# Is Exchange Rate Volatility "Excessive"?

By Jeffrey H. Bergstrand*

In recent years, one can scarcely read about exchange rates without some reference to their volatility—whether discussed by journalists, policymakers, or academicians. For instance:

> The only consensus in the foreign exchange market seems to be that the volatility that saw the dollar shift in value by as much as 5% a day against some major foreign currencies during the last two years could be equaled or exceeded in coming months.[1]

> Exchange rate fluctuations, it turned out, were a great deal wider (in the 1970s) than had been expected. These ups and downs were far more also than could readily be explained by differential movements in rates of inflation . . .[2]

> Since the move to generalized floating in 1973, exchange rates between major currencies have displayed large fluctuations. This turbulence of foreign exchange rates is an important concern of government policy and its explanation is a challenge for theories of foreign exchange market behavior.[3]

Concern about exchange rate variability has recently prompted calls for a "return to Bretton Woods," implying a restoration of a fixed exchange rate regime among the major industrialized nations. Yet despite repeated allegations of excessive turbulence in foreign exchange markets, little effort has been made to analyze exchange rate fluctuations empirically in the context of a broad macroeconomic perspective.

This article attempts to evaluate the exchange rate between two currencies in its role as one of many financial asset prices responding almost instantaneously to continual unanticipated real and financial macroeconomic disturbances. In the first section of this article, alternative definitions of exchange rate volatility are compared and contrasted. In the second section, various measures of exchange rate volatility are presented. Using the modern view that an exchange rate is the price of a financial asset, the measures suggest that exchange rates have been the *least* volatile of a representative sample of asset prices. The third section shows that— although exchange rate volatility increased during the 1980-82 period of reserve-aggregate targeting by the Federal Reserve—since September 1982 exchange rate volatility, as well as other asset prices' volatility, has actually declined. Thus, at a time when some economists and policymakers are calling for a return to a fixed rate regime, evidence shows that exchange rates are adjusting to macroeconomic disturbances with less volatility than other asset prices and exchange rate fluctuations have been declining.

## I. Alternative Measures of Exchange Rate Volatility

Our concern with the issue of exchange rate volatility arises from the economic and social costs that result

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[1] "Waiting Out the Volatile Dollar," *Business Week*, January 24, 1983, p.78.

[2] Henry C. Wallich (a governor of the Federal Reserve Board), "Exchange Rate Stability via Internal Moves," *Journal of Commerce*, April 14, 1983, p. 4A.

[3] Jacob A. Frenkel and Michael Mussa, "The Efficiency of Foreign Exchange Markets and Measures of Turbulence," *American Economic Review*, vol. 70, no. 2, May 1980, p. 374.

Table 1
Average Absolute Percentage Changes in Selected Exchange Rates and Aggregate Price Indexes

| | Monthly Data: April 1973–February 1983 (in percentages) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Canada | France | Germany | Italy | Japan | U.K. | U.S. |
| Exchange Rate with U.S. Dollar | .81 | 1.99 | 2.19 | 1.75 | 2.04 | 1.85 | 1.59* |
| Wholesale Price Index | .84 | .99 | .46 | 1.38 | .79 | 1.18 | .85 |
| Consumer Price Index | .78 | .89 | .41 | 1.30 | .86 | 1.10 | .70 |
| Relative Wholesale Prices | .47 | .86 | .49 | .98 | .82 | .60 | na |
| Relative Consumer Prices | .32 | .35 | .40 | .69 | .75 | .65 | na |

NOTES: *denotes weighted-average foreign-currency value of U.S. dollar. "na" denotes not applicable. Indexes are means of absolute values of monthly percentage changes in exchange rates, indexes, or relative indexes (foreign price index divided by U.S. price index).
SOURCES: Board of Governors of the Federal Reserve System, *Selected Interest and Exchange Rates* (tape); International Monetary Fund, *International Financial Statistics* (tape, June 1983).

from exchange rate swings. However, the nature of these costs varies according to the time frame examined; hence, exchange rate turbulence can be reasonably defined in a variety of ways. In this section, two measures of exchange rate volatility are suggested where the associated costs of "excessive" volatility are reasonably identifiable and potentially of greatest concern.

One important traditional view of exchange rate determination is purchasing power parity (PPP). According to the relative version of PPP, if the home country's inflation rate over a certain period exceeds the foreign country's inflation rate by x percent, the domestic currency should depreciate by x percent over that period, provided the exchange rate was in equilibrium at the period's beginning. If the exchange rate—defined as the domestic price of a unit of foreign currency—changes more than proportionately to the change in relative commodity prices, the exchange rate displays excessive volatility according to this view. Consequently, excessive exchange rate volatility has often come to be defined as substantial and prolonged deviations from PPP.

One study has suggested that, "Perhaps the simplest measure of turbulence in foreign exchange markets is the average (absolute) percentage changes in exchange rates over some interval of time."[4] Table 1 presents estimates of exchange rate volatility and aggregate price index volatility for the seven largest industrialized countries, using the measure suggested by that study. According to this measure, for the period of floating exchange rates that began in spring 1973 the average monthly percentage change in each exchange rate consistently exceeded the average monthly percentage change in the corresponding aggregate price index or relative aggregate price index, except for Canada.

In light of similar evidence from earlier studies, the international finance literature expanded rapidly during recent years with various "monetary" and "portfolio-balance" models of exchange rate determination that included prominently explanations for "overshooting" — that is, short-run changes in the equilibrium exchange rate that exceeded long-run changes in that rate.[5] With the long-run equilibrium exchange rate change usually assumed to be determined by relative PPP, these models explained excessive volatility, or short-run overshooting, of the long-run equilibrium exchange rate without appealing to speculative bandwagon effects, imperfect information, or persistent errors in the formation of exchange rate expectations. Explaining large and persistent deviations from PPP was of interest because of the possible associated misallocation of resources. Furthermore, extreme monetary restraint in the home country that raises the domestic interest rate relative to the foreign interest rate over an extended period could lead to a large real (or inflation-adjusted) appreciation of the home currency. Such appreciation reduces the home country's international competitiveness, driving domestic firms and factors of production out of internationally traded and into nontraded goods

[4] Ibid.

[5] See Jeffrey H. Bergstrand, "Selected Views of Exchange Rate Determination After a Decade of 'Floating'," *New England Economic Review*, May/June 1983, pp. 14-29, for a survey and synthesis of some of these views.

industries. The home country incurs costs if resources become temporarily unemployed during the shift of factors from the traded to the nontraded goods sector. When the home currency eventually depreciates, firms and factors will be attracted back into traded goods industries. Again the home country may incur costs if resources are temporarily unemployed during the movement of factors back into the traded goods sector. In addition, a substantial appreciation of the domestic currency induces large current account deficits, necessitating net capital inflows from abroad to finance the deficits. Such net inflows from a foreign country will tend to raise interest rates in that country, but the simultaneous depreciation of the foreign currency will make the foreign country's traded goods sector more competitive. Firms and factors of production abroad will be attracted away from interest-sensitive and/or nontraded goods industries to traded goods industries. The foreign country will incur costs to the extent that resources are temporarily unemployed as factors shift from interest-sensitive and/or nontraded goods industries to traded goods industries.

By contrast, excessive exchange rate volatility can also be measured by the *unpredictability* of exchange rate fluctuations. This alternative focus is consistent with the widely held view that, "The burden on trade consists not so much in the fact or size of fluctuations during particular years as in *uncertainty* about possible changes."[6] Daily and monthly exchange rate changes alter the domestic-currency prices of exports and imports of goods and services. Consequently, the domestic-currency values of exports and imports purchased on credit and denominated in foreign currencies fluctuate with spot exchange rate changes. Similarly, debt repayments denominated in foreign currencies are altered by exchange rate changes. To some extent, the difficulties faced by many less developed countries recently in servicing their foreign debt stems from the strong appreciation of the dollar over the past three years, the currency in which the bulk of their debt repayments is scheduled. Thus, as one economist notes, "The concern with exchange rate variability stems in almost all cases from its impact on the domestic-currency *value* of international transactions . . ." (italics added).[7]

Forward exchange markets redistribute (and partially eliminate) the risk associated with the uncertainty of exchange rate movements. A U.S. exporter or importer can contract to buy or sell foreign exchange in the future at a price agreed upon today, ensuring the domestic value of future payment for a foreign transaction. The forward "premium" or "discount" on foreign exchange corresponds approximately to the "cost" of hedging for a firm.

Yet, an exporter or importer may still incur an opportunity cost from exchange rate variation even after contracting to sell or buy forward exchange. For example, a U.S. importer may contract today to purchase German marks three months hence at the 90-day forward exchange rate. If the dollar is at a forward discount at the time of the contract, the importer gains (or at least does not lose) if the dollar depreciates by more than this discount over the three-month period. However, if the dollar appreciates the importer incurs an opportunity cost, in that he would have been better off to buy German marks in the spot market at the end of the 90 days. On average, the forward exchange rate has been shown to be a rather unbiased predictor of the future spot exchange rate, limiting the extent of opportunity costs associated with forward exchange contracts under excessive spot exchange rate variability. But evidence shows that less than 10 percent of actual monthly exchange rate changes are predicted precisely by forward exchange premiums or discounts, suggesting the latter are poor predictors of corresponding future spot exchange rate changes.[8]

Furthermore, the cost of obtaining spot or forward foreign exchange tends to increase with greater exchange rate variability. The spread between bid and ask quotations is usually accepted as a good estimate of the transaction cost of purchasing or selling an asset. Studies have found that bid-ask spreads for spot or forward foreign exchange usually increased with greater exchange rate volatility, although such spreads typically remain a small fraction of a transaction's value.[9] Costs also result for U.S. investors from capital gains and losses by holding net open asset or liability positions in foreign currencies. Since forward exchange markets are not designed for offsetting indefinite "exchange risk,"

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[6] Leland B. Yeager, *International Monetary Relations: Theory, History, and Policy*, Second Edition, New York: Harper and Row, 1976, p. 252.

[7] Anthony Lanyi and Esther C. Suss, "Exchange Rate Variability: Alternative Measures and Interpretation," IMF *Staff Papers*, vol. 29, no. 4, December 1982, p. 530.

[8] See Michael Mussa, "Empirical Regularities in the Behavior of Exchange Rates and Theories of the Foreign Exchange Market," *Policies for Employment, Prices, and Exchange Rates*, Carnegie-Rochester Conference Series on Public Policy, vol. 11, 1979.

[9] For example, see Norman S. Fieleke, "Exchange Rate Flexibility and the Efficiency of the Foreign Exchange Market," *Journal of Financial and Quantitative Analysis*," vol. 10, 1975, pp. 409-426, and International Monetary Fund *Annual Report*, 1982, pp. 41-51.

Table 2
Standard Deviations of Monthly Percentage Changes in Selected Exchange Rates and Aggregate Price Indexes

| | Monthly Data: April 1973–February 1983 (in percentages) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Canada | France | Germany | Italy | Japan | U.K. | U.S. |
| Exchange Rate with U.S. Dollar | 1.03 | 2.65 | 2.87 | 2.34 | 2.76 | 2.28 | 2.06* |
| Wholesale Price Index | .70 | 1.18 | .50 | 1.18 | 1.16 | .73 | .94 |
| Consumer Price Index | .36 | .30 | .30 | .57 | 1.00 | .87 | .37 |
| Relative Wholesale Prices | .63 | 1.10 | .54 | 1.23 | 1.15 | .72 | na |
| Relative Consumer Prices | .40 | .41 | .41 | .62 | 1.01 | .89 | na |

NOTES: *denotes weighted-average foreign-currency value of U.S. dollar. "na" denotes not applicable. Indexes are standard deviations of monthly percentage changes in exchange rates, indexes, or relative indexes (foreign price index divided by U.S. price index).
SOURCES: Board of Governors of the Federal Reserve System, *Selected Interest and Exchange Rates* (tape); International Monetary Fund, *International Financial Statistics* (tape, June 1983).

hedging imposes a cost by requiring reallocations of wealth in order to neutralize the uncertainty of exchange rate changes. Hence, the costs of transacting internationally and maintaining net open foreign positions generally increase with greater exchange rate variability.[10]

Consequently, in this study exchange rate volatility is also measured by the standard deviation of the monthly percentage changes in the price of foreign exchange.[11] The standard deviation measures how much an exchange rate's monthly change typically deviates from the average monthly change; that is, the standard deviation is one index of the degree of unpredictability in monthly exchange rate variation.

To contrast this measure of exchange rate volatility with the one used in Table 1, consider the following example. The average (absolute) monthly percentage change for the dollar value of a German mark during the past decade was roughly 2 percent. If every month the value of the mark could be expected to rise 2 percent, such volatility would not increase the cost of planned international transactions because the change in the domestic-currency value of those international transactions would be anticipated; that is, exchange risk would be zero. However, if the monthly percentage change in the exchange rate typically deviated widely from its average change (i.e., the standard deviation of the monthly percentage change was large), uncertainty surrounding exchange rate movements would be great, imposing a burden to society in terms of the greater cost for international transactions.[12]

Using standard deviations of monthly percentage changes, Table 2 indicates that exchange rate volatility is still excessive compared with that of aggregate price or relative price indexes. In the next section, however, exchange rate volatility is compared with the volatility of other financial asset prices to determine whether the former—under certain criteria—is excessive.

## II. Measuring Exchange Rate Volatility

A major insight of recent research on exchange rates has been the recognition that foreign exchange is a financial asset and, as a result, the techniques for determining the price of foreign exchange, as well as the observed behavior of its price over time, should bear strong resemblance to (that of) other financial assets.[13]

[10] See Peter B. Clark, "Uncertainty, Exchange Risk, and the Level of International Trade," *Western Economic Journal*, vol. 11, no. 3, September 1973, for a microeconomic analysis of a risk-averse firm's price and output responses to increased exchange rate variability. Clark shows that even when forward markets are "perfect" and forward contracts are obtainable for any maturity, the existence of such facilities will not eliminate exchange risk even in the long run as long as the foreign currency price in the transaction is a random variable.

[11] Lanyi and Suss, "Exchange Rate Variability," used this measure in their study which compared the extent of variability across a large number of exchange rates. See their study for a discussion of the relative advantages of this measure compared to the standard deviation of a moving average or deviations from a trend. Also, Jacob A. Frenkel, "Flexible Exchange Rates, Prices, and the Role of 'News': Lessons from the 1970s," *Journal of Political Economy*, vol. 89, no. 4, August 1981, pp. 665-705, used this measure of volatility for three monthly exchange rate series.

[12] Because of its quadratic nature, the standard deviation of monthly percentage changes imposes proportionately more weight on large deviations from the norm.

[13] Richard M. Levich, "Overshooting in the Foreign Exchange Market," Group of Thirty Occasional Papers No. 5, New York, 1981, p. 3.

Despite a large number of remaining differences, economists studying foreign exchange markets generally accept that the short-run equilibrium exchange rate is determined like other financial asset prices (or commodity prices determined in organized auction markets). Some modern monetary approaches to exchange rate determination emphasize the importance of expectations. Like other financial asset prices, spot exchange rates are influenced by present and expected future values of various real and monetary factors. An unanticipated policy change can cause spot exchange rate volatility as the spot rate is influenced directly by current demands for and supplies of currencies and indirectly by future demands for and supplies of currencies, the latter linked to spot exchange rates via expected future exchange rates and international capital markets. Other modern monetary approaches emphasize the importance of rapid foreign exchange market clearing, the price of foreign exchange adjusting instantaneously to eliminate disequilibrium. Exchange rates may display excessive volatility relative to aggregate price indexes because disequilibrium in most goods markets (other than organized commodity exchanges) may be prolonged because of quantity rationing rather than eliminated by rapid price adjustments. Other modern views recognize that exchange rates are generally determined simultaneously with other financial asset prices as wealth holders continuously adjust their portfolios to maintain financial equilibrium. Thus, in the short run, an unanticipated policy disturbance causing substantial changes in relative asset supplies will require large changes in financial asset prices and in exchange rates to restore portfolio balance before any impact occurs in goods markets.[14]

In light of the continual real, monetary, and fiscal shocks occurring in an economy, prices of foreign exchange and other financial assets should be expected to adjust continually to restore equilibrium. Because asset markets are relatively efficient (compared to most goods markets), prices in these markets must adjust instantaneously to "vent" disequilibrium. The variability of asset prices arises from unanticipated changes in underlying economic factors. When underlying economic shocks are substantial, exchange rates— and other asset prices—should change substantially to restore equilibrium. As the magnitudes of underlying shocks change over time, the volatility of exchange rates and other asset prices should fluctuate over time. In contrast, goods markets can channel disequilibrium through either price- or quantity-adjustment mechanisms. Thus, aggregate price indexes may be very sluggish to change in response to an unanticipated economic shock if disequilibrium is borne primarily by inventory corrections, changes in order backlogs, and the like.

Consequently, one method for appraising foreign exchange market turbulence is to compare exchange rate volatility with price volatility of other financial assets and of commodities traded in markets organized similarly to foreign exchange markets, where underlying shocks are dispersed in a like manner. If exchange rates are less volatile—in size or unpredictability of changes—than other asset prices, one might conclude that foreign exchange markets are truly broad, deep, and resilient. While other markets may be "organized" in a like manner to foreign exchange markets, inherent economic and institutional characteristics of each market will, of course, affect the degree of price volatility in that market. For example, the influence of weather may cause prices to be more volatile in agricultural compared to metals markets; the varying role of "commodity agreements" may influence price volatility in the tin market relative to the iron market. To take account of these issues, a wide array of different financial and real assets are compared to foreign exchange so that the intrinsic properties of any *particular* market in one of the various "groups" of markets will be less likely to bias the results. Moreover, price indexes of various *baskets* of primary commodities are analyzed as well. Tables 3 and 4 present volatility estimates using average absolute monthly percentage changes and standard deviations of monthly percentage changes, respectively, for the array of exchange rates, other financial asset prices, prices of individual commodities, and price indexes of primary commodity baskets.[15]

The first four lines in Table 3 reveal that each country's exchange rate with the dollar showed less monthly volatility than the corresponding country's short-term interest rate, long-term bond yield, or stock market

[14] See Bergstrand, "Selected Views of Exchange Rate Determination," for a more detailed discussion of each of these points.

[15] Frenkel and Mussa, "The Efficiency of Foreign Exchange Markets," calculated average absolute monthly percentage changes for stock market price indexes of four countries and found that stock market price index volatility exceeded exchange rate volatility. Richard M. Levich, "Overshooting in the Foreign Exchange Market," also compared exchange rate volatility with volatility of some U.S. stock market price indexes, a U.S. bond price index, a commodity price index, and gold. However, Levich estimated volatility using solely average absolute percentage changes for daily observations spanning only a 4-month period and for weekly observations spanning only a 12-month period.

Table 3
Average Absolute Percentage Changes in Selected Exchange Rates and Other Asset Prices

| | Monthly Data: April 1973–February 1983 (except where noted below) (in percentages) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Canada | France | Germany | Italy | Japan | U.K. | U.S. |
| Exchange Rate with U.S. Dollar | 0.81 | 1.99 | 2.19 | 1.75 | 2.04 | 1.85 | 1.59* |
| Stock Market Price Indexes | 4.45 | 4.92 | 2.61 | 5.66 | 2.36 | 4.60 | 3.22 |
| Short-Term Interest Rates | 4.94 | 4.84 | 5.28 | 4.31 | 4.26 | 6.32 | 6.72 |
| Long-Term Bond Yields | 2.36 | 1.50 | 2.66 | 1.46 | 2.55 | 3.58 | 2.80 |
| Relative Short-Term Interest Rates | 5.60 | 7.82 | 8.12 | 8.16 | 8.22 | 8.95 | na |
| Relative Long-Term Bond Yields | 1.76 | 3.25 | 3.19 | 3.23 | 3.37 | 3.89 | na |

| | Gold | Cotton | Iron | Pulp | Tin | Wheat | Zinc |
|---|---|---|---|---|---|---|---|
| Commodity Prices | 5.90 | 5.62 | 3.03 | 2.92 | 4.86 | 4.53 | 2.55 |

| | Food | Beverages | Agricultural Raw Materials | Metals | Assorted Primary Commodities |
|---|---|---|---|---|---|
| Primary Commodity Basket Price Indexes | 4.05 | 4.95 | 2.55 | 3.52 | 2.90 |

Notes: *denotes weighted-average foreign-currency value of U.S. dollar. "na" denotes not applicable. Stock market price indexes are Canada's Toronto Stock Exchange Index, France's Industrials Index (INSEE), Germany's Industrials Index (Federal Statistical Office), Italy's Milan Stock Exchange Index, Japan's Tokyo Stock Exchange Index, the United Kingdom's Financial Times Actuaries Index (500), and the United States' Standard & Poor's Industrials Index. Stock market price index data are from the OECD's *Main Economic Indicators*. Short-term interest rates are the 3-month Eurodollar deposit rate for the United States and 3-month interbank loan rates for the other six countries (for Japan, the 2-month Tokyo loan and discount rate); observations for France and Italy begin with February 1975. Long-term bond yields are Canada's long-term government bond yield, France's long-term public-sector bond yield, Germany's long-term public authority loan rate, Italy's long-term interest rate (a weighted average of yields on instruments of 8-year maturity or longer issued by quasi-public enterprises), Japan's long-term government bond yield, the United Kingdom's government war loan yield, and the United States' 10-year constant maturity bond yield. Observations for Italy's long-term interest rate begin with February 1977. Relative interest rates (and yields) are foreign divided by U.S. rates. Individual commodity prices and commodity basket price indexes are from the IMF's *International Financial Statistics*. The food index is comprised of oil and oilseeds, cereals, sugar, meat, and bananas; the beverage index: coffee, cocoa, and tea; the agricultural raw materials index: cotton, wool, rubber, hides, jute, and sisal; the metals index: copper, iron ore, tin, aluminum, zinc, nickel, and lead.

Sources: Board of Governors of the Federal Reserve System, *Selected Interest and Exchange Rates* (tape); International Monetary Fund, *International Financial Statistics* (tape, June 1983); OECD, *Main Economic Indicators* (various issues).

price index for all countries except France and Italy.[16] The French and Italian long-term bond yields showed less volatility than their exchange rates with the dollar. In Table 4, each country's exchange rate with the dollar showed less monthly volatility than the corresponding country's short-term interest rate, long-term bond yield, or stock market price index for all countries except France and Italy. For both countries, long-term bond yield volatility was again smaller than exchange rate volatility. Both countries, however, have displayed sluggish adjustment for long-term interest rates relative to short-term interest rates, possibly intended for policy reasons. As noted for Italy by the OECD:

> With regard to interest rates, the authorities have tried to ensure that the rise in short-term rates, which they encouraged is not entirely passed on in long-term rates.[17]

[16] Two points are noteworthy. First, short-term interest rates and long-term bond yields are used rather than secondary market prices of (short-term) bills and (long-term) bonds, respectively. Unlike the other assets examined in this part—foreign currencies, equities in firms, and commodities—bills and bonds have *finite* lives or maturities (while the other assets have potentially infinite maturities, like "consols"). Because a 3-month bill has a maturity so much shorter than that of a foreign currency or commodity (or even a long-term bond), its market price is inherently much less volatile. To illustrate, consider the following example. The yields on a 10-year Treasury bond (assumed fixed coupon rate of 8 percent) and on a 3-month Treasury bill each increase from 10 percent to 11 percent in one week. While this implies a 10 percent increase in either asset's yield, the 100 basis point rise implies roughly a 6.3 percent fall in the market price of the 10-year bond but only a 0.23 percent fall in the market price of the 3-month bill. While a 0.23 percent market price change seems trivial, a one-week 100 basis point interest rate rise for either instrument suggests an "excessively volatile" market to its analysts. Consequently, to calculate indexes that capture price volatility in certain financial assets as likely "perceived" by market traders, interest rates rather than secondary market prices are used as the representative "prices" of short-term and long-term debt instruments. Second, percentage changes in interest rates (i.e., $(i_t - i_{t-1})/i_{t-1}$) are considered preferable to changes in interest rates (i.e., $i_t - i_{t-1}$) to measure price volatility of bills and bonds. The reason is that a one-week 100 basis point change would imply high interest rate volatility in some countries with historically low interest rates (e.g., Japan) while it may *not* imply high interest rate volatility in other countries with historically high interest rates (e.g., Italy).

[17] OECD *Economic Survey: Italy*, OECD: Paris, January 1975, p. 24.

Table 4
Standard Deviations of Monthly Percentage Changes in Selected Exchange Rates and Other Asset Prices

| | Monthly Data: April 1973–February 1983 (except where noted below) (in percentages) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Canada | France | Germany | Italy | Japan | U.K. | U.S. |
| Exchange Rate with U.S. Dollar | 1.03 | 2.65 | 2.87 | 2.34 | 2.76 | 2.28 | 2.06* |
| Stock Market Price Indexes | 5.69 | 6.84 | 3.56 | 7.07 | 3.05 | 6.94 | 4.27 |
| Short-Term Interest Rates | 6.92 | 6.52 | 7.37 | 8.10 | 6.45 | 8.83 | 9.15 |
| Long-Term Bond Yields | 3.29 | 2.21 | 3.51 | 2.12 | 3.84 | 4.58 | 3.91 |
| Relative Short-Term Interest Rates | 7.32 | 10.86 | 11.66 | 12.51 | 11.30 | 11.68 | na |
| Relative Long-Term Bond Yields | 2.32 | 4.24 | 3.90 | 4.60 | 4.41 | 5.12 | na |

| | Gold | Cotton | Iron | Pulp | Tin | Wheat | Zinc |
|---|---|---|---|---|---|---|---|
| Commodity Prices | 8.42 | 7.39 | 5.54 | 4.31 | 6.92 | 8.20 | 5.44 |

| | Food | Beverages | Agricultural Raw Materials | Metals | Assorted Primary Commodities |
|---|---|---|---|---|---|
| Primary Commodity Basket Price Indexes | 5.25 | 6.72 | 3.28 | 5.94 | 3.74 |

Notes and Sources: See Table 3.

Monetary policy in France may also have intentionally induced large and variable differentials between short- and long-term interest rates:

> Pressure on money market rates continued throughout the year, with the authorities accepting wide fluctuations in the (short-term) rates over short periods in order to adjust them to fluctuations on the exchange markets and in rates abroad . . . .In order to prevent excessive fluctuations in the cost of credit, the authorities allowed money market rates to move somewhat out of line with the interest rates of banks and financial institutions.[18]

French monetary authorities regulated interest rates on pass-book bank accounts and on savings accounts throughout the last half of the 1970s. Such stability for interest rates of banks and financial institutions has been attributed to the monetary authorities' wish to funnel this savings toward medium- and long-term financial instruments[19]—traditionally "thin" markets owing to the French history of price inflation. Consequently, long-term bond yields may have been kept stable by French monetary authorities indirectly as a result of regulated interest rates for bank deposits—the source of funds for long-term investments.

In light of the high degree of international capital mobility displayed over the past decade, some theories recommend viewing the exchange rate between two currencies as the *relative* price of financial assets in the two countries. This view suggests that exchange rate volatility should be compared with relative asset price volatility. Relative asset prices are defined as the ratio of the price of the foreign country's financial asset to the price of the corresponding U.S. financial asset. However, Tables 3 and 4 illustrate that exchange rates were less volatile than even the corresponding relative short-term and long-term interest rates over the past decade. Relative stock price indexes were not calculated because the conceptual basis for such a measure was weak and international capital mobility was presumed stronger in short-term and long-term debt markets than in equity markets.

Prices of homogeneous primary commodities tend to display greater variability than prices in differentiated goods markets, because in the latter quantity rationing often supplants price adjustment to restore market equilibrium. Tables 3 and 4 demonstrate that exchange rates were not only less volatile than a sample of individual primary commodity prices, but exchange rates were even less volatile than price indexes of various baskets of primary commodities.

In summary, exchange rates have been shown generally to be the *least* volatile of a sample of financial and

[18] OECD *Economic Survey: France*, OECD: Paris, December 1977, pp. 29-31.

[19] OECD *Economic Summary: France*, OECD: Paris, May 1980, pp. 40-41.

real asset prices during the past 10 years of floating exchange rates, as measured in this study. In the next section, asset price volatility is demonstrated to have increased from the 1970s to early 1980s, as the U.S. monetary authorities' operating procedures changed. However, during the past few months as the Federal Reserve has apparently adopted a broader array of guidelines, exchange rate and other financial asset prices' volatility has declined.

## III. Asset Price Variability and U.S. Monetary Policy

U.S. monetary policy has undergone some well-publicized changes over recent years that have had considerable impacts on domestic and world economic conditions. For many years prior to October 1979, the federal funds rate— the interest rate U.S. banks charge for overnight interbank lending—served as a short-run guide for Federal Reserve open market operations. Given specific projections for the domestic money demand function, the Federal Reserve would purchase or sell government securities to maintain a federal funds rate believed to be consistent with a certain range of values for the domestic money stock.

However, in October 1979 the Federal Reserve began to place much more emphasis on controlling nonborrowed reserves in the banking system and less emphasis on influencing the federal funds rate. Under this system, the Federal Reserve still set targets for monetary aggregates. Given specific projections for the money supply and money demand functions, nonborrowed reserves would be set to meet the desired ranges for the monetary aggregates. Consequently, the federal funds rate—and other short-term U.S. interest rates—would be expected to change fluidly to offset unexpected disturbances to money supply or money demand.[20]

By fall 1982, the Chairman of the Federal Reserve Board, Paul A. Volcker, indicated that growth in monetary aggregates above the targeted ranges would be tolerated during the remainder of the year "in circumstances in which it appeared that precautionary or liquidity motivations, during a period of economic uncertainty and turbulence, were leading to stronger than anticipated demands for money."[21] Indeed, for one of the aggregates—M1—the Federal Reserve decided to set no objective for the period from September to December 1982, primarily because of the temporary impact of a large volume of maturing all savers certificates. Even in setting targets for monetary aggregates for 1983, the Federal Reserve indicated that much less emphasis would continue to be given to M1—owing to the changing relationship of this monetary aggregate to income because of the increasing availability of transaction accounts bearing interest. As reported by the Federal Reserve to Congress in February 1983:

> All of these factors contributed to the complexity of setting target ranges for 1983, and the Committee recognized that an unusual degree of judgement would be necessary in interpreting the growth of money and credit in coming months. Some flexibility in reassessing the ranges could be important . . . .For the time being, in implementing monetary policy, the Committee agreed that substantial weight would be placed on behavior of the broader aggregates—M2 and M3 . . .[22]

Table 5 presents measures of asset price volatility for three specific subperiods of the past few years, chosen to reflect price variability under the different operating procedures of the Federal Reserve. Price volatility is measured by the standard deviation of the weekly percentage change in each asset's price. Weekly rather than monthly percentage changes were chosen to generate a sufficient number of observations for the third subperiod, September 1982–May 1983. Table 5 reveals that U.S. short-term interest rates did exhibit much greater volatility under reserve-aggregate targeting in subperiod 2 than under federal funds rate targeting in subperiod 1. Owing to the high degree of international mobility of short-term capital, the operating strategy change's effects were transmitted to other countries. Short-term interest rates in Canada, France, Germany, and Italy also exhibited greater volatility in the second compared to the first subperiod; only in the United Kingdom did short-term interest rate volatility decline.[23] Relative short-term interest rates (foreign relative to U.S. rates) displayed greater volatility in the second period over the first for all countries except the

[20] See Stephen H. Axilrod and David E. Lindsey, "Federal Reserve System Implementation of Monetary Policy: Analytical Foundations of the New Approach," *American Economic Review*, vol. 71, no. 2, May 1981, pp. 246-252, for a discussion of these two operating procedures.

[21] "Remarks on Monetary Policy," excerpted from an informal talk by Paul A. Volcker, Chairman, Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin*, November 1982, p. 692.

[22] "Monetary Policy Report to Congress," *Federal Reserve Bulletin*, March 1983, pp. 136-137.

[23] Japan was excluded from this part of the analysis because weekly observations on short-term interest rates suggested that the Japanese monetary authorities' influence prevented the rate from being market-determined; from January 1977 through September 1979 the Tokyo 2-month loan and discount rate did not change during 105 of the 143 weeks. Also, weekly observations on a Japanese long-term government bond yield were not available.

Table 5
Standard Deviations of Weekly Percentage Changes in Selected Exchange Rates and Other Asset Prices (in percentages)

| | Subperiod 1 Jan. 1977–Sept. 1979 | Subperiod 2 Oct. 1979–Aug. 1982 | Subperiod 3 Sept. 1982–May 1983 |
|---|---|---|---|
| Short-Term Interest Rates for: | | | |
| United States | 2.14 | 4.99 | 2.99 |
| Canada | 1.47 | 3.45 | 1.73 |
| France | 2.32 | 2.90 | 1.37 |
| Germany | 2.59 | 2.96 | 2.45 |
| Italy | 1.34 | 1.99 | 1.10 |
| United Kingdom | 4.71 | 2.51 | 2.69 |
| Relative Short-Term Interest Rates for: | | | |
| Canada | 2.54 | 4.16 | 2.69 |
| France | 3.20 | 5.61 | 3.21 |
| Germany | 3.30 | 5.38 | 3.09 |
| Italy | 2.50 | 5.38 | 3.36 |
| United Kingdom | 5.24 | 5.15 | 3.05 |
| Long-Term Bond Yields for: | | | |
| United States | 0.89 | 2.55 | 1.96 |
| Canada | 0.56 | 2.32 | 1.99 |
| France | 1.56 | 1.36 | 0.44 |
| Germany | 1.17 | 1.68 | 1.42 |
| Italy | 0.53 | 0.99 | 0.95 |
| United Kingdom | 2.65 | 3.00 | 5.95 |
| Relative Long-Term Bond Yields for: | | | |
| Canada | 0.82 | 1.73 | 1.35 |
| France | 1.80 | 2.63 | 2.36 |
| Germany | 1.47 | 2.29 | 2.10 |
| Italy | 0.98 | 2.64 | 2.35 |
| United Kingdom | 2.85 | 3.42 | 6.15 |
| Gold | 2.14 | 4.56 | 3.76 |
| Exchange Rates | | | |
| Weighted Average U.S. $ | 0.79 | 1.10 | 0.91 |
| U.S. $ / Canadian Dollar | 0.44 | 0.53 | 0.38 |
| U.S. $ / French Franc | 0.95 | 1.39 | 1.31 |
| U.S. $ / German Mark | 1.08 | 1.37 | 1.11 |
| U.S. $ / Italian Lira | 0.59 | 1.20 | 1.06 |
| U.S. $ / U.K. Pound | 0.94 | 1.26 | 1.10 |

NOTES: Indexes are standard deviations of weekly percentage changes in prices or rates. Relative rates are foreign divided by U.S. rates.
SOURCE: Board of Governors of the Federal Reserve System, *Selected Interest and Exchange Rates* (tape).

United Kingdom[24] as well. Furthermore, long-term bond yields (except for France), relative long-term bond yields, and the price of gold showed greater volatility in the second subperiod over the first; as discussed in the previous section, monetary authorities in France may have intentionally influenced the course of long-term interest rate volatility. Finally, exchange rates demonstrated greater volatility in the second compared to the first subperiod. Yet exchange rate volatility generally remained below the corresponding country's short-term and long-term interest rate volatility in the second, as well as in the first, subperiod. As discussed in the previous section, Italy's long-term interest rate was less volatile than its exchange rate.

More recently, interest rate (except for the United Kingdom[25]) and exchange rate volatility has declined. All exchange rates shown have displayed less volatility in the recent nine-month period compared to the previous three-year period. Furthermore the U.S. dollar/Canadian dollar rate has been less volatile in the recent nine-month period compared to the previous six-year period. While this decline in asset price variability may be due to the Fed's abandoning strict adherence to an M1 target range during subperiod 3, the volatility decline may also be attributable to other influences. In

[24] In the last week of November 1977, the U.K. short-term interest rate rose 40 percent—roughly 8 standard deviations from the mean. Excluding this one outlying observation, the standard deviation of the weekly percentage change in the U.K.'s relative short-term interest rate for subperiod 1 is 3.93—well below the corresponding second subperiod value.

[25] During the last two weeks of November 1982, the U.K. long-term bond yield (and relative long-term bond yield) first fell 13 percent and then rose 30 percent. By excluding these two weeks in calculations for subperiod 3, the standard deviations of the weekly percentage changes in U.K. long-term and relative long-term bond yields are 2.76 and 3.10, respectively—both below their corresponding second subperiod values. Similarly, by excluding the same two weeks, the standard deviation of the weekly percentage changes in the U.K.'s short-term interest rate in subperiod 3 is 2.42—below the corresponding second subperiod value of 2.51.

particular, asset price variability may have increased from subperiod 1 to subperiod 2 because of the "tightening" of monetary policy and the subsequent recession, not only because of a change in the "operating strategy" or techniques of the monetary authorities. Yet, at a time when floating exchange rate critics have called for a return to fixed rates, evidence shows not only that exchange rates are less variable than other asset prices, but that exchange rate variation has declined as interest rate variation has subsided.

## IV. Conclusions and Implications

Owing to some recent calls for a return to fixed exchange rates among the major industrialized nations—notably, by Economist Robert Mundell and Congressman Jack Kemp—a question demanding primary attention is: Have exchange rates displayed excessive volatility? The answer depends crucially on how exchange rate volatility is measured. In this article, exchange rates — as well as other financial asset prices and prices of commodities traded in organized (auctioneering) markets—are viewed as efficient "vents" for macroeconomic disturbances. As every economy experiences continual unanticipated real and financial shocks, asset prices change quickly to reestablish equilibrium between demands for and supplies of an array of assets in each country. If unanticipated disturbances in underlying macroeconomic factors are large, all asset prices should display large fluctuations. Although price volatility in any particular asset market is affected by intrinsic characteristics of that market as well as by macroeconomic disturbances, this study examined a wide array of financial and real assets— as well as baskets of various commodities—in an attempt to minimize the bias introduced by markets' individual idiosyncrasies.

According to two alternative measures of exchange rate volatility— corresponding to two different types of costs associated with variability, exchange rates were the least volatile of a representative sample of financial and real asset prices. Furthermore, although exchange rate volatility—as well as other asset prices' volatility—increased after October 1979 during the three-year period of reserve-aggregate targeting in the United States, this volatility has recently declined.

The analysis in this study assumes that actual short-run financial asset price changes reflect movements in the corresponding assets' equilibrium short-run prices. In fact, actual short-run exchange rates may deviate substantially from the equilibrium exchange rates that would prevail if market participants were perfectly informed and there were no government barriers to the transactions. Meanwhile, actual short-term interest rates may not deviate substantially from their equilibrium values. Thus, while actual exchange rates may appear to be less volatile than actual interest rates, exchange rates may be more volatile around their corresponding equilibrium values compared with short-term (or long-term) interest rates. In the absence of adequate models to predict equilibrium asset prices, empirical tests such as in this study must presume that foreign exchange markets are no less efficient than domestic money and capital markets, which does not seem too restrictive an assumption.

Even with these qualifications, the evidence in this study sheds some light on the fixed versus floating exchange rate controversy. By comparing exchange rate volatility with that of an array of commodity and financial asset prices, the broad spectrum of channels through which unanticipated economic disturbances are dispersed is sharply illustrated. An exchange rate is just one channel for adjustment to macroeconomic disequilibrium. If this channel were closed (that is, exchange rates were fixed), macroeconomic disturbances would still occur but would be dispersed through a smaller number of channels, each remaining channel responding to relatively greater pressure. Thus, interest rates, commodity prices, and capital flows (official and private) might all become more volatile. Under fixed exchange rates, interest rate sensitive industries such as housing, automobiles, and consumer durables would likely shoulder an even greater share of the burdens of macroeconomic adjustment.

Consequently, even if exchange rate volatility is still considered "excessive," the solution is not to eliminate a channel of adjustment but rather to eliminate the sources of exchange rate, commodity price, and other financial asset price volatility. Although open economies cannot isolate themselves from many types of economic shocks, like a large rise in the price of an imported commodity (oil), such economies—sharing highly integrated capital markets—may want to better cooperate to prevent large policy divergences that lead to excessive asset price volatility.