

DO THE MONETARY AGGREGATES HAVE A FUTURE
AS TARGETS OF FEDERAL RESERVE POLICY?

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Economists in recent years have been writing prolifically about a new phenomenon--sudden, unanticipated shifts in the public's "demand for money," shifts which have not been explained by the traditional determinants of the rate of growth of the nominal GNP and changes in interest rates. This much greater instability in the money demand function coincided in time with the increased pace of financial innovation. Has the public's demand for money really become much more unstable, or does it just seem more unstable because of our inability to measure money accurately in a world of rapid financial innovation?

The pace of financial innovation has led us to the point where any definition of the money supply must be arbitrary and unsatisfactory. Any definition of the money supply will include assets that some people view as short-term investments (not transactions balances) and will exclude other assets that some people view as transactions balances. For example, a percentage (probably small) of money market funds are used as transactions balances and ought to be included in the money supply, but the great bulk of money market funds are viewed as short-term investments by their owners. Perhaps a survey could determine what percentage of money market funds should be included in the money supply, but there is no reason to believe that the percentage revealed by a survey would be stable over time. Furthermore, money market funds are only

one of an array of new financial instruments that an inventive market has spawned in recent years and some unknown part of these new instruments ought to be included in the money supply.

Therefore, I have concluded, most reluctantly, that we can no longer measure the money supply with any kind of precision. The consequences of such a conclusion are obviously far-reaching and will be discussed at a later point. For now, let me reassure the reader that my position is not widely shared by my colleagues in the Federal Reserve System.

In the simple financial world of my graduate school days (circa 1950) we had no problems in distinguishing money from other liquid assets. Money consisted of currency and demand deposits. These were the only vehicles by which payments could be made. Of course, we recognized that there were "near-monies," but "near-monies" had to be converted into money before a payment could be made. Moreover, costs were incurred in converting "near-money" into money, if only the cost of taking your passbook down to the bank and arranging to transfer funds from a savings account to a checking account. The costs were, of course, more formidable in transforming other "near-monies," such as Treasury bills, into money.

Four factors combined to change this simple world:

- (1) The sharp rise in interest rates, which dramatically raised the opportunity costs of leaving funds in noninterest bearing deposits.

- (2) The development of the computer, which reduced to minimal levels the cost of transferring liquid assets into money. It is difficult, for example, to imagine such a complex system as the cash management account developing in the pre-computer era. The cost of operating the system would have been prohibitive.
- (3) The prohibition against the payment of interest on demand deposits, which creates a great incentive to transform the demand deposit into an income-earning asset, whenever feasible.
- (4) The structure of reserve requirements, which puts a heavy franchise tax on anything called a transaction account. This gives an advantage to institutions not subject to reserve requirements to offer a similar financial service on a more advantageous basis.

This wave of financial innovation might have little enduring significance if it could be argued that it was largely concluded and that innovations in the future would have little effect on the growth rates of the monetary aggregates. Unfortunately, both seem highly improbable.

Interest rates are likely to decline in the years ahead. Certainly, the Federal Reserve's long-term policy is designed to produce this result. However, there is no reason to believe

that interest rates will fall so low in the foreseeable future as to eliminate the incentive to shift demand balances to some form of earning asset.

Conceivably, the Congress could reduce the incentives for innovation by passing legislation removing the prohibition against the payment of interest on demand deposits and permitting the payment of interest on reserve balances held at Federal Reserve Banks. However, such legislation also seems highly improbable in the foreseeable future. The Congress has a long list of banking reform issues on its agenda, but the list does not include either of these proposals.

Thus, it seems unlikely that the incentives for financial innovation will be substantially reduced in the years ahead and the cost of computer transfers is likely to continue to decline. Moreover, the intensified competition between banks, thrift institutions, and nonbanking institutions offering financial services, is likely to stimulate innovation.

The particular innovation likely to have the most impact on the monetary aggregates in the next few years is deposit-sweeping--an attractive service under which deposit balances over a specified amount are shifted automatically into an income-earning asset on a daily or weekly basis. At present, deposit-sweeping is largely confined to the accounts of large corporations, although this is a prominent feature of cash

management accounts available to individuals. To calculate the demand balances of large corporations accurately today, they should be measured between 9 a.m. and 10 a.m., before the deposit-sweeping operation occurs. Since it is our practice to calculate the money supply on the basis of balances at the close of business, we obviously miss a large part of corporate demand balances, funds which will automatically reappear in the corporate account the next morning or a few days hence. Clearly, these swept balances are considered by the corporate treasurer to be part of his corporation's money supply, but it is only the unswept balance which enters the national M1 statistics.

Here again, if the movement to deposit-sweeping were to be limited to large corporations, the impact on the monetary aggregates in the years ahead might not distort the monetary aggregates unduly. Unfortunately, deposit-sweeping appears to be in its infancy. There is ample evidence that it is being offered to medium-sized and small businesses and will soon be offered to consumer accounts as well. If the cash management accounts that brokerage firms offer provide deposit-sweeping to their clients, progressive banking institutions can do no less. Given the continued decline in the cost of computer terminals, it seems probable that in the not too distant future, the middle class consumer may have the capability at home of sweeping his account as often as he chooses by activating his bank's computer.

Unless this vision of the future is completely without merit, it would seem that the problems of measuring the "money supply," however defined, will be formidable in the future--as will the problems of interpreting the significance for monetary policy purposes of the numbers coming out of the Federal Reserve's computer.

Thus far, we have confined our remarks only to the problem of differentiating money and liquid assets. There is also a companion problem to be considered--the problem of differentiating money from debt. In 1950 I was taught that money could be differentiated from debt (at least private debt) in that money was a generally accepted medium for payment and that debt had to be converted into money before it could be accepted in making payments. That relationship is currently being stood on its head. In the case of overdraft accounts, credit card systems where the holders of cards may activate credits by writing a check and cash management accounts at brokerage houses, the payment is made by check before the debt is created. Certainly, the widespread development of such systems of automated credit programs must substantially reduce the need for precautionary deposit balances, a function that we used to talk about as one of the principal roles of money.

The financial world has been revolutionized since 1950, but the measurement of the money supply is little changed. We have exhibited in recent years a strong nostalgic urge to

retain a statistical concept of transaction balances, even though we understand intellectually that innovation and the computerization of the financial system have made it impossible to draw a clear line between money and other liquid assets.^{1/}

Where Do We Go from Here?

It is one thing to point out the inadequacies of M1 as a target for monetary policy, it is quite another to find an alternative. The problem stems essentially from the limited tools available to the FOMC Manager. The Manager can control the federal funds rate (as he did prior to October 6, 1979) or bank reserves (as he has done since then) or some combination of the two. It follows that, if the Manager is to be accountable to the FOMC, the instructions given him by the Committee must be framed in terms of the variables he can control, the federal funds rate or bank reserves. This simple fact raises serious obstacles to the control of variables other than M1.

Let us take a look at possible substitutes for M1 and comment on the problems in controlling them. Could we go with the broader aggregates, M2 and M3? Perhaps, but they, too, can be distorted by shifts of funds which have no monetary

^{1/}At the December 1980 FOMC meeting, I argued that we should not have a 1981 guideline for M1, since with the movement to nationwide NOW accounts, the M1 numbers would be impossible to interpret. With 1981 now in the record book, the results support my position. M2, M3, and bank credit bear a reasonably expected relationship to nominal GNP, but the extremely slow growth rate of M1 was a complete surprise. No one has yet found a satisfactory explanation for it.

policy significance. One example--to the large investor, money market funds, bank CDs, Treasury bills and high-grade commercial paper are fairly close substitutes. In a period of rapidly rising interest rates, it may pay the large investor to get out of money market funds, because the rates paid on the funds tend to lag the market. If he moves into a large CD, M2 goes down but M3 remains unchanged. If he moves, instead, into Treasury bills or commercial paper, both M2 and M3 go down. Similarly, savings bonds are fairly close substitutes for small CDs and money market funds. Presumably, the bulk of the substantial decline in savings bonds in recent years has been reflected in a shift into small CDs or money market funds, shifts which have increased M2 and M3. Shifts of these kinds have no significance for monetary policy, so it would seem that aggregates subject to these shifts are not ideally suited as targets for monetary policy.

If we are to abandon the concept of "money-ness" and to use liquid assets as a target, it would seem to follow that we should use total liquid assets, with the Federal Reserve being charged with incorporating new forms of liquid assets as soon as they become significant. The case for using any particular subset of liquid assets, such as M2 or M3, would not seem to be very compelling. Alternatively, we could use, as a target, total credit creation (excluding the debts of

financial institutions) or the nominal GNP.^{2/}

^{2/}Two Nobel prize winners, James Tobin and James Meade, have argued that the target for monetary policy should be the nominal GNP.

See Tobin in Controlling Monetary Aggregates III, Federal Reserve Bank of Boston Conference Series, October 1980, p. 75.

Professor Meade in his Nobel prize lecture stated:

If the velocity of circulation of money were constant, a steady rate of growth in the total money demand for goods and services could be achieved by a steady rate of growth in the supply of money, and this in turn could be the task of an independent Central Bank with the express responsibility for ensuring a steady rate of growth of the money supply of, say, 5% per annum. It is a most attractive and straightforward solution; but, alas, I am still not persuaded to be an out-and-out monetarist of this kind. It is difficult to define precisely what is to be treated as money in a modern economy. At the borderline of the definition substitutes for money can and do readily increase and decrease in amount and within the borders of the definition velocities of circulation can and do change substantially. Can we not use monetary policy more directly for the attainment of the objective of a steady rate of growth of, say, 5% per annum in total money incomes, and supplement this monetary policy with some form of fiscal regulator in order to achieve a more prompt and effective response?

"The Meaning of 'Internal Balance'," The Economic Journal, September 1978, pp. 430-431.

Henry Kaufman has long argued that monetary policy should be focused on credit creation as a target rather than the monetary aggregates. See Controlling Monetary Aggregates III, Federal Reserve Bank of Boston Conference Series No. 23, October 1980, p. 68.

Benjamin Friedman has argued for a dual money and credit target. See his article in this issue.

The difficulties begin to arise when we attempt to establish a control mechanism for the alternative targets. There is no support within the FOMC and very little outside of it to return to the pre-October 6, 1979 practice of attempting to control any of these variables by controlling the federal funds rate. The two fatal flaws in the old system were: (1) that we did not know how much of a change in interest rates was needed to meet our objectives and (2) given that fact and given also the awareness of FOMC members of the impact that sharp interest rate changes have on both the domestic and foreign economies, there was a systematic tendency on the part of the Committee to raise (or lower) interest rates in smaller increments than the situation required. The action taken was frequently too little and too late and, as a consequence, monetary policy was frequently more procyclical in character than any Committee member would have thought appropriate.

It has proven much easier for the FOMC to agree on a monetary growth path and to accept the interest rate consequences of that path than it was for the Committee to make explicit decisions to change interest rates to the extent required. As a result, since October 6, 1979, interest-rate adjustments have been much prompter and the changes in interest rates have been of a scale necessary to maintain reasonable control over the monetary aggregates.

If we agree that it would not be prudent to go back to using the federal funds rate as the control instrument, that leaves us only with bank reserves. Unfortunately, the structure of reserve requirements (12 percent against transactions balances 3 percent against nonpersonal time deposits and no reserves against all other liabilities) is well-suited for the control of M1, but not well-suited for the control of anything else. We are in a Catch 22 situation in that the one thing we are well-positioned to control through bank reserves is no longer a meaningful target for monetary policy.

To control the broader monetary aggregates, a uniform reserve requirement against all liabilities of depository institutions would be desirable. This would require new legislation which would be politically feasible only if the Federal Reserve were authorized to pay interest on reserve balances, and that proved to be politically impossible as part of the Monetary Control Act of 1980.

Of course, it makes no sense to talk about controlling through bank reserves, in any direct way, such broad targets as total liquid assets, total nonfinancial debt, or the nominal GNP. These can be controlled only indirectly through the effect of the growth rate of bank reserves on interest rates and the subsequent impact of changing interest rates on economic activity.

But, perhaps, the differences may not be as great as they seem. It can be argued that in a world of liability management where (unlike the banking system of the college textbook) banks first make loans and then buy the money to fund them, it is interest rates and the effect of interest rates on economic activity that fundamentally determine the growth rate of M1.

A Proposal for Change

There may be several ways to deal with the dilemmas I have described. I would like to suggest a possible solution which would entail a minimum of change in our present procedures.

The goal of monetary policy would be stated as the rate of growth of total liquid assets, total debt of the nonfinancial sector, or the nominal GNP. The word goal, rather than target, is used to emphasize that we cannot fine-tune these variables with monetary policy alone. In the present context, the goal rate of growth of the chosen variable would be one which would be compatible with a continued deceleration of the inflation rate.

At the beginning of the year, the FOMC would make an initial judgment as to the "expected" rate of growth of total bank reserves to be associated with the goal. Let us assume that the FOMC's goal is a 10 percent growth in the total liquid assets and that a 5 percent growth in total bank reserves would be expected to be associated with that goal. The execution of monetary policy would be essentially unchanged. The staff would calculate the week-to-week reserve growth path that would

be consistent with a 5 percent annual growth rate and the FOMC Manager would allow the federal funds rate to fluctuate to the extent needed to stay on that reserve path.

If the actual rate of growth of total bank reserves needed to support the Committee's goal turned out to be the same as the 5 percent "expected" rate, no changes would be needed. If, however, we were to find that the goal of the FOMC would more likely be achieved with a rate of growth of total bank reserves lower than 5 percent, the reserve growth path would be revised downward. Bank reserves would be an instrument, not the goal of monetary policy.

Of the three goals for policy mentioned earlier, my first choice would be total liquid assets, primarily because it seems to offer the easiest transition from the current system. Since the weakness of the present system stems from our inability to draw a clear line between money and other liquid assets, moving to a total liquid asset goal would seem to be a logical next step.

Furthermore, the relationship between total liquid assets and the nominal GNP is very stable and predictable (much more so than the relationship of M1 to the nominal GNP) and it has exhibited no substantial change in recent years.^{3/} The debt of the nonfinancial sector also has a very stable historical

^{3/} For an analysis of the relationship of M1, total liquid assets and the debt of the nonfinancial sector to the nominal GNP, see the appendix written by my colleague, Richard M. Kopcke.

relationship to the nominal GNP, but more difficult data problems would be encountered with its use as a goal for policy than would be involved with total liquid assets.

Control theory would suggest that the nominal GNP should be the preferred goal. One advantage of the nominal GNP as a goal is that it would upgrade the quality of the dialogue on monetary policy. There would be much more substance in such a dialogue than the current one over an M1, the meaning of which is growing increasingly obscure.

Monetary policy can influence the nominal GNP, but it normally has relatively little influence on how growth in the GNP is divided between increases in prices and real output. Another advantage of a nominal GNP goal for monetary policy is that it would emphasize to both management and labor that the tradeoff for increases in real output and employment is continued reduction in the inflation rate.^{4/}

Despite the advantages in theory of a nominal GNP goal, it may offer problems in practice. It may be more difficult for the FOMC to obtain a consensus on a nominal GNP goal than it would be to obtain a consensus on total liquid assets. In addition,

^{4/} James Meade, "The Meaning of 'Internal Balance'," pp. 428-429. If one is going to aim particular weapons at particular targets in the interests of democratic understanding and responsibility, it is, in my opinion, most appropriate that the Central Bank which creates money and the Treasury which pours it out should be responsible for preventing monetary inflations and deflations, while those who fix the wage rates in various sectors of the economy should take responsibility for the effect of their action on the resulting levels of employment.

problems may arise in reconciling the FOMC's GNP goal and the Administration's GNP objective. For these and, perhaps, other reasons people wise in the ways of Washington might opt for alternative goals, control theory notwithstanding.

Conclusion

The use of the monetary aggregates as targets for monetary policy rests fundamentally on the assumption that the relationship of the aggregates to the nominal GNP is relatively stable and predictable. Financial innovations raise serious doubts as to the continued validity of that assumption. The argument that M1 is "controllable," in the sense that the broader goals are not, is not compelling if M1 is no longer a reliable guide to policy.

M1 velocity has been difficult to predict in the past, particularly since 1974. It is likely to become even more unpredictable in the future for two reasons. First, there is the simple fact that the collection of assets we now call M1 is not the same collection as the old M1.^{5/} Therefore, there is no a priori reason to expect that new M1 would bear the same relationship to the nominal GNP as the old M1.

A case in point--the much discussed bulge in the new M1 in January 1982. If we examine the nature of this bulge, we

^{5/}As Alan Blinder of Princeton said in "Monetarism," Challenge, September/October 1981, p. 39:

One result of all these financial innovations (which, I might add, have improved the functioning of our financial markets enormously) is that no one knows what concept of M today corresponds to what we used to think of as M1 or M2 a few years ago.

find that demand deposits increased substantially during the week of January 6, but declined steadily thereafter. By the week of January 27, the old M1 was only \$1.3 billion higher than in the week of December 30--hardly cause for alarm. However, the new M1 showed a bulge of \$6.1 billion between December 30 and January 27, 80 percent of which was in NOW accounts.

One interpretation of the January NOW account bulge is that it reflected a defensive build-up of precautionary balances of the sort that in earlier times would have been largely reflected in an increase in savings accounts. Support for this hypothesis is found in the fact that ordinary savings account balances, which had been shrinking throughout most of 1981, showed a gain of \$1.7 billion at commercial banks between December 30 and January 27 and grew by \$3.3 billion at thrift institutions during the month of January.

This experience suggests two questions. First, does a \$6 billion bulge in the new M1 necessarily have the same significance for monetary policy as a similar bulge in the old M1 would have had. Second, did the new M1 provide a good guide for monetary policy in January 1982? I am inclined to answer both questions in the negative.

To further complicate matters, the pace of financial innovation is likely to mean that the behavior of the new M1 this year may give us no firm foundation for forecasting its behavior relative to nominal GNP next year. Let us assume

that deposit-sweeping becomes widespread in 1983. It is quite possible, given that assumption, that a 10 percent increase in nominal GNP might be compatible with a sizable contraction in M1 and that any positive growth rate in M1 might be highly inflationary. This is not an unprecedented situation. With the movement to nationwide NOW accounts in 1981, the old M1 declined by 7.1 percent while the nominal GNP rose by 9.3 percent. We tried to deal with the 1981 problem by redefining M1 to incorporate NOW accounts. How we would redefine M1 to reflect deposit-sweeping is not clear to me.

To conclude, it seems to me that the monetary aggregates, particularly M1, have been rendered obsolete by innovation and the computerization of the financial system. The time has come to design a new control mechanism for monetary policy, one which targets neither on interest rates nor on the monetary aggregates.

APPENDIX*

A conventional description of the demand for money equates the real money stock to a function of real GNP, nominal interest rates, and lagged money balances:¹

$$M1-B_t/P_t = A_0 (GNP_t/P_t)^{A1} (r_t)^{A2} (M1-B_{t-1}/P_t)^{A3} \exp(\epsilon_t)$$

where

P is the GNP price deflator,

r is a weighted average of the federal funds rate, the passbook savings rate, the 3-month Treasury bill rate, the commercial paper rate, the 5-year government bond rate, the 20-year government bond rate, and the dividend-price ratio on the Standard and Poor's index of 500 stocks. The weights are defined by the first principal component of these variables,

ϵ is a random disturbance.

This relationship implies that money velocity ($V1 = GNP/M1-B$) is described by the following equation:

$$V1_t = B_0 (GNP_t/P_t)^{B1} (r_t)^{B2} (V1_{t-1}P_t/GNP_{t-1})^{B3} \exp(\epsilon_t).$$

The first equation could be used to describe the demand for real balances for each of three financial aggregates -- M1-B, liquid assets (L), and net debt (D). Each of these three demand relationships then yields its own velocity equation. Therefore, the velocities for liquid assets (VL) and net debt (VD) are described by expressions that take the same form as the expression for V1 above, but the coefficients B will generally differ for these three velocity equations.

Estimating the coefficients B for V1 (shift adjusted in 1981), VL, and VD using annual data from 1959 to 1973 yields the following velocity equations:

$$(1) \log(V1_t) = - 2.1571 + 0.6930 \log(GNP_t/P_t) + 0.0154 \log(r_t)$$

(.9370) (.0462) (.0149)

$$+ 0.2179 \log(V1_{t-1}P_t/GNP_{t-1}) + \epsilon_{1t}$$

(.2277)

$$\epsilon_{1t} = - 0.0375 \epsilon_{1t-1} + v_{1t}$$

$$\hat{\sigma}_{v1} = 0.0056$$

*Prepared by Richard W. Kopcke, Vice President and Economist, and Mark Dockser, Senior Research Assistant, of the Federal Reserve Bank of Boston.

¹This demand equation is also examined by Byron Higgins and Jon Faust in "Velocity Behavior of the New Monetary Aggregates," Economic Review of the Federal Reserve Bank of Kansas City, September-October 1981, pp. 1-17. Our definition of r is the same as that proposed by Higgins and Faust.

$$(2) \log(VL_t) = 1.1242 + 0.1729 \log(GNP_t/P_t) + 0.0474 \log(r_t)$$

(.3393) (.2088) (.0241)

$$+ 0.3290 \log(VL_{t-1}P_t/GNP_{t-1}) + \epsilon_{L_t}$$

(.2303)

$$\epsilon_{L_t} = 0.7043 \epsilon_{L_{t-1}} + v_{L_t}$$

$$\hat{\sigma}_{vL} = 0.0108$$

$$(3) \log(VD_t) = 0.1377 + 0.4627 \log(GNP_t/P_t) + 0.0160 \log(r_t)$$

(.2082) (.1074) (.0120)

$$+ 0.5181 \log(VD_{t-1}P_t/GNP_{t-1}) + \epsilon_{D_t}$$

(.1147)

$$\epsilon_{D_t} = 0.7635 \epsilon_{D_{t-1}} + v_{D_t}$$

$$\hat{\sigma}_{vD} = 0.0055$$

These estimated equations were then used to forecast velocity one year at a time from 1974 to 1981.² The results appear in Tables A1 to A3.

In each table, the second column is the static forecast error of velocity. The columns on either side of the second column provide a set of error tolerance bounds. Assuming the expected value of the forecast error is zero, the number in the left-hand column is two standard errors below zero, the number in the right-hand column is two standard errors above zero.³ The dynamic forecast errors are shown in the fourth column.

This definition of the tolerance range is not as generous as it might first appear. If these static forecast errors were independent and the velocity models were stable, the probability that the forecast error for any year would fall outside tolerance bounds defined in this manner is less than 5 percent; yet the probability that at least one error would fall outside

²Higgins and Faust (see footnote 1) report the results of a dynamic forecast in Chart 1 of their article. The static forecast experiment described here is equivalent to a properly performed analysis of dynamic forecast errors. Even if these velocity equations were well specified and their coefficients were stable, the dynamic forecasts would tend to stray from actual velocity; errors tend to accumulate because each forecast depends on previous forecasts. In a static forecast, the actual values of lagged velocity are used to prepare each new velocity forecast so the size of each error is checked when it first appears. If these static forecast errors are too great to be consistent with the statistical properties of the fitted model, then the errors of the dynamic forecast will also be unacceptably large. If the static errors are small enough to suggest the model is tracking acceptably well, then the dynamic errors will also fall within their tolerance bounds.

³For a discussion of the deviation of the standard error for each static forecast see H. Theil, Principles of Econometrics (John Wiley & Sons, Inc., 1971), pp. 130-145.

the bounds in the entire 8 year sample is about 32 percent. The annual forecast errors are not independent, however, because estimates of the coefficients, not the true values of the coefficients B, are used in equations (1) through (3). If there were no reason to believe these estimates to be biased too high or too low, then the expected value of the forecast error is zero; but even if the estimation technique were not biased, these specific estimates of the coefficient B would not match their true values. If these coefficient estimates tended to produce a low forecast in 1974, they would tend to produce a low forecast in almost every subsequent year. This positive correlation among forecast errors would dictate the choice of generous tolerance bounds for a "fair" test. In other words, the probability that at least one of the 8 tabulated errors falls outside the bounds as defined above could be much greater than 32 percent.

Conclusion

This forecasting experiment suggests that the equations for net debt and liquid assets forecast their velocities most accurately. These financial aggregates have had the most predictable relationship to GNP, suggesting that these velocity equations plus knowledge of net debt or liquid assets would have yielded the most accurate forecasts of GNP during the past eight years.

The error tolerance bounds are narrowest for D. The standard error of the static forecast predicted by the estimated equation for D velocity averages only 0.7 percent of velocity, and the root mean squared error of its forecasts was 0.6 percent of velocity. The predicted standard error for L averages about 1.4 percent of velocity, but the root mean squared error of its forecasts was only 1.0 percent of velocity. The M1-B equation was most prone to error by a wide margin: the predicted standard error of its forecast rises from 0.7 percent in 1974 to 3.5 percent in 1981, and the root mean squared error of its forecast was 9.0 percent.

The tabulated forecast errors suggest that the M1-B equation is not stable. If the "true" coefficients B for V1 were stable from 1959 to 1981, the probability of all eight forecast errors falling outside the tolerance bounds is miniscule. In other words, the theoretical velocity equation discussed at the beginning of this appendix apparently represents V1 very poorly because the estimated equation cannot reliably describe past V1 behavior or forecast future values of V1. The estimated equations for VL and VD forecast relatively accurately, suggesting that the theoretical velocity equation may describe VL and VD rather well. In fact, the forecasts of liquid asset velocity were more accurate than predicted by the statistical properties of its estimated equation.

TABLE A1

FORECAST ERRORS FOR M-1B VELOCITY
(in percent of actual velocity)

	Static			Dynamic
	<u>Lower Tolerance Bound</u>	<u>Forecast Error</u>	<u>Upper Tolerance Bound</u>	<u>Forecast Error</u>
1974	-1.5	2.6*	1.5	2.6
1975	-2.4	6.1*	2.4	6.6
1976	-3.0	7.4*	3.0	8.6
1977	-3.5	7.3*	3.5	8.9
1978	-4.0	7.7*	4.0	9.3
1979	-4.7	8.9*	4.7	10.6
1980	-5.4	11.0*	5.4	13.0
1981	-7.1	15.2*	7.1	17.6
Root Mean Squared Error		9.0		

*Denotes errors falling outside the tolerance bounds.

TABLE A3

FORECAST ERRORS FOR NET DEBT VELOCITY
(in percent of actual velocity)

	Static			Dynamic
	Lower Tolerance Bound	Forecast Error	Upper Tolerance Bound	Forecast Error
1974	-1.4	-0.2	1.4	-0.2
1975	-1.3	0.2	1.3	-0.1
1976	-1.3	-0.5	1.3	-0.6
1977	-1.3	-0.5	1.3	-1.2
1978	-1.3	-1.4*	1.3	-2.6
1979	-1.4	-0.5	1.4	-3.4
1980	-1.7	-0.3	1.7	-3.6
1981	-1.4	0.1	1.4	-3.1

Root Mean Squared Error

0.6

*Denotes an error falling outside the tolerance bounds.

TABLE A2

FORECAST ERRORS FOR LIQUID ASSETS VELOCITY
(in percent of actual velocity)

	Static			Dynamic
	Lower Tolerance Bound	Forecast Error	Upper Tolerance Bound	Forecast Error
1974	-3.0	-1.9	3.0	-1.9
1975	-3.0	0.2	3.0	-1.8
1976	-2.6	0.1	2.6	-1.3
1977	-2.6	-0.2	2.6	-1.1
1978	-2.6	-0.8	2.6	-1.6
1979	-2.7	-1.2	2.7	-2.6
1980	-3.3	-1.3	3.3	-3.6
1981 ¹	-2.7	-0.3	2.7	-3.4

Root Mean Squared Error 1.0

¹Actual value for L derived from average of balances for first three quarters.