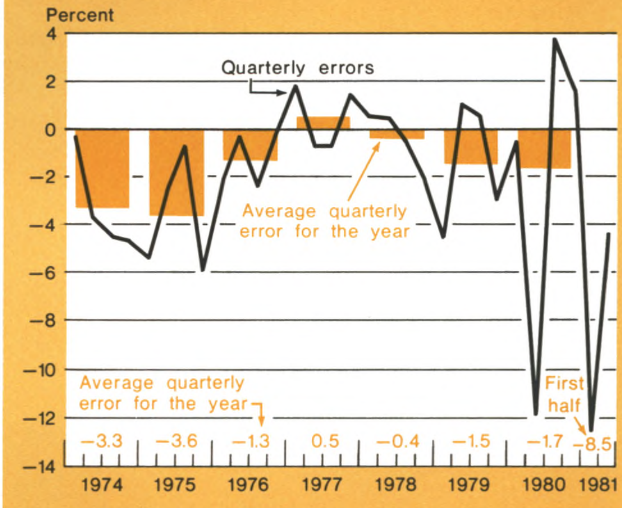
Recent Instability in the Demand for Money

In the mid-1970s (1974 to 1976) the growth of the narrow money stock became very weak relative to what would have been expected from past relationships of money to income and interest rates. Money growth averaged about 2¾ percentage points less than expected during that period.[1] For the next two years, 1977 and 1978, the simulation from the money demand equation tracked the actual performance of the money stock very well, suggesting the return of stability in the demand for money (Chart 1). Since 1979, however, the overpredictions once again have become very large (3.0 percentage points on average). But, in contrast to the 1974-76 period, the shift since 1979 has tended to be concentrated largely in just three or four quarters rather than as a series of more moderately sized errors.

In the first quarter of 1979 and second quarter of 1980, the large negative errors in growth rate terms did not appear to mark the beginning of another protracted shift in the money demand equation. Indeed, following the large error in the second quarter of 1980, some sizable *underpredictions* of money growth occurred in the second half of the year. For the first quarter of 1981, it is too early to know whether the large overprediction of money growth will be followed by several

Chart 1

Errors from the Money Demand Equation-- Quarterly Growth Rates of M-1B Adjusted* less Predicted



*See box for definition of this series.
Source: Table 1.

1 Extensive economic research was done on "why the money demand equation shifted" without any definitive solutions being found. A comprehensive review of this research can be found in Stephen Goldfeld, "The Case of the Missing Money", *Brookings Papers on Economic Activity* (1976:3). More than just one model of money demand exists. For the purposes of this article, the money demand equation refers to the conventional form used by Goldfeld in which real money balances are expressed as a function of a short-term market interest rate, the interest rate on savings deposits, real income, and lagged real money balances. The box contains a more detailed discussion.

Determinants of the Demand for Money

The "demand for money" in its basic form is an expression relating the public's desired holdings of money balances to a measure of the volume of transactions in the economy—usually gross national product (GNP)—and the opportunity cost (interest income foregone) of holding money balances (often measured by a short-term interest rate). An increase in the volume of transactions causes the demand for money balances to rise, while an increase in interest rates raises the cost of holding money balances, resulting in a reduction of money holdings. In this article, a commonly used specification is employed to examine the stability of the demand for money (footnote 1). The principal determinants are shown in the table below. Constant-dollar GNP per capita is used as the measure of transactions, and the opportunity cost of holding money balances is represented by the three-month Treasury bill rate and the commercial bank passbook (savings deposit) rate. A lagged dependent variable is also incorporated because the public's adjustment of actual money balances to the desired level resulting from a change in income or interest rates occurs gradually over time, not entirely in the same quarter as the change in income or interest rates. The estimated equation is shown in the table. The period from 1959-II to 1973-IV was used because the recomputation of the aggregates on the basis of the new definitions begins in 1959 and money demand equations have been unstable in the post-1973 period.

Estimated narrow money demand equation, 1959-II to 1973-IV

In logarithmic form

Dependent variable | Independent variables

$$\frac{M}{P.N} = \underset{(0.4)}{-0.11} + \underset{(4.0)^{**}}{0.097}\left(\frac{Y}{P.N}\right) - \underset{(2.3)^{*}}{0.011}\,(RTB) - \underset{(1.4)}{0.022}\,(RCBP) + \underset{(7.3)^{**}}{0.728}\left(\frac{M(-1)}{P.N}\right)$$

Summary statistics: RHO = 0.52; S.E.E. = 0.0043; $\bar{R}^2 = 0.93$.

Variables:

M = M-1B less the portion of other checkable deposits estimated as coming from sources other than demand deposits, primarily savings deposits. This adjustment was made to obtain a more accurate measure of transactions balances. "M-1B adjusted" is used throughout this article.

P = GNP deflator.

N = Population.

Y = Nominal GNP.

RTB = Three-month Treasury bill rate.

RCBP = Commercial bank passbook rate.

M (−1) = M lagged one quarter.

$\frac{Y}{P.N}$ = Real per capita GNP.

$\frac{M}{P.N}$ = Real per capita money balances.

Figures in parenthesis are t-values; * indicates significance at the 95 percent confidence level, ** at the 99 percent confidence level. The equation was estimated using the Cochrane-Orcutt method.

quarters of negative errors or whether some offsets will occur later in the year as in 1980. However, based on still preliminary gross national product (GNP) data, a sizable negative error for the second quarter of 1981 also appears likely and, barring any substantial revisions to the GNP statistics, the first half of 1981 would contain the largest two-quarter overprediction of money growth in the post-1973 period, averaging about 8½ percentage points.

The question of how much the money demand equation might shift is of crucial importance for monetary policy. If a downward shift in money demand occurs, perhaps reflecting financial innovation (new means of managing cash balances that enable individuals and corporations to undertake the same level of transactions with lower money holdings), then the Federal Reserve's monetary targets would need to be lower to be consistent with the goal of moderating inflationary pressures. In the next section, the shift in the money demand equation will be examined in more detail, and in the final section some of the explanations for this shift are reviewed. The technical analysis that follows is not necessary for reading the final section. The box contains a description of the conventional money demand equation used in this article.

Econometric results

To put the overall performance of this money demand equation into perspective, quarterly dynamic simulations were run for each year from 1960 to 1980. That is, in the first quarter of each year the simulation was started by using the actual value of the lagged money stock, while the predicted values generated from the equation were used in the final three quarters. Beginning in 1975, the equation was put "back on track" each year by adjusting the constant term for the money demand shift from the previous year.[2] For 1981, data for only the first two quarters are available, so that the equation was simulated for just the first half of the year. Successive one-year periods were used in the simulations because of the current policy focus on one-year targets. The errors (actual less predicted values) in growth rate terms are shown in Table 1 as well as the average and root mean squared prediction errors (RMSPE) for the periods 1960 to 1973, 1974 to 1976, 1977 to 1978, and 1979 to 1981-II.

For the period from 1960 to 1973, the RMSPE was almost 2 percentage points. Roughly speaking, this 2 percentage point error can be interpreted as indicating that 95 percent of the time the predicted values should be within + or − 4 percentage points of the actual values. In fact, only two out of the fifty-six errors (3.6 percent) were larger than + or − 4 percentage points.

While this might already seem like a fairly wide confidence band, the simulation accuracy of the equation deteriorated considerably in the 1974-76 period. During that time the money stock grew at an average rate just over 5 percent, but the simulations from the equation called for nearly 8 percent growth, for an average error (bias) of 2.7 percentage points. Furthermore, the RMSPE increased from 1.9 percent in the sample period to 3.4 percent, primarily as a result of the large bias. Once the bias in the forecasts is removed, however, the equation tracks about as well as it had within the sample period. In 1977 and 1978, on the other hand, the simulations from the equation were remarkably accurate; the prediction errors were all small, with zero average error, *i.e.*, both the actual and predicted values averaged about 7¾ percent. At that time, stability—in the sense of simulation accuracy—seemed to have been reestablished for the money demand equation.

But since 1979 the difficulties with trying to track money stock growth with a conventional money demand equation appear to have been compounded. For the period from 1979 through the second quarter of 1981 the prediction errors averaged 3 percentage points—just about as large as in the 1974-76 period. Moreover, the variance of the prediction error increased markedly. This is the result of much greater volatility in the money stock series without a corresponding increase in the variance of the predicted series. The greater variance of the prediction error, together with the reappearance of bias in the predictions, raised the RMSPE to 6 percent. Hence, not only did the money demand equation "shift again" in the 1979 to 1981-II period by an average amount of about the same size as in the 1974-76 period, but the errors became much more erratic in nature when compared with the 1974-76 period. The RMSPE over the last two and one-half years was about 75 percent larger than in the 1974-76 period (Table 1).

The reasons for the larger prediction errors in the 1979 to 1981-II period can be seen more clearly from Chart 2. The simulations relative to the actual values for each time period (1974-76 and 1979 to 1981-II) are plotted in two ways—one showing the simulation values not adjusted for bias (average error) and another showing the simulation results corrected for bias. By comparing the two series for each time period, a rough

[2] For a stable money demand relationship, the dynamic simulation for each one-year period would be started simply by incorporating the lagged value of the actual money stock. The demand for money, however, has not been stable in the post-1973 period. Hence, the constant term in the regression equation was lowered to correct for the previous shift in the demand for money before starting each new yearly simulation. The adjustments to the constant term are available from the authors upon request.

Table 1

Dynamic Simulation Results for Successive One-Year Periods, 1960-I to 1981-II

Actual less predicted growth rates; in percentage points

Period	M-1B adjusted*	Predicted	Error
1960: I	−1.4	−0.3	−1.1
II	−0.6	1.1	−1.7
III	4.0	2.3	1.7
IV	0.3	2.0	−1.7
1961: I	1.4	1.7	−0.3
II	3.4	2.5	0.9
III	2.5	2.8	−0.3
IV	3.6	3.0	0.6
1962: I	3.0	2.2	0.8
II	2.4	2.5	−0.1
III	−0.3	2.4	−2.7
IV	2.2	2.7	−0.5
1963: I	4.0	3.8	0.2
II	3.7	3.5	0.2
III	4.2	2.9	1.3
IV	3.7	3.4	0.3
1964: I	2.8	3.1	−0.3
II	2.8	3.3	−0.5
III	6.6	3.6	3.0
IV	5.0	3.0	2.0
1965: I	3.2	2.5	0.7
II	2.2	3.2	−1.0
III	4.9	3.9	1.0
IV	7.0	3.9	3.1
1966: I	6.9	3.3	3.6
II	4.4	4.2	0.2
III	−1.2	3.7	−4.9
IV	0.9	4.2	−3.3
1967: I	4.2	5.8	−1.6
II	5.7	5.9	−0.2
III	8.8	5.4	3.4
IV	6.2	5.1	1.1
1968: I	5.4	4.6	0.8
II	7.3	5.4	1.9
III	7.6	5.7	1.9
IV	8.3	5.4	2.9
1969: I	7.7	3.6	4.1
II	3.4	4.2	−0.8
III	1.6	4.6	−3.0
IV	2.7	4.5	−1.8
1970: I	3.9	4.9	−1.0
II	4.4	5.0	−0.6
III	4.8	5.3	−0.5
IV	6.4	6.0	0.4
1971: I	7.0	9.1	−2.1
II	9.5	8.2	1.3
III	6.2	6.8	−0.6
IV	3.3	7.0	−3.7
1972: I	8.2	9.7	−1.5
II	7.3	8.5	−1.2
III	7.9	7.1	0.8
IV	9.5	6.9	2.6
1973: I	8.3	6.7	1.6
II	4.9	6.0	−1.1
III	4.8	5.0	−0.2
IV	4.8	6.7	−1.9
1974: I	6.7	7.0	−0.3
II	3.7	7.4	−3.7
III	3.7	8.2	−4.5
IV	4.5	9.2	−4.7
1975: I	3.0	8.5	−5.5
II	6.0	8.4	−2.4
III	7.5	8.2	−0.7
IV	3.1	9.1	−6.0
1976: I	5.5	7.6	−2.1
II	6.5	6.8	−0.3
III	4.1	6.5	−2.4
IV	7.3	7.5	−0.2
1977: I	9.2	7.4	1.8
II	7.1	7.8	−0.7
III	6.6	7.3	−0.7
IV	8.3	6.9	1.4
1978: I	7.5	7.0	0.5
II	9.1	8.7	0.4
III	7.8	8.3	−0.5
IV	6.5	8.6	−2.1
1979: I	3.9	8.4	−4.5
II	9.2	8.2	1.0
III	8.5	8.0	0.5
IV	4.3	7.3	−3.0
1980: I	6.5	7.0	−0.5
II	−3.6	8.3	−11.9
III	12.9	9.1	3.8
IV	10.0	8.3	1.7
1981: I	−1.1	11.4	−12.5
II	5.2	9.6	−4.4

* See the box for definition of this series.

Table 1 *(continued)*

Summary statistics; in percentage points

Period	Mean (standard deviation) Actual	Predicted	Error	RMSPE†	Period	Mean (standard deviation) Actual	Predicted	Error	RMSPE†
Entire period	5.0 (2.9)	5.7 (2.4)	−0.7 (2.7)	2.9	1977 to 1978	7.8 (1.1)	7.8 (0.7)	0 (1.2)	1.2
1960 to 1973	4.5 (2.7)	4.5 (2.0)	0 (1.9)	1.9	1979 to 1981-II	5.6 (5.0)	8.6 (1.3)	−3.0 (5.1)	6.0
1974 to 1976	5.1 (1.6)	7.9 (0.9)	−2.7 (1.8)	3.4					

† Root mean squared prediction error.

Table 2

Comparison of the Sources of Prediction Errors

Period	MSPE*		Decomposition of MSPE* Bias		Unequal variation		Incomplete covariation
1974 to 1976	11.6	=	7.5 65%†	+	0.5 4%†	+	3.6 31%†
1979 to 1981-II	36.5	=	8.9 24%†	+	12.8 35%†	+	14.8 41%†
Formula	$(1/N)\ \Sigma\ (P_t - A_t)^2$	=	$(\bar{P}-\bar{A})^2$	+	$(s_P - s_A)^2$	+	$2\ (1-r)\ s_P s_A$

where:

P = the predicted value,

A = the actual value,

$\bar{P}$ = the mean of the predicted values,

$\bar{A}$ = the mean of the actual values,

s_P = the standard deviation of the predicted values,

s_A = the standard deviation of the actual values,

r = the correlation coefficient of the predicted and actual values,

N = the number of observations.

* Mean squared prediction error.

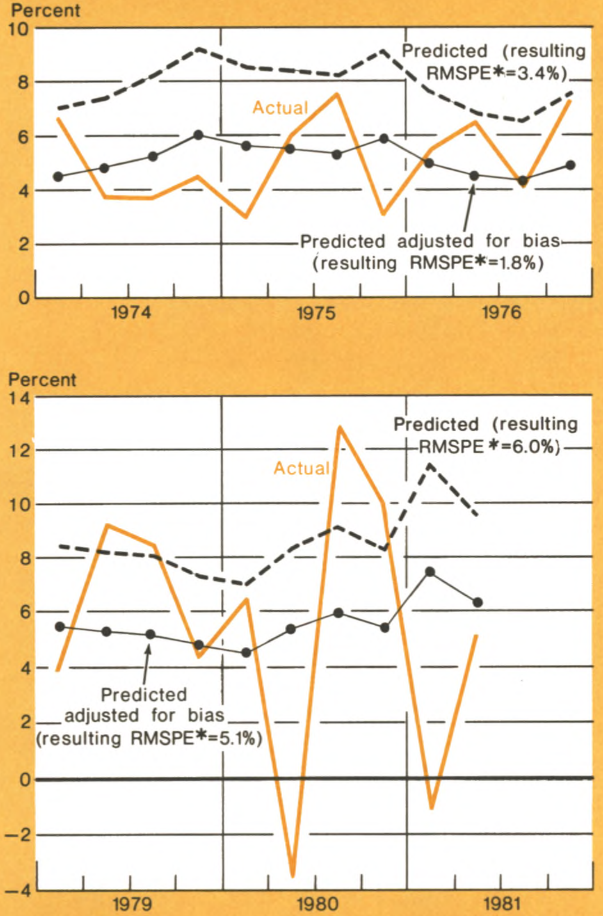
† Percentage of total.

idea can be obtained of how much of the error was due to the bias in the simulations and how much was due to other factors.

In the 1974-76 time period most of the error was due to bias, whereas in the 1979 to 1981-II period much of the error was due to the failure of the predicted series to parallel the movements in the money stock. In the 1974-76 period, adjusting the simulations for bias reduces the RMSPE by almost one half from 3.4 percentage points to 1.8 percentage points. In contrast, for the 1979 to 1981-II period, adjusting the simulations for bias reduces the RMSPE by only about 1 percentage point from 6 percent to 5.1 percent.

Chart 2

Comparison of Money Demand Errors 1974-76 and 1979 to 1981-II



*Root mean squared prediction error.

Source: Table 1.

These results can be shown more formally by using the Theil error decomposition procedure.[3] The mean squared prediction error (MSPE) can be separated into three elements, each of which refers to a particular kind of prediction error.

- *Bias.* This term is zero if the average of the forecast values is equal to the average of the actual series.
- *Unequal variation.* If the standard deviations of the predicted and the actual series are the same, this term equals zero.
- *Incomplete covariation.* This term is zero only if the predicted and actual series are perfectly correlated.

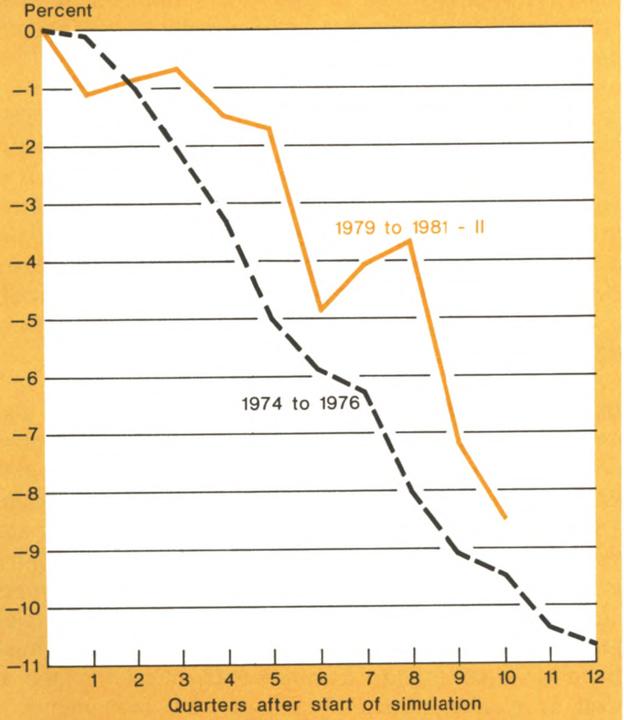
Table 2 shows the breakdown of the MSPE for the periods 1974-76 and 1979 to 1981-II. In the 1974-76 time period, 65 percent of the error was due to bias, and the percentage stemming from incomplete covariation was about 30 percent. In contrast, in the 1979 to 1981-II period the percentage of the MSPE stemming from bias (24 percent) is far less than in the 1974-76 period even though the size of the average error was about the same. Unequal variation and incomplete covariation became relatively and absolutely more important factors; this means that the predicted series in the latter time period was not only relatively less variable than—but also less well correlated with—the actual series.

In sum, two and one-half years after what appears to be "another shift" in the money demand equation, both similarities and differences have become evident when compared with the 1974-76 period. Chart 3 contains a comparison of the errors in predicting the level of the money stock as a percentage of the actual values for the two time periods. Two and one-half years into the shift periods, the errors in each case have amounted to roughly 9 percent of the actual values. But in contrast to the rather smooth shift in the 1974-76 period, the shift in this later time period has shown a great deal of volatility—complicating the interpretation of the monetary data. The significantly different features of the prediction errors in these two periods of money demand shift raise the question of whether the explanations offered for the 1974-76 shift also pertain to the 1979 to 1981-II period. In the section to follow, these explanations will be reviewed to see if they are still applicable to the 1979 to 1981-II period.

[3] Henri Theil, *Applied Economic Forecasting* (Amsterdam, Holland: North Holland Publishing Co., 1966).

Chart 3

Cumulative Errors from the Money Demand Equation as a Percentage of Actual Levels*



*A dynamic simulation was performed for each time period; in the second simulation the equation was put back on track by adjusting the constant term for the 1974-76 shift.

Explanations for the shift

What causes the money demand equation to overpredict money growth for a prolonged period of time either by a relatively constant amount (1974-76) or sporadically by a large magnitude (1979 to 1981-II)? Little agreement exists in the economics profession on this question even though extensive research has been done. Some economists have attributed the post-1973 shift in the conventional equation, at least in part, to an incorrect specification of the demand for money; that is, an important factor determining the demand for money has been omitted. For example, a case has been made that long-term, as well as short-term, financial assets are substitutes for money. Hence, long-term yields—such as the twenty-year Government bond yield and/or the dividend-price ratio of common stocks—influence the public's demand for money; and therefore these yields should be included in the demand for money equation.[4]

Others take the view that wealth should appear in the equation along with a measure of transactions for two basic reasons. First, wealth belongs in the demand for money because the public holds money balances, not only to undertake current expenditures on goods and services (for which current income serves as a proxy), but also for purely financial transactions. Second, as wealth increases, the public can better afford the conveniences resulting from holding money balances instead of a less liquid asset earning a higher rate of return. Along these same lines, some analysts argue that permanent income, a weighted average of current and past income, is a better determinant of the transactions demand for money because the public does not desire to incur the costs of adjusting money holdings for temporary movements in income.[5] In the remainder of this article, two additional explanations often cited for the post-1973 shift will be reviewed.

Financial innovations. Some analysts have taken the view that when interest rates attain record levels, not only does the expected flow of funds from demand deposits into market instruments occur—accounted for in the money demand equation—but consumers and businesses also seek out new ways to manage money balances more efficiently. The effects of innovations are not captured in the conventional money demand equation.[6] Moreover, since not all firms will adopt these new techniques immediately, money growth continues to appear weak for several quarters after short-term interest rates decline from record levels, making it appear that lower interest rates are not resulting in the expected pickup in money growth (Chart 4).

This line of reasoning seemed to explain the 1974-76 period rather well in that money growth remained weak relative to predictions for several quarters following the peak level of interest rates. Repurchase agreements are often pointed to as a financial instrument gaining widespread use during this time that might have contributed to the shift. Money market mutual funds were

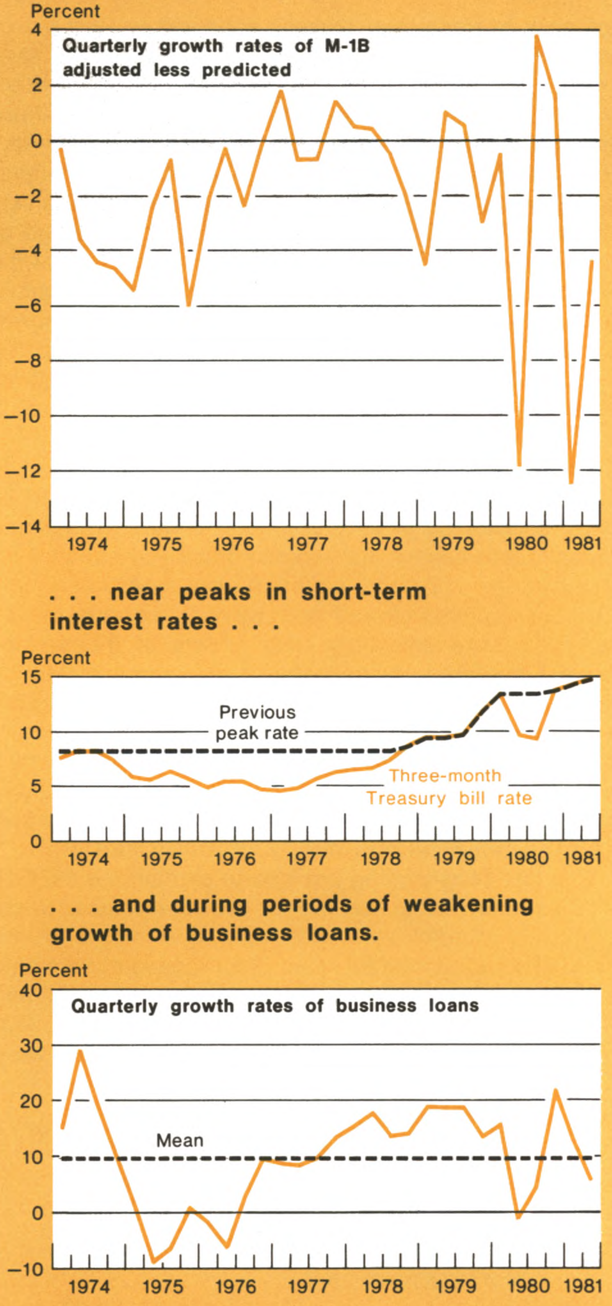
[4] M.J. Hamburger, "Behavior of the Money Stock: Is There a Puzzle?", *Journal of Monetary Economics* (1977:3).

[5] G.S. Laumas and D.E. Spencer, "The Stability of the Demand for Money: Evidence from the Post-1973 Period", *Review of Economics and Statistics* (1980, Vol. 62); B.M. Friedman, "Crowding Out or Crowding In? Economic Consequences of Financing Budget Deficits", *Brookings Papers on Economic Activity* (1978:3).

[6] J. Enzler, L. Johnson, and J. Paulus, "Some Problems of Money Demand", *Brookings Papers on Economic Activity* (1976:1); T. Simpson and R. Porter, "Some Issues Involving the Definition and Interpretation of the Monetary Aggregates", *Controlling the Monetary Aggregates III* (Federal Reserve Bank of Boston, Conference Series No. 23, October 1980).

Chart 4

Since 1973, the money demand equation has tended to overpredict money growth . . .



Sources: Board of Governors of the Federal Reserve System (middle and bottom panels). Table 1 contains the data for the top panel.

also developed during this period, but their total assets were small relative to the size of the shift in the demand for money. The explanation in terms of financial innovation does not work well for 1980, however, when two quarters of unusually weak money growth at about the time interest rates peaked were followed by even stronger than expected money growth in the second half of the year. The imposition and subsequent lifting of the credit restraint program probably had important impacts on the public's demand for money during 1980, masking the possible effects of financial innovation. The large error in the first quarter of 1981 occurred about the time of yet another peak in short-term rates, but only time will tell whether this will mark the beginning of another series of consecutive overpredictions. Based on preliminary GNP data, however, another sizable overprediction of money growth appears to have occurred in the second quarter of 1981.

Business loans. Shifts in the demand for money also have tended to occur during periods of weakening business loan growth, possibly because compensating balances are declining or expanding at a slower rate.[7] The 1974-76 period, the second quarter of 1980, and the first half of 1981 were all periods of weakening loan demand, as well as times when the money demand equation overpredicted money growth (Chart 4). Moreover, since banks often require firms to hold these balances against loan commitments or credit lines as well as against outstanding loans, the movements in compensating balances could be even more pronounced than expected just from the reduced pace of business lending. During a period of weakening loan demand, firms would not be willing to incur the expense in terms of idle balances of maintaining credit lines at levels established during a period of strong loan demand. Also, in response to weak loan demand, banks might reduce compensating balance requirements instead of or along with the rate charged on the loans.

Business loans and compensating balances are sensitive to the interest rate cycle. When rates begin to decline from cyclical peaks, corporations often restructure their debt away from short-term borrowings at banks into long-term debt issues, thereby lowering compensating balances. This makes it difficult to untangle the effects of financial innovation and business loans on money stock growth, because the effects often tend to occur at about the same time in the interest rate cycle and impact in the same direction. When the events of

[7] Goldfeld, *loc. cit.*, reviews the empirical evidence on using business loans to explain money growth.

1980, however, are viewed in light of the volatility in business loans, some sense can be made out of the erratic growth of the money stock. In the second quarter as rates declined from record levels, corporations were able to reduce their borrowings from banks and, hence, a shift in the money demand equation occurred. In the second half of the year, as the economy became stronger than expected and inflationary expectations ratcheted upward, activity in the bond market slowed considerably and firms relied more on bank loans again, resulting in stronger money growth than would have been expected given the pace of economic activity. In contrast, in the 1974-76 period, corporations were able to restructure their debt over a period of several quarters as the economy remained weak and interest rates low. Thus, the shift in the money demand equation seemed to last for a much longer period.[8]

Finally, the shift in money demand might have occurred, at least in part, as a result of a combined effect of financial innovation and business loans. That is, at high rates firms develop more effective cash management techniques, and they use those funds no longer kept in demand deposits to repay expensive short-term loans. Since these loans could have compensating balances against them, demand deposits are subsequently reduced beyond the initial effect of the financial innovation. This type of explanation would seem to work for the 1974-76 period but to a lesser extent for 1980.

Moreover, it appears that the impacts of business loans and/or financial innovation on the performance of the money demand equation are not limited to the post-1973 period. The simulations from the money demand equation overpredicted money growth for several quarters about the time interest rates peaked in 1966 and 1969 (Table 1). These were also periods of weakening business loan demand, again making it difficult to know whether financial innovation, compensating balances, or some combination of the two caused money growth to be overpredicted.

In sum, the extreme volatility in the errors from the money demand equation during the last two and one-half years appears to reflect some of the severe strains that the economy has gone through. While shifts in the money demand equation are easy to identify *ex post*, the underlying reasons are much more difficult to discover. Short-term interest rates have risen to record levels during this period, undoubtedly spurring at least some increased emphasis on cash management. Moreover, wide swings in short-term credit demands at commercial banks have also taken place. By and large, the sources of the recent instability in the money demand equation could well be the same ones often pointed to for the 1974-76 shift in money demand—financial innovation and compensating balances, with financial innovation probably contributing the larger part.

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[8] If compensating balances "explain", at least in part, the shift in the money demand equation, why not incorporate them directly in the equation? Some analysts have attempted to do this by using business loans as a proxy since data on compensating balances are not collected. But business loans are not a very good proxy. Compensating balances are determined, not only by the level of business loans outstanding, but also by the percentage required which varies with credit conditions. Moreover, compensating balances are held for other reasons as well, such as to pay for loan commitments and cash management services. Also, even if business loans were a good proxy for compensating balances, demand deposits would be affected only to the extent that firms were holding more balances than needed for day-to-day transactions as a result of compensating balance requirements. The increased emphasis on cash management in recent years has lowered the desired level of demand deposits for any given level of transactions, while the increasing use of explicit fees by banks rather than compensating balances has also lowered the level of these balances for any given level of lending activity. This makes it difficult to know whether firms are holding deposits beyond what is needed for transactions purposes to a greater or less extent than in the past. Finally, business loans are highly correlated with GNP, making it difficult to get both variables "to work" in a money demand equation.