# Exchange Rate Volatility and Federal Reserve Policy

*By Craig S. Hakkio*

There has been widespread concern in recent years over the volatility in foreign exchange rates. Much of this concern stems from the adverse effects of exchange rate volatility on international trade and capital flows.[1] By increasing the risk of importing and exporting, unpredictable changes in exchange rates may reduce international trade. Similarly, by increasing the risk of investing in foreign assets, exchange rate volatility may retard the flow of capital between countries. Because international trade and capital flows contribute to the smooth functioning of the world economy, exchange rate volatility can impair economic welfare.

Several proposals have been offered for reducing exchange rate volatility. Some would require a fundamental restructuring of the international financial system by returning to a gold standard or a fixed exchange rate system. Other, less extreme, proposals call for monetary authorities to limit fluctuations in exchange rates. Because the U.S. dollar is the primary currency used in international transactions, these proposals have focused on the role of the Federal Reserve in reducing volatility in the exchange value of the dollar.

This article argues that pursuit of domestic price stability is the most effective contribution the Federal Reserve can make to exchange rate stability. The first section documents that exchange rates have been both variable and unpredictable since a flexible exchange rate system was adopted in 1973. The second section analyzes the sources of this volatility. The third section discusses the role of the Federal Reserve in eliminating the sources of exchange rate volatility. In particular, the article argues that domestic monetary policy actions to keep the price level stable are likely to be more effective in reducing

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[1] For evidence concerning the effect of exchange rate volatility on international trade, see Richard K. Abrams, "International Trade Flows Under Flexible Exchange Rates," *Economic Review*, Federal Reserve Bank of Kansas City, March 1980, pp. 3-10, and 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.

exchange rate volatility than direct intervention in foreign exchange markets.

## Degree of exchange rate volatility

Foreign exchange transactions are exchanges of one country's money for another country's money. They arise from international trade and investment. A foreign exchange rate, then, is the price of one country's money in terms of another's. For example, an exchange rate of 2.50 between the German deutsche mark (DM) and the U.S. dollar means that U.S. dollars can be bought at a price of DM 2.50 each in the foreign exchange market.

Under the fixed exchange rate system that prevailed from 1944 to 1973, exchange rates were essentially stable and predictable. The system established at the Bretton Woods Conference in 1944 required that the United States maintain a fixed relationship between the international value of the dollar and the official price of gold. It required that other countries maintain a fixed relationship between their currencies and the dollar. The system, then, required stable exchange rates. These requirements could be met only if all governments prevented high domestic inflation—and thereby chronic balance of payments deficits—and actively bought and sold their currencies in foreign exchange markets as needed to maintain a balance between supply and demand at the prevailing fixed exchange rate. Although some countries had to devalue their currencies occasionally, the system worked reasonably well through the mid-1960s. However, recurring balance of payments crises and rising inflation in the United States in the late 1960s and early 1970s led to the collapse of the Bretton Woods system. It was replaced by a flexible—or floating—exchange rate system in 1973.

The essential feature of a flexible exchange rate system is that market forces determine exchange rates. Instead of central banks maintaining balance between supply and demand by buying and selling foreign currencies at fixed exchange rates, the exchange rates themselves are allowed to adjust to market forces. If the foreign demand for dollars exceeds the supply, the price increases—the exchange rate rises. Similarly, an excess supply of dollars leads to depreciation of the dollar, a decline in the exchange rate.

Many economists expected exchange rates to be fairly stable under the flexible exchange rate system. Because most market-determined prices are not volatile, it was believed that the market-determined price of foreign exchange would not be volatile.[2] Earlier experience with floating rates seemed consistent with this reasoning. Canada had allowed its exchange rate to float from 1950 to 1962. Over that time, the value of the Canadian dollar in foreign exchange markets was reasonably stable. Several influential economists argued that, in light of theory and practical experience, adoption of a flexible exchange rate system would not increase exchange rate volatility significantly. For example, Harry Johnson said, "The freedom of [exchange] rates to move in response to market forces does not imply that they will in fact move significantly or erratically."[3]

Instead of being stable, however, exchange rates have been highly variable under the flex-

[2] Exchange rates, for the 1973-83 period, have been found to be less volatile than stock market price indexes, short-term interest rates, most long-term bond yields, commodity prices (such as gold, cotton, and wheat) and primary commodity price indexes (such as food, beverages, and metals). See Jeffrey H. Bergstrand, "Is Exchange Rate Volatility 'Excessive'?" *New England Economic Review*, September/October 1983, pp. 5-14.

[3] Harry G. Johnson, "The Case for Flexible Exchange Rates, 1969," Federal Reserve Bank of St. Louis *Review*, June 1969, p. 12.

ible exchange rate system. One measure of variability for the exchange value of the dollar against the German deutsche mark is shown in Table 1 for the period from July 1973 to April 1984.[4] According to this variability measure, the annual average absolute percentage change, the monthly and daily changes in exchange rates since July 1973 have been very large—29.8 percent on a monthly basis and 107.4 percent on a daily basis. The exchange rate has been appreciably more variable since October 1979, when the Federal Reserve changed its operating procedures to allow more fluctuation in short-term interest rates.[5]

Variability in itself is not a serious problem. Changes in exchange rates would not have significant adverse consequences if the changes were predictable. Exporters, importers, and investors could take account of the predicted changes in the exchange rate by adjusting the agreed-on prices. Even if quite large, predictable changes in exchange rates would not impede international trade or capital flows.

Exchange rate changes have not been predictable, though. To support this assertion, actual exchange rate changes must be compared with some measure of expected changes. One measure of expected exchange rate changes is related to the forward premium. In contrast to spot market transactions where currencies are exchanged immediately, forward exchange market transactions are agreements to buy or sell currencies at a specified exchange rate in the future. This specified rate is the forward rate. Anyone needing foreign currency in the future can either wait until the currency is needed and buy it on the spot market or buy it beforehand in the forward market. The forward exchange rate, therefore, must adjust until the expected cost of obtaining foreign currency is the same in both markets. Since it is risky to wait until the foreign currency is needed, part of the expected cost of waiting includes compensation for bearing this risk—the risk premium.[6] The forward premium—the percentage difference between the forward rate and the spot rate—incorporates the expected percentage change in the spot rate and the risk premium. Therefore, one measure of the expected change in the spot rate is the forward premium minus the risk premium. Using this measure of expected change, Chart 1 shows that actual

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[4] Volatility is measured by the average value of the absolute percentage change in the exchange rate. The average value of the absolute percentage change of a data series $X_t (t=1,...,N)$ is defined as

$$(1/N) \sum_{t=2}^{N} |\ln X_t - \ln X_{t-1}|$$

where $|a| = a$ (if a is positive) and $|a| = -a$ (if a is negative). $\ln X_t - \ln X_{t-1}$ approximates the percentage change in X. That is,

$$\ln X_t - \ln X_{t-1} \cong \frac{X_t - X_{t-1}}{X_{t-1}}$$

Consider two series of exchange rates: series A = [100, 101, 100, 99, 100] and series B = [100, 110, 100, 90, 100]. Then, the percentage changes for series A are [1, -1, -1, 1] and for series B are [10, -10, -10, 10]. Therefore, the average absolute percentage change for series A is 1 and for series B is 10. The absolute value ensures that increases or decreases in the exchange rate are equally bad and that a percentage change equal to 10 is ten times as bad as a percentage change equal to 1. This is the measure proposed by Jacob A. Frenkel and Michael L. Mussa, "The Efficiency of Foreign Exchange Markets and Measures of Turbulence," *American Economic Review*, 70, May 1980, p. 374.

[5] Until October 6, 1979, the Federal Reserve focused on controlling short-term interest rates in an effort to achieve its monetary growth objectives. Since then, it has focused on the availability of reserves to financial institutions. For a further description of the change in operating procedures, see J. A. Cacy, "Monetary Policy in 1980 and 1981," *Economic Review*, Federal Reserve Bank of Kansas City, December 1980, pp. 18-25.

[6] The forward exchange rate will equal the expected future spot exchange rate if market participants are risk neutral. If market participants are risk averse, a risk premium will separate the forward rate from the expected future spot rate. The empirical evidence on this hypothesis is mixed. Richard Levich, "Empirical Studies of Exchange Rates: Price Behavior, Rate Determination and Market Efficiency," NBER Working Paper No. 1112, April 1983, pp. 68-70, provides a summary of recent evidence.

**TABLE 1**
**Absolute percentage change in the U.S.-German exchange rate**
(Average annual rate)

| Period | Monthly Change | Daily Change |
|--------|----------------|--------------|
| June 1973 - April 1984 | 29.8 | 107.4 |
| June 1973 - September 1979 | 27.6 | 95.3 |
| December 1979 - April 1984 | 32.6 | 126.0 |

Note: Monthly change refers to the average absolute percentage change in the exchange rate from the beginning of the previous month to the beginning of the current month. Daily change refers to the day-to-day average absolute percentage change in the exchange rate. Both are expressed at an annual rate.

changes in the spot exchange rate have been much larger than expected.[7] By this measure, exchange rate changes have been unpredictable.

**Determinants of exchange rate volatility**

Dollar exchange rates are defined to be volatile when changes in the value of the dollar are unpredictable. Since the exchange rate under a flexible exchange rate system is determined by market forces, all the factors affecting the supply of and demand for dollars influence the equilibrium exchange rate. These factors are called the market fundamentals. Unexpected changes in current or expected future values of the market fundamentals cause unpredictable changes in the exchange rate and contribute to exchange rate volatility. In addition, volatility can be magnified by short-run overshooting of long-run equilibrium exchange rates. A model of exchange rates is useful to understand how market fundamentals affect exchange rates.

*The monetary theory of exchange rates*

The monetary theory of exchange rates assumes that movements in the exchange rate between two currencies are explained by changes in the demand for or supply of money in the two countries.[8] Two major premises underlie the theory. First, the exchange rate is assumed to be equal to the ratio of the domestic price levels in the two countries. Second, domestic price levels are assumed to be determined by the supply of and demand for money in each country.

The assumption that the exchange rate between two currencies is equal to the ratio of the countries' price levels is based on the purchasing power parity (PPP) condition, which is shown as equation 1 of Table 2.[9] According to PPP, the amount of goods that can be

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[7] An estimate of the risk premium is given by the average value of $\ln S_{t+1} - \ln F_t$ (where $S_{t+1}$ = spot exchange rate at time $t+1$ and $F_t$ = forward exchange rate at time $t$). This equals 0.0027 for the period from June 1973 to April 1984. There is some evidence, however, indicating that the risk premium is not constant.

[8] For alternative views of exchange rate determination, see Douglas K. Pearce, "Alternative Views of Exchange Rate Determination," *Economic Review*, Federal Reserve Bank of Kansas City, February 1983, pp. 16-30.

[9] The literature on PPP is extensive. See, for example, Jacob A. Frenkel, "Purchasing Power Parity: Doctrinal Perspective and Evidence from the 1920's," *Journal of International Economics*, May 1976, pp. 169-91, and Lawrence H. Officer, "The Purchasing Power-Parity Theory of Exchange Rates: A Review Article," *Staff Papers*, International Monetary Fund, March 1976, pp. 1-61.

Percent

Actual change

Predicted
change

1973    '75    '77    '79    '81    '83
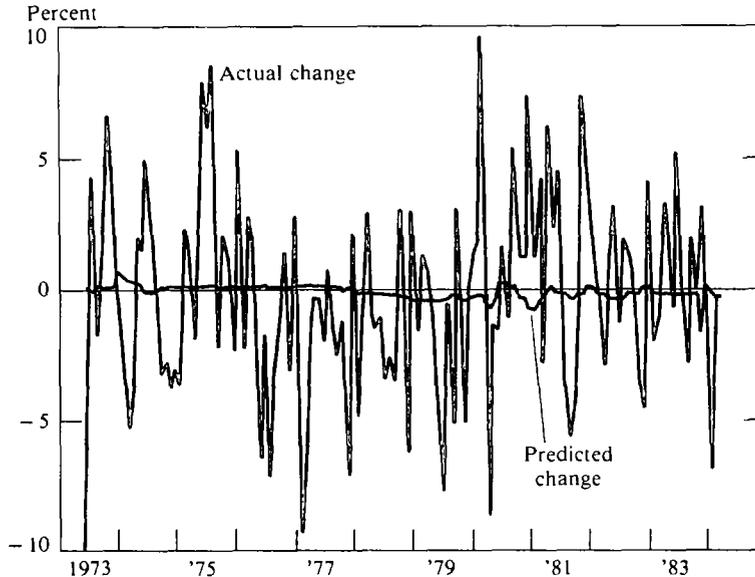
bought with a given amount of money bal-
ances must be equal in both countries, when
the money balances are both expressed in the
same currency unit.[10] This condition is met if
firms and households buy goods where they
are cheapest.

Why this is so can be shown by considering
what would happen if the PPP condition were not
met. Suppose, for example, that the price of
wheat is $4 a bushel in the United States and DM
10 in Germany and that the exchange rate is DM 2

per dollar. This situation does not fulfill the PPP
condition because a given amount of money, say,
$80, would buy more wheat in the United States

[20 bu $= \dfrac{\$80}{\$4/bu}$ ] than in Germany [16 bu

$= \dfrac{\$80 \times DM\ 2/\$1}{DM\ 10/bu}$ ]. At an exchange rate of DM 2

per dollar, German wheat would not be competi-
tive in world markets. Millers in Germany and
elsewhere would begin exchanging deutsche
marks for dollars and using dollars to buy U.S.
wheat. The increased demand for dollars would
drive the exchange rate up to its equilibrium
value of DM 2.50 per dollar. At this exchange
rate and existing wheat prices, the given money
balances would buy 20 bushels of wheat in either

[10] It is assumed here that terms of trade—the relative price of
domestic goods in terms of foreign goods—is fixed at 1.0.
Changes in the terms of trade can also lead to changes in the
exchange rate. For example, an increase in the demand for U.S.
goods would lead to an increase in the terms of trade. Since an
increase in the demand for goods will lead to an increase in the
demand for dollars, the exchange rate will rise.

**TABLE 2**
**Model of exchange rate determination**

(1) $\quad E = \dfrac{P^*}{P}$

(2) $\quad MV = PQ$

(3) $\quad E = \dfrac{QP^*}{MV}$

Definitions:
E = exchange rate, price of dollars in terms of
    foreign currency
P = domestic price level
P* = foreign price level
M = money stock
V = velocity of money
Q = real income

the United States or Germany. A 10 percent increase in the U.S. price level that caused a 10 percent increase in the dollar price of wheat would cause a 10 percent decline in the equilibrium exchange rate, bringing it down to DM 2.25 per dollar to maintain purchasing power parity. Similarly, an increase in the German price level would increase the exchange rate to maintain the purchasing power parity condition.

The assumption that the price level in each country is determined by the demand for and supply of its money is based on the quantity theory of money, which is shown as equation 2 of Table 2. The velocity of money, defined as the ratio of nominal income to the money stock, measures the amount of money relative to income that individuals and firms want to hold. Thus, the dollar flow of expenditures—the money supply times the velocity of money—must equal the market value of output—the price level times the level of real output. Assuming that real output is independent of monetary factors, the price level is directly related to both the money stock and the velocity of money.[11]

Combining the quantity theory with the PPP condition shows that the exchange rate is inversely related to both the money stock and velocity. This inverse relation is shown by equation 3 in Table 2. If both the foreign price level and the level of domestic real output are assumed fixed, an increase in the domestic money supply, with no offsetting change in velocity, would cause a proportionate decrease in the price of the dollar.

The reason for the decrease in the exchange rate follows from the theory just developed. With no change in the demand for money relative to income, the increase in the money stock would lead to a proportionate increase in total spending (PQ in equation 2). If no change in real output is assumed, the higher spending will cause a proportionate change in the domestic price level (P in equation 2). The increase in domestic prices relative to foreign prices will cause a proportionate decline in the exchange rate to maintain PPP (since $E = P^*/P$ in equation 1). A similar line of reasoning leads to the conclusion that a decline in demand for money relative to income will increase velocity, causing proportionate increases in spending (PQ) and prices (P) and a proportionate decline in the exchange rate. Thus, according to the monetary theory of exchange rates, market fundamentals include all of the factors that affect either the supply of money or the demand for money.[12]

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[11] It is assumed that real output is equal to its full employment level. The full employment level is determined by real factors and is independent of monetary factors. See George A. Kahn, "Theories of Price Determination," *Economic Review*, Federal Reserve Bank of Kansas City, April 1984, pp. 16-28. This assumption ignores the short-run effects of money surprises on real activity.

[12] While not discussed in the text, the current account also affects the exchange rate. A deficit in the current account leads to a dollar depreciation, for two reasons. First, a deficit can be offset by a depreciation of the dollar, which reduces the price of imports, raises the price of exports, and leads to an offsetting sur-

## Changes in current market fundamentals

Unexpected changes in the U.S. money stock can make exchange rates more volatile. Recognizing the links between monetary growth and inflation and between inflation and the value of the dollar, foreign exchange dealers base their quotations for dollar exchange rates partly on their reading of the implications of current monetary growth for U.S. inflation. They scrutinize Federal Reserve data—including growth in reserves, changes in the discount rate, and money market conditions—and interpret these data in the context of statements by Federal Reserve officials to determine whether monetary policy actions are likely to cause an increase or decrease in inflation. Accordingly, current exchange rates reflect market participants' expectations of current monetary growth.

If the Federal Reserve announces a change in the money stock different from what exchange market participants expected, the announcement will lead to a change in exchange rates. For example, suppose exchange market participants expect no change in the M1 measure of the money stock in a given week, but the Federal Reserve announces that M1 jumped $5 billion that week. If market participants interpret this as resulting from an easing of Federal Reserve policy and believe the easing will cause faster inflation, the exchange rate will decline.[13] In

this way, unexpected changes in the money stock contribute to exchange rate volatility.

However, even if unexpected, changes in the money stock do not always lead to changes in exchange rates. As shown in equation 3, the combination of the money stock and its velocity affects exchange rates. Both the supply of money and the demand for money matter. An unexpected change in the money stock, accompanied by an offsetting unexpected change in velocity, would be interpreted as having no inflationary consequence and would, therefore, have no effect on exchange rates. This may have been the case in the second half of 1982 and the first half of 1983. Despite an increase in M1 growth that was not generally expected, the exchange value of the dollar continued to climb. This seemingly paradoxical situation could have been due to a simultaneous unexpected decline in velocity of almost 5 percent. Whether because of a buildup of precautionary balances resulting from the severity of the recession or a sharp reduction in the opportunity cost of holding money resulting from the sharp drop in market interest rates beginning in mid-1982, the demand for money relative to income increased sharply. The resulting unexpected drop in velocity may have convinced market participants that rapid monetary growth would not boost inflation. Therefore, the unexpectedly rapid growth in the money stock over this period did not cause a decline in dollar exchange rates.[14] In such cases, unexpected changes in the money stock do not lead to exchange rate volatility.

Unexpected changes in the size of the government's budget deficit also contribute to exchange rate volatility. Though budget defi-

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plus. Second, a current account deficit can also be balanced by a capital account surplus, which represents a fall in domestic wealth. A fall in wealth leads to a fall in the demand for money and a fall in the dollar.

[13] If market participants expect the Federal Reserve to react to the increase in the money stock by increasing reserve restraint in the future, the dollar will rise. The dollar rises because the money stock is expected to fall in the future (due to reserve restraint) and because the reserve restraint is expected to lead to an increase in real interest rates.

[14] For further evidence on the effects of the change in velocity, see the *Economic Report of the President*, 1983, pp. 21-26, and the *Economic Report of the President*, 1984, pp. 24-26.

cits do not fit neatly into the monetary theory presented above, they affect exchange rates by leading to higher real interest rates.[15] Higher real interest rates cause an increase in the demand for U.S. assets—an inflow of capital from other countries. The capital inflow affects the exchange rate in two ways. First, because dollars must be acquired to purchase U.S. assets, the higher foreign demand for U.S. securities increases the demand for dollars in foreign exchange markets. This higher demand for dollars causes the price of dollars to rise. Second, a surplus on the capital account portion of the balance of payments must be counterbalanced by a deficit on the current account, which includes the balance of trade.[16] To produce the necessary trade deficit, the value of the dollar must rise to reduce exports and increase imports. Because the size of the budget deficit affects the exchange rate two ways, unexpected changes in the budget deficit contribute to exchange rate volatility. For example, information indicating that government spending is running ahead of expectations would cause an unpredicted increase in the exchange rate.

### Changes in expected future market fundamentals

Changes in expected future values of market fundamentals also contribute to exchange rate

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[15] The consensus among economists is that large budget deficits lead to high real interest rates. See, for example, the *Economic Report of the President, 1984*, pp. 51-62. However, some economists dispute this link. See, for example, Paul Craig Roberts, "Economic Watch," *Business Week*, May 21, 1984, p. 22.

[16] The current account equals the balance of trade plus the service account plus remittances, pensions, and other unilateral transfers. Since the largest component of the service account is interest income earned on past investments and since remittances, pensions, and transfers are largely exogenous, a current account deficit is most easily achieved through a trade balance deficit.

volatility. A major characteristic of any asset price is its reflection of expectations regarding future supply and demand conditions for the asset. The price at which government bonds sell, for example, reflects investors' expectations for future interest rates and, therefore, the price at which government bonds will sell in the future. Similarly, the current price of foreign exchange reflects expectations of future exchange rates. Since exchange rates in the future will be influenced by the future value of market fundamentals, the expected values of future market fundamentals also affect the current exchange rate. For example, a change in expected future market fundamentals that caused market participants to reduce their estimate of the future exchange rate would cause the current exchange rate to drop immediately. If those buying dollars in the exchange market expect the dollar to decline, they will postpone their purchases in hope of buying dollars at a lower price. Thus, a depreciation expected in the future causes a reduction in current demand for dollars on foreign exchange markets, leading to a drop in the current exchange rate. In this way, changes in expected future market fundamentals can make exchange rates volatile.

Changes in expectations of future monetary growth can make exchange rates volatile. For example, unless faster monetary growth is expected to be accompanied by an offsetting change in velocity, faster future money growth will cause faster inflation to be expected in the future. Higher expected inflation would cause an immediate increase in market interest rates. If the demand for money relative to income depends on interest rates, the rise in current market rates would cause a rise in velocity, causing a jump in inflation and a fall in the exchange rate. Consequently, changes in expectations of future money growth can increase exchange rate volatility.

Changes in expectations of future budget deficits can also make exchange rates more volatile. Higher expected budget deficits, for example, cause market participants to raise their expectations of future real interest rates and, therefore, the future exchange rate. By raising the current demand for dollars in the exchange market, a higher expected future exchange rate will cause the exchange rate to rise immediately.

What would cause market participants to alter expectations of future market fundamentals? Knowing that future market fundamentals affect current exchange rates, exchange market participants have an incentive to base their decisions on all the available information. Only when new information becomes available will they change their expectations of future market fundamentals. Announcements of policy changes are an important source of such new information. For example, announcements by the Federal Reserve of changes in monetary growth targets or by Congress or the administration of changes in spending or tax programs would cause changes in expectations of future exchange rates and would therefore lead to immediate changes in equilibrium exchange rates. In this way, frequent changes in policy can make exchange rates volatile.

### Exchange rate volatility and overshooting

Exchange rate volatility may be magnified by "overshooting" the equilibrium value.[17] Overshooting occurs because exchange rates are more flexible than some other prices. Wages, for example, tend to be inflexible in the short run because many of them are fixed by long-term contracts. Prices of many goods and services are also somewhat inflexible.[18] In contrast, exchange rates, like most asset prices, are highly responsive to current supply and demand conditions. As a result, changes in market fundamentals have a disproportionately large short-run impact on exchange rates. Actual exchange rates, then, change more than equilibrium exchange rates to compensate for the other prices that are slower to adjust to their equilibrium values. As the general price level adjusts to its equilibrium level, the amount of overshooting subsides and the exchange rate approaches its equilibrium level.

An unexpected increase in the money stock, for example, may cause the exchange rate to decline more in the short run than the model in Table 2 predicts. According to that model, a 10 percent increase in the money stock changes the equilibrium price level and the equilibrium exchange rate by 10 percent. However, if the aggregate price level does not adjust immediately to its higher equilibrium level, the exchange rate will compensate by falling more than the equilibrium amount. This overshooting leads to greater exchange rate volatility than if wages and the overall price level were completely flexible. In Figure 1, Panel A shows how the price level and the exchange rate would respond to an unexpected 10 percent increase in the money stock if wages and prices were totally flexible. In this case, the exchange rate drops immediately to its new equilibrium level and stays there. In contrast, the adjustment is much more protracted when wages and prices are inflexible,

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[17] This explanation was proposed by Rudiger Dornbush, "Expectations and Exchange Rate Dynamics," *Journal of Political Economy*, 84, December 1976, pp. 1161-76.
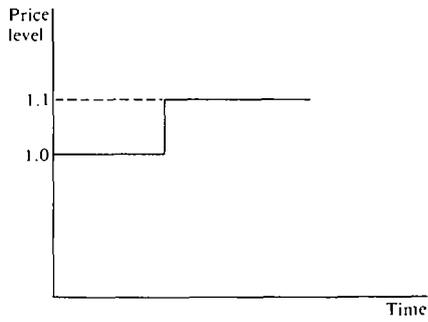
[18] For further explanations of wage inflexibility, see George A. Kahn, "Wage Behavior in the United States: 1907-1970," *Economic Review*, Federal Reserve Bank of Kansas City, April 1983, pp. 16-26. For further explanations of price inflexibility, see Kahn, "Theories of Price Determination."

**FIGURE 1**
**Example of exchange rate overshooting**

Panel A: Flexible Prices

Panel B: Inflexible Prices
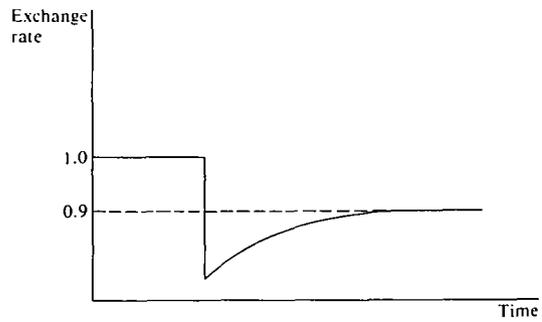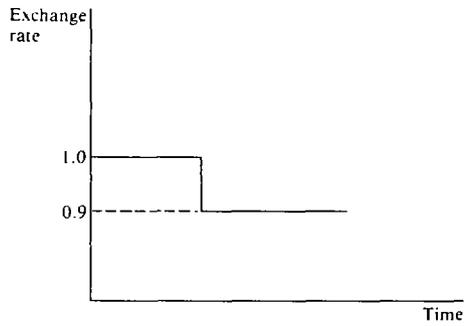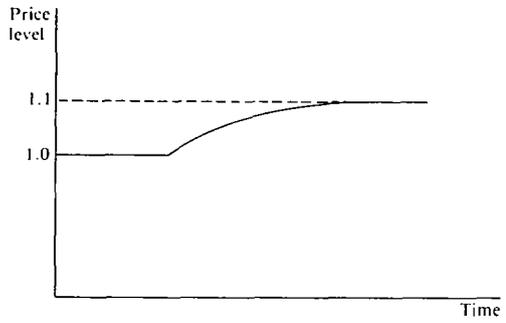
as shown in Panel B of Figure 1. With little initial change in the price level, the exchange rate overshoots its new, lower equilibrium. Moreover, the exchange rate subsequently rises gradually as the price level adjusts. Because of both the initial overshooting and the subsequent move toward equilibrium, exchange rate overshooting magnifies the impact of changes in market fundamentals on exchange rate volatility.

## Implications for Federal Reserve policy

Federal Reserve actions affect exchange rate volatility. As explained above, the Federal Reserve's implementation of domestic monetary policy by controlling money growth influences actual and expected inflation rates, thereby affecting exchange rate volatility. Even under floating exchange rates, the Federal Reserve may sometimes also intervene directly in foreign exchange markets to reduce exchange rate volatility.

### Domestic monetary policy

The Federal Reserve can contribute to exchange rate stability by conducting monetary policy to ensure a predictable domestic price level. Although monetary policy does not appreciably affect most of the market fundamentals, it has major effects on the general level of prices. According to the quantity theory, the domestic price level is directly related to monetary growth. The Federal Reserve can influence monetary growth by using open market operations to control the amount of reserves available to support deposit expansion by banks and thrifts. By avoiding unpredictable swings in monetary growth, the Federal Reserve can help make prices more predictable.

Experience suggests that price level stability is the most effective means of producing a predictable price level. In principle, predictable price levels could be accompanied by any rate of inflation, as long as it is anticipated. In practice, however, predictability tends to be inversely related to the level of inflation.[19] For example, inflation in the 1970s was not only higher than in the 1960s but was also more variable and less predictable. Thus, Federal Reserve policy geared to stabilizing the price level will also reduce exchange rate volatility.

Constant growth in the money stock could produce stable prices in some conditions. Price level stability requires that aggregate demand increase at the same rate as aggregate supply. If the "natural" level of real output grows at a constant rate, constant growth in aggregate demand would result in price stability. The growth in aggregate demand is determined by the growth of money and the growth in velocity. If the demand for money relative to income were constant, velocity growth would be constant and constant money growth would yield price level stability. Thus, a constant money growth rule would ensure price level stability and therefore contribute to exchange rate stability if velocity growth and real output growth were also constant.[20]

Adjustments to constant money growth targets would be required if these conditions

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[19] See Stanley Fischer, "Towards an Understanding of the Costs of Inflation, II," in *Theory, Policy, Institutions: Papers from the Carnegie-Rochester Conferences on Public Policy*, by Karl Brunner and Allan H. Meltzer, eds., North-Holland, Amsterdam, 1983, for evidence on a positive relationship between inflation and inflation variability.

[20] This result can be derived from equation 2 of Table 2. Converting equation 2 to growth rate form (a dot over a variable denotes growth rate) yields $\dot{M} + \dot{V} = \dot{P} + \dot{Q}$. A policy of price level stability means $\dot{P} = 0$. Substituting $\dot{P} = 0$ and solving for the rate of monetary expansion yields $\dot{M} = \dot{Q} - \dot{V}$. If velocity is predictable, then setting $\dot{M} = \dot{Q} - \dot{V}$ is the desired money growth rule. If $\dot{Q}$ and $\dot{V}$ are constant, then the desired money growth rule is also a constant money growth rule.

were not met. Variability of growth in the natural level of real output due, for example, to variability in the growth of the work force or the growth of productivity, would require offsetting changes in money growth targets to ensure price stability. So too would variability in velocity growth.[21] For example, the Federal Reserve's adjustments to monetary growth targets in 1982 and 1983 in response to the unusual behavior of velocity may have improved prospects for stability of both the price level and the exchange rate. For monetary growth targets to contribute to exchange rate stability, they must be reevaluated when information suggests that other factors have changed unexpectedly.

### Exchange market intervention

The Federal Reserve sometimes intervenes directly in foreign exchange markets to affect exchange rates. This intervention is conducted by the foreign exchange desk at the Federal Reserve Bank of New York through the purchase and sale of foreign currency. The ultimate effect of intervention is a change in the composition of the Federal Reserve's and the public's portfolio of domestic and foreign securities. Conditions in which exchange market intervention should be undertaken are established by the Federal Open Market Committee (FOMC), in consultation with the Secretary of the Treasury. The FOMC's most recent directive specifies that "System operations in foreign currencies shall generally be directed at countering disorderly market conditions. . . ."[22]

Exchange market intervention as conducted by the Federal Reserve is said to be sterilized because it has no effect on the money supply.[23] Sterilized intervention occurs when the Federal Reserve sells foreign currency for dollars and then buys U.S. securities in order to put dollars back into circulation. Sterilized intervention influences exchange rates through its effect on the supplies of domestic and foreign securities available to the public.

The effectiveness of sterilized exchange market intervention in influencing exchange rates depends on the extent to which investors consider foreign and domestic securities to be substitutes. If foreign securities are viewed as perfect substitutes for U.S. securities, exchange market intervention will have no effect on exchange rates. The reason is that investors will willingly hold the new supplies at unchanged interest rates and exchange rates. But if the foreign securities are viewed as imperfect substitutes, a change in their relative supplies caused by exchange market intervention will have some impact on exchange rates.[24] Even in this case, though, the resulting

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[21] A policy of accommodating unexpected changes in velocity to reduce exchange rate volatility rests on several assumptions. First, since the Federal Reserve observes velocity with a lag, current changes in velocity must be inferred from observing changes in other variables. That is, there must be some observable variable that indicates velocity has changed. Although interest rates have often been suggested as an indicator, they may not be a good indicator. Second, the argument depends on the Federal Reserve being able to react to changes in velocity before market participants do. Third, such actions by the Federal Reserve must be clearly understood by market participants. If participants do not understand, they may believe that there has been a change in monetary policy. Such a misunderstanding would lead to changes in the exchange rate.

[22] *Annual Report, 1983*, Board of Governors of the Federal Reserve System, p. 84.

[23] A useful statement on exchange market intervention appears in the report of the Working Group on Exchange Market Intervention Established at the Versailles Summit of the Heads of State and Government, June 4-6, 1982, mimeograph, March 1983.

[24] The explanation follows from the portfolio balance theory of exchange rate determination, a generalization of the monetary approach developed in the previous section. According to this view, the relative supply of domestic to foreign securities determines the exchange rate. The exchange rate determines the cur-

change in exchange rates is only temporary and relatively small.[25]

Exchange market intervention cannot offset the exchange rate volatility arising from changes in market fundamentals. A change in market fundamentals causes a permanent change in the equilibrium exchange rate. Since exchange market intervention has no lasting effect on exchange rates, intervention to offset the effects of changes in market fundamentals would at most only delay the necessary adjustment to the new equilibrium. Although intervention might be thought a useful device to avoid overshooting of equilibrium, which itself is temporary, this too is likely to be inef-

fective. First, overshooting persists until wages and prices have fully adjusted to their equilibrium levels. With three-year union labor contracts common, overshooting could last several years, much longer than the effect of intervention. Second, because the effect of intervention is relatively small, offsetting a large overshoot would require massive intervention. Moreover, even if effective to some extent, efforts to offset overshooting by intervention might not be appropriate because of the difficulty of determining the extent of any given change in exchange rates that is due to overshooting. For all of these reasons, most economists agree with President Reagan's assessment that "Pure [sterilized] exchange market intervention cannot offset the fundamental factors that determine the dollar's value."[26]

There is less consensus regarding the appropriateness of using exchange market intervention to counter "disorderly" markets. Some deny that free markets can be disorderly in any meaningful sense. Even those that think disorderly markets can be a problem admit that providing an operational definition of disorderly markets is difficult. The definition provided by the Working Group on Exchange Market Intervention is that disorderly markets are characterized by "a substantial widening of bid-asked spreads, large extra-day exchange rate movements, perceptions that trading has become 'thin' or highly uncertain, and, at times, judgments that market psychology was beginning to generate self-sustaining exchange rate movements."[27] The same group found intervention was sometimes successful in countering disorderly markets but stressed that intervention was not a substitute for effective

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rent account, which equals the capital inflow. The capital inflow determines the expected rate of change of the exchange rate. A reduction in the relative supply of U.S. assets leads to a fall in U.S. interest rates and a rise in foreign interests. In addition, the fall in U.S. assets relative to foreign assets means that investors' desired portfolio is out of balance—they have too much of their wealth in foreign securities. However, a rise in the dollar will reduce the dollar value of foreign securities and act to achieve portfolio balance. The appreciation of the dollar leads to a current account deficit and a capital inflow. The capital inflow occurs over time and implies an expected fall in wealth. The expected fall in wealth reduces the demand for money and leads to an expected depreciation of the dollar.

[25] The change is temporary for two reasons. First, if there is a cost to changing one's portfolio of securities, securities may be imperfect substitutes in the short run but perfect substitutes in the long run. Second, since the ultimate effect of intervention is a change in the security composition of the Federal Reserve's and the public's portfolio, unless the Federal Reserve continues to intervene to maintain the new composition, the supplies will eventually return to their original levels as the securities mature. At that point, the exchange rate will return to its original level. The change is small for two reasons. First, empirical evidence suggests that securities are close to perfect substitutes. Second, the size of an intervention operation is small. The 1983 summer intervention was only 1 percent of the flow through the U.S. interbank foreign exchange market (*Economic Report of the President, 1984*, p. 60). Such reasoning led Henry Wallich (Member, Board of Governors of the Federal Reserve System) to state in testimony before the House Subcommittee on Domestic Monetary Policy on October 5, 1983, that "Intervention in the exchange market, if sterilized, as U.S. intervention routinely is, would have only limited effects, unless undertaken on an enormous scale."

[26] *Economic Report of the President, 1984*, p. 5.

[27] "Report of the Working Group on Exchange Market Intervention," pp. 8-11.

domestic policies in achieving stable exchange rates.

## Conclusion

Rising inflation and prolonged periods of world recession have been accompanied by severe exchange rate volatility since 1973. Uncertainty about exchange rates has made business and investment decisions more difficult at a time when the world economy and financial system were becoming more integrated. To reduce uncertainty, many have called for government action to smooth exchange rate movements. But there are limits to what government policy can do to dampen exchange rate volatility.

The most effective role the government can play in reducing uncertainty is to provide a stable policy environment. Fiscal policy can contribute to a stable environment by avoiding large, unpredictable swings in the size of the budget deficit. Monetary policy can contribute by ensuring that monetary growth is consistent with a stable domestic price level. To the extent that growth in real output and velocity is constant, a constant growth rate rule for the money stock could be devised that would yield price stability. In most cases, however, the Federal Reserve must take account of prospective output and velocity changes in setting monetary growth targets.

A stable policy environment would not eliminate all exchange rate volatility, however. Unexpected changes in the market fundamentals that the Federal Reserve or other U.S. policymakers cannot control—such as foreign inflation rates and the real terms of trade—will continue to cause some volatility in exchange rates. Moreover, short-run market psychology may occasionally lead to disorderly exchange markets. Direct intervention in exchange markets on these occasions may reduce the extent of the resulting exchange rate volatility. Although perhaps a useful complement, exchange market intervention is no substitute for stable, predictable macroeconomic policies in limiting exchange rate volatility.