Implementing Open Market Policy with Monetary Aggregate Objectives

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The purpose of this paper is to survey recent research on some technical problems of implementing open market policy at a time when the proper intermediate policy objective is widely believed to be the behavior of the money supply and related monetary aggregates. The mere existence of a widely held preference for monetary aggregate targets in setting policy is a relatively recent development. Even five years ago, the notion that the money supply should be the primary target of monetary policy was a decidedly minority position. This was true not only of academic and business economists, but of policy makers and the interested general public as well. Ten to fifteen years ago, discussions of monetary policy were only rather rarely couched in terms of the money supply. Practical discussions of policy were framed mainly in terms of interest rates and credit market conditions.

Things are now quite different. If one asks the average bank or business economist what they think monetary policy should be over the coming months, most will eventually get around to saying that the money stock should grow at such and such a rate. The ensuing elaboration will often owe more to the familiar equation of exchange than to the Keynesian "IS-LM" analysis.[1] Similar comments could be made of discussions of monetary policy in the Congress and in the business press.

There is, to be sure, a danger of overdrawing this picture. Views on these matters are not and never have been uniform or monolithic. Yet, it is really striking the extent to which the monetarists have succeeded in shifting the focus of commonly received opinion on the role of money. One could of course ask whether this shift has been justified by an equally clear shift in the weight of the evidence. And one may entertain reservations on this score. However, the subject matter of the present paper is limited to the problems of implementing the monetarist program as regards using monetary policy to control the money supply and related monetary aggregates.

MONEY VERSUS INTEREST RATES AS POLICY TARGETS: HOW SHOULD THE CHOICE BE MADE?

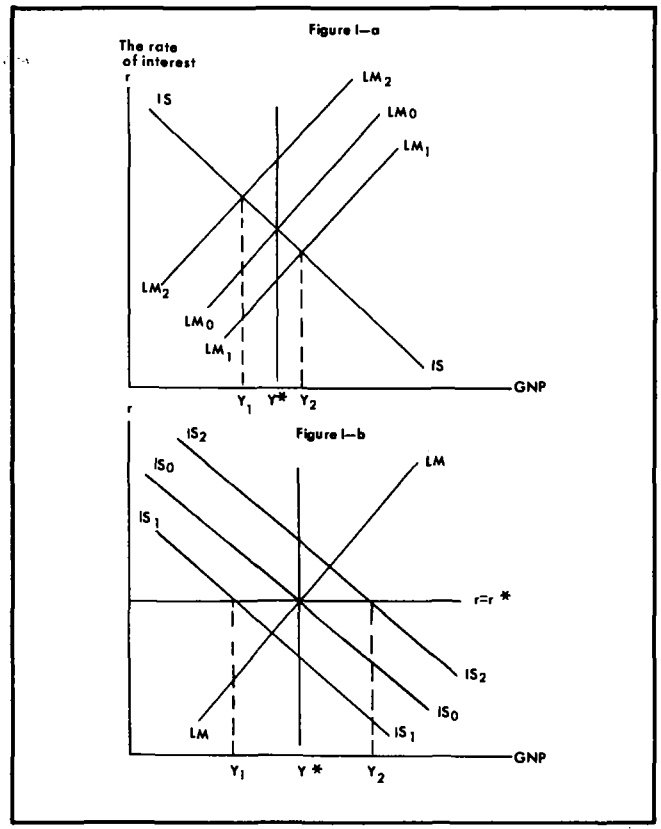
It is important to stress at the outset that the problem of choosing between the money supply (M), or some other related monetary aggregate as a policy target, on the one hand, and interest rates (r) and credit market conditions, on the other, is really quite distinct from any issue of

[1] In this algebraic summary of a simplified version of the Keynesian system, often used in the classroom, the so-called "LM" equation represents alternative combinations of GNP and the level of interest rates at which the supply and demand for money are equal. Similarly, the "IS" equation represents alternative combinations of GNP and interest rates at which the supply and demand for current output, including consumption goods, capital goods, and Government purchases, are equal. The solution of these two equations, the equilibrium value of the system as a whole, is that particular combination of income and interest rates for which *both* the supply and demand for money *and* the supply and demand for currently produced output are equal. Algebraically, the equilibrium values of GNP and interest rates are determined by the simultaneous solution of the two equations, LM and IS, each of which contains two unknowns, GNP and the level of interest rates (treated for simplicity as a single, "representative" interest rate). Graphically, the equilibrium values of the unknowns are shown by the intersection of the LM and IS lines (see Figure I).

"monetarism" versus "Keynesianism", "fiscalism", or what have you. One could perfectly well believe in the potency of fiscal policy and the importance of market interest rates, and, indeed, in the whole standard neo-Keynesian framework, and yet embrace the money stock rather than interest rates as the proper intermediate target for monetary policy. The question is, what is the most efficient target for policy makers to aim at in a world of uncertainties?

Recently, several papers have pointed out that even in the context of the standard neo-Keynesian IS-LM analysis, the choice between money stock targets and interest rate targets depends upon the relative importance of the various sources of instability in the economy.[2] Thus, for example, a money stock target may work quite badly in a world subject to large and unforeseen fluctuations in liquidity preference. If the money stock target is not adjusted for such shifts in the demand for money, the LM curve shifts (as in Figure I-a) and the shifts in the demand for money are transmitted to interest rates and, ultimately, to aggregate demand. Conversely, if the major source of unforeseeable disturbances arises in the nonfinancial markets (i.e., from shifts in the IS curve), an interest rate target will work badly. Maintaining interest rates at a predetermined target (r* in Figure I-b) in the face of such shifts in the IS curve will (as shown in Figure I-b) allow these shifts to be transmitted fully into shifts in aggregate demand. A money stock target, in contrast, would limit the effects of shifts in the IS schedule on aggregate demand by allowing interest rates to rise or fall in an offsetting way.

In terms of this analysis, therefore, the choice of money versus interest rates depends upon the stochastic properties of the economy (that is, the sources and magnitudes of random disturbances) and not just upon its structural coefficients. Since Milton Friedman has identified belief in the stability of the demand for money as the



[2] See William Poole, "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model", *Quarterly Journal of Economics* (May 1970) and "Rules-of-Thumb for Guiding Monetary Policy" in *Open Market Policies and Operating Procedures* (Board of Governors of the Federal Reserve System, July 1971). See also John Kareken, "The Optimal Monetary Instrument Variable", *Journal of Money, Credit, and Banking* (August 1970). The argument made in these papers is as follows:

Let the demand for money function be

$$M = b_0 + b_1 Y + b_2 r + v$$

where Y and r are income and the interest rate and v is a random variable. With M given, the LM schedule becomes

$$Y = -\frac{b_0}{b_1} - \frac{b_2}{b_1} r + \frac{M}{b_1} - \frac{v}{b_1}.$$

Let the IS schedule be

$$Y = a_0 + a_1 r + u$$

where u is a random variable. The effect on income of using a money supply target (M*) is given by the reduced-form equation of the system,

$$Y = \frac{-a_1 b_0 + a_0 b_2}{a_1 b_1 + b_2} + \frac{a_1}{a_1 b_1 + b_2} M^* - \frac{a_1}{a_1 b_1 + b_2} v + \frac{b_2}{a_1 b_1 + b_2} u.$$

Now assume that the "loss" resulting from deviations of actual income from its target equals the square of these deviations. If M is used as the instrument, then the expected value of this loss is given by

$$\text{Var } Y_m = \frac{a_1^2}{(a_1 b_1 + b_2)^2} \sigma_v^2 + \frac{b_2^2}{(a_1 b_1 + b_2)^2} \sigma_u^2 - \frac{2 a_1 b_2}{(a_1 b_1 + b_2)^2} \sigma_{uv}.$$

Inspection of the model makes it clear that the effect on income of an interest rate target (r*) is simply

$$Y = a_0 + a_1 r^* + u,$$

so that the variance of income is

$$\text{Var } Y_r = \sigma_u^2.$$

Comparison of the variances under M and r targets indicates that their relative size depends on the relative variances of the disturbance terms in IS and LM as well as on the values of the various structural parameters.

hallmark of monetarism, monetarists, naturally enough, should prefer money. But, as noted earlier, Keynesians need not prefer interest rates. Indeed, given Keynes's emphasis on the volatile "animal spirits" of businessmen as a source of economic instability, it is by no means clear he would have thought IS more stable than LM and, therefore, r preferable to M as a policy target.

THE CHANGING ROLE OF MONEY SUPPLY TARGETS IN THE UNITED STATES

For better or worse, money supply targets have come to have a growing importance in policy making, as already indicated. Before turning to the technical problems raised by the attempt to implement such targets, however, it may be useful to sketch briefly how the role of money supply objectives in policy formulation has evolved in recent years. First, it should be noted that the very concept of a "money supply policy" is open to some ambiguities. The Federal Reserve of course does not control the money stock directly. The actual behavior of the money supply is the joint result of Federal Reserve actions with respect to its own instrument variables—its open market portfolio, discount rate, etc.—and the actions of the Treasury, of foreigners, of the banks, and of the nonbank public. Thus both Federal Reserve and non-Reserve influences interact to make the money supply whatever it is at any given time. Under these circumstances, there can really only be a money supply "policy" if the Federal Reserve consciously seeks to achieve a certain path for money by using its instruments to offset the effects of actions taken by others.

Prior to at least 1960, while there was much *"monetary policy"*, there can really not be said to have been much *"money supply policy"*. The Federal Reserve, by and large, marched to a different drummer. The actual behavior of the money supply "fell out", for the most part an endogenous by-product of the System's actions with respect to whatever targets it *was* following and the actions of the public and the banks. To be sure, it can be argued —and has been by some—that whatever the System's *conscious* targets, the actual behavior of the money stock, or at least its broader and more significant movements, have been dominated all along by the behavior of the Federal Reserve's policy instruments rather than by the behavior of the public or the banks. But even if this were true, it would still imply only that the Federal Reserve *could* control the money stock if it chose to, not that it actually *did* so in any particular historical period.

As the 1960's wore on, the behavior of the money supply seemingly came to have increasing importance in the thinking of the policy makers, roughly paralleling developments in the economics profession and among the public generally. In the first instance, this meant that some individual members of the Federal Open Market Committee (FOMC) began to give more weight to money supply behavior in voting on specific policy alternatives. But despite this increased weight, it is probably fair to say that at no time in the 1960's did the recent and prospective behavior of the money stock become the dominant influence in the policy makers' thinking with regard to open market policy targets. Moreover, the FOMC continued to eschew any agreed-upon, formal money supply target. Actual policy alternatives continued to be stated in terms of money market conditions, as measured, for example, by free reserves and the levels of certain key money market interest rates.

Perhaps the earliest operational result, insofar as open market strategies were involved, of the increased concern over the behavior of the money supply and related monetary aggregates was the use by the FOMC, beginning in 1966, of the so-called "proviso clause". This was a clause included in the directive addressed by the FOMC at each of its monthly meetings to the Account Management at the Federal Reserve Bank of New York. It required the Account Management to shift money market targets from the levels initially directed by the Committee in an appropriately offsetting direction whenever growth in bank credit proved to be deviating significantly from the rates projected at the time of the previous meeting. The significance of this "proviso clause" as a step toward direct targeting of money supply and other aggregates was limited, however. First, it stopped short of committing the FOMC to an explicit target. Secondly, in practice it involved only quite gingerly and modest adjustments of money market conditions targets in response to unexpectedly rapid or slow growth in the bank credit proxy.

A more fundamental change took place in early 1970 when the Committee for the first time adopted explicit goals for the behavior of the narrow and broadly defined money supply (M_1 and M_2) and the bank credit proxy. At most of its meetings since early 1970 the Committee has continued to adopt explicit goals, covering varying time horizons, for the growth rates of one or more of these aggregates. At the same time, the Committee has experimented with various operational tactics to achieve these goals. However, this most emphatically does *not* mean that actual money supply behavior over the period since early 1970 can be interpreted as conforming to the FOMC's objectives in the short run. The bulk of the remainder of this paper is devoted to reasons why the money supply cannot, and perhaps even *should not*,

be made to conform exactly to predetermined target values over short periods. Beyond this, however, goals for the growth rates of the monetary aggregates have seldom been the sole immediate objective of the FOMC even in the period since 1970. The Committee has generally retained concern for avoiding unstable conditions in the money markets and has also retained an interest in the behavior of short-term interest rates and money and capital market conditions generally.

THE CHOICE OF A TARGET AMONG THE MONETARY AGGREGATES

Turning directly to some of the technical problems of implementing monetary policy where the intermediate objectives of policy are framed in terms of the monetary aggregates, several fairly basic questions come to mind immediately. The first might well be which monetary aggregate do you use: M_1, M_2, some measure of bank credit, total reserves, the monetary base (i.e., what is sometimes called "high-powered money", or total reserves plus currency in the hands of the nonbank public)? Without defending the point in detail, I would argue that while measures of reserves and the monetary base may be useful in developing strategies to achieve goals for one of the other aggregates, these measures are not themselves the best choices for framing monetary policy goals. The basic point is that we are interested in influencing the economy at large, not the banking sector *per se*. Setting targets in terms of reserves would allow random developments within the banking sector—which might be summarized by movements in the reserve-deposit multiplier—to be transmitted to the overall economy, interfering with the achievement of the more basic goals for the gross national product (GNP) and similar variables.[3]

With regard to the remaining choices, between, say, M_1, M_2, and some measure of total bank credit, I would argue that this is essentially a second-order issue. It is, for example, very difficult to differentiate between these three aggregates in terms of the closeness of their relationship to GNP in the postwar period.[4] Real questions about which aggregate to use are, however, likely to develop during periods when Regulation Q ceilings are changed or when open market rates are rising above or falling below existing ceilings. Such "artificial" distortions in rate spreads induce marked decelerations or accelerations of time deposit growth and therefore distort the "normal" growth rate relationships among M_1, M_2, and bank credit.[5] For example, a rise in market rates above Regulation Q ceilings will cause the public to shift out of time deposits and into open market securities. The resulting slowdown in M_2 undoubtedly overstates the restrictiveness of monetary policy in such periods. The moral would seem to be that policy makers can, with reasonable safety, set goals either in terms of M_1, M_2, or bank credit during normal times (provided allowance is made for differences in trend growth rates), but careful interpretation of differential growth rates is imperative during periods when Regulation Q (or some other special disturbances that do arise from time to time) is a factor.[6]

[3] In "Improving Monetary Control" (*Brookings Papers on Economic Activity*, 2-1972), William Poole extends his analysis cited earlier to examine the situation where the central bank's options are not M and r, but the monetary base (B) and r. The additional variance introduced by the banking sector via the supply equation for money may make B targets inferior to r targets even where M targets would be superior to r targets. The argument against B targets is simply that the authorities ought to permit themselves maximum flexibility in adjusting as needed to variations in the relationship between B and M. As Poole points out, arguments for a steady rate of growth in M simply cannot be extended to a steady rate of growth in B.

[4] Michael Hamburger presents some results for changes in GNP regressed on current and lagged changes in various monetary aggregates in "Indicators of Monetary Policy: The Arguments and the Evidence", *American Economic Review* (May 1970). For the 1953-68 period, the R^2s are .39 for M_1 and bank credit and .28 for M_2. However in the 1961-68 subperiod, M_2 does much better than M_1 (.43 versus .31) and only a little less well than bank credit (.45). An unpublished paper by Frederick C. Schadrack, "An Empirical Approach to the Definition of Money" (June 1971) summarizes some previous published work of George Kaufman and Milton Friedman and Anna Schwartz and presents some new results using Almonized distributed lag techniques. For the period 1953-68 there is very little to choose between M_1 and M_2, both including and excluding large CDs (all adjusted R^2s are around .55), though bank credit does a bit better at .61. Schadrack, however, expresses some preference for M_2 (excluding large CDs) on the grounds that its coefficients appear more stable over time.

[5] The view that Regulation Q provides the main reason for worrying about whether to use M_1 or M_2 was expressed as long ago as 1959 by Milton Friedman in *A Program for Monetary Stability*, page 91.

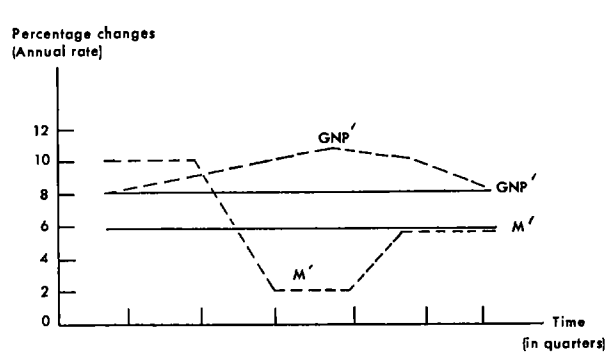
[6] Milton Friedman has recently expressed a preference for M_2 (excluding large CDs) over M_1 on the grounds that the income velocity of M_2 has shown essentially no trend since the early 1960's while the income velocity of M_1 has continued to show an uptrend of somewhat uncertain dimensions (see "How Much Monetary Growth" in the *Morgan Guaranty Survey*, February 1973). Friedman's argument is couched in terms of the substantially larger range of the *level* of the M_1 income velocity relative to the range of the *level* of the M_2 income velocity in the 1962-72 period. The relevant issue, however, is the variance of the rates of growth of these two velocity measures—at least as far as setting intermediate-run or countercyclical monetary growth targets is concerned. To put it differently, what one cares about for these purposes is the closeness of fit of equations relating growth in nominal income to growth in money, not the size of the constant term in such equations.

HOW LARGE ARE THE ECONOMIC COSTS OF FAILING TO HIT MONETARY TARGETS IN THE SHORT RUN?

A second basic question with regard to implementing monetary aggregate targets for monetary policy is how long or short should the time horizon be for achieving these targets: i.e., should you try to set and meet targets for monetary growth over a month, a quarter, six months, a year? The answer to this question seems to depend essentially on two factors: (1) the decreasing feasibility of controlling the aggregates over successively shorter periods and (2) the increasing costs in terms of economic stability of failing to hit them over successively longer periods. This second aspect is examined first.

Just how much difference does it make to aggregate demand objectives if the M_1 target is missed by 2 percentage points over one month, over three months, etc.? The key to this question lies in the lag structure relating money growth to the behavior of the economy at large. If, for example, the influence of M on GNP were essentially instantaneous, deviations from monetary targets lasting even for very short periods could have a marked impact. On the other hand, if the influence of money operates with a long distributed lag, the impact of deviations from M_1 targets may be greatly attenuated. Suppose, for example, the Federal Reserve wants to hit a 6 percent money growth rate target. Suppose, instead, it actually hits 10 percent for two quarters in a row (as illustrated in Figure II) and then drops down to 2 percent for the next two quarters. If the influence of money operates with a distributed lag—i.e., the effective impact of money at any point reflects a weighted average of past money supply growth rates—the overshoot effect of the two 10 percent quarters will never register its full impact on GNP. Long before this can happen, the *over*shoot effects will begin to be offset by the *under*shoot effects of the two 2 percent quarters. If lags are sufficiently long, the course of events in the economy may turn out to differ little from what would have happened had the 6 percent money target been successfully reached in each and every quarter instead of just on average over the whole four-quarter period.

Figure II



One way to arrive at quantitative estimates of the costs of permitting M to deviate from target values over periods of varying lengths is to use econometric model simulations. Such simulations can be used to compare the results of steady monetary growth at an x percent rate with uneven monetary growth that averages out to the same rate over the longer run. One such simulation has been performed on a version of the well-known Federal Reserve Bank of St. Louis econometric equation.[7] In this equation, nominal GNP is determined mainly by the behavior of the money supply in the current and three prior quarters. The control simulation assumes a steady 6 percent rate of growth in M_1 in each quarter. Other simulations assume M_1 growth rates of 10 percent for one, two, and three quarters, respectively, followed by growth rates of 2 percent for an offsetting number of quarters, with M_1 returning to a 6 percent growth rate thereafter.

The results of these simulations (see Table I) suggest that a one-quarter deviation of M_1 growth from target amounting to 4 percentage points or less would have essentially negligible effects on GNP. Deviations from target lasting for *two* quarters would have only moderate effects. In this case, the resulting deviations of GNP from the path implied by steady 6 percent M_1 growth path would reach a maximum of only about 1 percent of the level of GNP. Deviations of M_1 from its target growth rate amounting to 4 percentage points and lasting for as long as three quarters do have more serious effects, however.

Of course these results are only as valid as the lag structures embodied in the underlying model. Probably most large-scale structural models incorporate somewhat longer lags in the money-GNP relationship than do St. Louis-type "reduced-form" equations. As a result, simulations with these models would no doubt suggest that deviations from target growth rates could occur over

[7] See James Pierce and Thomas Thomson, "Some Issues in Controlling the Stock of Money", in *Controlling Monetary Aggregates II: The Implementation* (Federal Reserve Bank of Boston, 1972), pages 115-36.

Table I

SIMULATIONS OF GROSS NATIONAL PRODUCT

Period	Control simulation (steady 6% M_1 growth)		Simulation II		Simulation III		Simulation IV	
	% Δ M	Level of GNP (billions of dollars)	% Δ M	GNP minus control simulation (billions of dollars)	% Δ M	GNP minus control simulation (billions of dollars)	% Δ M	GNP minus control simulation (billions of dollars)
1972: I	6	1,092.9	10	2.4	10	2.4	10	2.4
II	6	1,108.5	2	3.3	10	8.3	10	8.3
III	6	1,125.8	6	2.6	2	12.0	10	17.1
IV	6	1,145.6	6	1.1	2	10.3	2	22.6
1973: I	6	1,166.3	6	—0.3	6	5.4	2	21.1
II	6	1,187.3	6	—0.4	6	0.9	2	13.5
III	6	1,208.4	6	—0.4	6	— 0.8	6	5.3
IV	6	1,229.7	6	—0.4	6	— 0.8	6	0.5

Note: Simulations were performed with the equation described in "A Monetarist Model for Economic Stabilization" by L. Andersen and K. Carlson (Federal Reserve Bank of St. Louis *Review*, April 1970). The simulations are reported in James Pierce and Thomas Thomson, "Some Issues in Controlling the Stock of Money".

somewhat longer periods without serious consequences for aggregate demand objectives. For what they are worth, however, the available simulation results suggest that the FOMC need not be too concerned about even fairly sizable deviations from M_1 target growth rates lasting up to around six months—providing there is some subsequent undershooting. Putting it somewhat differently, the policy makers should perhaps not be too disturbed by sizable intrayearly fluctuations in M_1 growth, provided the average growth rate for the year as a whole comes out about on target.[8]

[8] These conclusions are also supported by the results presented in "Income Stabilization and Short-run Variability in Money" by E. Gerald Corrigan, *Monthly Review* (Federal Reserve Bank of New York, April 1973), pages 87-98. In this paper Corrigan first uses a "money-only" reduced-form equation to compare what GNP behavior would have been in 1970-71 if M_1 had grown at a steady value equal to its average growth over the entire period relative to (a) the actual behavior of GNP over the period and (b) what the money-only equation would have projected for GNP given the actual behavior of M_1 over the period. Corrigan concludes that events would not have been very different with steady growth. In all but two quarters, GNP growth in the steady M_1 case would have differed by only 0.7 percent (annual rate) or less relative to the GNP growth indicated by the equation given the actual pattern of M_1 growth rates. The 1963-65 period exhibits similar results. Simulations of the Board-MIT econometric model for 1970-71 also indicate little difference between the results of smooth M_1 growth and the quite uneven quarterly pattern of M_1 growth rates that actually occurred—the largest difference for any quarter was an 0.6 percent annual rate of growth in GNP. Corrigan also runs simulations similar to the Pierce-Thomson simulations cited in Table I and the text, though using a money-only reduced-form equation. The results are essentially the same as the Pierce-Thomson results.

ACHIEVING MONETARY OBJECTIVES: THE NEED FOR SHORT-RUN OPERATING TARGETS

Having tried to establish some notion of the costs of failing to hit money supply targets over varying lengths of time, the next question is what operational procedures are available to achieve these M targets and how well can such procedures be expected to work? One begins from the obvious fact, noted earlier, that the Federal Reserve has direct control only over certain instrument variables, most notably the size of its open market portfolio of Government securities. To hit targets for any monetary variable—be it the money supply, the monetary base, or even member bank nonborrowed reserves—forecasts of noncontrolled factors influencing these variables must first be made. Next, the Federal Reserve's instrument variables must be adjusted in such a way as to take account of the movements of these noncontrolled factors. The harder the movements of these noncontrolled factors are to predict, or the more complex are their interaction with movements in the Federal Reserve's own instrument variables, the more difficult will it be to hit any given target.

This is a complex matter, but the main points can be summarized as follows: to implement a money supply objective, defined, say, in terms of the desired M_1 growth rate over a month or period of months, an operationally meaningful strategy requires that week-to-week open market operations be laid out in terms of target values for other variables, variables easier to hit than the money supply itself. The targeted levels of these other variables

must then be adjusted so that their achievement maximizes the likelihood of achieving the money supply target itself. In other words, one has to project, for example, the week-by-week levels of nonborrowed reserves that appear to be consistent with the desired money supply growth rate. Once this is done, the day-to-day decisions as to whether to buy or sell in the open market can be made in terms of the nonborrowed reserve objectives.[9]

As a practical matter, what variables are open to the Federal Reserve as feasible day-to-day and week-to-week operating targets? In practice, the number of available options is really rather small. First, one would have to rule out all total reserve and related measures, such as the total monetary base and the recently developed concept of RPD (total reserves behind private nonbank deposits). In practice, the Federal Reserve does not have the power to fix the levels of any of these measures within a given week. The problem is that changes in borrowings at the discount window, a magnitude over which the System exerts only the most general influence, will offset the effects on total reserves of System actions taken to change nonborrowed reserves.[10] However, by the same token, the various measures of nonborrowed reserves, including the nonborrowed monetary base and nonborrowed RPD, *are* feasible weekly operating targets. This is not to say the weekly targets for these nonborrowed reserve measures are easy to hit with accuracy. Quite the contrary. The non-Federal Reserve controlled factors affecting reserves, most notably float, are very difficult to predict accurately on a weekly basis.[11]

A different sort of weekly operational target that could be used to achieve the more basic money supply objectives is represented by money market interest rates, perhaps most notably the Federal funds rate (the rate on interbank overnight lending). On the one hand, this would be an operationally feasible target since the Trading Desk could feed funds into and out of the market as the actual market rate fell below or rose above the target rate. Thus on a weekly average basis, say, it is possible to operate so that the average Federal funds rate will, most of the time, approximate a target rate. At the same time, the required weekly interest rate objective can be related to the more fundamental money supply target through forecasts of the demand for money at various interest rates. This problem is discussed further below.

In summary, to implement a money supply objective, the Federal Reserve must lay out a week-to-week program for operationally feasible short-run targets. It must set values for these targets that are projected to be consistent with the underlying money supply objective. If the projections prove wrong, the weekly target values will have to be adjusted. In practice, the Federal Reserve can use either a nonborrowed reserves measure or an interest rate measure, perhaps most especially the Federal funds rate, as its weekly operational target.

RELATIONSHIP OF RESERVE AND INTEREST RATE OPERATING TARGETS TO MONEY SUPPLY OBJECTIVES: A SIMPLE MODEL OF THE SUPPLY AND DEMAND FOR MONEY

Given the feasibility of either nonborrowed reserves or some measure of short-term interest rates as a week-to-week operating target, what is entailed in using these targets for achieving somewhat longer run objectives for

[9] The problem of laying out short-term tactics for achieving the goals set in a money supply strategy is discussed in Richard G. Davis, "Short-Run Targets for Open Market Operations", in *Open Market Policies and Operating Procedures—Staff Studies* (Board of Governors of the Federal Reserve System, July 1971).

[10] This problem is examined in more detail in Davis, *op. cit.*, pages 42-44. If the Federal Reserve supplies nonborrowed reserves in excess of required reserves, which are fixed for a given reserve period under lagged reserve accounting, the result is likely to be mostly a paydown of outstanding borrowings and little if any build-up of excess reserves—at least up to the point where borrowings are reduced to frictional minima. On the other hand, reductions in the amount of nonborrowed reserves supplied are likely to lead to an offsetting increase in borrowings rather than a reduction in excess reserves. The point is simply that in a period where excess reserves are very low and are probably very insensitive to money market rates in the short run, total reserves are fixed by required reserves (determined on the basis of deposit levels two weeks earlier) plus the frictional minimum level of excess reserves. (A regression of weekly levels of excess reserves on the weekly average Federal funds rate for 1970 and 1971 had a—nonsignificant—R^2 of only .005; the coefficient indicated that a full 1 percentage point increase in the Federal funds rate would reduce excess reserves by only $16 million.) Fluctuations in nonborrowed reserves lead to offsetting movements in the Federal funds rate and in borrowed reserves but not, to any significant extent, to fluctuations in total reserves. Precisely the same argument applies to the total reserve base and total RPD. Note that the situation under lagged reserve accounting, with the resulting fixity of required reserves in any given week, may not be much different from the situation where reserve requirements are determined by deposit levels in the same week if bank asset supplies are quite insensitive to money market interest rates over periods as short as one week.

[11] In 1971, the average error in projecting market factors affecting nonborrowed reserves (float, currency in circulation, and the effects of Treasury and international transactions) as of the beginning of statement weeks was $275 million. See "Open Market Operations and the Monetary and Credit Aggregates—1971", this *Monthly Review* (April 1972), pages 79-94.

the money supply? To examine this, it is useful to set up an illustrative skeleton model of the supply and demand for money—or, to simplify matters somewhat, for deposits (D) alone. The demand equation for deposits in this model is the standard liquidity preference schedule. It includes a short-term interest rate (r) and some measure of transactions demand (Y). This latter variable can be treated as exogenous, given the short period purposes of the model. The supply of deposits is assumed to depend upon the level of nonborrowed reserves (Ru) and on the short-term interest rate (r). This latter dependency reflects the dependency of the banks' demand for borrowed reserves on short-term interest rates, the (smaller) dependency of their demand for excess reserves on rates, and the dependency on interest rates of the time-demand deposit mix. The latter of course has attendant effects on the banks' demand for reserves as a result of the difference in reserve requirement ratios for the two types of deposits. Thus the model (in linear form) consists of

$$(1)\quad D = b_1Y + b_2r + u \qquad \text{(Demand)}$$

$$(2)\quad D = c_1Ru + c_2r + e \qquad \text{(Supply)}$$

where u and e are random terms.

Now the choice of an interest rate operating target to achieve the broader money supply objectives is tantamount to treating the interest rate as an exogenous variable. In such a situation, nonborrowed reserves become *en*dogenous, that is, such reserves are allowed to come out at whatever level proves necessary to achieve the interest rate target. The resulting "reduced-form" equation of the model is the same as the demand equation, i.e.,

$$(3)\quad D = b_1Y + b_2r^* + u,$$

where r* is the weekly interest rate target used by the Federal Reserve.

On the other hand, if the FOMC decides to work with a nonborrowed reserves operating target, the short-term interest rate becomes endogenous. The relevant reduced form for the reserve-target case is derived from the solution of the demand and supply equations as follows:

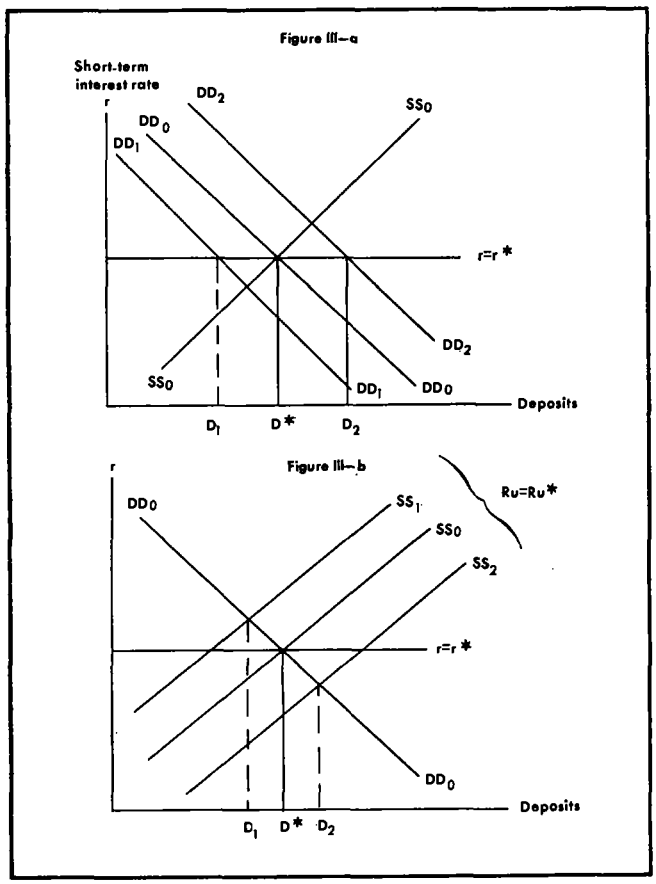
$$(4)\quad D = \frac{b_1c_2}{c_2 - b_2}Y - \frac{b_2c_1}{c_2 - b_2}R_u^* + \frac{c_2}{c_2 - b_2}u - \frac{b_2}{c_2 - b_2}e.$$

A great deal of work has been done within the Federal Reserve System on estimating structural models of the type represented by equations (1) and (2)—though of course any realistic model requires far more than two structural equations—and "reduced-form" equations of the type represented by equations (3) and (4). While the estimation of these equations has raised the usual quota of econometric conundrums, some useful insights have been obtained from this work. Three areas in particular should be mentioned: (1) the different sorts of risk one is exposed to in using a nonborrowed reserves operating target as against an interest rate target, (2) the approximate limits of our ability to forecast and achieve money supply objectives with, respectively, these two types of operating targets, and (3) the existence of lags and their implication for policy making.

SOURCES OF ERROR IN HITTING MONEY SUPPLY OBJECTIVES

As equation (3) indicates, the use of a short-term interest rate target entails making a short-term forecast of the demand for deposits. The interest rate target can then be set at the level that is expected to give the desired deposit behavior. (Of course, a formal econometric equation need not be used, but a judgmental forecast would require making much the same calculations implicitly.) There are two possible sources of error in picking the interest rate target needed to achieve the money supply goals: (1) random errors (or shifts in the demand equation) and (2) errors in forecasting Y—which is taken as exogenous for the short-term purposes at hand. Note that both types of error tend to be accommodated when using an interest rate target. That is, if the demand for money is greater than expected, for example, holding to the interest rate target (r* in Figure III-a) will mean automatically supplying enough reserves to accommodate the demand.

This tendency for interest rate targets—and "money market conditions" targets generally—automatically to accommodate changes in the demand for money has been the chief complaint of monetarists about this type of target over the years. However, the complaint should not be leveled against interest rate operating targets *per se*. Rather, the complaint should have been, as applied to the procedures in use prior to 1970, (1) that the FOMC did not formulate explicit monetary growth rate objectives and (2) that it would not have been willing to move money market targets often enough, quickly enough, and decisively enough to achieve monetary growth objectives even if it had formulated them. Given the willingness to move interest rate targets as needed to achieve money sup-



ply objectives, such targets are a perfectly feasible way of operating open market policy to achieve money supply objectives.

As equation (4) indicates, the use of a nonborrowed reserves operating target can also be expected to lead to errors in controlling the money stock. The new element here is errors stemming from the supply side—errors which might be summarized in terms of unforeseen movements in the ratio of nonborrowed reserves to private deposits, i.e., unforeseen movements in the "deposit multiplier". Such movements can result, in turn, from unforeseen shifts in the banks' demand for excess and borrowed reserves and from unforeseen movements in the average required reserve ratio. This ratio is of course affected by shifts among the various categories of deposits and by movements of deposits between banks with different reserve requirement ratios. Another important potential source of error on the supply side can originate from unforeseen movements into and out of Treasury deposits at the commercial banks. These deposits absorb required reserves but are not themselves included in the money supply as usually calculated.

Relative to an interest rate target, nonborrowed reserves have some advantages and some disadvantages as an operating target for achieving money supply goals. Nonborrowed reserves are superior to interest rates in the face of a change in the demand for money. Such a change tends to get fully accommodated under an interest rate target, as already noted.[12] Under a nonborrowed reserves target, however, an increase in the demand for money will be accommodated only to the extent that the resulting upward pressure on money market rates engenders some elasticity of supply—to the extent, for example, that the banks themselves are induced by rising interest rates to accommodate the increase in demand by increasing borrowings from the Federal Reserve Banks or by drawing down excess reserves. Such offsets may not be too large, however, and will, in any case, not be complete. Thus the money supply is likely to stay closer to target in the face of a demand shift if the Federal Reserve uses a nonborrowed reserves operating target than with an interest rate target.

On the other hand, a nonborrowed reserves target does not perform as well as an interest rate target in the face of an unforeseen shift in the average required reserve ratio —whatever its cause—or a shift in the banks' demand for excess and borrowed reserves. Such shifts will lead to a change in the actual money supply as long as the supply of nonborrowed reserves is held on target (see Figure III-b). With an interest rate operating target, in contrast, the volume of nonborrowed reserves would automatically be adjusted to offset the impact on money of these changes in supply conditions. As a result, their distorting effects on the money supply would be neutralized.

ESTIMATING ERRORS IN ACHIEVING MONEY SUPPLY OBJECTIVES IN THE SHORT RUN

In principle, then, either nonborrowed reserves or interest rates can be used as operating handles to achieve money supply goals; each has its own advantages and

[12] It should also be noted, however, that short-term, random, and reversible shifts in the demand for money *should* be accommodated since such accommodation prevents them from having any impact on real activity.

disadvantages.[13] Which can be expected to work better in practice, and how well each will work, are empirical questions. A fair amount of statistical work has been done in the Federal Reserve System on the probable size of errors in using these operating targets. Table II is fairly representative of the general thrust of the results—and it also gives some idea of the probable order of magnitude of errors in hitting money supply targets in the short run.

Three sets of forecasts are presented in Table II.[14] The first two are based on "reduced-form" equations of the types suggested by equations (3) and (4) presented earlier. The first set uses changes in the Federal funds rate as the open market operating target: thus it is essentially a complex variant of equation (3) cited earlier. The second set of projections uses the nonborrowed monetary base as the operating target—i.e., it is a variant of equation (4). The third set is a method developed at the Federal Reserve Bank of St. Louis. It simply estimates the money-reserve base multiplier from a regression using a three-month moving average of past values of the multiplier, an adjustment for changes in legal reserve requirement ratios, seasonal dummies, and a measure of autocorrelation. The two reduced-form equations were estimated from 1965-69 data, while the St. Louis method calls for updating the regression equation in each month. The forecasts were made for monthly changes in money supply (expressed as an annual rate of growth) over the 1970-72 period. The forecasts labeled *"ex-ante"* in the table are *ex-ante* forecasts in the sense that all inputs were entered as of the estimates or projections that would have been available at the time.

Some interesting results emerge from Table II. First, the forecasts using the nonborrowed monetary base and the Federal funds rate, respectively, do roughly equally well. Some other results (not presented in the table) which adjust nonborrowed reserves for required reserves against Treasury and interbank deposits (in other words, nonborrowed RPD) also seem to suggest a roughly comparable performance. This particular evidence, at least,

Table II

ERRORS IN FORECASTING M_1 GROWTH RATES, 1970-72

Seasonally adjusted annual rates; in percent

Measure	Using Federal funds rate*	Using nonborrowed monetary base†	FRB St. Louis method‡
Mean absolute error of *ex post* monthly forecasts	2.91	3.47	6.33
Root mean square error of *ex post* monthly forecasts	3.60	4.22	8.61
Mean absolute error of *ex ante* monthly forecasts	3.36	3.61	§
Root mean square error of *ex ante* monthly forecasts	3.93	4.53	§
Mean absolute error of *ex ante* quarterly forecasts	2.10	2.13	§
Root mean square error of *ex ante* quarterly forecasts	2.34	3.08	§
Mean absolute error of *ex ante* six-month forecasts	1.19	2.10	§
Root mean square error of six-month *ex ante* forecasts	1.39	2.52	§

* Based on $\Delta M_1 = \sum_{i=0}^{7} b_i \, \Delta \text{ Federal funds rate}_{t-i} + \sum_{i=0}^{7} c_i \, \Delta \text{ business sales}_{t-i} + d \, \Delta \text{ Treasury deposits} + \text{constant}$. Estimated on 1965-69 data.

† Based on $\Delta M_1 = \sum_{i=0}^{7} b_i \, \Delta \text{ nonborrowed monetary base}_{t-i} + \sum_{i=0}^{7} c_i \, \Delta \text{ business sales}_{t-i} + d \, \Delta \text{ Treasury deposits} + \text{constant}$. Estimated on 1965-69 data.

‡ See A. Burger, L. Kalish, and C. Babb, "Money Stock Control and Its Implications for Monetary Policy", Federal Reserve Bank of St. Louis *Review* (October 1971).

§ Not available.

[13] As a purely formal matter, the question of whether nonborrowed reserves or interest rates is the better instrument for controlling money can be treated with precisely the same analysis used by Poole to examine whether the money supply or the interest rate is the better handle to control GNP (see footnote 2). The question turns on the relative instability of demand (analogous to the IS curve in Poole's analysis) or supply (analogous to LM). The variance of deposits, using an interest rate target, depends on the variance of Y from forecast values and the variance of the error term u in equation (3) and on their covariances as well as on the income elasticity of demand. The variance of deposits, using a nonborrowed reserves target, depends on the variance of Y, the variances of the error terms in both supply and demand equations, their covariances, and the various income and interest rate elasticities in the supply and demand equations (see Pierce and Thomson, "Some Issues in Controlling the Money Stock"). Just as Poole's analysis has to be modified to allow for the possibility that M cannot be precisely controlled, however, the present analysis should really be modified for the possibility that nonborrowed reserves cannot be precisely controlled. In this case, nonborrowed reserves should be replaced in the supply equation with the sum of changes of Federal Reserve credit, the forecast value of operating factors affecting reserves, and a new random error term reflecting errors in forecasting operating factors. Some specialists object strongly to the proposition that nonborrowed reserves could be hit with any high degree of accuracy. They argue that under a pure nonborrowed reserves target, where the Federal funds rate could be expected to show much wider week-to-week movements than at present, the behavior of the Federal funds rate would no longer serve to assist the Open Market Account Management in warning when operating factors affecting reserves are going seriously off track. They argue that the margin of error in hitting funds rate on average, week to week, would be much smaller. In that case, evidence purporting to compare nonborrowed reserves and the funds rate as competing targets for controlling money is seriously biased in assuming the two operating targets are themselves equally achievable.

[14] These results represent an updating of material presented in a paper to be published in a forthcoming issue of the *Journal of Money, Credit and Banking*, by Fred J. Levin, "Examination of the Money Stock Control Approach of Burger, Kalish, and Babb". See also A. E. Burger, L. Kalish III, and C. T. Babb, "Money Stock Control and Its Implications for Monetary Policy" (Federal Reserve Bank of St. Louis *Review*, October 1971).

does not provide a decisive case for or against any one of the potentially available operating targets.

A second point is that the two "reduced-form" equations forecast markedly better for this period than the St. Louis approach, which is essentially a purely autoregressive estimate of the money multiplier.

Finally, and most important, all three methods of projection do rather poorly in forecasting monetary growth rates for individual months. The same conclusion has to be drawn about attempts to forecast short-term growth rates judgmentally. Despite considerable investment of time and talent, all presently available techniques for making short-term projections of the monetary growth rate that would be associated with any particular setting of an operating target are subject to large errors on average and very large errors in many particular instances.

It is possible to be more optimistic when somewhat longer time horizons are considered, however. *Ex ante* forecasts for one quarter ahead have an average absolute error of 2.13 percent for the nonborrowed base equation and 2.10 percent for the Federal funds equation. Forecasts for six months ahead show corresponding average absolute errors of 2.10 percent and 1.19 percent, respectively. This means that for six-month periods, we seem to be able to get at least "ball park" estimates of the consequences for monetary growth rates of particular settings of open market operating targets. Even for these periods, however, the errors are clearly not negligible.

THE LAGS BETWEEN FEDERAL RESERVE ACTIONS AND MONEY SUPPLY RESPONSE

Finally, with regard to the lags: All the econometric evidence available to us suggests that there is a lag between a change in operating targets and the full impact of that change on the money supply. Indeed both the Board staff's monthly money market model—a very complex version of structural equations (1) and (2)—and the reduced-form equations developed at this Bank—essentially complex versions of (3) and (4)—suggest that the effects may take on the order of six to eight months to work themselves out fully.[15] This means, for example, that a maintained step-up in the level of nonborrowed reserves will not have its full effect on the level of the money supply for several months. Similarly, a once and for all increase in a Federal funds rate target will not have its full effect on the level of the money supply for several months.

Now it is of course true that the estimation of lag structures is a very uncertain business. The evidence that these lags are as long as six to eight months cannot be considered at all firm. One possibility is that the use of monthly time units instead of shorter units may bias estimates of the lag upward; this sort of bias does seem to have turned up in some other areas of econometric work. However, the Board staff has also estimated a weekly model, and its lags, while not as long as those in the monthly model, are still substantial.[16] The point is that even if the true lags were, say, only one half the six- to eight-month range indicated by most of the econometric work, they would still have significant implications for policy.

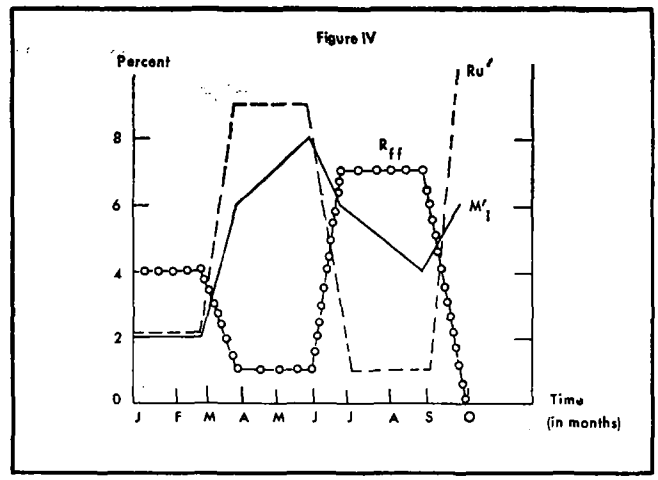
The existence of these lags creates a potential control problem for the Federal Reserve in trying to hold monetary growth rates to any targeted rate. As indicated, these lags delay the ultimate impact on the money supply of a change in the operating target, be it nonborrowed reserves or short-term interest rates. By the same token, however, they also imply that an adjustment in the operating target large enough to produce a desired correction in the monetary growth rate *immediately* will ultimately overshoot this desired correction and will then have to be reversed (see Figure IV). For example, if M_1 is currently growing at 2 percent (January through March in Figure IV) and the Open Market Committee objective is 6 percent, the desired correction could be achieved by lowering a Federal funds rate target (labeled R_{ff} in the figure) or raising a nonborrowed reserves target (labeled Ru′ in the figure). However, a reduction large enough to bring M_1 back to 6 percent within a month (April), would eventually (by June) push the monetary growth rate up to, say, 8 percent. At that point, a near-term correction back to 6 percent (in July) might require a drastic *increase* in the Federal funds rate target, one that

[15] See "A Monthly Econometric Model of the Financial Sector" by Thomas Thomson and James Pierce, unpublished; "Estimating Monthly Changes in Deposits with Reduced-Form Equations" by Richard G. Davis (April 1972, unpublished), and "A Reduced-Form M_1 Equation" by Frederick C. Schadrack and Susan Skinner (June 1972, unpublished).

[16] Helen T. Farr, Steven M. Roberts, and Thomas D. Thomson, "A Weekly Money Market Model—A Progress Report" (June 1972, unpublished). The lags in the major structural equations of this model run from five to thirty-four weeks. Simulations performed by the authors indicate that an increase in nonborrowed reserves achieves its maximum effect on M_1 after about three months, while a decrease in the Federal funds rate produces its maximum impact after about six months.

might ultimately (in August and September) push M_1 growth once more below the 6 percent target, and so on. Indeed, if the lag structure is sufficiently unfavorable, it would not be too difficult to imagine situations where explosive oscillations in the operational target would be required to hold the M_1 target, month by month, to a steady target growth rate.[17]

There appears to be a fairly clear moral to be derived from these implications of the existence of lags: policy makers should avoid taking too short a view in deciding where to set week-to-week operating targets. Even in a world where the money supply implications of a given target setting were known with certainty, operational targets should be set so as to achieve money supply goals *on average* over a period of time. Attempts to rejigger operating targets so as to hit the long-run money supply objectives in each and every month—assuming this to be possible at all—are likely to involve excessive volatility in the operating target. This volatility will mean excessive instability in money market rates. This will result directly, if the Federal funds rate is used as the operating target, and indirectly if some measure of nonborrowed reserves is used.



Similarly, when trying to speed up or slow down the monetary growth rate, the policy makers should keep in mind the fact that a movement in operating targets sharp enough to achieve this change rapidly will, because of lags, eventually overshoot. This overshooting will, in turn, require an eventual further adjustment of the instrumental target in the opposite direction. For this reason, it may well be desirable to take a somewhat gradualist approach to slowing down or speeding up monetary growth rates, aiming to accomplish the change over a period of months rather than immediately. Of course in any particular situation, the right decision depends on for how long and by how much monetary growth has been deviating from what the policy makers consider desirable and how serious the economic consequences of these deviations seem likely to be if not corrected promptly.

In thinking about these matters, it quickly becomes apparent that the use of a money supply strategy for monetary policy confronts the policy makers with a very interesting and complex problem in control theory—one that is only just now beginning to be appreciated and explored. The policy maker is confronted with two sets of distributed lags. One set of lags, the one just discussed, relates operationally feasible open market target variables, such as nonborrowed reserves and the Federal funds rate, to the money supply. The other set, mentioned earlier, relates the money supply to the variables that ultimately matter. *Shortening* the attempted time horizon of monetary control increases the technical problems of monetary management and the likelihood of an unacceptable degree of

[17] In principal, at least, this proposition can be tested. First, reduced-form equations of the sort presented in Table II, having been estimated statistically, can be solved for the current value of the instrument variable. Thus, for example, equation (1) in that table, where the Federal funds rate is the instrument variable, can be rewritten so that the current change in the Federal funds rate is the dependent variable and is a function of the current change in deposits, lagged changes in the Federal funds rate, and the current and lagged changes in the exogenous variables. If we assume the current change in deposits equal to some given target value in each and every month, we then have a seventh-order difference equation in the Federal funds rate plus some exogenous variables. This equation tells us the change in the instrument variable—the Federal funds rate in this case—that will be required to hold M on target given the current values of the exogenous variables and the past history of these variables and the funds rate. Some preliminary analysis of this equation suggests that under a fairly wide range of assumptions about the lag coefficients on the Federal funds rate in the original reduced-form equation, the time path of monthly changes in the funds rate needed to maintain changes in M at the targeted rate in each and every month would be oscillatory and explosive. Moreover, using some plausible values for the behavior of the exogenous variables and initial conditions as of early 1972, simulations of the difference equation for constant monthly changes in the money supply did generate explosive oscillations in the Federal funds rate. Indeed the simulation after just a few months involved a negative funds rate to hold changes in deposits on target, clearly an impossibility. While one would hardly want to jump to the conclusion that these simulations accurately reflect the way the world is actually constructed, their results are not really so implausible. There may be literally *no* way of getting M to grow by more than x percent next month. At some point, injections of nonborrowed reserves may drive the funds rate and borrowed reserves to zero, with further injections merely having the effect of piling up excess reserves. Of course as these reserves begin to be utilized, with a distributed lag, money supply growth could subsequently become explosive, forcing the authorities to jump the funds rate up by amounts that would rock the structure of the money market—and so on.

money market instability. *Lengthening* the period of control increases the probable deviations of aggregate demand and related variables from desired behavior.

No doubt there is an optimum control period here somewhere. It was mentioned earlier that some calculations seem to suggest that if monetary growth rate targets are hit on average over a year, deviations of GNP from the path it would follow with absolutely steady monetary growth might well remain within acceptable limits. However, if monetary growth rates have drifted off target over the first half of the year, for example, the authorities then have only six months in which to get the yearly average back on track. Thus it seems fairly clear that the authorities will have to be prepared to move their instrument variables with sufficient vigor to control average monetary growth rates over periods shorter than one year. Clearly there are some messy problems here in this whole area. Quite possibly they have not yet even been clearly formulated—let alone solved.[18]

CONCLUSION

The main points made in this paper can be summarized as follows. The Federal Reserve has moved with the shift in the general climate of ideas over the past few years, putting increasing emphasis on the money supply and other monetary aggregates as intermediate objectives of monetary policy. The Federal Open Market Committee now sets explicit goals for the growth of the money supply and bank credit and issues operating instructions to the Account Management in New York that are drawn up largely with a view to achieving these objectives. The qualification "largely" is necessary since the behavior of money and capital market conditions, and international financial developments, have also continued as a source of explicit concern to the Committee. At times, this concern has dictated operating decisions different from those that might have been made if hitting money supply objectives had been the sole aim. In trying to improve its ability to achieve money supply goals, the FOMC has experimented with alternative approaches to operating tactics. It has also made a substantial investment of research resources in the problems of monetary control.

The results to date suggest that attempts to forecast and control the money supply over short periods, whatever operating targets are used, will normally be subject to quite large errors. A rough judgment might be that reasonably close forecasts, and control, can be achieved over periods down to six months if the Committee is prepared to move its operating targets sufficiently vigorously to achieve the desired results.

Fortunately, the tentative evidence also suggests that very short-term control over the money supply is not necessary for satisfactory economic performance. Evidently, fairly large deviations from target may not do any significant harm, provided they do not last longer than a quarter or two and provided monetary growth rates average out about on target over longer periods of perhaps a year. None of these estimates can be regarded as firmly established, however.

In controlling money, shorter term operating targets that are more readily achievable than the monetary targets themselves are needed as a guide to day-by-day and week-by-week decisions. Various measures of nonborrowed reserves and short-term interest rates are available for this purpose. Each has advantages and disadvantages. The available evidence does not establish any clear overall superiority for any one of them.

Finally, it is clear that a great deal has been learned about the problems and possibilities of implementing money supply targets in the past few years. Virtually all of the research drawn upon in this survey is less than three or four years old. Many of the topics discussed would have seemed quite novel only a relatively short time ago. The progress in this area has been rapid. Indeed, one may wonder if diminishing returns may not already have begun to set in in some respects. Perhaps the direction in which research efforts will now move is to deal with the implications of the lags and uncertainties—in short the "control theory" issues mentioned earlier. What should be the time horizon for monetary control? How should targets be adjusted in response to the past "misses" that will inevitably arise? Work in this area will have to be sufficiently grounded in reliable evidence and sufficiently "robust" to be useful to properly skeptical policy makers. Nevertheless, we can be hopeful that further progress in this area will be forthcoming over the period ahead.

[18] It might be noted that these problems would not disappear though they might be simplified, if one were to adopt a steady growth of the money supply at some fixed rate à la Milton Friedman. In the first place the economy would not "start out" on its long-run trend path with full employment and a history of steady monetary growth, sustainable real growth, and an "acceptable" rate of inflation. Consequently, one might want to approach the long-run monetary growth rate target only gradually. Secondly, all the technical problems of short-run control over the money supply would remain. Consequently, the actual growth rate could expect to go off track much as it does now. Therefore, the problems of an optimum control period, how to compensate for past errors, and how sharply to adjust operating targets to get back on track would still exist.