Abandoning Monetary Aggregates

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As a result of financial innovation encouraged by regulation in a high interest rate environment, the relatively stable empirical relationships between GNP, interest rates, and the monetary aggregates proposed by Friedman and Schwartz in 1970 (12) broke down some time in 1974. The resulting difficulty of explaining and predicting the old Ms led to the search for, and the recent adoption of, the new aggregate definitions shown in Table 1.[1] This paper offers an eclectic discussion of several topics related to these new monetary statistics. The paper's primary conclusion is that with the possible exception of M-1A and M-1B, the new definitions do not make sense in principle and have no empirical support and therefore should be abandoned.

This paper is organized as follows. Section I briefly describes the new definitions and summarizes the *a priori* arguments made in their support. The emergence of new financial assets and changes in the characteristics of existing ones rendered the old monetary aggregates obsolete. The new monetary aggregates incorporate these changes in the financial environment and so have this much to recommend them. However, because of the aggregation procedure employed in constructing the new data, this conceptual improvement is unlikely to make the new aggregates any more useful in policy planning and analysis than the old ones they were designed to replace. Empirical evidence for the new aggregates is analyzed in section II. The argument in this section is that available empirical tests are unreliable and have low power. These tests do more to reveal the weaknesses of the aggregates approach to the analysis of monetary economics than to lend credence to the new definitions or to the current conduct of monetary policy. The concluding section addresses the broader issue of why we bother to define more than one monetary aggregate in the first place. Both the monetarist and the rational expectations views imply that one aggregate is sufficient for monetary policy, although neither view offers guidance for selecting the appropriate definition or assurance that the definition selected on the basis of *ex post* considerations will be useful *ex ante*. The monetary indicators view admits that aggregates may provide useful information about the economy, although it also suggests that they are neither superior indicators relative to other data nor efficient targets of monetary policy. Thus, aside from their value for increasing the number of degrees of freedom enjoyed by the FOMC, there is no compelling theoretical reason to publish and to set official growth targets for more than one definition of money.

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[1] See (21) for a complete description of the new aggregates.

Table 1
New and Old Monetary Aggregate Definitions

	The New Monetary Aggregates	Amount in billions of dollars, November 1979		The Old Monetary Aggregates	Amount in billions of dollars, November 1979
M-1A	Currency	106.6	M-1	Currency	106.6
	Demand Deposits[1]	265.5		Demand Deposits[2]	276.0
M-1B	M-1A	372.2			
	NOW and ATS account balances, credit union shares draft balances, demand deposits at mutual savings banks	15.7			
M-2	M-1B	387.9	M-2	M-1	382.6
	Overnight RPs issued by commercial banks[3]	20.3		Savings deposits at commercial banks	210.6
	Overnight Eurodollar deposits at Caribbean branches of U.S. banks held by U.S. nonbank residents	3.2		Small time deposits at commercial banks[4]	352.1
	Money market mutual fund shares	40.4			
	Savings deposits at all depository institutions	420.0			
	Small time deposits at all depository institutions[4]	640.8			
	M-2 consolidation component[5]	-2.7			
M-3	M-2	1510.0	M-3	M-2	945.3
	Large time deposits at all depository institutions	219.5		Savings and small time deposits at thrift institutions	664.2
	Term RPs issued by commercial banks	21.5			
	Term RPs issued by savings and loan associations	8.2			
					1609.5

			M-4	M-2	945.3
				Large time deposits at all depository institutions	95.9
					1041.2
			M-5	M-3	1609.5
				Large time deposits at all depository institutions	95.9
					1705.4
L	M-3	1759.1			
	Other Eurodollars of U.S. nonbank residents	34.5			
	Bankers acceptances	27.6			
	Commercial paper	97.1			
	Savings bonds	80.0			
	Liquid Treasury obligations[7]	125.4			
		2123.8			

[1] Equals demand deposits at all commercial banks other than those due to domestic commercial banks and the U.S. government, less cash items in the process of collection and Federal Reserve float, less demand deposits due to foreign commercial banks and official institutions.

[2] Equals demand deposits at all commercial banks other than those due to domestic commercial banks and the U.S. government, less cash items in the process of collection and Federal Reserve float, plus foreign demand balances at Federal Reserve Banks.

[3] Estimated as 51 percent of all commercial bank RPs with the nonbank public and net of RPs held by money market mutual funds.

[4] Time certificates of deposit other than negotiable time certificates issued in denominations of $100,000 or more.

[5] Consists of demand deposits included in M-1B that are held by thrift institutions and are estimated to be used for servicing their savings and small time deposits included in the new M-2 measure.

[6] Negotiable time certificates of deposit issued in denominations of $100,000 or more.

[7] Consists of Treasury bills with an original maturity of one year or less plus Treasury notes and bonds which mature within 18 months.

SOURCE: (21, p. 99)

I. The New Monetary Aggregates: Some Theoretical Objections

Because of new legislation and changes in regulation, the sharp distinctions among deposits and between depository institutions that once produced agreement on the usefulness of the old aggregates no longer exist. Over the past decade new types of deposits have been created and the characteristics of old ones have been changed. In addition, new financial instruments that compete with those deposit liabilities of the banking system traditionally identified as "money" have emerged and grown rapidly in the fertile environment of high interest and inflation rates since the mid-1970s.

The distinction between old M-1 and M-2 rested on the notion that passbook and time accounts at commercial banks cannot be used directly as media of exchange; between old M-2 and M-3 on the notion that passbook and time accounts at thrift institutions are less than perfect substitutes for comparable deposits at commercial banks. Both of these distinctions have been blurred by the introduction of checkable NOW and ATS accounts. Similarly, the introduction of various long-term high-yield time deposits subject to early withdrawal penalties has weakened the argument that the lumping together of savings and time accounts in old M-2 and M-3 is justified because their liquidity is roughly the same. The new definitions incorporate these and other changes in the nation's payments mechanism into the monetary statistics and thus into the purview of monetary policy.

Responding in part to changes in the financial environment and in part to recommendations developed by the Bach Committee in 1976 (14), the Board originally proposed a set of redefined monetary aggregates in January 1979 (18). These aggregates differed from the old ones in two ways. First, all transactions balances — including interest-bearing checkable deposits at all depository institutions but excluding money market mutual fund shares (MMS) — were included in proposed M-1. Old M-1 only included currency and commercial bank demand deposits subject to the zero interest restriction. Second, all savings deposits were included in proposed M-2 and all time deposits (including large negotiable and nonnegotiable CDs) were included in proposed M-3. Old M-2 included savings and time deposits (except large negotiable CDs of large banks) issued by commercial banks, old M-3 included savings and time deposits issued by thrift institutions, and M-4 and M-5 included large negotiable CDs issued by large banks.

Reaction to this proposal by the various reserve banks and by academic and business consultants was mixed.[2] The idea of grouping the components of the aggregates by their functional characteristics — an implicit measure of their elasticity of substitution in demand — rather than by the type of institution issuing them — an implicit measure of their elasticity of substitution in supply — received general approval. On the other hand, most reviewers argued that the proposed definitions were seriously deficient because they

[2] Comments were presented at seminars held at the Board of Governors of the Federal Reserve System, Washington, D.C., on 19 April and 5 June 1979.

ignored MMS, RPs, Eurodollars, and other substitutes for demand, savings, and time deposits.

The Board responded to these criticisms in September 1979 with a revised set of aggregate definitions (20). As before, savings accounts at all depository institutions were included in M-2, but the revised aggregate also included MMS and overnight RPs at commercial banks. Revised M-3 added small time deposits at all depository institutions to M-2, but large negotiable and nonnegotiable time deposits were now included in a new aggregate L. In addition, the liquid asset measure L contained term RPs at all depository institutions, bankers acceptances and commercial paper, Eurodollar deposits, savings bonds, Treasury bills with an original maturity of less than one year, and Treasury notes and bonds scheduled to mature within 18 months.

Subsequent discussion and empirical analysis as well as the development of several new data series led to further modifications of the aggregate definitions. In the final form adopted in February 1980 (21) and shown in Table 1, certain overnight Eurodollar deposits were added to M-2 and small time deposits at all depository institutions were inserted into this aggregate instead of M-3. Term RPs at commercial banks and savings and loan associations joined large negotiable and nonnegotiable time deposits in M-3 instead of L. The liquid asset measure otherwise was left unchanged. Finally, M-1 was divided into two aggregates: M-1A, equal to old M-1 minus demand deposits owned by foreign commercial banks and official institutions; and M-1B, equal to M-1A plus interest-bearing checkable deposits.[3]

According to Simpson (21, pp. 99–100), "the organizing principle underlying the redefined monetary aggregates is that of combining similar kinds of monetary assets at each level of aggregation." The word "similar" in this context is taken to mean a high elasticity of substitution in demand for the various components, not a high elasticity of substitution in supply. This choice is not dictated either by index number or economic theory. A sensible aggregation scheme only requires that like things appropriately weighted be added to like things. It does not require that the similarity be on the demand rather than the supply side. Monetary theory recognizes the importance of both the demand for and the supply of money. Neither demand nor supply in isolation fully determines or is determined by interest rates, income, and prices. The decision to group monetary assets on the basis of demand elasticities is not forced upon us for profound conceptual reasons. On the contrary, this decision is an intuitive one that reflects professional preoccupation with the demand for money and the habit of taking the money supply as fixed or completely under the control of the monetary authority. It also may reflect the view endorsed by Friedman and Schwartz (12, p. 139) but yet to be demonstrated empirically that the money demand relationship is more stable and subject to more compact modeling than the relationship describing money supply. These arguments may justify demand-side aggregation on

[3] See (7) for an explanation of why these deposits were removed from the demand deposit component.

grounds of convenience but they certainly do not justify the implicit assumption that the only demand elasticities "count."

In any event, in the absence of explicit, generally accepted estimates of the relevant elasticities of substitution in demand, the selection of appropriate component groupings for the aggregates is far from obvious. This much is clear from the difficulty the Board staff experienced in achieving a concensus on the new definitions. The continuing controversy partly reflects confusion over whose elasticities of substitution are being measured, even if only implicitly. The demand for money by the public is composed of the demands of two distinct groups at least — households and firms. In general, the behavioral relationships describing the transaction or portfolio demands of these two groups will be different, as will be the assets that are the subject of their respective choice problems. While the elasticity of substitution between savings and time deposits may be high for households and the elasticity of substitution between overnight RPs and overnight Eurodollars may be high for (certain) firms — the elasticities of substitution in supply of savings for time deposits and of RPs for Eurodollars no doubt are high for (certain) banks — surely the elasticities of substitution between the former two components and the latter two for households and firms are rather low. Why, then, should they be lumped together in M-2? Inconsistencies such as this are evident in all of the aggregates to some extent, but the problem is most acute for the higher order definitions M-2, M-3, and L.

The justification for grouping assets with high elasticities of substitution is to insure that the relationship between the aggregate and other variables of interest will not shift with every change in the relative contribution of the aggregate's individual components. But since the components of the higher order aggregates (and perhaps M-1A and B as well) are not uniformly close substitutes, the coefficients in an estimated demand or reduced-form income regression fit with a particular aggregate will not be unaffected by changes in the composition of that aggregate. These estimated coefficients reflect some weighted combination of the coefficients of the true underlying behavioral relationships of each of the economic agents represented by the various components of the aggregate. Because the underlying behavioral relationships are different for each agent considered, the weights are entirely dependent on the unique historical pattern of the contribution of each agent and hence of each component to the aggregate. Therefore, if the share of a particular component in the total should change, the estimated coefficients in a regression using this aggregate also will change even if the underlying behavioral equations themselves are perfectly stable. Aside from such other potential sources of instability in the econometric relationships between money, income, prices, and so on as the emergence of more new financial assets or further changes in regulation, the aggregation procedure used to construct the new definitions alone suggests that standard demand and reduced-form income regressions will be unstable. The new aggregates may prove to be far less useful as an intermediate target of policy than was hoped.

Consistent application of the avowed principle of aggregation would

have resulted in either a large set of (perhaps) partially overlapping simple sum aggregates or a small set of monetary quantity index numbers. The index number approach, advocated vociferously in a series of papers by Barnett (1, 2, 3), eliminates the objections to the new definitions just described. Unfortunately, Barnett's approach is not without problems of its own. First are the theoretical problems of whether "money" belongs in the utility function and whether it is any more appropriate to aggregate over the utility functions of different transactors than over the asset demand equations derived from them. Second are the practical problems of estimating the elasticities of substitution required to select the components and the own rates of return on certain components required to compute the relevant weights. Third is the issue of public acceptance of monetary quantity index numbers in place of the simple sum aggregates to which people are accustomed. Fourth are the questions of how the Fed could control the time path of an index number and how an index of "moneyness" could be used to define and conduct monetary policy. These problems offset the otherwise compelling theoretical case for monetary quantity index numbers.

An alternative response to the burgeoning menu of available financial instruments is not to add them, hands waving, to existing aggregates — a "solution" that is likely to exacerbate in the long run the instability problem that it ameliorates only slightly in the short run (see below) — but to turn instead toward *narrower,* more numerous definitions. One can imagine a set of simple sum aggregates relevant to households, say the household share of M-1B and this aggregate plus MMS (but only that fraction owned by households!), savings and time deposits, and another set relevant to firms, say the firm share of M-1A and this aggregate plus RPs, Eurodollars, and CDs. Even this degree of aggregation may be too extensive to insure the reliability of the statistical relationships between the aggregates and monetary policy tools and objectives if the demand equations for individual components vary significantly by size of transactor within each category. For example, large firms may display markedly different reactions to a change in the relative yields on CDs, RPs, and Eurodollars than small firms who are effectively prevented from participating in these markets by the high minimum value of transactions. Disaggregation on a grand scale may be required to produce a sensible set of monetary statistics.

The new monetary aggregates correct the problem of omission that allegedly reduced the usefulness of the old definitions of money. However, this correction and the associated "solution" of the case of the missing money to be described in the next section were purchased at the cost of introducing another potentially more serious problem into the data. The new higher order aggregates lump together with equal weights assets that clearly are not equally close substitutes in demand for all transactors. A similar problem may plague M-1A and B if the behavioral relationships that determine the demand for currency and the various checkable deposits also vary from transactor to transactor. These inconsistencies will render the statisical relationships between the aggregates and other variables of interest unstable.

Policymakers therefore cannot be confident that a policy defined by a vector of x percent aggregate growth rates if achieved will produce the expected outcomes, nor can they expect deviations of aggregate growth from target to convey unambiguous information about the appropriate policy response. What sense does it make to define monetary policy in terms of such data or to continue to devote scarce resources to the quixotic search for stable demand functions and close fits to nominal GNP? Since simple sum aggregation cannot be justified on theoretical grounds, and since properly constructed monetary quantity index numbers have serious practical deficiencies as well, the Fed may be better off simply reporting the nominal quantities of each individual component than continuing to publish and to set official growth targets for the new monetary aggregates.

II. The New Monetary Aggregates: Some Empirical Objections

Professional opinion has traditionally been divided on the issue of the appropriate definition of money, a subject vigorously debated in the literature from time to time over the past several hundred years.[4] The new definitions mark the preliminary skirmishes in the second postwar incarnation of this controversy, the first having begun in the early 1960s with the appearance of articles on the relative efficacy of monetary and fiscal policy in influencing nominal income on the one hand (see, e.g., 11) and on the empirical specification of the aggregate money demand function on the other (see, e.g., 15). From this battle emerged the old set of monetary aggregates as well as the general acceptance, or perhaps better stated the absence of widespread rejection, of the use of reduced-form "St. Louis" regressions to estimate the relative impact of alternative money (and fiscal) measures on fluctuations in GNP and "stock adjustment" equations to explain the observed variance in the monetary statistics.

Because the profession in earlier years primarily was concerned with resolving the important theoretical and econometric questions raised by the ongoing monetarist versus fiscalist debate, and because then existing customary and legal distinctions between the various types of financial assets offered by various financial intermediaries permitted their more or less unambiguous classification into money and nonmoney categories, most analysts were content to accept the old aggregate definitions and to quarrel instead over which was "best" in the sense of having the highest correlation with income or the most stable estimated demand relationship. This controversy was settled in a fairly pragmatic way by frequent users of the data, including the FOMC, by monitoring the behavior of more than one aggregate. In contrast, the current controversy was ignited by the nearly simultaneous and seemingly related appearance in the mid-1970s of new financial instruments and apparent "instability" in formerly reliable money demand

[4] Prominent examples include the bullionist controversies of the 17th and 18th centuries and the banking school-currency school debates of the 19th century.

equations (17, 23). Since these events created difficulties with all of the old definitions, the uncertainty could not be resolved as in earlier times simply by substitution among them. Attention in the current round thus has been focused from the beginning on the definition of the monetary statistics, with relatively little attention paid to the analytical ground rules for pursuing the debate — reduced-form regressions and money demand functions — established some years earlier.

Demand Equations

The Board staff has prepared a comprehensive empirical analysis of the new monetary aggregates based on these principles (4). Representative demand equations for the old and the new definitions estimated over the 1960:4–1979:4 period are shown in Table 2. A standard inventory model of money demand underlies the log-linear specification used for old M-1, M-1A, and M-1B. Demand equations for all of the other old and new aggregates are based on a simple portfolio allocation model where the share of each aggregate in total wealth depends on own and competing rates of interest as well as on current income and the lagged dependent variable.

As would be expected from the similarity of the definitions, the estimated demand equations for old M-1, M-1A, and M-1B are almost identical. All three regressions yield low income and interest elasticities and a high coefficient on the lagged money stock. Evidently growth in transactions balances is little influenced by growth in transactions or by interest rates under the direct or indirect control of the monetary authority. Rather, the time series of the various M-1s largely is explained by a first-order autoregression: the standard error of the regression of M-1B on a constant and lagged M-1B is only about 10 percent larger than the standard error for the M-1B demand equation reported in Table 2, for example. When estimated over the 1960–69 period the demand equations produce a somewhat more hopeful income elasticity of about .2 and a more reasonable coefficient on lagged money of .6 but a still disappointing interest elasticity of –.02 on both the bill and the passbook rates. When the sample period is extended through mid-1974 or when the equations are estimated with data for the 1970s alone, the income and bill rate elasticities decline somewhat but the passbook rate elasticity and the coefficient on lagged money rise. Although the estimated coefficients in a standard M-1 demand equation generally conformed to theoretical expectations of sign and magnitude in earlier years, the properties of the equation for both the old and the new definitions deteriorated dramatically in the 1970s.

A somewhat different conclusion emerges in the case of the higher order aggregates. For these definitions, the properties of the estimated share equations are poor regardless of the sample period. Table 2 shows that with the exception of old M-2, the coefficient on the lagged dependent variable always is close to one. This is true whether the equations are estimated separately over the 1960s and the 1970s or when the log-linear inventory specification is

Table 2
Representative Demand Equations for the Old and the New Monetary Aggregates

Aggregate	Constant	GNP	Treasury Bill Rate	Commercial Bank Pass-book Rate	Commercial Bank Time Deposit Rate	Lagged Dependent Variable	$\bar{R}^2$	Standard Error	RHO
Old M-1	-.397 (3.04)	.041 (3.28)	-.010 (2.82)	-.013 (1.06)	—	1.030 (42.96)	.988	1.971	.29
New M-1A	-3.87 (3.15)	.038 (3.28)	-.011 (3.11)	-.009 (0.73)	—	1.030 (47.73)	.987	1.993	.24
New M-1B	-.343 (2.56)	.048 (3.98)	-.010 (2.80)	-.015 (1.26)	—	1.011 (39.93)	.988	1.911	.28
Old M-2	.0191 (3.33)	.0778 (3.09)	-.000520 (4.03)	.000564 (0.98)	.000144 (0.72)	.683 (11.09)	.991	1.803	.90
Old M-3	-.000801 (0.17)	-.0058 (0.17)	-.000916 (5.64)	.0023 (3.56)	.000584 (2.50)	.994 (22.95)	.997	1.573	.51
New M-2	.000838 (0.18)	.0030 (0.09)	-.000987 (6.09)	.0021 (3.39)	.000713 (2.91)	.973 (11.81)	.99	1.796	.40
Old M-4	.0042 (0.69)	.0113 (0.35)	-.000367 (1.97)	.0023 (3.02)	.000148 (0.52)	.903 (16.49)	.994	2.385	.76
Old M-5	.0044 (.063)	-.0212 (0.55)	-.000969 (3.28)	.0032 (3.68)	.000352 (1.14)	.978 (23.37)	.998	1.794	.73
New M-3	.0032 (0.43)	-.0260 (0.64)	-.000608 (2.66)	.0027 (2.91)	.000345 (1.04)	.988 (23.39)	.998	1.965	.69
New L	.0377 (3.59)	.0742 (1.73)	-.000137 (0.70)	.000485 (0.57)	-.000121 (0.82)	.825 (15.16)	.998	1.410	.98

Estimated equation for old M-1, new M-1A, new M-1B:

$$\ln(M_t/P_t) = a_0 + a_1 \ln(Y_t/P_t) + a_2 \ln(RTB_t) + a_3 \ln(RCBPASS_t) + a_4 \ln(M_{t-1}/P_t)$$

Estimated equation for remaining aggregates:

$$(M_t/W_t) = b_0 + b_1 (Y_t/W_t) + b_2 RTB + b_3 RCBPASS + b_4 RCBTD + 5_b (M_{t-1}/W_t)$$

where RTB = annual effective yield on 3-month Treasury bills
RCBPASS = annual effective yield on commercial bank passbook deposits;
RCBTD = maximum rate on commercial bank time deposits adjusted for the market yield curve, annual effective yield;
W = beginning-of-quarter nominal household net worth (from MPS data base);
Y = nominal GNP;
P = GNP price deflator.

Period of fit for all regressions is 1960:4–1979:4; t-statistics are in parentheses.

SOURCE: (4, Table 2-1)

used instead of the share specification.[5] On the other hand, the size, sign, and statistical significance of the coefficients on income and the various interest rate variables generally are unstable across different sample periods for every aggregate considered. For example, the coefficient on the commercial bank passbook rate in the old M-3 and new M-2 equations is negative when estimated over the 1960s and positive when estimated over the 1970s; the estimated coefficient on the Treasury bill rate in the old M-5 and new M-3 equations is negative in both periods but is 10 times larger in the 1960s than in the 1970s; the estimated coefficient on the commercial bank time deposit rate in the new L equation is positive and significant in the 1960s but negative and not significant in the 1970s; the estimated coefficient on the ratio of GNP to wealth changes from negative in the earlier period to positive in the latter period for all of the old and new higher order aggregates except new M-2, where the coefficient is always negative but is significant only in the 1960s.

The casual impression that the demand equations for both the old and the new definitions are "unstable" is reinforced by the results of a battery of F-tests (4, p. 28). The hypothesis that the coefficients in the demand equations in the 1960s are equal to the coefficients in the 1970s is rejected at the 5 percent significance level for *every* old and new aggregate. The hypothesis that the coefficients for the period 1960:4–1974:2 are equal to those for the period 1974:3–1979:4 cannot be rejected only for M-1A, old M-4, old M-5, and L. To the extent that the demand equations for the old monetary aggregates are instable, so also are those for the new aggregates; to the extent that the new aggregates are correlated with income and interest rates, so also are the old aggregates.

One of the factors that originally motivated the search for new aggregate definitions was the accumulation of large errors after mid-1974 from formerly reliable demand equations for the old definitions. Dynamic simulations of the equations for the old aggregates between 1974:3 and 1979:4 produce cumulative overpredictions of the actual level of M-1 of 16.4 percent, of M-2 of 11.8 percent, of M-3 of 7.7 percent, and of M-4 and M-5 of 20.1 and 20.2 percent, respectively (4, Table 2–5). That this apparent downward shift in the demand for the old aggregates occurred nearly simultaneously with the emergence of such new financial instruments as MMS and RPs on the one hand and the widespread adoption of modern cash management techniques on the other (16, 17) focused attention on these developments as the probable solution to the "case of the missing money" (13). These coincidences also established as a primary empirical test of the new definitions their ability to get the money demand equation back "on track."

Dynamic simulation of the M-1A demand equation over the 1974:3–1979:4 period produces a cumulative overprediction of 16.9 percent, essentially the same as that for old M-1. The M-1B equation performs slight-

[5] The standard error from a first-order autoregression on new M-2 exceeds the standard error from the inventory model regression for this aggregate by 23 percent; the standard error of a first-order autoregression on new M-3 exceeds the standard error from the inventory model regression for this aggregate by 10 percent.

ly better, however, with a cumulative overprediction of 12.2 percent. Evidently at least some of the demand deposits that were "lost" in the late 1970s now may be found in NOW, ATS, and other interest-bearing checkable accounts. Further evidence that changes in the nation's payments mechanism explain the shortfall in money demand is provided by the simulation results for new M-2. This equation yields a cumulative *underprediction* of the actual level of new M-2 of 1.9 percent. On the basis of this evidence, despite the instability of the new M-2 demand equation, the case of the missing money apparently is closed.

Unfortunately, most of the strength of this support for the new definitions as the solution to the money demand puzzle evaporates when the investigation is carried two steps further. First, with a 20.8 percent cumulative overprediction, the simulation results for new M-3 are no better than those for old M-4 and M-5. The argument in (4) is that this dramatic deterioration may have occurred because the large CDs and term RPs included in new M-3 are managed liabilities, so their behavior may be inadequately represented by an equation that ignores "supply side" considerations. Hence, "a more logical approach (sic) would be to model (these) components separately, rather than to tack (them) onto the other components" (4, p. 28). Whatever the merits of the managed liability hypothesis to explain the large forecast errors of the new M-3 demand equation, one wonders why so little attention was paid to this conclusion in the preparation of the new monetary aggregates.

The second difficulty with the solution is that there are at least three other aggregates in the spectrum between M-1B and new M-2 whose demand equations track money growth as accurately as the new M-2 demand equation. Dynamic simulations of the demand equations for four such intermediate aggregates — M-1B plus overnight RPs, M-1B plus MMS, M-1B plus overnight RPs and MMS, and M-1B plus small time and savings deposits at all depository institutions — yield cumulative overpredictions for the 1974:3–1979:4 period of 14.1, 3.6, 3.8, and 0.2 percent, respectively (4, Table 2–7).[6] At the very least, these results suggest that the shortfall in money demand can be "explained" without appeal to the alleged massive substitution of MMS and RPs for demand deposits.[7] On the other hand, since the errors from the equations for small time and savings deposits in the MPS model do not offset the errors from the demand deposit equation (4, p. 27), the money demand puzzle apparently cannot be resolved satisfactorily by a shift to time and savings deposits either. The M-2 demand equation "works," but it is not clear why it works. This hardly constitutes compelling support for new M-2, any more than the simulation results for the other new aggregates inspire confidence in their usefulness.

[6] Other intermediate aggregates are conceivable. For example, Tinsley and Garrett (23) experiment with an aggregate equal to M-1B plus that share of total RPs predominantly used for transactions.

[7] The puzzle has been "solved" in many ways. A discussion of several of these solutions is presented in (6).

Reduced-Form Regressions

Table 3 shows the results from a set of reduced-form income regressions for the old and the new aggregates over the period 1963:4–1979:2 (4, Table 3–1). In each case, the rate of growth of nominal GNP is regressed against a constant, a strike variable, and the rate of growth of a money and a fiscal variable over the current and previous 15 quarters. This is one version of the standard St. Louis regression that appears frequently in the literature.

The standard error of estimate is the relevant summary statistic for comparing the ability of the various definitions of money to "explain" the growth of nominal GNP within sample. The results are very close. While old M-4, old M-5, and new M-3 perform somewhat worse than the other aggregates and old M-3 and new M-2 somewhat better, none of the definitions emerges as a clear "winner" given the standards of approximation commonly applied in macroeconomic analysis. Indeed, when estimated over the period 1963:4–1974:2, the standard errors range from a low of 2.33 percent for old M-1 and old M-2 to a high of 2.43 percent for old M-4 and new M-3 — a virtual tie. Nor do the estimated coefficients in the regressions provide a basis for distinguishing among the definitions. With the exception of old M-4, the sum of estimated coefficients on money is significant for every aggregate while the sum of the fiscal coefficients is marginally significant at best. And since theory does not suggest the precise definition of money with respect to which the economy may be "neutral," the differences in the sum of the lagged coefficients similarly are of no help in choosing among the alternative definitions.

An indication of the forecasting performance of the various definitions is provided by the errors from dynamic simulations over the period 1974:3–1979:2 of the set of reduced-form equations fit through 1974:2. Summary error statistics are reproduced in Table 4 (4, Table 3–3). With a mean error of –.16 percent and root mean square error (RMSE) of 2.96 percent, new M-2 tracks nominal GNP growth more accurately than any other aggregate. Its closest competitor — old M-3 — has an average bias of .73 percent and an RMSE of 3.24 percent. By these measures new M-3 and L perform slightly better than their old counterparts M-4 and M-5, and M-1A and B perform slightly better than old M-1.

These simulation results provide the strongest support yet for the new monetary aggregates, especially new M-2. But this evidence will not impress anyone who is concerned about the well-known theoretical and econometric difficulties with reduced-form regressions. A problem remains even for those who are willing to overlook the shortcomings of the reduced-form approach and to consider these results seriously: who cares about nominal GNP? A particular rate of growth of nominal GNP is consistent with any combination of real GNP growth and inflation. Growth of nominal GNP therefore says nothing about the value of the objective function the Fed presumably attempts to maximize.[8] The justification for the regression of an endogenous

[8] On this point also see (8).

Table 3
Representative Reduced-Form Estimates for the Old and the New Monetary Aggregates

Aggregate	Constant	Sum of Money Coefficients	Sum of Fiscal Coefficients	Strike Variable	$\overline{R}^2$	Standard Error	RHO
Old M-1	1.29 (0.65)	1.34 (3.68)	1.42 (1.25)	-5.27 (4.49)	.409	2.812	-.003
New M-1A	1.27 (0.64)	1.36 (3.67)	1.49 (1.35)	-5.24 (4.48)	.419	2.788	-.009
New M-1B	1.42 (0.81)	1.29 (4.01)	1.74 (1.73)	-5.40 (4.69)	.448	2.718	-.073
Old M-2	-2.63 (1.01)	1.41 (4.31)	0.73 (0.71)	-5.29 (4.45)	.414	2.800	-.030
Old M-3	-1.82 (0.91)	1.19 (5.23)	0.99 (1.18)	-5.49 (4.78)	.464	2.678	-.127
New M-2	-2.05 (1.16)	1.26 (6.12)	1.06 (1.36)	-5.60 (5.04)	.505	2.573	-1.83
Old M-4	4.53 (1.72)	0.47 (1.54)	1.40 (1.22)	-5.32 (4.22)	.263	3.139	.137
Old M-5	1.78 (0.79)	0.75 (3.03)	1.07 (1.09)	-5.38 (4.36)	.343	2.964	-.020
New M-3	1.51 (0.72)	0.76 (3.39)	1.17 (1.22)	-5.46 (4.48)	.367	2.911	-.006
New L	0.97 (0.59)	0.85 (4.00)	1.30 (1.62)	-5.58 (4.83)	.456	2.697	-1.54

Estimated equation for all aggregates:

$$Y_t = a + \sum_{i=0}^{14} b_i M_{t-1} + \sum_{i=0}^{14} c_i F_{t-1} + dS_t$$

where Y = annualized percentage rate of growth of nominal GNP in quarter t;
M = annualized percentage rate of growth of indicated monetary aggregate;
F = annualized percentage change in the ratio of the nominal high employment federal deficit to nominal potential GNP;
S = annualized percentage change in the ratio of manhours lost due to strikes to manhours worked.

Third-order polynomial distributed lags, constrained to zero at t-5, were estimated for money and fiscal variables; t-statistics are in parentheses.

SOURCE: (4, Table 3-1).

Table 4
Post-Sample Simulation Errors from Reduced-Form Regressions for Nominal GNP Growth

	Aggregate									
	Old M-1	New M-1A	New M-1B	Old M-2	Old M-3	New M-2	Old M-4	Old M-5	New M-3	New L
Mean Error	2.41	2.30	1.79	1.54	0.73	-0.16	2.43	1.77	1.62	1.07
Mean Absolute Error	2.95	2.86	2.59	2.62	2.29	2.10	3.72	2.84	2.71	2.43
Root Mean Squared Error	3.88	3.77	3.57	3.75	3.24	2.96	4.54	3.86	3.77	3.40

These error statistics are from dynamic simulations over the period 1974:3–1979:2 of the reduced-form regression specified in Table 3 over the period 1963:4–1979:2.

SOURCE: (4, Table 3-3).

variable like nominal GNP on "exogenous" money and fiscal measures is that it is supposed to represent the reduced form of the true structural macromodel. Since the arguments in the Fed's objective function — growth of real GNP, inflation, unemployment, the exchange value of the dollar — also are endogenous, they may appear as the dependent variables in reduced-form regressions for exactly the same reason. To the extent that the reduced-form approach is valid, the correlation between the monetary aggregates and real GNP, inflation, and so on is the relevant test of the new definitions not their correlation with nominal income.

An alternative set of reduced-form regressions using nominal GNP growth, real GNP growth, growth of the GNP deflator, and the unemployment rate as dependent variables was run over the periods 1960:1–1969:4, 1970:1–1979:4, and 1960:1–1979:4. In these regressions only the rate of growth of money and fiscal variables in the current and previous four quarters appear on the right hand side. No strike variable is included. Standard errors from these regressions are shown in Table 5. The sum of the lag coefficients on the various definitions of money are shown in Table 6. Finally, summary error statistics from dynamic simulations over the 1974:3–1979:4 period of the equations for nominal and real GNP growth and inflation fit through 1974:2 are shown in Table 7.

The within-sample results for the nominal GNP regressions are broadly consistent with those reported in (4). As before, the sum of the lagged coefficients on money is positive and significant for every definition. Also as before, none of the new aggregates does a noticeably better job "explaining" nominal GNP growth than the aggregates they were designed to replace; one definition of money evidently is as good as another for this purpose. The standard errors are somewhat larger than those reported in (4), however. One reason for this is that the alternative regressions use only a four-quarter distributed lag rather than a 14-quarter lag.[9] The absence of a strike variable is important as well. Defined in (4) as the percentage change in the ratio of manhours lost due to strikes to manhours worked, this variable clearly is not exogenous but is highly correlated with GNP. Thus it hardly is surprising that the strike variable enters with a large and significant negative coefficient in the regressions reproduced in Table 3 or that these regressions fit the data more closely than the alternative regressions.

Perhaps because of this missing strike variable, the post-sample simulation results for nominal GNP in Table 7 are by no means as favorable for the new definitions as those in Table 4. Although new M-2 still yields a relatively small mean error, the RMSE is more than a full percentage point higher than the RMSE reported in (4). Moreover, the errors for new M-2 are no smaller than those for several other old and new aggregates. The simulation performance of reduced-form regressions apparently is not a robust test of alterna-

[9] A four-quarter lag was selected because it appears to have become standard practice in the literature. Except as noted in footnote 10, none of the conclusions in the text is altered when a 14-quarter lag is used instead. Some illustrative results from these regressions are shown in the Appendix.

Table 5
Standard Errors from Alternative Reduced-Form Regressions

Dependent Variable and Sample Period	Old M-1	New M-1A	New M-1B	Old M-2	Old M-3	New M-2	Old M-4	New M-5	New M-3	New L
Nominal GNP (%Δ)										
1960–1979	3.346	3.278	3.272	3.339	3.335	3.378	3.643	3.495	3.478	3.317
1960–1969	2.586	2.568	2.567	2.241	2.149	2.292	2.235	2.233	2.359	2.434
1970–1979	3.848	3.696	3.652	4.021	3.993	3.981	4.284	4.169	4.027	3.608
Real GNP (%Δ)										
1960–1979	3.556	3.534	3.562	3.512	3.425	3.376	3.642	3.542	3.552	3.474
1960–1969	2.620	2.619	2.619	2.430	2.145	2.211	2.196	2.055	2.124	2.347
1970–1979	4.083	3.922	4.040	4.079	3.809	3.759	4.455	4.195	4.073	3.639
Implicit Price Deflator (%Δ)										
1960–1979	1.565	1.573	1.556	1.596	1.589	1.609	1.598	1.598	1.607	1.558
1960–1969	1.006	1.009	1.012	1.187	1.268	1.257	1.253	1.276	1.276	1.224
1970–1979	1.795	1.808	1.804	1.801	1.732	1.751	1.829	1.784	1.820	1.755
Unemployment Rate										
1960–1979	0.343	0.344	0.343	0.346	0.338	0.338	0.356	0.349	0.353	0.343
1960–1969	0.256	0.257	0.258	0.250	0.247	0.251	0.255	0.252	0.255	0.254
1970–1979	0.411	0.418	0.415	0.424	0.396	0.397	0.431	0.424	0.428	0.411

Estimated equation for all aggregates:

$$Y_t = a + \sum_{i=0}^{4} b_i M_{t-i} + \sum_{i=0}^{4} c_i F_{t-1}$$

where Y = annualized percentage change in indicated dependent variable in quarter t;
M = annualized percentage change in indicated monetary aggregate;
F = annualized percentage change in high-employment federal expenditures.

Third-order polynomial distributed lags, constrained to zero at t–5, were estimated for money and fiscal variables; t-statistics are in parentheses.

SOURCE: see text.

Table 6
Sum of Lagged Coefficients on "Money" from Alternative Reduced-Form Regressions

Dependent Variable and Sample Period	Old M-1	New M-1A	New M-1B	Old M-2	Old M-3	New M-2	Old M-4	Old M-5	New M-3	New L
Nominal GNP (%Δ)										
1960–1979	1.113	1.182	1.081	1.052	0.896	0.828	0.570	0.689	0.686	0.826
	(5.48)	(6.00)	(5.97)	(5.63)	(5.60)	(5.24)	(3.18)	(4.13)	(4.40)	(5.43)
1960–1969	1.019	1.098	1.094	1.292	1.660	1.719	1.066	1.169	1.241	1.305
	(3.68)	(3.85)	(3.87)	(6.15)	(6.72)	(5.71)	(5.96)	(4.85)	(4.87)	(4.32)
1970–1979	1.260	1.388	1.201	0.867	0.629	0.549	0.348	0.487	0.628	0.920
	(2.99)	(3.54)	(3.56)	(2.54)	(2.43)	(2.54)	(1.29)	(1.82)	(2.55)	(4.05)
Real GNP (%Δ)										
1960–1979	0.338	0.421	0.304	0.635	0.709	0.713	0.228	0.464	0.408	0.173
	(1.13)	(1.39)	(1.06)	(2.44)	(3.24)	(3.64)	(1.04)	(2.16)	(1.99)	(0.81)
1960–1969	0.396	0.472	0.468	0.816	1.426	1.454	0.828	1.119	1.125	0.796
	(1.08)	(1.25)	(1.25)	(2.68)	(5.32)	(4.88)	(4.25)	(5.65)	(5.09)	(2.43)
1970–1979	1.083	1.335	0.953	1.093	1.051	0.917	0.337	0.762	0.827	0.790
	(2.00)	(2.72)	(2.02)	(2.76)	(4.01)	(4.21)	(1.01)	(2.53)	(3.03)	(3.21)
Implicit Price Deflator (%Δ)										
1960–1979	0.569	0.534	0.622	0.209	−0.080	−0.119	0.199	0.008	0.104	0.532
	(2.40)	(2.18)	(2.78)	(1.03)	(0.39)	(0.62)	(1.28)	(0.04)	(0.59)	(2.85)
1960–1969	0.637	0.653	0.652	0.481	0.325	0.504	0.238	0.111	0.174	0.507
	(7.00)	(6.95)	(6.94)	(2.92)	(1.20)	(1.64)	(1.43)	(0.52)	(0.78)	(2.16)
1970–1979	0.131	−0.014	0.113	−0.087	−0.327	−0.364	0.082	−0.173	−0.087	0.158
	(0.30)	(0.03)	(0.26)	(0.72)	(1.55)	(1.86)	(0.41)	(0.84)	(0.43)	(0.70)
Unemployment Rate										
1960–1979	−0.138	−0.120	−0.123	−0.008	0.020	0.021	0.015	0.036	0.007	−0.146
	(2.19)	(1.94)	(1.95)	(0.17)	(0.44)	(0.50)	(0.41)	(0.86)	(0.17)	(2.39)
1960–1969	−0.045	−0.047	−0.044	0.038	0.068	0.035	0.031	0.053	0.042	−0.059
	(0.63)	(0.67)	(0.64)	(0.60)	(0.96)	(0.48)	(0.61)	(0.88)	(0.70)	(0.82)
1970–1979	−0.241	−0.184	−0.205	0.017	0.033	0.038	0.047	0.068	0.045	−0.171
	(2.08)	(1.60)	(1.68)	(0.22)	(0.52)	(0.68)	(0.87)	(1.11)	(0.75)	(1.63)

t-statistics are in parentheses

SOURCE: see text, Table 5.

Table 7
Post-Sample Simulation Errors from Alternative Reduced-Form Regressions

Dependent Variable	Old M-1	New M-1A	New M-1B	Old M-2	Old M-3	New M-2	Old M-4	Old M-5	New M-3	New L
Nominal GNP (%Δ)										
Mean Error	1.70	1.66	0.91	1.70	1.20	0.76	2.75	2.05	1.82	0.64
Mean Absolute Error	3.01	2.97	3.00	3.26	3.25	3.30	4.06	3.44	3.28	3.28
Root Mean Squared Error	4.35	4.22	4.13	4.53	4.28	4.27	5.35	4.73	4.62	4.40
Real GNP (%Δ)										
Mean Error	-0.93	-0.87	-1.30	-1.22	-1.78	-2.31	-0.60	-1.01	-1.13	-1.16
Mean Absolute Error	3.35	3.33	3.50	3.48	3.55	3.64	3.52	3.48	3.60	3.74
Root Mean Squared Error	4.42	4.42	4.56	4.47	4.42	4.46	4.95	4.73	4.71	4.61
Implicit Price Deflator (%Δ)										
Mean Error	1.25	0.64	0.42	0.05	-0.43	-0.80	1.01	-0.36	-0.28	0.89
Mean Absolute Error	2.03	2.00	1.85	2.32	2.29	2.40	2.22	2.28	2.27	1.88
Root Mean Squared Error	2.48	2.43	2.22	2.74	2.76	2.90	2.64	2.75	2.71	2.25

These error statistics are from dynamic simulations over the period 1974:3–1979:4 of the reduced-form regression specified in Table 5 fit over the period 1960:1–1974:2.

tive aggregate definitions.

The within-sample results of the regressions for real GNP growth are similarly unimpressive. For the 1960–79 period as a whole, the standard error for each aggregate is at least as large as the average rate of growth of real GNP during the simulation period. Further, while the sum of the lagged coefficients on old M-2, old M-3, old M-5, new M-2, and new M-3 is positive and significant in all three periods considered, only for old M-2 is the hypothesis of stability of the regression coefficients not rejected at the 5 percent level of significance. The *ex ante* forecasting performance of the real GNP regressions also is poor regardless of which aggregate appears on the right hand side. The RMSEs exceed the actual mean growth of real GNP by at least 1.3 percentage points in every case. Not much support here for the new (or the old) monetary aggregates, or for that matter for the reduced-form approach to the analysis of issues in macroeconomics.

The same conclusion emerges from the regressions for the inflation and unemployment rates. For neither dependent variable is there an economically meaningful difference in the standard errors produced by the various aggregates. Nor are any of the aggregates consistently significantly related to inflation or unemployment: for inflation, the sum of the lagged coefficients frequently is significant during the 1960s but is significant during the 1970s only for new M-2 (with an estimated coefficient of the "wrong" sign); for unemployment, the sum of the lagged coefficients never is significant during the 1960s and is significant and has the expected sign during the whole period or during the 1970s only for old M-1, new M-1A, new M-1B, and new L.[10] Post-sample simulation errors for the inflation rate in Table 7 also fail to reveal the superiority of the new over the old definitions, with new M-1B and new L performing somewhat better than average but new M-2 and new M-3 performing somewhat worse.

One unambiguous result these statistical exercises provide is that money demand equations and reduced-form regressions have no power to discriminate among alternative aggregate definitions. The uniformly weak empirical support for the new definitions thus may arise more from the crudeness of the statistical techniques currently available or from the paucity of observations on several of the new components than from any inherent deficiencies in the definitions themselves. Some intuitive considerations strongly support the redefinition of the monetary aggregates adopted in February. After all, there is no doubt that funds have shifted out of demand deposits into MMS and

[10] Using a 14-quarter lag, the sum of the lagged coefficients in the regressions for the implicit price deflator is positive and significant for *every* aggregate during the 1962:4–1979:4 period. The standard errors from these regressions are virtually identical, ranging from 1.436 for new M-1B to 1.560 for old M-4 (see Appendix); however, they are only marginally smaller than the standard errors reported in Table 5. Moreover, only old M-1, old M-2, new M-1A, and new M-1B are significant in both the 1962–69 and 1970–79 periods considered separately, and in these cases the relationship between inflation and money does not appear to be stable (with the possible exception of old M-2). The sum of the lagged coefficients for the remaining aggregates is significant only in the 1970s, in contrast to the results using a four-quarter lag where the sum of the lagged coefficients generally is significant only in the 1960s (see Table 6).

RPs in the past and may continue to do so in the future. Nor is there doubt that changes in regulations have eliminated many of the distinctions between commercial banks and thrift institutions that formed the basis for the old definitions. In view of these developments, and given the low power of available empirical tests, one perhaps is justified in relying on intuition to select new aggregate definitions — "it must be thus!" — rather than on empirical results, with the expectation that the accumulation of additional observations will vindicate the selections. But not all *a priori* arguments point to this conclusion. For example, the problems of aggregation discussed in the previous section imply that the new financial instruments — and some of the existing ones as well — should *not* be lumped together in the monetary statistics. Interpreted this way, the ambivalent empirical results serve to weaken rather than to strengthen the intuitive case for the new monetary aggregates.

III. Conclusion: Why Monetary Aggregates?

Monetarists and "rational expectationists" support a stable money growth rule because they believe it reduces the frequency of disruptive innovations emanating from the central bank (see, e.g., 10, 18). However, theoretical expositions of this position offer no guidance in selecting that definition of money whose growth the monetary authority should attempt to peg. The models allow for but do not require more than one definition of money; whatever the definition, the models simply instruct the central bank to control "M." From the monetarist perspective "M" presumably should be that aggregate or set of aggregates most reliably related to ultimate objectives of policy. That is, the appropriate definition of money "is to be sought for not on grounds of principle but on grounds of usefulness in organizing our knowledge of economic relationships" (12, p. 137). This approach sounds good, but the previous section demonstrated its vacuousness. At their current stage of development, empirical tools hardly are able to narrow down the universe of possible aggregate definitions, let alone to indicate the single "best" definition or set of definitions. Left with no clear choice among alternative aggregates — one "works" as well as another — and recognizing the problems with simple-sum aggregation for the higher order definitions, perhaps the solution to the definition problem is to select that low-order aggregate that can be controlled — M-1A or B, say, or just demand deposits alone, or (as Tobin (24) and others would have it) the outside money base — and to abandon other aggregates while continuing to publish their individual components. No violence is done to monetarist or rational expectations doctrine by defining "M" in this pragmatic way.

In the monetary indicators' view, aggregates in general are inefficient targets of monetary policy although they may provide useful information about the economy (8). Controlling money growth therefore is irrelevant. Instead, aggregates should be selected on the basis of their value as leading indicators of ultimate policy objectives. But as shown empirically by Tinsley and Spindt, "There is a substantial loss of information incident to aggre-

gation in the construction of the monetary totals" (22, p. 42). Thus, the indicator criterion points toward disaggregation rather than redefinition of the monetary statistics.[11]

The Federal Reserve nevertheless may wish to continue the by-now traditional practice of defining monetary policy in terms of a set of aggregate growth rates because the aggregates, dominated though they may be by other data, do provide *some* information about the economy. Unfortunately, though, divining the information imbedded in a particular constellation of aggregate growth rates and selecting the appropriate policy response still will require analysis of individual components. For example, whether or not an alteration in the nonborrowed reserves objective (or federal funds rate target) is warranted by a series of unexpectedly large increases in new M-2 may depend on whether demand deposits or overnight RPs are responsible for the money growth misses.[12] Moreover, once the guilty component has been identified, there remains the problem of determining the nature of the disturbance — "IS or LM" — responsible for its surprising growth.

The analysis of monetary problems is in no way simplified by the use of monetary aggregates. The monetary aggregates are not supported by empirical evidence; they do not facilitate policy making; they cannot be defended on theoretical grounds. The monetary aggregates should be abandoned.

[11] Theoretical and empirical development of disaggregated models of the financial sector is well underway. See, for example, the paper by Modigliani and Papademos elsewhere in this volume.

[12] This point is discussed further in (5).

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Appendix
Some Results from Alternative Reduced-Form Regressions Fit with a 14-Quarter Lag

	Period of Fit	Old M-1	New M-1A	New M-1B	Old M-2	Old M-3	New M-2	Old M-4	Old M-5	New M-3	New L
Standard Errors:											
Real GNP (%Δ)	1962:4–1979:4	3.252	3.158	3.161	3.342	3.315	3.260	3.673	3.535	3.524	3.436
Implicit Price Deflator (%Δ)	1962:4–1979:4	1.442	1.446	1.436	1.442	1.456	1.461	1.560	1.542	1.511	1.466
Implicit Price Deflator (%Δ)	1962:4–1969:4	0.997	0.994	0.995	1.064	1.197	1.218	1.167	1.198	1.201	1.195
Implicit Price Deflator (%Δ)	1970:1–1979:4	1.523	1.547	1.594	1.561	1.472	1.500	1.704	1.566	1.514	1.437
Sum of Lagged Coefficients on "Money":											
Real GNP (%Δ)	1962:4–1979:4	−0.413 (1.09)	−0.402 (1.12)	−0.541 (1.66)	−0.177 (0.41)	0.154 (0.47)	0.374 (1.23)	−0.392 (0.98)	−0.098 (0.29)	−0.142 (0.45)	−0.221 (0.72)
Implicit Price Deflator (%Δ)	1962:4–1979:4	1.372 (5.38)	1.419 (5.40)	1.371 (5.99)	1.402 (5.68)	0.980 (4.39)	0.859 (3.80)	0.903 (3.10)	0.843 (3.18)	0.906 (4.08)	1.046 (4.96)
Implicit Price Deflator (%Δ)	1962:4–1969:4	0.862 (3.25)	0.978 (3.54)	0.978 (3.54)	1.236 (3.05)	0.902 (0.87)	−0.175 (0.14)	0.675 (1.28)	−0.008 (0.01)	−0.025 (0.03)	0.113 (0.11)
Implicit Price Deflator (%Δ)	1970:1–1979:4	2.929 (4.64)	2.930 (4.45)	2.250 (4.20)	1.689 (4.22)	0.918 (3.35)	0.594 (2.28)	1.086 (2.80)	1.029 (3.80)	1.067 (4.70)	1.264 (4.96)

Estimated equation for all aggregates is the same as the equation shown in Table 5 in the text, except a 14-quarter rather than a 4-quarter lag was used.

t-statistics are in parentheses.

Discussion

John D. Paulus

Since long-run monetary aggregates targets were first announced in 1975, target ranges have been successively lowered by the Federal Reserve. The first annual target range for M-1 set in March of 1975 was 5 percent to 7½ percent. In the last five years this range has been shaved more than a percentage point: The 1980 target range for M-1A, which is nearly identical with old M-1, is 3½ percent to 6 percent and the 1981 range, the Fed has announced, will be lowered by another one-half percentage point.

During this five-year period when the monetary target ranges were being lowered, inflation has been increasing steadily. In 1976, for example, the consumption deflator increased by about 5 percent. At the Fed and in the financial markets there were grumblings at the time that the economy seemed to be "stuck" with a core inflation rate of 5 to 6 percent. But by 1979 the core inflation rate had moved up to 10 percent. And today, the core, or underlying, inflation rate is thought to be between 9 and 10 percent.

As inflation has accelerated, so too has money growth. Indeed, since mid–1976 M-1 growth has frequently exceeded the Fed's annual target ranges. Unfortunately, the failure to take targeting seriously has not been costless for the Fed. In particular, the credibility of the Fed, the integrity of its word, has been compromised. This in turn has made the use of restrictive monetary policy as an anti-inflation tool more costly than ever. Because of its failure to consistently hit monetary aggregates targets, Fed pronouncements of lower money growth have been greeted with skepticism. When the Fed has followed through on its announced intention to slow money growth, as it did earlier this year, economic agents found that their prices, wages, and interest rates were set too high to clear markets, and economic activity contracted. This contraction was due in part to a lack of credibility in the Federal Reserve's policy pronouncements, and this credibility gap is partly a consequence of the failure to achieve monetary aggregates targets in the past.

Given the importance of integrity in financial markets, and particularly in banking, why has the Fed continued the charade of announcing ever lower targets during a period which inflation and money growth have been moving up? Can the Fed's credibility loss be restored? Or will the targets again be missed in 1981, as it seems likely they will in 1980? A part of the answer to these questions is contained in the Fed's experience in setting monetary aggregates targets during the last five years, and in particular during 1975 and 1976 when the relationship among money growth, economic activity and interest rates first broke down.

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Experience with Aggregates Targets

In April 1975, the Federal Reserve announced one-year ahead target ranges for M-1 and for other higher aggregates.[1] These ranges were updated quarterly until 1979 when annual ranges began to be specified only once a year. The first annual growth range for M-1 covering the period from March 1975 to March 1976 was 5 to 7½ percent. This range was maintained until January 1976 when its lower end was reduced to 4½ percent. Then in April 1976 the top of the range was lowered to 7 percent. This reflected both declining inflation and growth in M-1 of 5½ percent during the previous year, which was well within the Fed's long-run ranges. In November 1976 the top of the M-1 range was lowered by another one-half percentage point to 6½ percent. Over the previous year, M-1 had grown by only 4½ percent.

On the surface these monetary aggregate target reductions seem justified by the inflation record of the United States in 1975 and 1976 and by the slow growth of money. But the slowdown in money growth was more artificial than real. Because of the record high interest rates in 1973 and 1974, business firms sought new methods of economizing on noninterest-bearing cash balances. In investigating the puzzling slowdown in money growth in 1975 and 1976, Federal Reserve Board staff found that the use of a number of sophisticated cash management devices was greatly increased in response to these high rates. These included depository transfer checks, zero balance accounts, concentration accounts, balance reporting, lock boxes, and remote disbursement. The increased sophistication of payments practices resulting from these innovations permitted a given number of transactions to be carried out with a smaller stock of money. And as long as this process of implementing and refining the use of new cash management devices continued, a given rate of growth in nominal expenditures could be financed with a relatively small increase in money.

The fundamental overhaul of payments practices appears to have contributed significantly to the sluggish growth of money in 1975 and 1976. According to Federal Reserve Board staff, money growth was depressed by almost 4 percentage points in 1975 and 1976 by the change in cash management practices. Put another way, the reported money growth rate of 5 percent in 1975 and 1976 understated by 4 percentage points that which, on the basis of the historical relationship among money, economic activity and interest rates, would have been required to finance actual growth in GNP in 1975 and 1976, given the decline in interest rates that occurred.

The Federal Open Market Committee (FOMC) in 1975 and 1976 focused not on the 9 percent growth in M-1 that would have been required to finance 1975–76 GNP in the absence of the downward shift in money demand, but rather on the reported 5 percent growth. This produced a false optimism over prospects for future inflation and money growth. And this helps to explain the lowering of the targets in 1976.

[1] Only the range of M-1 is considered hereafter because ranges for M-2 and M-3 were of considerably less importance than that of M-1 in policy deliberations between 1975 and 1979.

When payments practices stabilized and the so-called money demand "shift" ceased in early 1977, money began to advance more in line with GNP. But by 1977, the economy was moving at a rapid pace. Real GNP grew by 5½ percent and, with inflation averaging around 6 percent, nominal GNP expanded by almost 12 percent that year. Money growth moved up to almost 8 percent and the M-1 targets set earlier began to be breached. In fact, for every targeting period in the second half of 1976 and all of 1977 actual M-1 growth for the four-quarter targeting period ahead eventually exceeded the top of the target range. Some improvement in this performance emerged in 1978 when one-year growth rates of money again began to fall within the target ranges. But this largely reflects a sizable downward shift in the demand for money beginning late in 1978.

In early 1979, the FOMC, in compliance with provisions of the Humphrey-Hawkins Act, began providing projections in February of each year for monetary growth during that year. For 1979 the top of the FOMC target range for M-1 was set at 4½ percent. This projection assumed that the new automatic transfer (AT) facility[2] would drain enough funds off demand deposits and into savings accounts to lower M-1 growth by 1½ to 4½ percent. When it later appeared that the AT drain on demand deposits was closer to 1½ percent than to 4½ percent, the FOMC announced (in October 1979) that, taking account of this smaller downward shift in M-1, the 1979 maximum growth range for M-1 should be 6 percent and not 4½ percent. Actual growth in M-1 in 1979 was 5 percent.

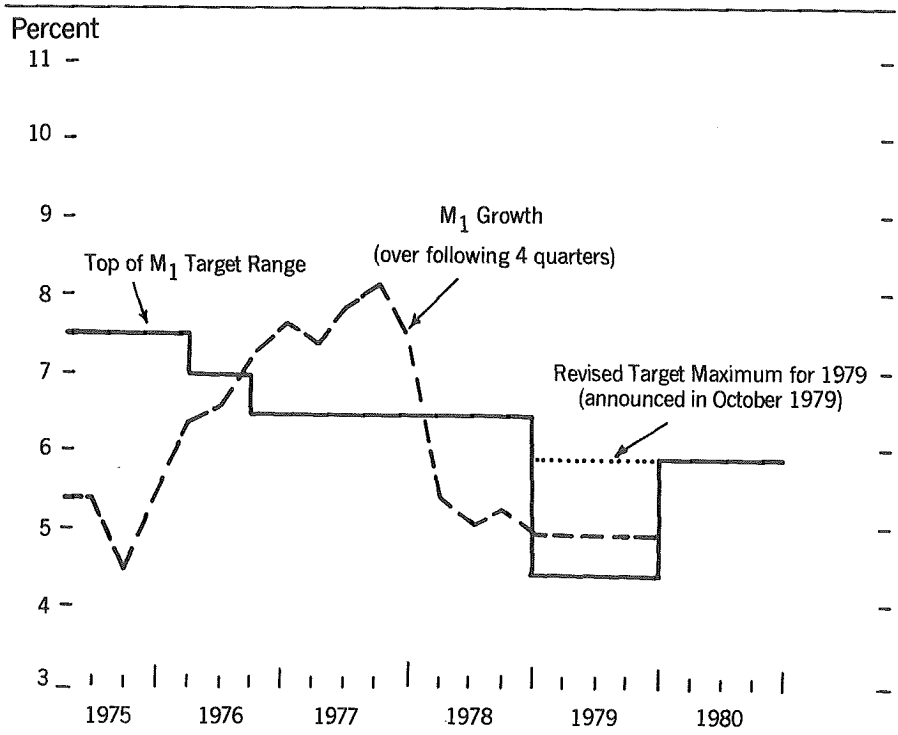
In 1980 the top of the range for M-1A was set at 6 percent. Despite an overall decline in real GNP during the first three quarters of 1980 and a major downward shift in money demand in the spring, M-1A is now at the top of its target range. With rapid growth in nominal GNP projected for the remainder of 1980, it seems likely that M-1A will exceed the top of its range for this year.

The targeting record for the Fed from 1975 to 1980 is summarized in Chart 1. For each quarter shown the target range is the maximum growth specified by the FOMC for M-1 for the subsequent four quarters, and the M-1 growth shown is that which actually occurred for the same four-quarter targeting period.

During the 15 quarters when long-run targets were established quarterly, from early 1975 through the end of 1978, actual M-1 growth exceeded the top of the FOMC annual ranges six times, fell below the lower range once, and during the other eight quarters, about half the time, grew at rates consistent with the ranges. Average growth in M-1 over this 15-quarter period was 6.4 percent. This falls in the upper half of the average of the lower and the upper ranges announced between March 1975 and October 1978 of 4.4 percent and 6.8 percent respectively. The targeting record of 1979 and

[2] That is, the automatic transfer of funds from savings to demand accounts in the event of an overdraft in the demand account. With overdraft worries eliminated, this facility encouraged depositors to transfer funds out of demand and into savings accounts.

Chart 1 **Federal Reserve Targets and Monetary Growth**



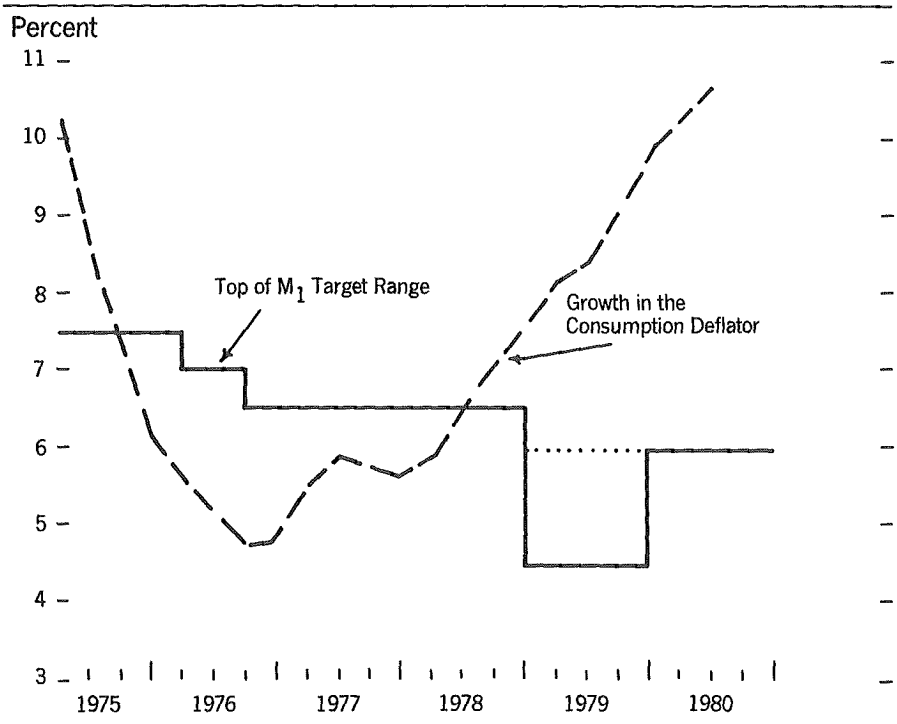
1980 similarly shows a tendency for money growth to be maintained near or above the top of the announced target ranges.

The Fed's targeting problems since 1976 were clearly related to rising inflation: quite simply, while the targets were being lowered, inflation was accelerating. This is seen in Chart 2, which shows the declining target ranges and the acceleration in inflation in the consumption deflator that began in mid-1976. By mid-1978 the rate of increase in the deflator had come to exceed the top of the target range for M-1.

About that time the FOMC began to recognize that it had boxed itself into a corner. Inflation was rising and so too was money growth. The frustration of the Committee was evident in the minutes of the July 1978 meeting which included this statement on the consequences of raising the long-run ranges:

> . . . any increase in the (long-run) ranges could be misleading. Such an action, no matter what reasons might be offered for it, was likely

Chart 2 Federal Reserve Targets and Inflation



to be interpreted both in this country and abroad as a signal of a shift in system policy toward less emphasis on fighting inflation.

So, after lowering the aggregates targets in 1976, partly in response to the downward shift in money demand, the FOMC found that once the shift was over, it could not raise the targets. When honesty would have dictated higher targets, the FOMC, fearing public opinion, caved in to expediency and continued to announce unrealistically low target ranges.

Targets for 1981 and Prospective Money Growth

Preliminary targets for M-1A for 1981 are 0 to 2½ percent; this assumes the nationwide introduction of NOW accounts will lower growth of this

aggregate by 3 percentage points.[3] Thus the target range for M-1A reflects an expectation that in the absence of NOW accounts M-1A would expand in a 3 to 5½ percent range. Given a core inflation rate of 8 to 9 percent for 1981, is this a realistic expectation? Can the 1981 target be achieved?

The simplest way to assess this question is to determine what it implies about real GNP, interest rates and M-1A velocity — i.e., the relationship between GNP growth and money growth. For example, over the last decade M-1A velocity (V-A) has increased by a little over 3 percent per year on average. If velocity were to grow at its average rate in 1981 and if M-1A (adjusted for NOW accounts) were to expand no faster than 5½ percent, nominal GNP could grow by no more than 8½ to 9 percent. But this is just about equal to projected core inflation for 1981. Thus if the M-1A target is to be hit and if velocity rises at an average rate, real GNP must be flat from the fourth quarter of 1980 to the fourth quarter of 1981.

Additional insight into the restrictive nature of the 1981 target can be gained by examining the behavior of the fundamental determinants of the rate of growth in velocity. These are generally thought to include: (1) ongoing improvements in cash management practices; (2) the rate of growth in real GNP; and (3) the rate of growth in nominal short-term interest rates. Improvements in cash management practices tend to lower the amount of money required to finance a given level of economic activity, and thus to raise velocity. Increases in real income also will raise velocity so long as the rise in real income is financed with less than a proportionate increase in money balances. Hikes in interest rates similarly will raise velocity as economic agents seek to manage cash balances more closely so that a portion of these funds can be diverted to higher yielding assets.

To illustrate the effect improved cash management practices and fluctuations in real GNP and in interest rates can have on V-A, a fairly standard velocity equation is presented in Table 1. The estimated value of the so-called "constant" term "1.4" represents the percentage increase in velocity that occurs each year as a result of ordinary improvements in cash management practices. The value of the coefficient on real GNP, ".34," indicates that for every 1 percent increase in real GNP, V-A will rise by .34 percent. The next estimate, ".04" for the commercial paper rate, implies that for every 1 percent increase in the commercial paper rate, V-A will rise by .04 percent. The final estimate represents the effect that the downward "shift" in money demand in 1974, 1975, and 1976 had on V-A. During those three years V-A was increased by an average of 2.6 percent per year by the extraordinary change in payments practices.

This simple representation of V-A helps to identify a fundamental problem that the Fed faces in hitting its 1981 monetary aggregates targets. Suppose that real GNP grows by 2 percent in 1981, as forecast by Goldman

[3] NOW accounts, included in M-1B but not in M-1A, are expected to attract a substantial volume of funds from household demand deposits, which are in M-1A. This drain of household demand funds is projected by Federal Reserve Board staff to lower M-1A growth by about $12 billion in 1981, or by 3 percent.

Table 1
Factors Affecting M-1A Velocity

	Estimate	(t-statistic)*
Constant	1.4	(2.2)
Real GNP	.34	(2.7)
C-Paper	.04	(3.1)
Dummy	2.6	(2.5)

* Measures the statistical "significance" of each estimate. Values exceeding "2" reflect "statistically significant" estimates.

Sachs, and, using the forecast implicit in the T-bill futures market, that short-term interest rates in 1981 average slightly above their average for 1980. The velocity relationship displayed in Table 1 would then predict that V-A would rise by about 2 percent in 1981, assuming no shift in money demand (1.4 percent would be due to improved cash management practices, .7 percent to the 2 percent rise in real GNP, and a small decline due to the forecast of a modest rise in interest rates implicit in the T-bill futures market). This means that if inflation averages 9 percent for the year, so that nominal GNP rises by 11 percent, M-1A would have to expand by 9 percent. Thus, growth of only 2 percent in GNP and roughly stable interest rates would imply that the M-1A target would be exceeded by 3½ percentage points.

Assuming no shift in money demand and no growth in real GNP in 1981, what level of interest rates would be required to achieve the Fed's 5½ percent target in 1981? If it is assumed that inflation averages only 8 percent, V-A would have to rise by 2½ percentage points. Given the small effect interest rates have had on money growth in the past (as represented by the .04 elasticity estimate), the rise in rates might be fairly large. In fact, using the estimate of the effect of higher rates on V-A from Table 1, it appears that short-term interest rates would have to rise by a little over 25 percent in 1981 from the average level maintained in 1980 — which is about 11 percent. Thus, short-term interest rates would have to average about 14 percent in 1981 in order for the M-1A target to be hit, if real GNP were flat and inflation averaged 8 percent.

Obviously, there is no guarantee that any of these options are consistent — e.g., 14 percent short rates may well imply negative growth in real GNP for the year. But they serve to illustrate a fundamental dilemma facing the Fed: namely, that in the absence of a downshift in money demand the Fed will either have to maintain short-term interest rates at a level that will probably abort the 1981 recovery if the monetary aggregates targets are to be hit, or, if a recovery is to be promoted, the targets will have to be exceeded again.

Unfortunately, even a downshift in money demand will not really save the Fed. It will only postpone the day of reckoning. The breakdowns in the relationship among money, GNP, and economic activity in the 1970s were

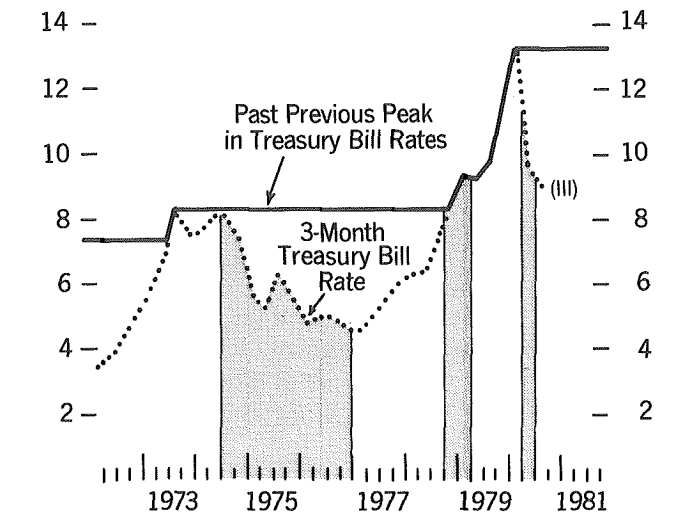
generally initiated by a bout of record high interest rates, as is demonstrated in Chart 3. As shown in this chart, the slowdowns in money growth that cannot be accounted for by changes in GNP and interest rates occurred after the record high short-term interest rates recorded in 1973–74, late 1978, and in late 1979.

It is not surprising that extraordinarily high interest rates should trigger efforts to improve cash management practices and lower the rate of growth of money. The incentive for cash managers to alter basic payment practices when interest rates reach extraordinary levels is based upon an improvement in the relationship between the marginal, or additional, cost of investing in a more efficient cash management technology on the one hand and the increased revenues arising from utilizing that technology on the other. There is always a wide array of techniques, differing in cost and sophistication, available to households and, particularly, firms for managing cash balances. A cash manager deciding on any given set of practices must balance the cost of implementing these more efficient, or sophisticated cash management techniques against the potentially higher earnings from reducing cash balances and holding a larger share of his liquid assets in higher yielding money market instruments such as money market mutual funds and RPs. While the cost of implementing more efficient techniques is largely independent of the level of interest rates, the earnings gain from shifting a given amount of funds out of cash balances and into higher yielding market instruments increases linearly with interest rates. Thus, the tradeoff between the higher costs of improving cash management techniques and the higher revenues from the resultant greater interest bearing balances that had been shifted out of cash improves with higher interest rates.

For most firms there is some critical level of interest rates beyond which this tradeoff becomes favorable enough to introduce more sophisticated devices to manage cash balances. When interest rates are well below previous record values, few firms will find it in their interest to make such a major change. But when interest rates reach or exceed previous record levels, increasing numbers of firms and households should find it advantageous to implement a more efficient cash management technology.

Unfortunately, though the fundamental alteration of cash management practices may provide the Fed with a face-saving escape from the dilemma posed earlier, it does not really provide the Fed with a "free lunch" escape from this dilemma. The extraordinary alteration of payments practices, by greatly increasing the efficiency of cash management practices, significantly lowers the desired money stock for any given level of output. Thus, a smaller stock of money is needed to finance a given level of transactions for each interest rate level. The temporary slowdown in money growth that occurs while this process is operative is then artificial in the sense that each dollar is turning over faster as a result of these improved payments practices. The faster turnover of money, in turn, means that the slowdown in money growth is not necessarily consistent with slower growth in aggregate demand and, ultimately, in prices.

Chart 3 **Short-Term Interest Rates and Shifts in Money Demand**



Note: The 10-quarter downward shift from 1974:3 to 1976:4 lowered M1 growth by 4.2% per year on average; the 2-quarter shift from 1978:4 to 1979:1 lowered growth an average of 8.4%; and the 1-quarter shift in 1980:2 lowered growth by 12%.

What Are the Fed's Options?

The Fed's policy options for 1981 are not very attractive. A money demand shift adding perhaps 3 percentage points to V-A might permit achievement of the M-1A target without forestalling a 1981 recovery. But such a shift severely compromises the reliability of the monetary aggregates as an indicator of the effect of monetary policy on the economy. Indeed, if the traditional relationship among money, GNP, and interest rates is to be used to gauge the effect of a given rate of growth of money on the economy whenever the money demand function shifts down, the shift would have to be added back to actual money growth to obtain an accurate reading. Thus because of the increase in the rate at which money turns over when demand is shifting down, M-1A growth of, say, 5 percent during a period when the demand for M-1A has shifted downward by 3 percent would be equivalent to 8 percent growth in M-1A in the absence of the shift. If "truth in packaging"

were applied to monetary policy as the FDA applies it to food and drug manufacturers, the Fed would have to explain to the public whenever a major money demand shift occurs that what you see in the money numbers is not what you get.

Without a shift the Fed faces the grim alternatives of aborting the 1981 recovery by hitting its targets, on the one hand, or exceeding its targets by promoting the recovery on the other. The former alternative may not be politically feasible and the latter would weaken the Fed's already fragile credibility.

As argued earlier, this dilemma is a direct consequence of a sequence of strategic errors made when setting unachievably low targets between 1975 and 1980. Perhaps as important as setting the targets too low over that period was the fact that, despite the rise in inflation, a precedent for raising targets was never established. As a consequence, to announce increases in the target ranges for 1981 now, with inflation at 10 percent, would, as the July 1978 minutes stated, almost surely be misinterpreted.

One possible way out of this dilemma is to announce that aggregates targets in the future will be tied to the inflation rate in the previous year. This may seem self-defeating because a rise in inflation would permit more rapid growth in money, and this would produce greater inflation . . . and so on. But even though such a procedure would have some of the properties of targeting on real money, it would provide the Fed with a fresh start in aggregates targeting.

For 1981 the M-1A target might be set equal to the rate of inflation in consumer prices in 1980 (using the consumption deflator) less, say, 3 percentage points. The Fed could easily make the case that if followed faithfully, such a procedure would eventually lead to lower inflation. After all, in the steady state when interest rates are stable, money growth equal to the inflation rate plus 1 to 2 percentage points (to finance real growth) would be consistent with stability in the inflation rate. Slower growth with stable or declining interest rates would imply an eventual reduction in inflation.

Such a targeting procedure may not be a very attractive option, but, like the popular description of democracy, though unattractive in itself, it may be better than the next best alternative.