Alternative Definitions of the Money Stock and the Demand for Money

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In the last five years, the monetary aggregates have played an important role in the formulation and execution of monetary policy. At the same time, there has been growing concern that developments in financial practices over the postwar period and innovations in financial instruments and technology over the last few years have reduced the importance of the narrowly defined money stock (M_1) in the financial system and have blurred the distinction between M_1 and savings and time deposits at both commercial banks and thrift institutions. The ratio of M_1 to total liquid assets has declined steadily over the postwar period. More recently, the introduction of negotiable order of withdrawal (NOW) accounts, checking accounts at thrift institutions, expanded third-party payment privileges from savings accounts, telephone transfers between savings and demand deposit accounts, and electronic funds transfer systems have made the association of M_1 with the means of payment increasingly less compelling.

This paper is concerned with the problem of defining the money stock in this changing financial environment. In Part I, the five official measures of the money stock are presented, the savings instruments included in the broader money stock measures are briefly defined, and the developments that may have altered the role of M_1 in the financial system are discussed. Empirical evidence on the definition of money is reported in Part II. The empirical analysis is confined to M_1, M_2, and M_3, the three money stock measures for which the Federal Reserve System currently sets growth ranges.

In determining the ranges for growth in the monetary aggregates, the Federal Reserve System uses econometric models, among other tools, to predict the paths of income, prices, and employment associated with alternative rates of monetary expansion. The precision with which the System can predict the economy's response to alternative monetary growth rates depends, in some of these models at least, on the precision with which it can estimate the demand for money. And precision in estimating the demand for money can be maximized by selecting the definition of money with respect to which wealth owners exhibit the most stable and systematic behavior. Hence, the focus of Part II of this paper is on the relative predictive performance of demand functions for alternative definitions of the money stock. The empirical results reported in this section suggest that there has been a perceptible deterioration in the predictive performance of the M_1 demand function relative to the M_2 and M_3 demand functions in the 1970's. While the M_1 definition permitted the most accurate prediction of money demand over the full sample period including both the 1960's and 1970-75, the M_2 and M_3 equations yield more accurate predictions when the analysis is confined to the 1970's alone.

DEFINITIONS OF THE MONEY STOCK

There recently has been a proliferation in the number of official definitions of the money stock.[1] Until April 1971, the *Federal Reserve Bulletin* recognized only the M_1 definition of money in reporting financial data. At that time, it began to report regularly three measures: M_1, M_2, and M_3 (the sum of M_2 and deposits at mutual sav-

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[1] For the purposes of this study, measures of money regularly reported in the *Federal Reserve Bulletin* are considered official.

Table I

MEASURES OF THE MONETARY AGGREGATES

In billions of dollars, June 1976

Money stock measures	Totals
M_1 (Private demand deposits adjusted + currency outside commercial banks)	303.1
M_2 (M_1 + savings and time deposits at commercial banks other than large negotiable certificates of deposit)	700.3*
M_3 (M_2 + deposits at mutual savings banks, savings and loan association shares, and credit union shares)	1,159.2†
M_4 (M_2 + large negotiable CDs)	770.9‡
M_5 (M_3 + large negotiable CDs)	1,229.8‡

* Time and savings deposits at commercial banks other than large negotiable CDs (T) were $397.3 billion.
† Savings deposits at thrift institutions (S) were $458.9 billion.
‡ Large negotiable CDs were $70.6 billion.

ings banks and savings and loan association shares). Beginning in April 1975, M_3 was redefined to include credit union shares and two additional measures of the money stock were introduced: M_4 (the sum of M_2 and large negotiable CDs) and M_5 (the sum of M_3 and large negotiable CDs). Table I reports the magnitudes of the five official measures and the savings components of the broader measures as of June 1976.

SAVINGS AND TIME DEPOSIT COMPONENTS. As previously noted, the broader money stock measures include, in addition to M_1, one or more of the three time deposit totals mentioned above. In this section the savings instruments included in the broader definitions are described. Commercial banks and thrift institutions issue a wide assortment of savings instruments, differing in the maximum interest rate that can be paid, in the term over which the account must be held, and in the minimum denomination of the account.

Savings deposits or shares are mostly passbook accounts. Although commercial banks and thrift institutions must reserve the right to require at least thirty days' written notice before withdrawal, in practice withdrawals are honored on demand. In effect, therefore, any amount may be added to or withdrawn from a savings deposit account at any time, making it particularly well suited for savers whose deposits are in small amounts or whose needs for withdrawals may be irregular or unpredictable. *Time deposits,* unlike savings deposits, explicitly specify a maturity but may be redeemable prior to maturity with some sacrifice of interest. In addition, time deposits may require some minimum denomination and are generally issued in certificate rather than in passbook form.

During the 1950's and much of the 1960's, the savings account was the major savings instrument issued by both commercial banks and thrift institutions. However, changes in regulations and competition for savings deposits have resulted in the development of a wider assortment of instruments. By the end of 1974, the value of time accounts had increased to more than one third of the total value of accounts in mutual savings banks, almost half of the savings and time accounts (excluding large CDs) at commercial banks, and more than half of the savings and time accounts at savings and loan associations.

Several important regulatory changes affecting savings deposits at commercial banks were initiated in 1975 to permit commercial banks to compete more efficiently with thrift institutions. Effective April 7, 1975, the Board of Governors of the Federal Reserve System authorized member banks to permit the use of the telephone to withdraw funds from savings accounts or to transfer funds from savings accounts. As of September 2, 1975, the Board permitted member banks to offer a bill-paying service through preauthorized transfers of funds from customers' savings accounts to pay their debts. Previously only mortgage-related payments were permitted. These two changes may have enhanced the substitutability of savings deposits for demand deposits and, at the same time, may have increased the distinction between savings and time accounts. Effective November 10, 1975, the

Table II

CORPORATE SAVINGS DEPOSITS AT COMMERCIAL BANKS*

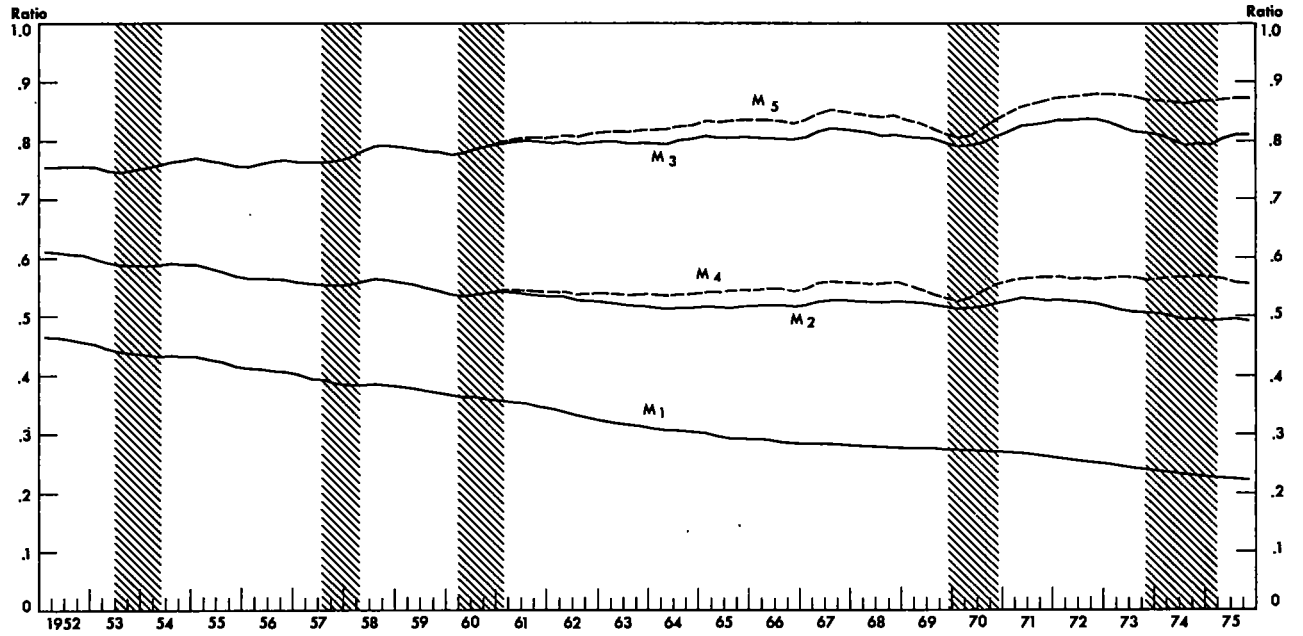
In billions of dollars

Period	Total
1975: October	0
November	0.6
December	1.5
1976: January	2.6
February	3.9
March	4.8
April	5.3
May	5.9
June	6.0

*These figures were derived by "blowing up" the data from weekly reporting banks and using the ratio of corporate savings deposits at all commercial banks to those at weekly reporting banks based on a one-time survey taken on January 7, 1976.

Chart I

RATIOS OF ALTERNATIVE MEASURES OF THE MONEY STOCK TO LIQUID ASSETS, 1952-75



Note: Shaded areas represent periods of recession as defined by the National Bureau of Economic Research, except for the latest recession which is tentatively judged to have ended in March 1975.

Source: Board of Governors of the Federal Reserve System.

Board amended the definition of savings deposits in Regulations Q and D to permit corporations, partnerships, and other profit-making organizations to maintain savings deposits of up to $150,000 per depositor at member banks. Estimates of the growth of corporate savings deposits through June 1976 are reported in Table II. These deposits increased to $6 billion dollars in seven and one-half months. During late 1975 and early 1976, this growth in corporate savings deposits may have contributed to the sluggish growth in M_1.

A *negotiable time certificate of deposit* (CD) commits the issuing bank to pay the amount deposited plus specified interest on a date specified. Because the instrument is negotiable, it can be traded in the secondary market prior to its stated maturity. Negotiable CDs typically are issued in minimum denominations of $100,000 and are the most volatile of the deposit measures. Negotiable CDs were first introduced in 1961; prior to this date, M_2 and M_4 were identical as were M_3 and M_5.

RATIOS TO TOTAL LIQUID ASSETS. Chart I depicts movements in the ratio of each money stock measure to total liquid assets over the period 1952-I to 1975-IV. Total liquid assets are defined here as M_5 plus short-term Government securities, United States savings bonds, and commercial paper. The secular trend in the money stock measures points up a concern among those who favor the broader money stock definitions. As a ratio of total liquid assets, M_1 has steadily declined over the period—from almost half in 1952 to less than one quarter in 1975.

M_2 has also declined as a percentage of total liquid assets, although to a substantially smaller degree. The M_2 ratio has declined from just over 60 percent in 1952 to 50 percent in 1975. The greater stability of the M_2 ratio reflects offsetting influences stemming from the declining proportion of M_1 in total liquid assets counterbalanced by an increase in the proportion of savings and time deposits at commercial banks. The share of the latter in total liquid assets rose from 15 percent in 1952 to about 27 percent in 1975. The proportion of total liquid assets held as savings and time deposits at thrift institutions underwent a similar increase, climbing from about 15 percent in

1952 to about 30 percent in 1975. As a result of the growth of savings and time deposits at commercial banks and thrift institutions, the share of M_3 in total liquid assets increased from 75 percent in 1952 to 80 percent in 1975.

The behavior of M_4 and M_5 relative to total liquid assets is also evident in Chart I. Over the period of its independent existence, the ratio of M_4 to total liquid assets has changed little, with growth of CDs offsetting the reduction of the M_2 share. The ratio of M_5 to total liquid assets has increased from 80 percent in 1961 to 87 percent in 1975, reflecting the proportionate run-up in both M_3 and CDs.

Overall, M_1 and M_2 have declined as proportions of total liquid assets, with the decline in the M_2 ratio far less dramatic than the halving of the M_1 ratio over the period. On the other hand, the shares of M_3 and M_5 in liquid assets have risen, while the M_4 proportion has changed very little. The pronounced decline in the ratio of M_1 to total liquid assets, however, is not necessarily evidence that the usefulness of the M_1 definition of money has deteriorated. M_1 could still be the aggregate with respect to which wealth owners behave most systematically, and the decrease in the ratio of M_1 to total liquid assets simply could reflect lower income and/or wealth elasticities of demand for M_1 compared with the savings components included in the broader measures.

FINANCIAL DEVELOPMENTS. Nevertheless, the financial innovations of the last several years seemingly have blurred the distinction between savings and demand deposits and may have weakened the close link between M_1 and the means of payment. Two important innovations were the introduction of checking privileges on interest-bearing savings accounts in New England and the spread of noninterest-bearing checking facilities at thrift institutions in states where checking privileges for savings accounts are prohibited.

In January 1974, Congressional legislation became effective authorizing all depository institutions in Massachusetts and New Hampshire to issue NOW accounts but prohibiting their introduction in other states. Depository institutions are permitted to pay a maximum interest rate of 5 percent on NOW accounts; these accounts can be issued only to individuals and nonprofit organizations. In March 1976, Federal legislation which sanctioned NOW accounts in the four other New England states (Connecticut, Maine, Rhode Island, and Vermont) became effective. The growth of NOW accounts is reported in Table III.

Noninterest-bearing accounts with negotiable order of withdrawal provisions, called payment order accounts, were introduced by savings banks in New York in 1974. In May 1976, New York State legislation which permitted state-chartered thrift institutions to offer checking accounts to individuals and nonprofit institutions became effective. Of the eighteen states and territories (including Puerto Rico) with mutual savings banks, ten currently permit savings banks to offer checking accounts (Indiana, Delaware, New York, New Jersey, Connecticut, Maine, Maryland, Oregon, Rhode Island, and Vermont). Federal regulations prohibit Federally chartered savings and loan associations from issuing checking-type deposits, but some states have permitted state-chartered savings and loan associations to offer either third-party payment orders (Illinois) or demand deposit accounts (Connecticut, Maine, Vermont, Rhode Island, and New York). Interest-bearing check-like instruments, called "share drafts", were introduced by credit unions in October 1974.

Interest-bearing NOW accounts at commercial banks are included in their savings deposit totals and therefore are included in M_2 but not in M_1. Interest-bearing NOW accounts and noninterest-bearing checking accounts at savings and loan associations are included in M_3 but not in M_1 or M_2, and NOW accounts at mutual savings banks are included in M_3 but not in M_1 or M_2.

Table III

NEGOTIABLE ORDER OF WITHDRAWAL (NOW) ACCOUNTS IN NEW ENGLAND

In thousands of dollars

Month ended	Total of all offering institutions in New England	Commercial banks	Mutual savings banks	Savings and loan associations
1972: December	45,272		45,272	
1973: December	143,254		143,254	
1974: December*	312,576	65,249	213,661	33,666
1975: December	839,256	358,940	386,560	93,756
1976: January	880,357	394,239	389,589	96,529
February	942,779	435,080	406,217	101,482
March†	1,091,004	543,456	435,352	112,196
April	1,206,880	627,525	456,166	123,189
May	1,324,030	738,586	458,288	127,156
June	1,415,712	804,328	476,112	135,272

* Congressional legislation enacted by the Congress which authorized all depository institutions in Massachusetts and New Hampshire to issue NOW accounts became effective on January 1, 1974.

† Federal legislation which sanctioned NOW accounts in all depository institutions in Connecticut, Maine, Rhode Island, and Vermont became effective on March 1, 1976.

Source: *Monthly Statistical Release on Now Accounts* (Research Department, Federal Reserve Bank of Boston), June 30, 1976.

Checking accounts at mutual savings banks which do not earn interest are not included in any of the monetary aggregates. Accounts at credit unions against which share drafts can be written are included in M_3 but not in M_1 or M_2. If NOW accounts and thrift checking accounts become increasingly important, M_1 may well include a declining proportion of the stock of assets used as a means of payment.

Overdraft banking also may have reduced the role of M_1 in the payments process. Overdraft banking permits the user to secure a loan simply by writing a check in excess of the current balance in his checking account. If the overdraft is used to make a purchase and is subsequently offset by the transfer of funds from the purchaser's savings account, in effect final payment is made from the savings account and M_1 has played no role at all in carrying out the exchange.[2]

VELOCITY. In addition to these changes in financial practices, concern over the appropriate definition of money has been heightened as a result of the behavior of M_1 velocity relative to that of the other monetary aggregates. Velocity measures the relationship between the stock of money and the flow of income or payments; more precisely, the income velocity of money is the ratio of income to money, or the rate at which the money stock "turns over" in income transactions during a period. Velocity can be viewed as the link between the money stock and spending. This can be seen by writing current-dollar income (Y) as the product of velocity (V) and money (M):

$$Y=VM$$

In Chart II, movements in the velocity measures corresponding to the five monetary aggregates discussed in this paper are depicted for the period 1952-I to 1975-IV. The only velocity measure with a pronounced trend over the entire period is V_1. During the period, V_1 grew at a 2.9 percent compound annual rate. The trend rate was 3.2 percent over the period 1952-66, but then it slowed to 2.4 percent per year over the 1967-75 period.[3] The velocity measure corresponding to M_2 exhibits a more moderate upward trend prior to 1962 and no significant trend thereafter. Over the period 1962 to 1975-IV, V_2 remained in the narrow range of 2.30 to 2.45. The V_3, V_4, and V_5 series (corresponding to M_3, M_4, and M_5, respectively) also displayed less trend than the V_1 series.

These differences in observed velocity do not necessarily indicate that M_1 velocity is more difficult to predict. Predictability and stability are not the same thing.[4] The determinants of velocity are precisely the forces that determine the demand for money; i.e., the value of V is the outcome of portfolio decisions about how much money wealth owners want to hold relative to income. Hence, concern with velocity suggests the importance of focusing on the relative performance of money demand functions that employ alternative definitions of money.

EMPIRICAL EVIDENCE ON THE DEFINITION OF MONEY

The declining share of M_1 in liquid assets, the marked upward trend in its velocity, and recent innovations in financial practices all raise questions about continued emphasis of this aggregate. However, as noted above, the issue hinges on the relative predictive performance of demand functions for money using alternative definitions of the money stock. From the perspective of stabilization policy, accurate prediction of the demand for money is important in part because it can affect the precision with which the consequences of alternative monetary growth rates can be forecasted. More specifically, in many models one element in assessing accurately the implications of alternative money growth targets for real income, employment, and prices is a reasonably stable money demand function.

Reliance on the predictive performance of the money demand function under alternative definitions of money has been urged as a criterion for determining the definition of money by Friedman and Meiselman [4] and Friedman and Schwartz [5].[5] The preferred measure of money is the one exhibiting the smallest prediction error. The

[2] Proposals to cover automatically overdrafts at commercial banks with funds from savings accounts are pending.

[3] However, the growth of V_1 over the 1970-75 years alone was roughly equal to that in the 1952-66 interval.

[4] Friedman [3] suggests that the best definition of money is the one that yields the most easily predictable velocity. However, in comparing M_1 and M_2, Friedman identifies *stability* of the velocity series with its *predictability* and concludes that M_2 should be preferred to M_1, because M_2 velocity (V_2) is relatively constant while M_1 velocity (V_1) exhibits a pronounced upward trend.

[5] Friedman and Schwartz suggest that "the desideratum is a monetary total whose real value bears a relatively stable relation to a small number of variables that theoretical considerations lead us to believe affect the real quantity of money demanded. . . ." [5, pp. 139-40]. In their empirical work on the definition of money, however, Friedman *et. al.* employed money income correlations rather than explicit money demand functions.

empirical analysis in this paper is confined to M_1, M_2, and M_3, the three money measures for which the Federal Reserve System currently sets growth ranges.[6] The empirical approach employed below uses two separate objective criteria—the first previously employed by Brunner and Meltzer [1] and the second introduced by Goldfeld [6]—to assess the relative predictive performance of alternative money demand functions and therefore to shed light on the appropriate definition of money:

(1) Comparison of percentage prediction errors for M_1, M_2, and M_3 demand equations (Brunner and Meltzer [1]).

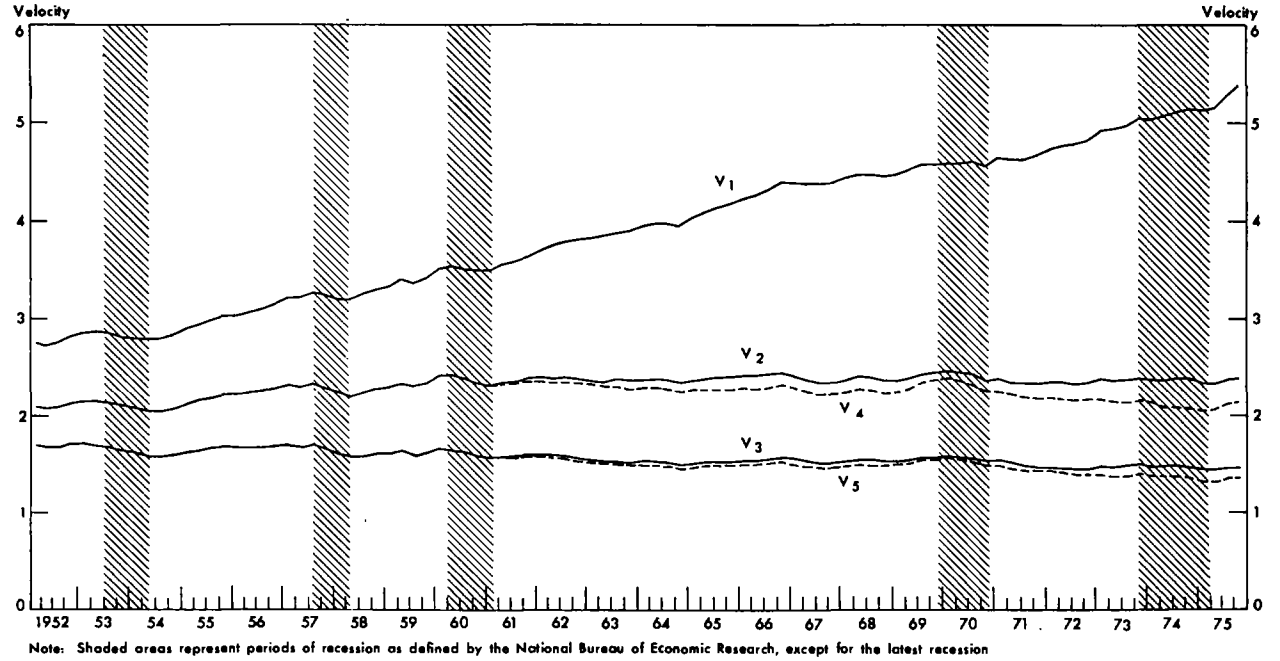
(2) Comparison of aggregate and disaggregated predictions of M_2 and M_3 (Goldfeld [6]). For example, assume the choice is between M_1 and M_2. M_2 predictions can be made directly from an M_2 equation (referred to as an aggregate prediction) or by summing the predicted values of separate M_1 and time deposit equations (referred to as a disaggregated prediction). If the disaggregated prediction is superior to the aggregate prediction, this suggests that "aggregation is inflicting some positive harm" [p. 594] and M_1 is preferred to M_2. On the other hand, if the aggregate prediction outperforms the disaggregated, M_2 would be preferred to M_1. This second approach is applied below to M_2, M_3, and the sum of savings and time deposits at commercial banks and thrift institutions.

SPECIFICATION OF THE DEMAND FUNCTION. Demand functions for M_1, M_2, and M_3, time and savings deposits at commercial banks other than large negotiable CDs (T), savings deposits at thrift institutions (S), and the sum of T and S (TS) were estimated over the period 1952-II

[6] For previous empirical research on the stability and predictive performance of the money demand function, see Brunner and Meltzer [1], Laidler [8], Hamburger [7], and Goldfeld [6]. Laidler concluded that the M_2 function was more stable than the M_1 function, but the other studies favored the M_1 definition.

Chart II

VELOCITY OF ALTERNATIVE MEASURES OF THE MONEY STOCK, 1952-75



Note: Shaded areas represent periods of recession as defined by the National Bureau of Economic Research, except for the latest recession which is tentatively judged to have ended in March 1975.

Source: Board of Governors of the Federal Reserve System.

to 1974-II.[7] As in most standard formulations, the demand for money is assumed to depend on income and/or wealth and interest rates. The income version reflects the transactions view of the demand for money.[8] The transactions view immediately suggests the M_1 definition, given that M_1 appears to be the empirical counterpart to the theoretical construct of the medium of exchange. However, the increasing use of third-party payment privileges from savings accounts, NOW accounts, and checking accounts at thrift institutions suggests that the empirical counterpart to the means of payment is no longer as clear-cut as it once was.

The wealth version of the demand for money emphasizes the nonpecuniary return associated with holding money. Money is viewed as a temporary abode of purchasing power which bridges the gap between sales and purchases of goods and services. Viewed in this fashion, money includes the medium of exchange but may be broader. The empirical counterpart is not so clearly defined as for the means of payment, and the choice of assets to include is, of necessity, an empirical issue.

Based on the general considerations just discussed, to derive the money demand equation estimated in this paper the long-run desired level of real money holdings (m^*) is first specified as a function of real income (y), interest rates (r), and real net wealth (a):

$$m^* = L(r,y,a)$$

Portfolio adjustment costs are assumed to induce wealth owners to adjust actual money holdings (m) to the long-run desired level of money balances (m^*) with a lag. Using a stock-adjustment approach, the change in real money balances between periods t and t–1 is related to the discrepancy between desired money balances in t and actual holdings in t–1, or

$$m_t - m_{t-1} = \alpha\,(m^*_t - m_{t-1})$$

where α is the speed of adjustment. Following Goldfeld, the basic form of the equations is logarithms in the levels of the variables. Measures of money and time and savings deposits, income, and wealth are deflated by the gross national product (GNP) implicit price deflator. The commercial paper rate and one rate on savings deposits are used in each regression, except with M_2 where only the commercial paper rate is employed.[9] The wealth variable is net worth of households, constructed for use in the MPS econometric model of the United States economy.

The basic form of the money demand equation tested is as follows:

$$\ln m_t = a + b \ln y_t + c \ln a_t + d \ln RCP_t + e \ln RS_t + f \ln m_{t-1}$$

where *m* is one of the various measures of the money supply or a component thereof deflated by the GNP price deflator, *y* is real GNP, *a* is the real value of net worth of households, *RCP* is the commercial paper rate, and *RS* is one of the savings account rates.[10] Three versions were estimated for each aggregate depending on whether income only, wealth only, or both income and wealth were included as independent variables in the regression. Below the results for the income versions of the M_1, M_2, M_3, T, and TS equations are reported, along with the wealth version of the S equation. More complete results can be found in Meyer [9].

PERCENTAGE RMSE IN AND OUT OF SAMPLE. The most widely used criterion for comparing money demand functions under alternative definitions of money involves comparison of in-sample and out-of-sample predictive performance. The in-sample results are based on the

[7] The end point of 1974-II was selected because of indications that all equations exhibited structural shifts at or after this date.

[8] According to this view, the essential property of money is that of a medium of exchange, facilitating purchases and sales of goods and services. Money is held in portfolios between receipt from sales and expenditures on goods and services because of the transactions costs of moving between money and interest-earning assets. Income is included in the money demand function as a measure of the volume of transactions, and interest rates reflect the opportunity cost associated with holding money.

[9] The savings deposit rate was not statistically significant in the M_2 equation. The savings rate used in each equation is reported in the following table. RSAV is a weighted average of rates on savings and time deposits at commercial banks (RTD), at savings and loan associations, and at mutual savings banks; RTHR is a weighted average of rates at savings and loan associations and mutual savings banks. In both cases, the weights are the proportions of the total stock of assets in the previous quarter:

Equation	*Saving rate*
M_1	RSAV
T	RTD
S	RTHR
TS	RSAV
M_3	RSAV

[10] While this is a conventional specification of the money demand function (see, for example, Goldfeld [6]), it is by no means the only possibility. One characteristic of this equation which should be pointed out is that it implies that nominal money holdings adjust to price disturbances within a quarter, while adjustment to changes in all other independent variables occurs with a lag.

Table IV

PREDICTIVE PERFORMANCE OF M_1, M_2, AND M_3 EQUATIONS

RMSE as a percentage of the mean

Definition	In sample	Out of sample
	1952 to 1974-II	1962-75
M_1	0.42	0.96
M_2	0.47	0.96
M_3	0.44	1.23

RMSE = Root mean squared error.

Table V

OUT-OF-SAMPLE PREDICTIONS OF M_1, M_2, AND M_3

RMSE as a percentage of the mean

Definition	1962-69	1970-75
M_1	0.77	1.20
M_2	1.27	0.65
M_3	1.45	1.01

RMSE = Root mean squared error.

percentage root mean squared errors (RMSEs)[11] over the period 1952-II to 1974-II; the out-of-sample results are based on four-quarter dynamic simulations over the period 1962-I to 1975- IV.[12]

Table IV reports the RMSE as a percentage of the mean for the M_1, M_2, and M_3 equations for both in-sample and out-of-sample predictions. The results of this comparison favor the M_1 definition in that the M_1 equation yields the best predictive performance both in and out of sample. The prediction error for M_1 is 0.42 percent in the in-sample results, compared with 0.47 percent for M_2 and 0.44 percent for M_3. In the out-of-sample results, the percentage prediction error is 0.96 percent for both M_1 and M_2 and 1.23 percent for M_3.[13]

These results appear to provide support for the M_1 definition. To determine whether or not there has been any deterioration in the relative predictive performance of M_1, compared with M_2 and M_3, the period used for out-of-sample tests was broken into two subperiods: 1962-69 and 1970-75. The basic equation described above, using alternative definitions of money, was simulated dynamically for these periods. The results are reported in Table V.

During the earlier 1962-69 subperiod, the M_1 definition yields the smallest percentage prediction error (column 2 of Table V). During the 1970's, however, the M_2 definition yields the smallest prediction error and M_1 yields the largest error (column 3 of Table V).[14] The subperiod results suggest, therefore, that the performance of the M_1 equation relative to the M_2 and M_3 equations has deteriorated in the last several years.

AGGREGATE VS. DISAGGREGATED PREDICTIONS OF M_2 AND M_3. The second empirical criterion for the definition of money, discussed above, involves a comparison of aggregate and disaggregated predictions of the broader measures of the money stock. For example, if M_2 is the appropriate definition of money, it should be possible to predict movements in M_2 more accurately using an explicit demand function for M_2 rather than making predictions from separate demand functions for its components, M_1 and T. Similarly, predictions of M_3 based on an aggregate M_3 function should be compared with predictions derived from separate equations for its components.

This criterion is applied to the results of dynamic out-of-sample simulations over the 1962-75 period. For the

[11] The RMSE is defined as the square root of the sum of squared errors divided by the number of forecasts. The percentage RMSE is computed by deflating the RMSE by the mean of the actual values of the variable being predicted. Again, while comparison of RMSEs is a conventional procedure, it is not the only way to distinguish between these aggregates. Use of the RMSE means that large errors are given a great deal of weight.

[12] In a dynamic simulation, the predicted value of the money supply is used in the following period as the value of the lagged dependent variable. A regression is initially estimated over the period 1952-II to 1961-IV. To determine the predicted value of money in 1962-I, actual values are substituted for income, wealth, and interest rates in 1962-I and for the value of money in 1961-IV. To determine the predicted value of money in the next quarter, actual values of income, wealth, and interest rates in 1962-II and the predicted value of money in 1962-I are substituted in the equation. The same procedure is followed to yield predicted values in 1962-III and 1962-IV. At this point, four quarters are added to the sample period, the regression is rerun through 1962-IV, and predicted values are determined for 1963. The procedure is continued through 1975.

[13] The four-quarter out-of-sample dynamic predictions are extended through 1975 to increase the number of observations available to discriminate between aggregates.

[14] This result could depend heavily on the deterioration in the M_1 demand function evident since mid-1974. On this subject, see Enzler, Johnson, and Paulus [2].

Table VI

AGGREGATE VS. DISAGGREGATED PREDICTIONS

Four-quarter post-sample predictions
Root mean squared errors

Definition	1962-69		1970-75	
	Aggregate	Disaggregated	Aggregate	Disaggregated
M_2	5.02	4.98	3.14	3.66
M_3	8.87	7.06	7.93	8.27
TS	7.63	6.84	7.75	8.20

entire period, the out-of-sample results provide some superficial support for M_2 over M_1 in that the disaggregated M_2 prediction error exceeds the aggregate prediction error. However, there is also evidence suggesting that T and S should be treated as a single aggregate and, if this is the case, the appropriate comparison is between M_1 and M_3 and not between M_1 and M_2. The disaggregated prediction of M_3 dominates the aggregate prediction, suggesting a preference for M_1 over M_3.

Subperiod results for the post-sample prediction period are reported in Table VI. The disaggregated predictions are consistently superior in the 1960's, although the difference with regard to M_2 is small.[15] The results for the subperiod of the 1970's, however, are just the reverse. The aggregate equations consistently yield the better predictions. Taken together, these results seem to support the deterioration in the relative performance of the M_1 demand function in the 1970's that was evident in the results based on percentage prediction errors for M_1, M_2, and M_3. And, since these results also suggest that T and S should be treated as an aggregate, M_3 rather than M_2 may be the preferred definition.

CONCLUSION

The ability of the Federal Reserve System to predict the response of the economy to monetary policy may depend, in part, on the precision with which it can predict the portfolio behavior of the private sector. In turn, the precision with which private portfolio behavior can be predicted depends on identifying those asset categories with respect to which the private sector exhibits systematic behavior and, in part, it depends on estimating demand functions for those categories.

A number of recent financial developments have raised concern about the continued usefulness of the narrow definition of the money stock. The secular decline in the ratio of M_1 to total liquid assets may suggest a diminished role for M_1 in the financial system. The greater stability of the velocity measures corresponding to the broader money stock measures has been cited in support of broadening the definition of money. Yet neither of these secular trends represents direct evidence about the appropriate definition of money.

To provide direct evidence, this paper compared the predictive performance of demand functions for the M_1, M_2, and M_3 definitions of money. The evidence based on the full sample and full post-sample periods indicated that the private sector behaved in a more systematic fashion with respect to the M_1 variable than with respect to the broader measures. When the period was broken into the 1960's and the 1970's, however, evidence of deterioration in the predictive performance of the M_1 equation relative to the M_2 and M_3 equations was uncovered. While the M_1 definition yielded the best results during the 1960's, the broader money stock measures were generally superior in the 1970's. Consistent with this, moreover, was the superiority in the 1970's of the aggregate predictions of M_2 and M_3 in comparison with the disaggregated predictions.

[15] Similarly, for the period 1961-71, Goldfeld found that disaggregated predictions of M_2 outperformed the aggregate results (see [6, pp. 592-95]).

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