FEDERAL RESERVE BANK OF SAN FRANCISCO

ECONOMIC REVIEW

Financial Markets and Uncertainty

SUMMER 1976

Has the Money-GNP Relationship Fallen Apart?

Rose McElhattan*

During the first year of the current economic recovery (1975.1-1976.1), the nation's gross national product, in nominal terms, increased by 13 percent. This rapid rate of economic expansion occurred along with relative ease in financial markets; interest rates were lower in the first quarter of 1976 than when the expansion began in 1975. Surprisingly, however, the growth in the economy and the decline in interest rates have been accomplished with a relatively moderate rate of growth in the money supply.

The actual M_1 rate of growth was 5.1 percent from 1975.1 to 1976.1[1]—about half the rate which standard money demand models estimate as necessary to support the observed income growth and decline in interest rates. This overprediction of money demand constitutes an unusually large forecast error, since standard money demand functions (which relate the public's demand for money balances to the level of GNP and interest rates) generally have performed well in estimating the growth in money.[2] However, beginning with the third quarter of 1974, these equations began overestimating the public's demand for money by relatively large and increasing amounts.

The demand for money is an important component in the final relationship between money and GNP. Changes in money have had fairly predictable, although not exact, effects over time on the gross national product.[3] Because of this relationship, the money stock has become a significant variable in economic analysis. The central bank, in turn, has a degree of control over the stock of money, making it an important Federal Reserve policy variable. The recent large forecast errors in the estimated demand for money suggest a deterioration in the ability of policymakers to predict the impact of changes in money upon economic activity. This in turn suggests that less emphasis should be placed upon the money supply as a guide in the conduct of monetary policy. This paper attempts to determine how much M_1 has deteriorated as an indicator of movements in GNP since the recent appearance of large errors in money demand.

Utilizing a version of the MPS model (Massachusetts Institute of Technology-University of Pennsylvania-Social Science Research Council),[4] we conclude that there has been no material deterioration in the overall relationship between money and GNP since mid-1974, relative to what would be expected from past experience. The money supply (M_1) remains as useful an indicator of overall economic activity as it has been in the past.

In the next section, we indicate the forecast errors in the money demand equation included in the MPS model and, using the familiar LM-IS diagram, illustrate the policy question raised by the recent shifts (i.e., forecast errors) in estimated money demand functions. Following that, we analyze GNP forecast errors generated by the MPS model and attempt to interpret recent velocity movements.

Forecast errors in money demand

Since 1974.3, money demand equations have shown large forecast errors, with forecasted money holdings by the private sector exceeding actual money (M_1) balances. A conventional relation which illustrates the nature of these

*Economist, Federal Reserve Bank of San Francisco.

errors is included in the MPS model. This model uses two equations to forecast money (M_1) demand—one for the demand for currency and one for the demand for demand deposits. The currency equation has performed well since mid-1974; the errors are relatively small and within the range of past experience for this equation. The demand deposit equation, on the other hand, has overestimated the public's demand for demand deposits and by relatively large amounts. This equation (Appendix A) is the major source of error in the prediction of M_1.

In four of the six quarters from 1974.3 to 1975.4, the error in the demand deposit equation was outside the range of past experience (Chart 1A and B, Table 1).[5] The largest error prior to mid-1974 was $4.7 billion in 1972.2. By 1974.4, however, demand deposits were over-estimated by $6.7 billion and the error reached $19.9 billion in 1975.4.

These estimates and the MPS model equations are based upon National Income and Product Accounts (NIPA) data for which information is available only through 1975.4. Consequently, we cannot extend the MPS model estimates beyond the end of last year—but we are able to estimate a standard-type money demand equation using newly revised NIPA data. This differs from the MPS model specification in Appendix A in only a minor way: the discount rate is deleted and the commercial-bank passbook rate is used instead of the weighted time-and-savings deposit rate. These minor changes do not alter the error pattern shown above.

The demand deposit equation estimated with the revised NIPA data displays the same problematic errors as the MPS equation, with errors increasing after 1974.3 and sharply accelerating in the last half of 1975. However, the magnitude of the errors then appears to stabilize, at

MPS Model Demand Deposit Equation

Chart 1A

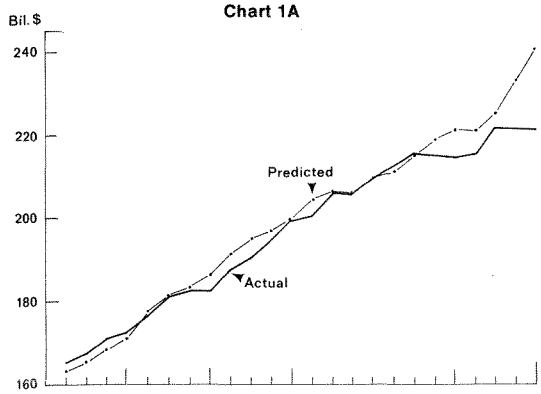
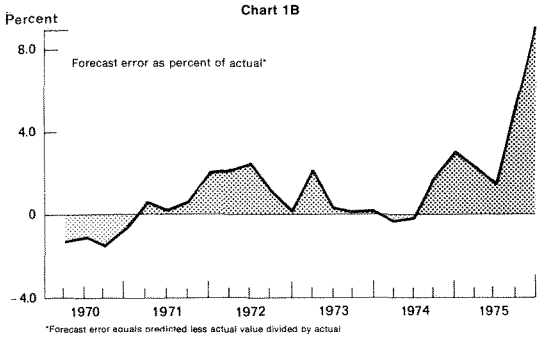


Chart 1B



*Forecast error equals predicted less actual value divided by actual

TABLE 1

Quarter	Forecast Error in billions $	Forecast Error as Percent of Actual Level
1970.1	–2.1	–1.3
.2	–1.8	–1.1
.3	–2.6	–1.5
.4	–1.3	– .7
1971.1	1.1	.6
.2	0.3	.2
.3	1.2	.6
.4	3.8	2.1
1972.1	4.1	2.2
.2	4.7	2.5
.3	2.2	1.1
.4	0.4	.2
1973.1	4.4	2.2
.2	0.5	.2
.3	0.3	.1
.4	0.3	.1
1974.1	–0.6	– .3
.2	–0.3	– .1
.3	4.2	1.9
.4	6.7	3.1
1975.1	5.1	2.4
.2	3.5	1.6
.3	11.7	5.3
.4	19.9	9.0

about $20 billion in each quarter from 1975.4 to 1976.2.

These relatively large forecast errors have led to questions regarding the stability of the public's demand for money—and even more importantly, to questions regarding the stability in the relationship between money and income. Specifically, do forecast errors in the demand for money indicate a change from past experience in the relationship between changes in money and changes in income? The question can be illustrated in terms of the familiar LM-IS diagram.

Large econometric models, such as the MPS model, can be thought of in terms of their two major economic markets—that for goods-and-services and that for money.[6] The IS function represents the equilibrium condition in the goods-and-services market. It provides the combination of all income levels and interest rates for which intended saving plus taxes are equal to investment plus government expenditures. The LM function represents the equilibrium condition in the money market. On the assumption of a given stock of money, it provides the combination of all income levels and interest rates for which the demand for money is equal to this supply. The equilibrium condition in the two markets is stated as a function of two variables—the rate of interest and the level of income.

In Diagram 1, the intersection of the LM and IS curves represents a solution of the model which provides the forecasted value of GNP, Y_0. If the public wishes to hold smaller money balances at each level of income, the demand for money and the corresponding LM curve will shift downward (LM_1). The observed value of GNP will be Y_1 (the intersection of IS and LM_1) rather than the forecasted value, Y_0.

If the public's demand for money and the LM curve continually shift downward by substantial magnitudes, the model (which provides a forecast based upon IS and the "old" LM function) will underestimate GNP by increasing amounts. It is in this sense that instability (i.e., shifts) in the money demand equation will lead to instability in the overall relationship between money and GNP. The uncertainty surrounding the degree and cause of shifts in the public's demand for money translates into uncertainty about the impact which monetary changes will have upon aggregate economic activity.

However, it is unrealistic to assume that everything else remains unchanged when LM fluctuates. The demand functions for goods and services, such as inventory investment and consumption, are not exact; in terms of Diagram 1, we expect shifts in the IS function also. A degree of uncertainty surrounds economic relations in both markets, so that a forecast generally is associated with a probable error range. This range can be represented in an LM-IS framework. In Diagram 2, LM_1 and LM_2 represent the range of values within which actual future values may be observed in this money market; IS_1 and IS_2 incorporate the range for the goods-and-services market values. As before, the forecast value for GNP is represented as the solution of the model, Y_0. Y_1 and Y_2 represent the range within which the actual value may occur because the model's estimate may be in error. When we take into consideration the uncertainty surrounding future events,

Diagram 1

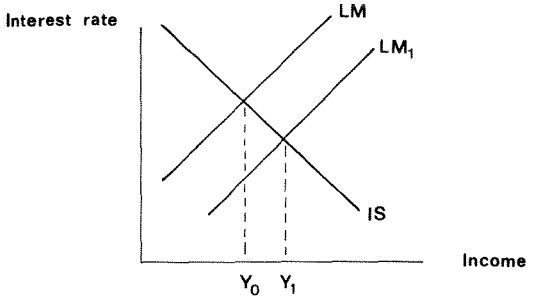
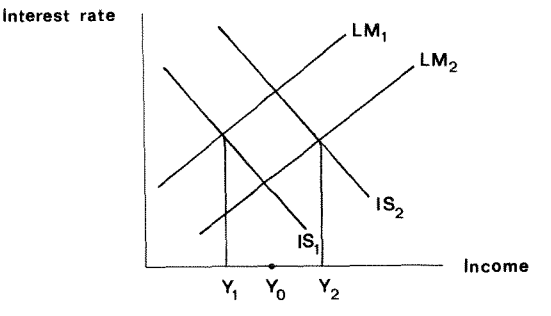


Diagram 2



the actual value of GNP could occur anywhere within the range Y_1-Y_2.

Diagram 2 illustrates that the forecast error in one equation—for example, the demand for money—may not throw the estimate of GNP outside the expected range when changes occur elsewhere, even when the forecast errors are very large. In other words, the overall net impact of unpredictable shifts in both the LM and IS sectors are important in the final determination of GNP. Despite the uncertainty surrounding the public's demand for money balances, we can determine empirically whether the overall relationship between money and GNP has changed from what past experience would lead us to expect.

Forecast errors in MPS model

The MPS model was designed to capture the channels through which monetary policy affects aggregate economic activity, as is described in a recent article by Albert Ando.[3] The forecast errors generated by the model should reveal any change in the ability of money to track GNP since large errors first occurred in money demand equations. The model was used to generate ex-post forecasts of GNP one to four quar-

TABLE 2

Nominal GNP Forecast Errors*
MPS Quarterly Model
No Correction for Serial Correlation
(in billions of dollars)

	Quarters Beyond Initial Conditions**			
Forecast of:	**1**	**2**	**3**	**4**
1970.1	1.8			
.2	–9.3	–8.2		
.3	–22.5	–15.4	–12.3	
.4	–20.4	–22.7	–11.8	–6.6
1971.1	–36.0	–33.2	–31.8	–17.8
.2	–24.1	–30.1	–22.5	–17.6
.3	–17.7	–16.6	–21.5	–10.1
.4	–23.6	–18.2	–19.5	–21.8
1972.1	–22.0	–16.2	–14.6	–14.9
.2	–16.0	–15.8	–6.3	–5.6
.3	–16.8	–9.7	–13.3	–2.2
.4	–14.1	–14.6	–8.5	–14.6
1973.1	–17.2	–15.9	–15.5	–10.9
.2	0.6	–12.7	–6.5	–7.7
.3	5.2	5.6	–2.5	3.5
.4	3.2	3.4	11.4	3.5
1974.1	3.4	15.3	18.1	24.6
.2	–26.0	–10.9	–1.0	1.2
.3	–30.9	–31.6	–15.1	–8.5
.4	–16.5	–16.8	–6.6	–6.5
1975.1	–17.2	1.1	17.2	28.7
.2	–4.6	6.1	22.7	40.6
.3	–47.4	–29.6	–18.4	–5.6

*Forecast error = Forecasted minus Actual.

**Quarters beyond initial conditions refers to the number of quarters after the initial conditions quarter on which the forecast was based. The first initial conditions quarter is 1969.4.

ters ahead from 1970.1 to 1975.3, the last quarter for which we have a consistent data bank.[7] Results of these simulations are presented in Table 2.[8]

These ex-post forecasts differ from the usual type of ex-ante forecasts in several important respects. First, all values of the exogenous variables are known and are set equal to their historical values. For the MPS model version we are using, this means that the forecasts use actual values for the money supply and such variables as federal government expenditures, tax rates, farm inventories, population measures, and exports.

Second, in our model simulations, we do not utilize information available from knowledge of previous behavioral equation errors. In an actual ex-ante forecast, the pattern of equation errors is projected forward if the errors appear systematic. Because this procedure is somewhat arbitrary, we have not used it here, and in fact have not used any information about past equation errors. All serial correlation terms have been removed from the behavioral equations.

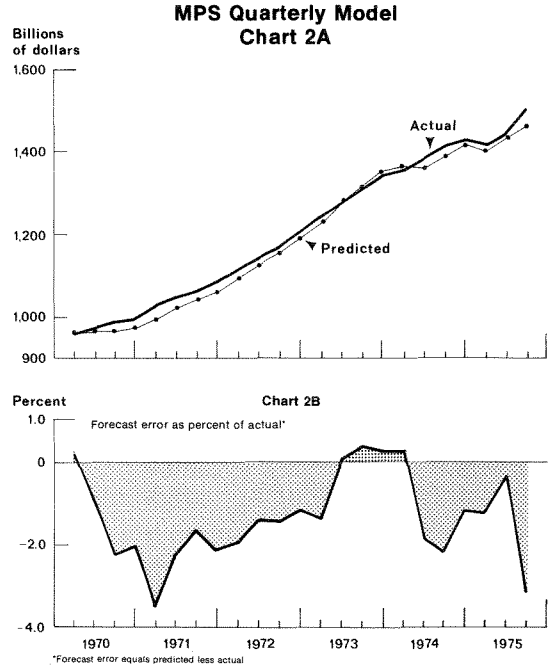
Third, we do not utilize the ex-ante forecast procedure, whereby knowledge of special factors not included in the model specification would be used to adjust the appropriate equations. For example, a labor strike which is expected in the forecast period would lead to some adjustment of the labor market equations, which of course are not structured to capture the impact of such events. This type of information, when used in an actual ex-ante forecast, can cut the model's errors substantially.

We do not utilize such model adjustments (with several exceptions noted below), because they contain an element of arbitrariness. We are interested in what the model's estimated structure has to say about the changing ability of money to predict total income in the recent period of money-demand overestimation. It is not our concern here to minimize model errors, but to observe and compare their size and pattern over time. Nevertheless, we have made several exceptions to take account of certain economic events which have directly affected the model's basic structure.

First, after the 1971 change in the international payments system, the model's import equations began to generate very large underestimates of imports. Second, the introduction of revenue sharing (which the model's state-and-local government expenditure equations could only treat as categorical grants) caused overestimates of state-and-local government expenditures. Third, major errors occurred because of the failure of the model's price equations to pass through price increases generated outside the domestic economy—such as those occurring in the wake of the dollar devaluations, OPEC oil price increases, and world crop shortages.

We adjusted for these factors by adding the residuals from the estimated behavioral equations into the model equations, using some judgment in adjusting for price increases. The adjusted equations for these variables then forecast historical values exactly when all the "right-hand" variables were known. In our dynamic simulations, errors in the adjusted equations result only from misestimates by other equations as they feed into the "corrected" equations. Thus the obvious misspecification in the foreign

Nominal GNP
MPS Quarterly Model
Chart 2A



and state-and-local government sectors is not allowed to bias the full model simulation results.

The forecast error for one-quarter out (column 1, Table 2) is shown in Graph 2B as a percentage of actual GNP. When shown in this form, the forecast errors remain within the range of the model's past experience throughout the period of large money-demand overforecasts. After declining from 1974.3 to 1975.2; the error increased in 1975.3 to 3.1 percent of GNP—understandably so, because quarters following a business-cycle trough are difficult periods to predict. Generally, however, these percentage errors do not reflect any marked deterioration in the money-income relation as structured in the MPS model after mid-1974. From 1974.3 to 1975.2, both the dollar level and the GNP percentage level of forecast errors are within the range of past observations (column 1, Table 2). It is interesting to note that the large $47.4-billion underforecast of GNP in 1975.3 occurred in the same quarter as the largest error in the demand-deposit estimate. But as noted above, this error is within the range of past model behavior when considered as a percentage of actual GNP.

It may be argued that changes in money have an impact upon GNP only after some delay, so that changes in money demand behavior should have little influence on aggregate demand until several quarters have passed. Thus, errors in the money demand equation may not show up immediately in the GNP forecasting model. Many studies indicate that between 25 and 40 percent of the response in nominal GNP to a change in money will occur within four quarters of a monetary change,[9] so we could expect a significant forecast error in GNP to appear about 4 quarters after the initial date (1974.3) of the large money demand errors. In other words, we should look at least three and four quarters ahead, in order to allow more time for a given change in money demand to influence GNP.

Only a limited number of such forecasts are available after 1974.3. The third quarter-out forecast errors for the first three quarters of 1975 are $17.2 billion, $22.7 billion and -$18.4 billion respectively. The four quarter-out forecast errors for 1975.2 and 1975.3 are $40.6 billion and -$5.6 billion. These forecast errors, with one exception, are within the range of error which the model has displayed since 1970. The size and pattern of these errors suggest no deterioration in the overall money-income relationship as structured in the MPS model. The one exception is the $40.6-billion overforecast of 1975.2, which results from the model's failure to capture the depth of the recent trough approximately one year before it occurred. However, this does not indicate a continuing forecasting failure, since the model was otherwise able to forecast within the range of past experience for all other forecast quarters since mid-1974.

We should emphasize that many of the errors in third and fourth quarter-out forecasts have the opposite sign from what the typical money demand-GNP model would suggest. Normally we would expect a decline in the demand for money to lead the model to underforecast GNP, and not the reverse. This point was demonstrated above in LM-IS Diagram 1. While the errors we have observed generally are within the expected historic range, the signs of many of the forecast errors are not consistent with the assumption that a downward shift in the money demand has dominated the money-income relationship.

In brief, no matter how uncertain money demand estimates have been since 1974.3, the money-income relation—as structured in the MPS model—does not appear to have gone off track because of shifts in money demand. In the one quarter in which the error was outside past experience, we observed a $40.6 billion overforecast of GNP. But we would have expected a negative forecast error, an underforecast of GNP, if downward shifts in money demand had dominated the money-income relationship.

A look at M_1 velocity

A key question is what has happened to the money-GNP relationship since 1975.3. The M_1 velocity series, the ratio of nominal GNP to the

money stock, provides some information regarding this matter. Current erratic movements in the velocity series could signal instability in the complicated economic process by which changes in money are related to current economic activity. In Michael Keran's words, "If we are entering a period of unpredictable movements in money turnover, it means increasingly unstable relationships between money and income due possibly to an increased instability in the demand for money."[10] But after looking at deviations from trend in the velocity data, Keran concluded that "velocity may not be too far out of line given the present stage of the business cycle. . . ."

The data in Chart 3 portray the typical cyclical pattern in M_1 velocity—growing below the trend rate in the downswing of a cycle and above it in the upswing. Recent velocity behavior follows that pattern. The past recession was particularly severe—the steepest decline since the late 1930's—and this was followed by the sharpest recovery of post-World War II history, with a 13-percent gain in nominal GNP from 1975.2 to 1976.2. Velocity mirrored these sharp GNP movements, growing slowly relative to trend during the recession and quite rapidly in the last half of 1975 (at about a 10-percent annual rate compared with a 3-percent trend rate). Thus, velocity was close to its long-run trend value by late 1975, and it has remained close to trend during the first half of 1976.

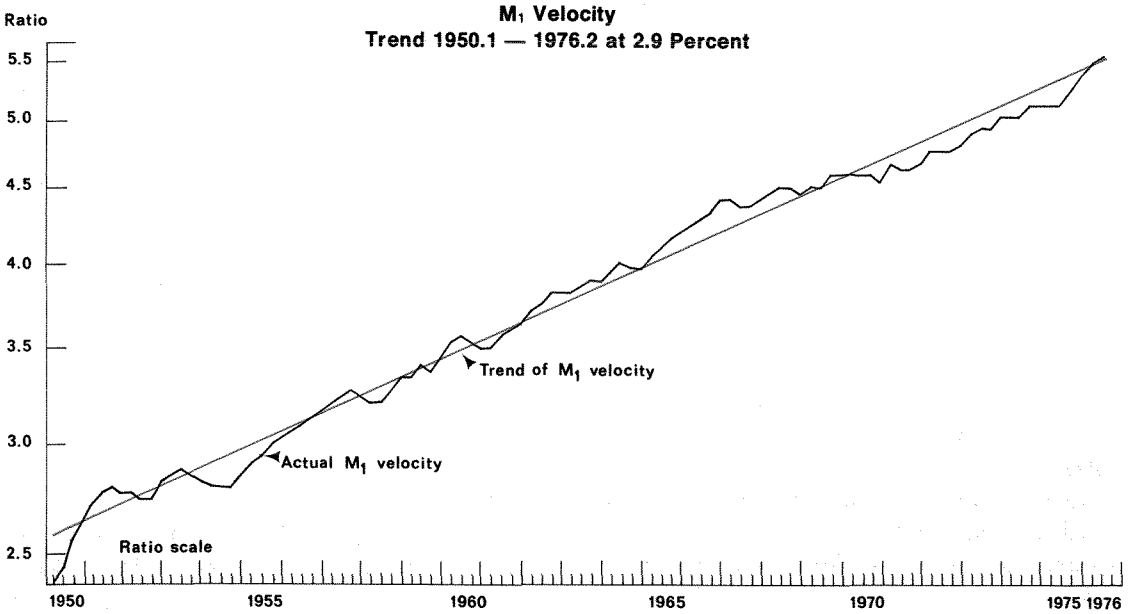
Despite the large shifts in velocity since 1974.3, the deviations from trend are within the range of past experience and are actually smaller than in some earlier periods, such as 1966-67. This suggests that a model relating movements in money to GNP should continue to be successful in its tracking abilities, as has been demonstrated by a small model developed at the Federal Reserve Bank of San Francisco.[11] The model's basic output equation relates movements in real money balances to real GNP. Its forecasting errors through 1975.4 indicate an ability to track GNP within an error range consistent with the equation's past performance.

In brief, the M_1 velocity series is not displaying atypical behavior. This suggests that the money-income relationship has remained stable after 1974.3, when increasingly large errors began to appear in money demand equations.

Summary and conclusions

Since mid-1974, economists have been bewildered by the large overforecasts of money growth which their standard money demand re-

Chart 3
M_1 Velocity
Trend 1950.1 — 1976.2 at 2.9 Percent



lationships have produced. Forecast money growth was about twice as great as actual money growth for the first year of the current recovery. These large forecasting errors have led to questions regarding the ability of standard models of the U.S. economy to forecast GNP. Econometric models of the U.S. economy link changes in a monetary aggregate to changes in overall economic activity. The demand for money is an important element in the transmission mechanism by which changes in money lead to changes in income.

In this paper we have focused upon an empirical study of the GNP forecast errors in one large quarterly econometric model. The forecast errors in GNP since mid-1974—the start of the large errors in money demand—were generally inside the range of forecast errors made by the model in the past. But since MPS data extend only through 1975.3, we have utilized the M_1 velocity series to gain some indication of the more recent money-income relationship. The data suggest that the current relation between money and income has remained similar to its past expected behavior. The relationship, while not exact, has remained consistent, and thus did not fall apart during the time of unpredictable shifts in money demand.

Our study suggests two possible interpretations of this finding. First, the MPS model results demonstrate that the money-income relationship may remain on track as a result of the net impact of errors in both the IS and LM sectors. Although errors in the money demand equation (and corresponding LM function) were larger than expected in late 1974, the GNP forecast errors demonstrate that the uncertainty in the goods-and-services sector for several quarters dominated the actual deviation of output from its expected value. The largest GNP errors in the latter forecast quarters were overestimates of GNP—rather than underestimates, which would have been consistent with the errors in money demand.

Whether or not money fails to track GNP will depend upon the behavior of all economic markets. This has an important policy implication. One factor in the choice of a monetary policy instrument is the relative stability of the monetary sector compared with that of the goods-and-services sector. When there is greater uncertainty (i.e., unpredictable shifts) in the monetary than in the goods-and-services sector, there may be less variation in final output with an interest-rate policy instrument than with a monetary aggregate. Accordingly, the unpredictable shifts in money demand since mid-1974 led some observers to advocate an interest rate policy. This policy, however, is not appropriate when the major source of unpredictability in GNP stems from changes in investment behavior, consumption expenditures or any of the other components of GNP. The MPS simulations suggest that the unpredictable nature of the real sector may have been the major source of unpredictable movements in GNP for some time after mid-1974, and that a monetary aggregate policy was appropriate although the money demand equation exhibited large overforecasts of money demand at that time.

This interpretation thus emphasizes the net impact of sector errors, and assumes that the estimated money demand function is an accurate representation of the public's behavior.

However, there is an alternative explanation for the stability of the money-income relationship—namely, that the public's demand for money has not changed. The velocity series appear consistent with this alternative interpretation. The observed errors may be the fault of a misspecification of the equation used to predict the public's actual demand for money. The estimated money demand function simply failed to capture the money demand relationship accurately, and the errors became pronounced beginning in 1974.3. Similar situations have occurred before, with large errors occurring in estimated money demand equations.[12] In previous instances, many analysts argued that forecast errors were the result of an inadequate specification of the demand for money. Their efforts led to the development of improved equations which provided a more accurate measurement of the public's behavior.

Recent work by Enzler, Johnson and Paulus[13] may be interpreted along these lines. These

authors contend that while the post mid-1974 errors in the money demand function are still relatively large, they can be substantially reduced from those shown in Table 1 by respecifying the income variable and the interest rate in the MPS equation. They also note that recent errors may be reduced by $4.5-5.0 billion, by adjusting demand deposit data to exclude foreign bank and official deposits and to include NOW accounts (Negotiable Orders of Withdrawal). Foreign balances are generally held for purposes unrelated to domestic economic activity; NOW accounts, which are still quite small but growing, are interest bearing accounts at commercial banks and thrift institutions on which checks can be drawn.

Work along these lines appears most promising and deserving of further research. Keran,[10] for example, is critical of the typical use of the Treasury bill rate as the appropriate measure of the opportunity cost of holding money. He suggests that alternative measures be sought to capture the substantial rise in risk which accompanied the recent era of unprecedented inflation and recession. In addition, there are many institutional factors and technological innovations which may reduce the (actual or potential) demand for transaction balances. Several of these factors, such as changes in compensating balance requirements or in the corporate management of cash balances, have been analyzed by Ruth Wilson.[14]

As the research into money demand continues, we may find that institutional factors and technological innovations will cause significant changes in the relationship between money (however defined) and total economic activity (as measured by GNP). However, the evidence presented in this paper suggests that much of the recent uncertainty in money demand can be reduced and that since mid-1974 the ability of M_1 to track movements in GNP has not deteriorated relative to past expected behavior.

The Federal Reserve has found M_1 to be a useful policy variable, although the achievement of a particular preconceived money stock is not the objective of monetary policy. Federal Reserve Chairman Arthur Burns, referring to targeted growth rates for monetary aggregates, has stated before Congress,

> We at the Federal Reserve have viewed these growth ranges as useful guides for the conduct of monetary policy. However, the objective of monetary policy is not to achieve any preconceived growth rates of monetary or credit aggregates, but to facilitate expansion of economic activity and to foster stability in the general price level.[15]

The recent errors in forecasting the public's demand for money have raised questions as to whether the money supply can still serve as a useful guide to monetary policy. The results presented in this paper suggest that it can do so.

APPENDIX A

The MPS Model Demand Deposit Equation

The demand for Demand Deposits by the nonbank public is represented in the MPS model by a standard type of money demand function which is consistent with the Baumol transaction demand model.*

$$\ln \frac{DD}{GNP\$} = -.519 + .280 \ln \frac{DD_{-1}}{GNP\$} - .062 \ln RTB$$

$$(-4.1) \quad (1.6) \quad (-5.1)$$

$$-.123 \ln RS - .339 \ln \frac{GNP}{N} + .078 \ln \frac{RDISC}{RDISC_{-1}}$$

$$(-5.1) \quad (-2.3) \quad (3.9)$$

DD is the commercial bank demand deposits measured as the two - month average surrounding the end of the quarter.

GNP$ is Gross National Product (GNP) in current dollars.

GNP is GNP in 1958 dollars.

RTB represents the 90-day Treasury Bill Rate.

RS is an average offering rate paid on time and savings deposits at commercial banks and thrift institutions.

RDISC is the Federal Reserve Discount Rate.

$\frac{GNP}{N}$ is the U.S. population.
is the highest per capita GNP achieved in the current or any preceding 19 quarters.
Sample period: 1955.3 - 1972.4.

An iterated instrumental variable estimation technique was used to estimate the equation together with the bank free reserves equation. The estimation included GNP per capita; this term was replaced by the maximum GNP per capita value early in 1974 although the equation was not re-estimated. The values in parenthesis are T-statistics. For further discussion of this equation as well as the currency equation, see Franco Modigliani, Richard Cooper and Robert Rasche, Central Bank Policy, Interest Rates, and the Money Supply, *Journal of Money, Credit and Banking,* Vol. 2, 1970: 166-218.

---

*See W. J. Baumol, "The Transactions Demand for Cash; An Inventory Theoretic Approach, *Quarterly Journal of Economics,* November 1952.

FOOTNOTES

1. M_1 refers to the narrowly defined money supply which is equal to currency in the hands of the public and demand deposits of commercial banks.
2. For a comprehensive review of conventional money demand equations see Stephen Goldfeld, "The Demand for Money Revisited." **Brookings Papers on Economic Activity,** 3 (1973): 577-638.
3. For a recent survey of the monetary transmission process which contains a comprehensive bibliography see Roger W. Spencer, "Channels of Monetary Influence: A Survey," Federal Reserve Bank of St. Louis **Review,** November 1974; 8-26. For a recent discussion of the channels of monetary influence structured in the MPS model, see Albert Ando, "Some Aspects of Stabilization Policies, the Monetarist Controversy, and the MPS Model," **International Economic Review,** Vol. 15, No. 3, October 1974: 541-571.
4. A listing of the MPS econometric model equations is obtainable from EFA, University of Pennsylvania, Philadelphia, Pennsylvania, and a comprehensive description is provided by Ando, see footnote 3.
5. The prediction errors in the MPS demand for demand deposits equation were obtained by setting all the explanatory variables equal to actual values and setting the autocorrelation coefficient equal to zero. The third quarter of 1975 is the last quarter for which we have consistent data bank: revisions are being made in light of the recently issued NIA data. Appendix A provides the money demand equation used in the MPS model.
6. For a text which describes the LM-IS functions, see Thomas F. Dernburg and Duncan M. McDougall, **Macro-Economics,** McGraw-Hill Book Co., Inc., New York, 1960.
7. The Board of Governors Staff is re-estimating an enlarged version of the MPS model using the recently revised NIPA data.
8. Table 2 is read as follows: The first forecast is based upon historical data values known through 1969.4 (i.e., the first initial conditions quarter is 1969.4). The first-quarter ahead forecast of GNP is a forecast for 1970.1 and GNP was overforecasted by $1.8 billion. The second-quarter ahead forecast for 1970.2 (still based upon the initial conditions of 1969.4) is an underforecast of $8.2 billion. The third- and fourth-quarter ahead forecasts for 1970.3 and 1970.4 are also underforecasts of $12.3 and $6.6 billion. The last simulation reported in the table was based upon historical data through 1975.2 and we could simulate only one-quarter ahead; the forecast error for 1975.3 is an underestimate of $47.4 billion.
9. For a discussion which uses an early version of the MPS model see Franco Modigliani, "Monetary Policy and Consumption, Consumer Spending and Monetary Policy: The Linkage," the Federal Reserve Bank of Boston, **Conference Series No. 5,** June 1971.
10. Keran, Michael, "Changing Money Demand?" **Business and Financial Letter,** Federal Reserve Bank of San Francisco, April 30, 1976.
11. See Larry Butler, "Has the Relation Between Income and Money Shifted?" unpublished paper, Federal Reserve Bank of San Francisco.
12. Meigs, James A. "Recent Innovations: Do They Require a New Framework for Monetary Analysis," **Financial Innovations,** William Silber editor, Lexington Books, 1975.
13. Enzler, Jared, Johnson, Lewis and Paulus, John; "Some Problems of Money Demand," **Brookings Papers on Economic Activity,** 1976.
14. Wilson, Ruth, "M_1's Institutional Factors," **Business and Financial Letter,** Federal Reserve Bank of San Francisco, March 5, 1976.
15. Statement by Arthur Burns before the Committee on Banking, Housing and Urban Affairs, U.S. Senate, May 3, 1976.