative effects of exchange risk on trade, only one showed that trade was reduced more than 7 percent.

Impact on total trade

Numerical estimates of the impact on trade of real exchange risk are presented in Table 3. The table shows estimates of the differences between actual cumulative trade volumes during the 1974-84 period and the volumes that would have occurred had exchange rate risk not been present.[14] Estimates based on statisti-

[13] The equations, which also include seasonal dummy variables, were estimated under a variety of simple lag structures to allow for time lags between order and delivery dates that are common in international commerce and to reflect the lags between changes in trade determinants, such as real GNP, and the influence asserted on trade volumes. The equations, which were estimated in logarithmic form, were adjusted whenever necessary for first-degree serial correlation.

[14] More precisely, the estimates show differences between actual trade volumes and volumes that would have developed had exchange risk been at a minimum feasible level. Allowance was made for a minimum level of risk because real exchange risk cannot be eliminated completely. The minimum feasible level of risk was assumed to equal the lowest average real risk recorded in four consecutive quarters during the period.

To compute the estimates, the quarterly percentage excess amounts of actual risk over minimum risk were multiplied by the corresponding risk coefficients to calculate the trade volume changes, which were then summed over the whole period. The estimated trade volume reductions in Table 3 are

cally insignificant coefficients are marked with asterisks to stress that they are unreliable.

The estimates show that, considering only significant cases, real exchange rate risk reduced total U.S. trade—imports plus exports—$13.0 billion in 1980 dollars, or 3.2 percent, during the 1974-84 period (Table 3). A breakdown of the effects on trade with different countries shows that exchange risk had statistically significant negative effects on total U.S. imports from Japan and exports to Germany. If real exchange risk had not been present over the 1974-84 period, total U.S. imports from Japan would have been greater by roughly $11.4 billion in real terms, or 3.4 percent. Thus, risk-averse behavior characterizes trade between U.S. importers and Japanese exporters.[15] Similarly, total U.S. exports to Germany would have been 2.2 percent greater if risk had not been present. Estimates of the impact of exchange risk on trade with other countries are statistically unreliable. The estimates show that exchange risk had a positive effect on U.S. exports to Japan. This is an anomaly, however, because the effect is statistically insignificant and none of the sectoral exports to Japan shows a similar result.[16]

Agricultural trade

According to the estimates, real exchange rate risk reduced total U.S. agricultural trade $656 million, or 6.0 percent, during the 1974-84 period. This is the largest percentage reduction for any sector, so that agricultural trade was the most susceptible to exchange rate uncertainty. The most likely reason is that the sector is highly open to international trade. In 1977, for example, agricultural exports and imports totaled 28 percent of domestic agricultural output, a much higher ratio than most manufacturing sectors.[17] Other factors underlying the high susceptibility of agriculture to exchange risk may include the sector's low level of industry concentration and tendency to enter into lengthy trade contracts.

Estimates of the effects on trade with different countries show that real exchange risk restricted U.S. agricultural exports to Germany and imports from Japan and Germany. Imports from Japan and Germany were reduced 5.8 percent and 4.3 percent, respectively; these countries are not major agricultural exporters to the United States, so the dollar effects were small. U.S. exports to Germany were reduced $426 million, or 6.6 percent. Thus, Germany would have been a considerably larger market for U.S. agricultural products if exchange risk had not been

not strictly comparable across sectors and countries because differences in lag structures and data availability led to slightly different estimating periods. As a result, some of the figures are summed over a different number of quarters. The percentage effects are comparable, however.

[15] Which country's traders bear the greater nominal exchange risk burden depends on the currency denomination of the contracts. U.S. imports are split fairly evenly between dollars and foreign currencies, while U.S. exports are invoiced predominantly in dollars. In the case of exports, most nominal risk is borne by foreign importers of U.S. products. The burden of real exchange risk depends also on unexpected relative price changes across countries and no inference on this risk distribution can be drawn from Table 3.

[16] The effects of risk on total imports or exports frequently were estimated to be less than the sum of the effects on individual sectoral imports or exports. This may be because other sectors have been excluded from the analysis, different lag structures and time periods are involved, and no constraints were placed on the estimating procedure to ensure that such a result would not occur.

[17] Some sectoral results should be viewed with caution because the estimated equations do not allow for government trade restrictions that may be important determinants of trade. For example, trade in agricultural goods has typically been subject to restrictive import quotas. One result of these restrictions might be that U.S. exporters would not restrict their shipments to Japan in the face of greater exchange risk for fear of losing their share of the Japanese import quotas. The effects of risk may, therefore, be understated relative to what they would be under free trade.

TABLE 3
Cumulative impact of real exchange rate risk on U.S. trade, 1974-84 (millions of 1980 dollars)

	Total				Agriculture			
	Imports		Exports		Imports		Exports	
Country	Volume	Percent	Volume	Percent	Volume	Percent	Volume	Percent
Japan	−11,395	−3.4	+2.184*	+1.2*	−158	−5.8	−703*	−2.1*
United Kingdom	−1,067*	−0.9*	−1,911*	−2.4*	−15*	−1.2*	−2*	−0.1*
Germany	−813*	−0.6*	−1,567	−2.2	−72	−4.3	−426	−6.6
Canada	−1,536*	−0.3*	−7,172*	−2.0*	−70*	−0.5*	−37*	−0.3*

	Imports plus exports		Imports plus exports	
	Volume	Percent	Volume	Percent
Total†	−12,962	−3.2	−656	−6.0

	Crude materials				Manufactured goods classified chiefly by material			
	Imports		Exports		Imports		Exports	
Country	Volume	Percent	Volume	Percent	Volume	Percent	Volume	Percent
Japan	−7*	−1.1*	−1,154*	−2.8*	−1,178*	−2.1*	−433	−4.1
United Kingdom	+51	+6.3	−450*	−8.1*	−699*	−4.9*	−65*	−0.8*
Germany	−72	−6.7	−574	−5.9	−836	−4.2	−151	−2.8
Canada	−2,324	−4.3	−604	−3.7	−291*	−0.4*	−2,239	−5.5

	Imports plus exports		Imports plus exports	
	Volume	Percent	Volume	Percent
Total†	−3,523	−4.3	−3,659	−4.8

* Figures were computed from insignificant risk coefficients and should be considered unreliable. Risk coefficients were considered insignificant if the standard deviations of the coefficients were too large to indicate, at a 90 percent level of confidence, that a relationship exists between exchange rate risk and the associated trade volume.

present. This result could be troublesome if real exchange rate uncertainty continues to be large. Real exchange risk had no statistically significant effect on other agricultural trade flows.[18]

Crude materials trade

Exchange risk reduced trade in crude materials 4.3 percent, the third largest effect among the sectors. A primary reason for this relatively large risk effect is that, with trade equaling 30 percent of output in 1977, the sector ranks as the one most open to trade. Other sources of the sensitivity of crude materials trade to risk are unclear. The sector ranks near the middle in industry concentration and trade contract lengths, so these factors may not be important in this case.[19]

Except for imports from the United Kingdom and Japan, which were relatively unim-

[18] The sources for computing these ratios were U.S. Department of Commerce, *Highlights of U.S. Export and Import Trade, Report FT990*, December 1977, and *Survey of Current Business*, May 1984.

[19] Import contract lengths with Japan and Germany in 1971 and 1973 for several U.S. industries are estimated in Stephen P. Magee, "U.S. Import Prices in the Currency-Contract Period." Industry concentration measures, given by four-firm concentration ratios, may be found for 1972 in U.S. Department of Commerce, *1972 Census of Manufacturers*.

TABLE 3
(continued)

Country	Chemicals				Machinery			
	Imports		Exports		Imports		Exports	
	Volume	Percent	Volume	Percent	Volume	Percent	Volume	Percent
Japan	−364	−4.9	−233*	−1.3*	−1,465*	−1.6*	−414	−2.1
United Kingdom	−162*	−1.7*	−41*	−0.7*	+762*	+3.3*	−806*	−3.6*
Germany	−357	−3.2	−137*	−2.2*	−414	−1.2	−185*	−1.1*
Canada	−2,723*	−13.0*	−338	−1.5	−914	−2.5	−215*	−0.3*

	Imports plus exports		Imports plus exports	
	Volume	Percent	Volume	Percent
Total†	−1,059	−2.6	−1,742	−1.9

Country	Transport equipment				Miscellaneous manufactures			
	Imports		Exports		Imports		Exports	
	Volume	Percent	Volume	Percent	Volume	Percent	Volume	Percent
Japan	−2,181	−2.1	−344*	−4.0*	−733	−2.4	−1,577	−16.3
United Kingdom	−84*	−0.8*	−181*	−2.7*	+315	+3.0	−437	−5.0
Germany	−1,510	−3.7	+144*	+2.5*	−68*	−0.7*	−211*	−3.0*
Canada	+2,433	+2.7	−4,451	−5.0	−431	−3.7	−19*	−0.1*

	Imports plus exports		Imports plus exports	
	Volume	Percent	Volume	Percent
Total†	−5,709	−1.8	−2,863	−4.1

† Only statistically significant trade effects were used to calculate the total effects.

portant, all crude materials trade flows were restricted by real exchange rate uncertainty during the 1974-84 period. In absolute terms, the largest reductions were $2.3 billion in imports from Canada and $604 million in exports to Canada. The largest percentage reductions were in trade with Germany.

Trade in manufactured goods classified chiefly by material

Total U.S. trade in manufactured goods was 4.8 percent less during the 1974-84 period than would have occurred had exchange rate risk not been present. This was the second largest risk effect among the sectors. Openness to trade was not the likely cause, however, as trade equaled only 10 percent of output in 1977, the lowest ratio among the sectors. A possible explanation is that the manufactured goods sector was the least multinational of the six nonagricultural sectors. In 1977, only 24 percent of total employment in the manufactured goods sector was accounted for by foreign affiliates, compared with an average of 34 percent in the other sectors.[20] Thus, firms in the sector had less oppor-

[20] See *Survey of Current Business*, February 1982.

tunity for diversifying foreign exchange risk through international, intra-firm shifts in production and trade. Also helping account for the high risk effect may be the relatively long contract lengths that appear to be common in the manufactured goods industry. In addition, concentration ratios are fairly low in some parts of the industry, such as paper and fabric manufacturers, suggesting a limited ability to absorb unexpected movements in real exchange rates.

U.S. exports of manufactured goods were restricted more by real exchange risk than U.S. imports of these goods. Significant negative effects were estimated for exports to Japan, Germany, and Canada, while only imports from Germany were restricted. Overall, the results suggest that risk-averse behavior was noticeable in the manufactured goods industry during the era of flexible exchange rates.

Empirical evidence reported in this article indicates that real exchange rate risk restricted the volume of U.S. trade during the floating rate period from 1974 through 1984.

Chemicals trade

U.S. trade in chemicals was 2.6 percent lower than it would have been with no exchange risk during the 1974-84 period (Table 3). This was the third smallest effect among the sectors. One reason for the limited effect is a low degree of openness, as trade was only 13 percent of sector output in 1977. Another reason is a high degree of multinationality, as 38 percent of total sector employment was in foreign affiliates in 1977. Still another reason is the use of relatively short contract lengths in the chemical sector. The sector is not very concentrated, so this factor was not important in determining responses to exchange risk.

Real exchange risk reduced chemical imports from Japan around 5 percent over the 1974-84 period. Imports from Germany and exports to Canada were also negatively affected.

Machinery trade

Machinery trade was reduced only 1.9 percent by exchange risk, the second smallest sectoral effect. The reduction was small even though the sector was relatively open, with trade accounting for 24 percent of output in 1977. The primary reasons for the small effect may be the high degree of concentration and extensive multinational character of the machinery industry, which allow the industry to adjust more easily to increases in real exchange rate risk.

The country breakdown of trade in machinery shows that, for statistically significant effects, the maximum effect was a reduction of $914 million in imports from Canada.

Trade in transport equipment

Real exchange rate risk reduced U.S. trade in transport equipment a slight 1.8 percent during the 1974-84 period. The explanations parallel those in the machinery sector, because the two sectors share similar characteristics. One exception is that trade in transport equipment appears to take place with short contract lengths. This would be consistent with small reductions in trade caused by exchange risk.

The breakdown shows that exchange risk noticeably restricted imports of transport equipment, mainly automotive vehicles, from

both Japan and Germany, suggesting that import penetration into the United States by these countries might have been greater if real exchange rate risk had not been present. In an unusual result, exchange risk had a positive effect on U.S. imports of transport equipment from Canada, although risk restricted exports to Canada. This development could be consistent with a shift in U.S. production to Canada, from which markets in both countries can be served. If this is true, it is an example of exchange risk inducing a highly multinational industry to engage in greater international trade, as Canadian exports to the United States have risen.

Miscellaneous manufactures trade

Overall, trade in the miscellaneous manufacturing sector was reduced 4.1 percent by exchange rate risk during the 1974-84 period, a fairly high amount compared with the other manufacturing sectors. In general, the products in this industry are not very open to trade, so the explanation is likely related to other factors. These would include the lack of industry concentration—the sector has the smallest concentration ratio of the nonagricultural sectors—and the tendency for firms in the industry to have few foreign affiliate operations.

The largest effect was on U.S. exports to Japan, which would have been $1.6 billion, or 16 percent greater, if exchange risk had not been present.

Summary

Two observations on the empirical results may be made. First, the sectoral differences in exchange risk effects on trade are related to specific industry characteristics. Openness to trade is a dominant reason for the susceptibility of nonmanufacturing trade to risk, while concentration is important in enabling manufacturing sectors to limit the negative effects of exchange rate uncertainty.[21] Second, there were different effects in different countries as well. Trade with Germany was most affected, with ten of the 16 trade flows in Table 3 significantly reduced by real exchange risk. Following Germany are Japan with eight significant declines, Canada with seven, and the United Kingdom with one.

To the extent that exchange rate uncertainty inefficiently reduces international trade, policies to reduce this uncertainty may be warranted.

Conclusions

Empirical evidence reported in this article indicates that real exchange rate risk restricted the volume of U.S. trade during the floating rate period from 1974 through 1984. The restrictions were modest on the whole, but there were potentially large effects on some sectors. Differences in effects on sectors and countries imply that risk may have induced shifts in resource allocation.

To the extent that exchange rate uncertainty inefficiently reduces international trade, policies to reduce this uncertainty may be warranted. These could include changes in macro-

[21] To demonstrate this, the manufacturing sectors were ranked in declining order based on their percentage trade reductions. They were also ranked based on rough measures of concentration, multinationality, openness, and average contract length. All of these ranked characteristics were correlated in the expected direction with the ranked trade reductions, but industry concentration was most strongly correlated.

economic policies to promote a more stable environment in which prices and exchange rates are determined, controls on the international flows of financial capital, greater intervention in the foreign exchange markets, or the adoption of fixed exchange rates.[22]

The evidence in this study suggests, however, that trade gains associated with lower exchange risk are likely to be modest, at least for the United States. These modest gains should be weighed against any problems created by interference in the market determination of the real exchange rate. Fixed exchange rates, for example, may be counterproductive if they hasten the international transmission of recessions. In that case, the resulting reductions in international trade would almost certainly outweigh any gains from lower real exchange rate risk.

[22] A discussion of these issues lies outside the scope of this study. See, for example, Hakkio, "Exchange Rate Volatility and Federal Reserve Policy."

Appendix

Defining real exchange risk

Real exchange risk in sector i for U.S. trade with country j in a particular quarter was defined as the average of the three monthly measures in the quarter:

$$RISK_{i,j} = \frac{1}{3} \sum_{m=1}^{3} |NRISK^{m}j + USINFERR^{m}_{i} - INFERR^{m}_{i,j}|.$$

In this equation, $NRISK^{m}j$ is the percentage difference between the bilateral spot and three-month previous forward rates in month m, $USINFERR^{m}_{i}$ is the error made in predicting inflation (usually the percentage change in the wholesale price index) in the United States in sector i in month m, and $INFERR^{m}_{i,j}$ is the corresponding error in country j. Absolute values are used because it is the size of the unexpected change in the real exchange rate that matters for risk, rather than its sign. Because $NRISK^{m}j$ is measured as foreign currency units per dollar, if it is positive the dollar has shown an unexpected nominal appreciation. If $USINFERR^{m}_{i}$ is also positive, then the U.S. price level in sector i has risen unexpectedly. From an exporter's viewpoint, both of these effects reduce competitiveness, and the reduced competitiveness would be offset only by a higher unexpected price increase abroad. This is why the U.S. inflation error is added to $NRISK^{m}j$, while the foreign inflation error is subtracted.

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