Money, Interest Rates, and Foreign Exchange Rates as Indicators for Monetary Policy

Jeffrey H. Bergstrand

Economist, Federal Reserve Bank of Boston. *The author gratefully acknowledges helpful comments from Karen Johnson and colleagues at the Bank and research assistance from Stephen Adelson.*

In the mid-1970s, the central banks of several industrial countries adopted one or more domestic monetary aggregates as intermediate targets for monetary policy. In most of these countries, one aggregate was given primary emphasis: M1 in the United States, Canada, and Switzerland, M2 in France, sterling M3 in the United Kingdom, and central bank money in Germany.[1] These aggregates were selected as intermediate targets at the time because they displayed stable relationships to these countries' national incomes and general price levels over lengthy periods in the past.

As matters developed, several of these central banks observed increasing instability in the relationship between national income and the domestic monetary aggregate. For instance, Gerald K. Bouey, Governor of the Bank of Canada, noted in the 1982 Per Jacobssen Lecture: "Perhaps the most troublesome problem in Canada is that the relationship between our target monetary aggregate—M1—and the levels of spending and interest rates has not turned out to be as stable as it appeared in the mid-1970s."[2] Consequently, the monetary authorities of these countries have come to use several *information variables*—such as monetary and credit aggregates, interest rates, and foreign exchange rates—jointly as barometers of domestic economic activity and price inflation. For instance, the Federal Reserve System has reported conducting U.S. monetary policy recently in light of "continuing appraisal of the relationships not only among the various measures of money and credit but also between those aggregates and nominal GNP, including evaluation of conditions in domestic credit and foreign exchange markets."[3] In Canada, the central bank has recognized that several linkages exist between a Bank of Canada policy action to alter the rate of monetary growth and its ultimate effect on the general price level. Accordingly, as one adviser has noted, "Various economic and financial variables have been used by the Bank of Canada as a source of information on the linkages involved."[4]

This article evaluates the relative importance of changes in a monetary aggregate, an interest rate, and the trade-weighted-average foreign exchange rate for predicting changes in income and the general price level in Canada, France, Germany, Switzerland, the United Kingdom, and the United States.[5] The first part reviews conceptually the strengths and weaknesses of money, interest rates, and exchange rates as barometers of domestic economic activity and price inflation. In the second part, the empirical results imply that exchange rates are generally as important as interest rates, but less important than monetary aggregates, for predicting income changes. However, exchange rates are occasionally more important than interest rates *or money* for predicting the domestic inflation rate. The analysis concludes that none of these three financial indicators bears any consistent relationship with incomes or general price levels, but that all three indicators—as well as other barometers of business activity and inflation—should be given due consideration in setting domestic monetary policies.[6]

I. Analytical and Historical Background

At the outset, it should be recognized that the relationships among money, interest rates, exchange rates, output, and prices are not at all simple. To illustrate this point, the following conceptual analysis assumes that a central bank uses the domestic money stock as an intermediate target to achieve its ultimate economic objectives of curbing domestic inflation while promoting sustainable growth of domestic real GNP. The monetary authority is assumed to adjust the supply of nonborrowed reserves to the banking system to attain its intermediate targets for the money stock. Hence, the domestic interest rate is allowed to vary. The exchange rate is also assumed to vary without direct central bank intervention. Quarterly changes in real GNP and the GNP price deflator are assumed to be observed only with a considerable lag. By contrast, the domestic money stock, domestic interest rate, and foreign exchange rate are assumed to be observed continuously and with virtually no lag. The domestic economy is assumed to be small; hence, the foreign interest rate, foreign price level, and foreign income are assumed given.[7]

Because money and interest rates are widely recognized barometers of domestic economic conditions, our first example illustrates how information on exchange rate movements might supplement that from money stock and interest rate movements to predict concurrently unobserved changes in output and prices. Suppose that initially the rate of increase of the money stock is in the middle of its target range. Subsequently, the central bank observes an unexpected rise in the interest rate and in the money stock's rate of growth. Such observed changes might result from an unobserved surge in aggregate demand resulting, say, from a larger than anticipated response to a tax cut. A rise in aggregate demand, by raising the demand for money, tends to increase the money stock above its target range and to raise the interest rate. If output is well below its full employment level, a rise in aggregate demand tends to increase production and employment with little corresponding inflation. On the other hand, if output is near its full employment level, a rise in aggregate demand tends to increase inflation with little corresponding rise in production and employment. Without more information, the central bank would be uncertain if the excessive (relative to target) monetary expansion and rising interest rate were portending more growth with stable inflation, rising inflation with sluggish growth, or some combination.

In this instance, exchange rate changes can help reveal what growth/inflation combination might follow, suggesting a suitable central bank reaction.[8] If output is well below the full employment level, higher aggregate demand tends to raise real domestic income and the prospect of further growth. The higher nominal interest rate reflects both the increased demand for money and the higher expected rate of return on domestic investment which, other things equal, induces a net inflow of foreign capital and an *appreciation* of the home currency. On the other hand, if output is near the full employment level, the increase in aggregate demand tends to aggravate inflation with little corresponding growth. Rising prices tend to increase money demand and the nominal interest rate. But the rising price level tends to reduce foreign demand for the country's exports, to raise domestic demand for foreign products, and to cause a *depreciation* of the home currency. Since curbing inflation is assumed to be a prominent ultimate objective, the central bank would tend to pursue a more accommodative monetary policy in the former instance but a more restrictive policy in the latter.

Yet a second example illustrates that the central bank—having observed the same changes in the money stock, interest rate, and exchange rate—should pursue a *different* policy response. Suppose that the previous observed rise in the interest rate and in the rate of growth of the money stock was

induced by a rise in aggregate demand and that output was already near the full employment level. For a given foreign price level, rising domestic prices would tend to cause a depreciation of the home currency, as just shown. But if the foreign price level is rising at a much faster rate than the domestic price level, the home currency would likely appreciate. Since curbing inflation is still assumed to be a prominent ultimate objective, the central bank would probably pursue a more restrictive monetary policy in the latter instance—despite an *appreciation* of the home currency in foreign exchange markets. Thus, the two examples illustrate why monetary aggregates, interest rates, and exchange rates need not be consistent indicators for monetary policy over time or across countries.

Interest rates or exchange rates or both could conceivably be more important than money for predicting concurrent and futures changes in income or prices.

Despite the ambiguous theoretical relationships among these macroeconomic variables, many central banks still chose to attach primary emphasis to one or more monetary aggregates in setting monetary policy in the 1970s. This decision was based on the strong *empirical* correlation between money and income (or prices). For instance, the main reason why central bank money has been used in Germany as an intermediate target is that "its relationship to the nominal gross national product . . . is fairly stable over lengthy periods."[9] In the United Kingdom, econometric research into the behavioral relationships among sterling M3, nominal interest rates and nominal GDP encouraged adoption of sterling M3 as an intermediate target; money supply growth relative to nominal GDP proved empirically to be a "better guide" for U.K. monetary policy than interest rates.[10] In Canada, M1 was selected in 1975 as an intermediate target because it displayed "a reasonably systematic relationship over time to the growth rate of aggregate spending in the economy as measured by the dollar value of GNE (gross national expenditures) . . ." in contrast to the broader Canadian monetary aggregates M2 and M3.[11] The Swiss central bank has made it clear that the policy emphasis given to its intermediate target is due entirely to a strong correlation:

> The decision to adopt a target for the money stock M1 in 1975 was not the outcome of a sophisticated research work, it simply reflected the casual observation that there had been a fairly close relationship between M1 and the consumer price index. . . .[12]

Similarly, a close correlation between other financial indicators—such as interest rates or exchange rates—and income or prices would support the view that these indicators should serve as additional barometers for monetary policy. In fact, interest rates or exchange rates or both could conceivably be more important than money for predicting concurrent and future changes in income or prices.

The next section demonstrates that in recent years monetary aggregates were not as systematically related to income or prices as central bankers once thought. Moreover, exchange rates and interest rates often provided significant additional information about imminent changes in nominal GNP and the GNP price deflator.[13]

II. Empirical Evidence

The statistical technique chosen to demonstrate the relative importance of movements in a country's money stock, interest rate, and exchange rate for predicting changes in domestic output and prices is "normalized regression analysis." Unlike the practice in standard regression analysis, all variables are first transformed so that the coefficient estimates ("beta coefficients") can be compared directly with one another, in much the same way that partial correlation coefficients can be compared. Moreover, in a normalized regression with one dependent variable and one independent variable, the beta coefficient *identically equals* the correlation coefficient between the two variables. Beta coefficients therefore can reveal more readily the relative importance of various indicators for predicting changes in income or prices.[14]

To contrast the conclusions that can be drawn from standard and normalized regressions, consider the following illustration relating the domestic inflation rate to current and lagged values of the rate of growth of the money stock and the rate of appreciation of the home currency. A standard regression may find that a 1 percentage point rise in the rate of increase of a country's money stock is associated eventually with a 1 percentage point rise in the domestic

inflation rate. However, a 1 percentage point rise in the rate of appreciation of the home currency is associated eventually with only a 0.2 percentage point decline in the inflation rate, partly because exports and imports of goods and services are only a small proportion of national output and expenditures. Does the relative magnitude of the money stock and exchange rate coefficients (1.0 and 0.2, respectively) suggest that the money stock is a better predictor of—or better correlated with—the price level than the exchange rate is? The answer is "No" for two related reasons. First, the coefficients from a standard regression can be changed at will by altering the variables' units of measurement. Second, while a 1 percentage point change in the rate of money stock growth may be common, such a change in the rate of appreciation may be unusually small. For instance, the growth rate of M1—a measure of the U.S. money stock—typically changed by 1 percentage point from quarter to quarter over the past decade, yet the rate of appreciation of the U.S. dollar typically changed by 3.5 percentage points. Coefficients from standard regressions are unsuitable for determining the relative importance of the money stock and the exchange rate for predicting inflation, because they fail to estimate the change in the inflation rate associated with typical (or "equally likely") changes in the rates of increase of money and of the exchange rate.[15]

Exchange rate movements were as systematically related to income changes as interest rate movements.

By contrast, coefficient estimates from a normalized regression can indicate the change in the inflation rate associated with typical, or 1 standard deviation, changes in the rate of growth of the money stock and the rate of appreciation of the home currency. For example, a typical rise in the rate of growth of the money stock may be associated eventually with a 2 standard deviation (1.25 percentage point) increase in the inflation rate, but a typical rise in the rate of appreciation of the home currency may be associated eventually with a 1.6 standard deviation (1 percentage point) fall in the inflation rate. These results would imply that the correlation between the exchange rate and prices is 80 percent as strong as that between money and prices (1.6/2.0 = .80).

Table 1 summarizes the results of estimating the relationship between changes in nominal GNP (GDP) and changes in the primary monetary aggregate, in a short-term interest rate, and in the exchange rate for the six industrialized countries using both regression techniques. The short-term interest rate is the three-month interbank lending rate in each country except the United States, for which the overnight interbank lending (federal funds) rate is used. The exchange rate is the Federal Reserve System's trade-weighted average of bilateral exchange rates for each country. The statistical specification is identical for all six countries and is described in detail in the appendix. The estimation period varies across countries depending upon data availability.[16]

Columns (2) to (5) summarize the statistical relationships among changes in nominal GNP and changes in the monetary aggregate, interest rate, and exchange rate using standard regression analysis. Canada, France and Germany share with the United States the result that a 1 percentage point rise in the money stock's growth rate is associated after one year with a 0.5 to 0.9 percentage point rise in nominal GNP. This relationship does not hold for Switzerland or the United Kingdom; moreover, the standard error of the equation (S.E.E.) is approximately twice as large for these two countries as for any of the others. Interest rate movements are positively correlated with concurrent nominal GNP changes in four of the six countries; exchange rate movements are positively correlated with concurrent nominal GNP changes in all countries but Germany.[17] The magnitudes of the coefficient estimates for these variables suggest that a 1 percentage point rise in any country's interest rate or rate of home currency appreciation has little association with the rate of increase of nominal GNP, except for the French or Swiss interest rate.

Columns (6) to (9) summarize the statistical relationships among these macroeconomic variables using normalized regression analysis. With this approach, the exchange rate is shown to convey relatively more information than suggested above about concurrent nominal GNP (GDP) in the United States, Canada, France and Germany. In the United States, a 1 standard deviation (or typical) rise in the rate of appreciation of the dollar is associated in the concurrent quarter with a 0.14 standard deviation rise in the rate of increase of nominal GNP. A 1 standard deviation rise in the rate of M1 growth is associated after one year with a 0.72 standard deviation rise in the rate of increase of nominal GNP. Thus, a typical

Table 1

Relationships between Monetary Aggregates, Interest Rates, Exchange Rates and Nominal GNP (GDP) in Six Industrial Countries

	A *one percentage point* rise in these variables is associated with the following percentage point change in nominal GNP (GDP) for the corresponding country:				A *one standard deviation* rise in these variables is associated with the following standard deviation change in nominal GNP (GDP) for the corresponding country:				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Country	Monetary Aggregate Growth Rate	Short-Term Interest Rate	Rate of Appreciation of the Home Currency	$\bar{R}^2$ S.E.E. D.W.	Monetary Aggregate Growth Rate	Short-Term Interest Rate	Rate of Appreciation of the Home Currency	$\bar{R}^2$ S.E.E. D.W.	Estimation Period
United States	.92 (.44)	−.26 (.27)	.05 (.06)	.14 4.60 1.95	.72 (.34)	−.16 (.17)	.14 (.17)	.16 .92 1.95	75:Q1–85:Q1
Canada	.68 (.19)	.10 (.30)	.09 (.05)	.35 4.07 1.99	1.14 (.31)	.05 (.15)	.24 (.13)	.36 .80 1.99	72:Q1–84:Q3
France	.50 (.25)	.62 (.22)	.06 (.05)	.23 3.46 2.37	.52 (.25)	.51 (.18)	.18 (.15)	.25 .87 2.37	72:Q1–82:Q2
Germany	.93 (.22)	.16 (.23)	−.07 (.05)	.31 3.91 2.48	.74 (.17)	.10 (.15)	−.19 (.13)	.32 .82 2.48	72:Q1–84:Q3
Switzerland	.01 (.12)	.63 (.60)	.01 (.08)	−.09 7.47 2.93	.04 (.54)	.23 (.22)	.02 (.18)	−.05 1.03 2.93	75:Q4–84:Q3
United Kingdom	−.19 (.24)	−.06 (.51)	.02 (.10)	−.09 9.52 1.71	−.16 (.21)	−.02 (.16)	03 (.16)	−.06 1.03 1.71	72:Q3–84:Q1

Notes: Quarterly data are used. GNP is used for the United States, Canada, and Germany; GDP is used for the other countries. Standard errors of the coefficient estimates are in parentheses. $\bar{R}^2$ is the adjusted coefficient of determination; S.E.E. is the standard error of the equation; D.W. is the Durbin-Watson statistic. Coefficient estimates shown for the money variable are the sum of coefficient estimates on current and lagged values of this variable. Details of the estimation technique and the lag structure for the money variable are provided in the appendix.

Sources of data: Board of Governors of the Federal Reserve System, Data Resources, Inc., and OECD *Main Economic Indicators: Historical Statistics 1964–1983.*

change in the rate of appreciation of the dollar is 19 percent as important as a typical change in the rate of increase of M1 for predicting a change in the rate of increase of U.S. nominal GNP (.14/.72 = .19). Moreover, a typical change in the rate of appreciation of the home currency is 21 percent as important as a typical change in the rate of increase of the financial aggregate for predicting a change in the rate of increase of nominal GNP in Canada, 35 percent in France, and 26 percent in Germany. In Germany, however, the beta coefficient of the exchange rate had a different sign than in the other countries for predicting changes in nominal GNP. In Switzerland and the United Kingdom, exchange rates conveyed little information about nominal GNP changes, but then so did these countries' monetary aggregates. Thus, exchange rates do not contribute so much information about concurrent nominal GNP that they should displace monetary aggregates as the primary information variable. Yet, exchange rate movements were as systematically related to income changes as interest rate movements, suggesting that exchange rates should not be ignored in monetary policy decisions.[18]

Table 2 summarizes the results of estimating the relationship between changes in the GNP (GDP) implicit price deflator and changes in the primary monetary aggregate, in a long-term interest rate, and in the exchange rate for these countries. A 1 percentage point rise in the U.S. money stock's rate of growth is associated after five years with a 0.9 percentage point

Table 2

Relationships between Monetary Aggregates, Interest Rates, Exchange Rates and the GNP (GDP) Implicit Price Deflator in Six Industrial Countries

(1)	A *one percentage point* rise in these variables is associated eventually with the following percentage point change in the price deflator for the corresponding country: (2)	(3)	(4)	(5)	A *one standard deviation* rise in these variables is associated eventually with the following standard deviation change in the price deflator for the corresponding country: (6)	(7)	(8)	(9)	(10)
Country	Monetary Aggregate Growth Rate	Long-Term Interest Rate	Rate of Appreciation of the Home Currency	R^2 S.E.E. D.W.	Monetary Aggregate Growth Rate	Long-Term Interest Rate	Rate of Appreciation of the Home Currency	R^2 S.E.E. D.W.	Estimation Period
United States	.93 (1.74)	.37 (.69)	−.33 (.14)	.43 1.97 2.23	.75 (2.29)	.38 (.67)	−1.83 (.76)	.44 .75 2.21	75:Q1–85:Q1
Canada	.97 (.42)	1.03 (.64)	−.14 (.10)	.48 3.01 1.86	1.95 (.82)	.64 (.40)	−.47 (.33)	.49 .71 1.86	72:Q1–84:Q3
Switzerland	.70 (.24)	−.22 (1.09)	−.40 (.15)	.26 4.04 2.64	5.34 (1.89)	−.05 (.25)	−1.29 (.50)	.25 .87 2.58	72:Q1–84:Q3
France	1.28 (.99)	.86 (1.38)	.12 (.32)	.58 1.93 2.75	1.92 (1.33)	1.09 (.74)	.54 (1.15)	.60 .63 2.76	75:Q1–82:Q2
Germany	.08 (.64)	.40 (.73)	.26 (.24)	.15 2.18 2.42	.17 (.82)	.27 (.44)	1.35 (1.23)	.18 .91 2.43	74:Q1–84:Q3
United Kingdom	−1.61 (1.31)	3.22 (2.73)	.89 (.41)	.56 4.26 2.52	−1.71 (1.45)	.60 (.60)	2.08 (.96)	.58 .65 2.55	76:Q3–84:Q1

Notes: Quarterly data are used. GNP is used for the United States, Canada, and Germany; GDP is used for the other countries. Standard errors of the coefficient estimates are in parentheses. R^2 is the adjusted coefficient of determination, S.E.E. is the standard error of the equation; D.W. is the Durbin-Watson statistic. Coefficient estimates shown are the sums of coefficient estimates on current and lagged values of these variables. Details of the estimation technique and lag structures used are provided in the appendix.

Sources of data: Board of Governors of the Federal Reserve System, Data Resources, Inc., and OECD *Main Economic Indicators: Historical Statistics 1964–1983*.

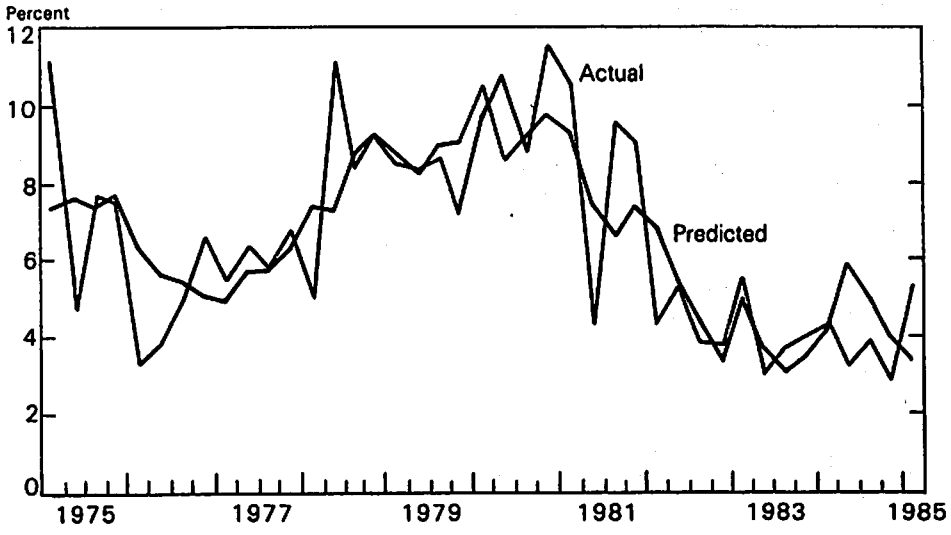
rise in the inflation rate, whereas a 1 percentage point rise in the U.S. interest rate or the rate of appreciation of the dollar is associated after two years with a much smaller change in the inflation rate. However, a typical rise in the rate of appreciation of the dollar is *more than twice* as important as a typical change in the rate of increase of M1 or in the interest rate for predicting a change in the U.S. inflation rate.

Chart 1 illustrates the relationship between the actual U.S. inflation rate and the inflation rate predicted by changes in M1, a U.S. government bond constant maturity yield, and the exchange rate. The model captured the overall trend of U.S. inflation during the past decade reasonably well. Moreover, the portion of the predicted U.S. inflation rate attributable to exchange rate changes rose and fell along with—and sometimes ahead of—the total predicted inflation rate, while the portion attributable to M1 changes usually followed, and that attributable to the long-term interest rate (not shown) often followed, the total predicted inflation rate. The lower predicted inflation rate since 1982 is attributable largely to exchange rate changes, since the long-term interest rate and M1 changes predicted a much higher U.S. inflation rate.[19]

Canada and Switzerland share with the United States the results that a 1 percentage point rise in the domestic money stock's rate of growth is associated ultimately with a 0.7 to 1.0 percentage point rise in the domestic inflation rate and that a rise in the rate of

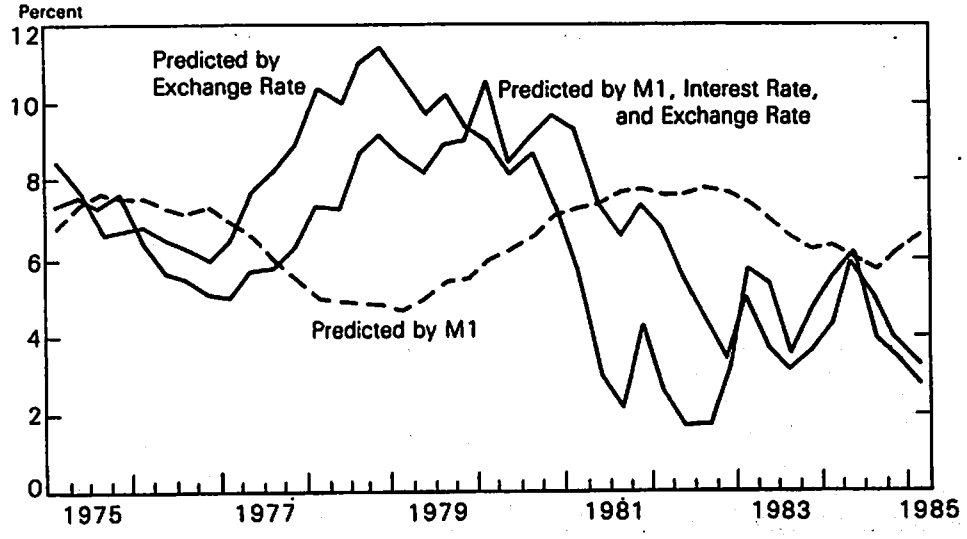
Chart 1

Actual Versus Predicted Percentage Changes in the U.S. GNP Price Deflator



Note: Quarterly data are the actual and fitted annualized percentage changes in the implicit price deflator using the normalized regression technique described in the appendix.

Predicted Percentage Changes in the U.S. GNP Price Deflator



Note: Quarterly data are the annualized percentage changes in the implicit price deflator predicted by changes in the exchange rate, by changes in the money stock, or by changes in the exchange rate, interest rate, and money stock, weighted (in normalized form) by their respective coefficient estimates from equation (A2) described in the appendix.

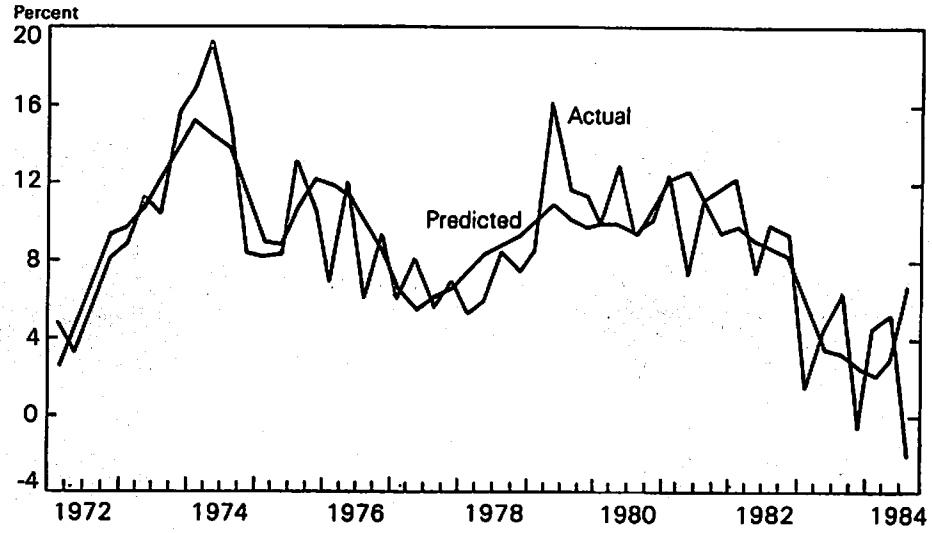
Source of data: Board of Governors of the Federal Reserve System, Data Resources Inc., and OECD *Main Economic Indicators*, various issues.

appreciation of the home currency is negatively correlated with the inflation rate. On the other hand, a typical change in the rate of appreciation of the home currency is only 24 percent as important as a typical change in the rate of increase of the financial aggregate for predicting a change in the inflation rate in Canada or Switzerland (.47/1.95 = 1.29/5.34 = .24). Chart 2 illustrates the relationship between the actual Canadian inflation rate and the inflation rate predicted by the model. Similar to the U.S. case, the model "explains" almost half of the variation in the actual inflation rate. The portion of the predicted inflation rate attributable to Canadian M1 changes approximated the actual inflation rate reasonably well from 1972 through 1975. However, this relationship deteriorated markedly beginning in 1976, whereas exchange rate changes predicted the inflation rate reasonably well from 1976 through 1981.

Changes in the exchange rate did not display a consistent relationship with the inflation rate across countries. By contrast with the findings for Canada, Switzerland, and the United States, a rise in the rate of appreciation of the home currency is associated with a *rise* in the inflation rate in France, Germany, and the United Kingdom, although only the U.K. correlation is statistically significant. Yet a systematic relationship between exchange rate change and the domestic inflation rate need not exist everywhere be-

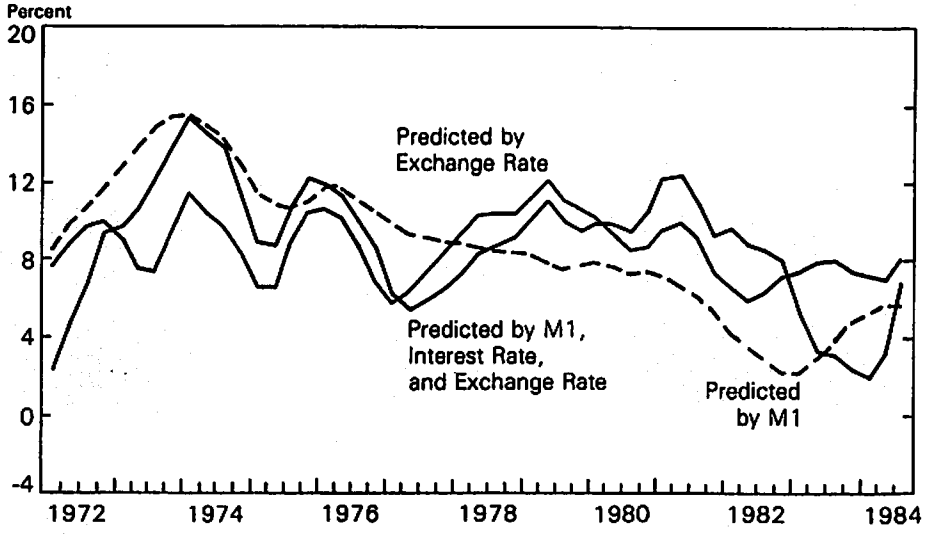
Chart 2

Actual Versus Predicted Percentage Changes in the Canadian GNP Price Deflator



Note: See Chart 1 (upper panel)

Predicted Percentage Changes in the Canadian GNP Price Deflator



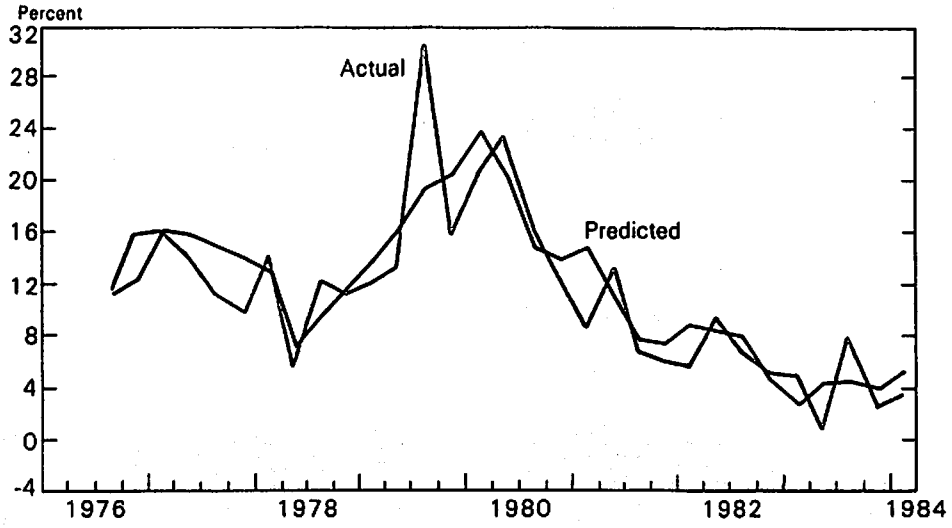
Note: See Chart 1 (lower panel)

Source: See Chart 1.

cause the dominant economic disturbances in one country may be absent in another. For instance, the United Kingdom experienced persistently rising inflation rates from 1978 to 1980 and then persistently declining rates from 1980 to 1984, much like the United States. In the United States the deteriorating international price competitiveness generated by the accelerating inflation of the late 1970s was accompanied by a 20 percent depreciation of the dollar. Unlike the U.S. dollar, the British pound appreciated considerably in the late 1970s, rising 20 percent between spring 1978 and spring 1980. This appreciation has been attributed to "substantial short-term capital inflows, largely stimulated by the expected benefits (notably the foreign exchange earnings) arising from North Sea oil operations . . . ."[20] Thus, the expected future growth generated by the development of a valuable natural resource seemingly had a larger influence on U.K. foreign exchange market conditions in the late 1970s than deteriorating price competitiveness and the misallocation of resources generally tied to rapid inflation. From 1980 to 1984, the U.K. inflation rate declined from 18 percent to 4 percent, at an annual rate, but the pound depreciated in each of these years. Exchange rate changes predicted most of the change in the U.K. inflation rate since 1978 (Chart 3), while sterling M3 and the long-term interest rate (not shown) predicted the inflation rate rather poorly.

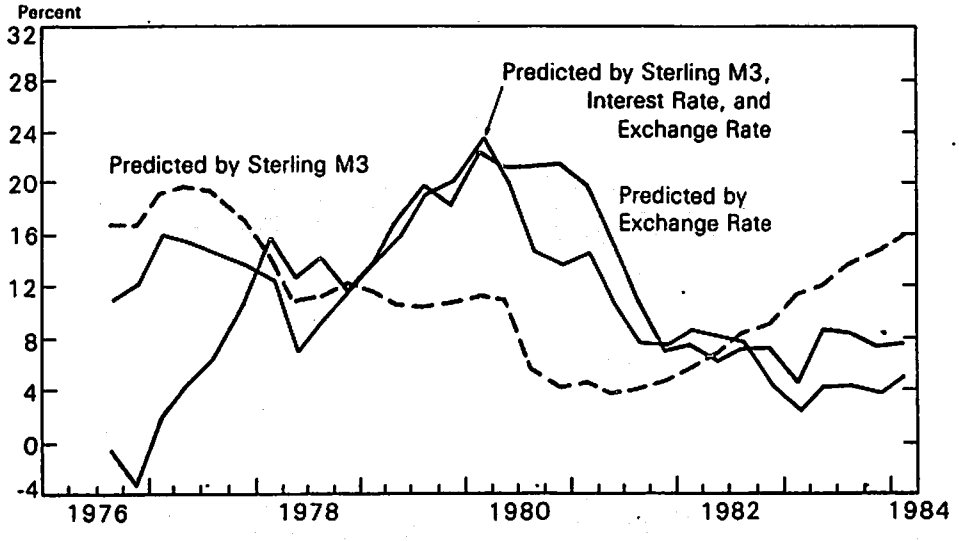
Chart 3

Actual Versus Predicted Percentage Changes in the U.K. GDP Price Deflator



Notes: See Chart 1 (upper panel).

Predicted Percentage Changes in the U.K. GDP Price Deflator



Notes: See Chart 1 (lower panel)
Source of data: See Chart 1.

On net, none of the three financial indicators demonstrates any *reliable* empirical association with the inflation rate across all countries. This finding accords with the analytical point stressed earlier that the relationships among money, interest rates, and exchange rates—on the one hand—and prices and output—on the other hand—need not be consistent across countries. The money stock and the exchange rate are each significantly correlated with the inflation rate in only two of the six countries. The interest rate is significantly correlated with changes in the price level in none of the countries. Therefore, much caution should be exercised in using these three indicators as barometers of inflation.

III. Conclusions

In the mid-1970s, several major industrial countries adopted one or more monetary aggregates as intermediate targets for monetary policy. This common decision was based predominantly upon the observation that the money stock had been stably related to—that is, highly correlated with—national income or prices in those countries. As time passed, these central banks observed increasing instability in the relationship between money and income or prices. Accordingly, many central banks have come to rely upon several indicators as barometers of economic activity and price inflation. This article examined

the relative importance of three financial indicators—monetary aggregates, interest rates, and exchange rates—for predicting changes in nominal GNP and prices among six industrial countries and arrived at several conclusions.

First, the conceptual analysis illustrated why none of these financial variables needs to bear any systematic relationship to income or prices over time or across countries. The relationships between a country's financial indicators and its income or prices depend largely upon the magnitude and frequency of the various disturbances in that particular economy.

Second, none of the financial indicators established a systematic empirical correlation with income or prices across all six countries. This accords with the theoretical point that different types of shocks will dominate different economies. For instance, accelerating inflation in the late 1970s in both the United States and the United Kingdom was accompanied by a 16 percent depreciation of the U.S. dollar but a 17 percent appreciation of the British pound, the latter owing largely to the discovery and exploitation of British oil in the North Sea.

Third, in four of the six countries, the correlation between money and income was similar to that typically found in other empirical studies. In those same countries, the exchange rate was 20 to 35 percent as important as the money stock for predicting nominal GNP changes during the sample period.

Finally, the correlations among money, exchange rates, and prices were quite diverse. The money stock was more important than the exchange rate for predicting inflation in three of the countries; in the other three, the exchange rate was more important than money. But the money stock and the exchange rate were each significantly correlated with the inflation rate in only two of the six countries for the period examined. The results suggest that neither indicator demonstrates a reliable relationship with inflation, but that both variables—in conjunction with other economic barometers—should be given consideration in setting monetary policy.

Appendix

Coefficients estimates presented in columns (2) to (4) of Table 1 summarize the results from estimating for each country using ordinary least squares:

$$(A1) \qquad \dot{NGNP}_t = a + \sum_{i=0}^{3} b_i \dot{M}_{t-i} + c\,STIR_t + d\,\dot{NER}_t$$

where $\dot{NGNP}$ is the annualized percentage change in nominal GNP (GDP), $\dot{M}$ is the annualized percentage change in a monetary aggregate, STIR is the three-month domestic interbank lending rate, expressed at an annual rate (the federal funds rate was used for the United States), and $\dot{NER}$ is the annualized percentage change in the Federal Reserve System's trade-weighted-average exchange rate in quarter t. $\dot{M}$ coefficients were constrained to follow a second order polynomial distributed lag (second, rather than third, order because of the short lag length). For the United States and Canada, variables were prefiltered for autocorrelation using rho estimates of .216 and .314, respectively. Nominal GNP was used for Canada, Germany, and the United States; nominal GDP was used for France, Switzerland, and the United Kingdom (seasonally adjusted for all countries except Switzerland). The monetary aggregates used were M1 for the United States, M1 for Canada, M2R for France, central bank money for Germany, adjusted central bank money for Switzerland, and sterling M3 for the United Kingdom (seasonally adjusted for all countries except Switzerland).

The entries in columns (6) to (8) in Table 1 summarize the results from estimating (A1) for each country again except that all variables were "normalized" first by subtracting from each variable its mean and dividing the difference by the variable's standard deviation. The resulting estimates are called beta coefficients.

Coefficient estimates presented in columns (2) to (4) of Table 2 summarize the results from estimating for each country using ordinary least squares:

$$(A2)\ \dot{DEFL}_t = a + \sum_{i=0}^{10} b_i \dot{M}_{t-i} + \sum_{i=0}^{7} c_i LTIR_{t-i} + \sum_{i=0}^{7} d_i \dot{NER}_{t-i}$$

where $\dot{DEFL}$ is the annualized percentage change in the GNP (GDP) implicit price deflator and LTIR is a long-term interest rate. Coefficients for all variables were constrained to follow third order polynomial distributed lags. The long-term interest rates used were the 10-year U.S. government bond constant maturity yield, Canada's long-term government bond yield, France's long-term public sector yield, Germany's long-term public authority loan rate, Switzerland's long-term government bond yield, and the United Kingdom's long-term government bond yield.

The entries in columns (6) to (8) in Table 2 summarize the results from estimating (A2) for each country again except that all variables were normalized first by subtracting from each variable its mean and dividing the difference by the variable's standard deviation.

---

[1] See Karen Johnson, "Foreign Experience with Targets for Money Growth," *Federal Reserve Bulletin*, October 1983. These aggregates are defined later.

[2] This quote was drawn from Karen Johnson, "Foreign Experi-

ence with Targets for Money Growth."

[3] "Records of Policy Actions of the Federal Open Market Committee," *Federal Reserve Bulletin*, July 1985 (March 26, 1985 meeting).

[4] Gordon G. Thiessen, Adviser, Bank of Canada, "The Canadian Experience with Monetary Targeting," *Central Bank Views on Monetary Targeting*, Federal Reserve Bank of New York, May 1982, p. 100.

[5] This study extends the research reported in Jeffrey H. Bergstrand, "Exchange Rate Variation and Monetary Policy," *New England Economic Review*, May/June 1985. In that article, some summary statistics suggested that exchange rate movements—in conjunction with M1 changes—provided useful information about fluctuations in U.S. nominal GNP, real GNP, and the general price level.

[6] The conclusions of this paper are not derived from a behavioral or structural econometric model of the relationships among money, interest rates, exchange rates, output, and prices. Instead, this study uses a single-equation analysis of normalized values of these variables to show that exchange rates and interest rates are occasionally as closely correlated with incomes and general price levels as money is. Hence, monetary aggregates should not be given undue emphasis in setting monetary policies.

[7] The small open economy assumption is used often in the international finance literature to allow the foreign price level, the foreign interest rate and foreign income to be treated as exogenous. The relevance of the following analytical conclusions with respect to the countries discussed in subsequent sections depends on the extent to which changes in any of those countries' variables influence these foreign variables in violation of the small open economy assumption. Moreover, many of the countries discussed later have used operating procedures more akin to interest-rate targeting than reserves targeting and have intervened extensively in foreign exchange markets.

[8] This is not to suggest that the central bank ignore other indicators, such as capacity utilization and unemployment rates. Such indicators would be used also since they provide information about the trend of real economic activity. However, those indicators provide little information about inflation trends and may not provide as *timely* information about economic conditions as exchange rates.

[9] Dr. Helmut Schlesinger, Deputy President of the Deutsche Bundesbank, "The Setting of Monetary Objectives in Germany," *Central Bank Views on Monetary Targeting*, p. 7. Central bank money comprises currency in the hands of nonbanks and required minimum reserves on banks' domestic liabilities at constant reserve ratios and can be calculated more promptly than other German aggregates (M1, M2, or M3).

[10] See John Fforde, An Adviser to the Governor, Bank of England, "The United Kingdom—Setting Monetary Objectives," *Central Bank Views on Monetary Targeting*, pp. 51-59. The United Kingdom has had a target range since 1976 for sterling M3, which consists of notes in circulation plus all deposits held by nonbank residents at U.K. banks. The Bank of England added ranges for M1 and private sector liquidity in 1982. These ranges were dropped in 1984 and a range for M0 was added.

[11] Bank of Canada, *Annual Report*, 1975, p. 16. Owing to extensive financial innovation and regulatory change, no explicit target range has been announced for M1 since 1982.

[12] Kurt Schiltknecht, Director, Swiss National Bank, "Switzerland: The Pursuit of Monetary Objectives," *Central Bank Views on Monetary Targeting*, p. 72. In fall 1978, M1 was abandoned as an intermediate target in favor of an exchange rate target. Since 1981, adjusted central bank money (ACBM) has been used as an intermediate target. ACBM is a monthly average of daily figures for the monetary base adjusted for transitory fluctuations in banks' balance sheets.

[13] Several economists and financial analysts have written recently of the advantages of using the exchange rate as an indicator for monetary policy. See Jacques R. Artus, "Toward a More Orderly Exchange Rate System," *Finance and Development*, March 1983, pp. 10-13; David Hale, "U.S. Economic Policy and the Dollar," *The Banker*, June 1983, pp. 33-38; and Ronald I. McKinnon, *An International Standard for Monetary Stabilization* (Washington, D.C.: Institute for International Economics, March 1984), Ch. 3. McKinnon makes the strongest claim in favor of exchange rates as a monetary policy indicator, suggesting that central banks follow a general rule to "increase the money supply above its long-run norm when the exchange rate appreciates and reducing the domestic money supply when depreciation threatens" (p. 22). He claims, furthermore, that "this rule is remarkably robust in improving the efficiency of domestic monetary policy." The claims of this article, however, are more modest. We argue that, because of the complex and tenuous relationships among the macroeconomic variables, the monetary aggregate need not be any more systematically related to income and prices than the exchange rate. In general, we find that the monetary aggregate is relatively more important than the exchange rate in predicting *income* changes. However, the monetary aggregate is relatively more important than the exchange rate for predicting *inflation* in only three of the six countries examined; in the other three (including the United States), the exchange rate is relatively more important than money.

[14] For more details on the normalized regression technique, see Arthur S. Goldberger, *Econometric Theory* (New York: John Wiley and Sons, Inc., 1964), pp. 197-198, or Robert S. Pindyck and Daniel L. Rubinfeld, *Econometric Methods and Economic Forecasts*, Second Edition (New York: McGraw-Hill Book Company, 1981), pp. 90-91.

[15] See Goldberger, *Econometric Theory*, p. 196.

[16] In the case of the United States, the estimation period begins in 1975:Q1 because President Nixon's four-phase price-wage control program did not formally end until 1974. In the case of France, the estimation period ends in 1982:Q2 because price-wage controls were instituted in 1982:Q3, beginning with a freeze.

[17] The positive correlation between the exchange rate and nominal GNP for most of the countries seemingly conflicts with some negative correlations found in Ronald I. McKinnon, *An International Standard for Monetary Stabilization*, and in Dallas S. Batten and R.W. Hafer, "Money, Income and Currency Substitution: Evidence from Three Countries," Federal Reserve Bank of St. Louis *Review*, vol. 67, no. 5, May 1985, pp. 27-35. The positive correlations between exchange rate (foreign currency value of the home currency) changes and *contemporaneous* income changes found in this article are consistent with the notion that demand for the home currency in foreign exchange markets will increase if economic activity at home is increasing relative to that abroad, generating a rise in the expected rate of return on domestic relative to foreign investments. In this instance, the exchange rate is acting as an information variable, reflecting economic activity at home. However, a rise in the foreign exchange value of the home currency may be associated *after a year* with a decline in national income, as the appreciation of the home currency dampens net export sales. In this case, the exchange rate is influencing economic activity. The negative correlation between nominal income and the *lagged* exchange rate was emphasized by McKinnon and by Batten and Hafer, although both reported some positive correlations between nominal income and the *contemporaneous* exchange rate.

[18] Note that the standard errors corresponding to five of the six exchange rate coefficient estimates were quite large; only Canada's exchange rate coefficient estimate was significantly different from zero at conventional t-test levels. Yet coefficient estimates for interest rate variables also had quite large standard errors for all countries except France.

[19] The lines illustrating the predicted inflation rate attributable to the interest rate are omitted to prevent crowding in the charts.

[20] *OECD Economic Surveys: United Kingdom*, Paris: OECD, 1980, p. 17.