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PROCEEDINGS OF A CONFERENCE HELD IN OCTOBER 1980

Sponsored by the Federal Reserve Bank of Boston

CONTROLLING MONETARY AGGREGATES III

Proceedings of a Conference
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The Control of Monetary Aggregates

Karl Brunner*

I. Introduction: The Nature of the Issues

Our entry into the age of permanent and erratic inflation has sharpened the public's focus on monetary policy. Substantial controversies are hardly maintained by clever construals or sophisticated contrivances. They require serious issues of major dimension bearing on important aspects of the world. The history of our discipline offers some remarkable examples in this respect. We note the bullion controversy early last century followed later by the dispute between the banking and currency school. This interest subsided with the professional dominance of Keynesianism. The emergence of "monetarist" analysis stirred however a dormant interest in monetary policy. The profession's attention expanded in the last decade and even the media increasingly recognized the ongoing controversy.

It may be tempting to say that our current disputes essentially repeat with some variations the great controversies of the 19th century. Indeed some similarities occur. These pertain most particularly to some aspects of the motivating problems and even to some questions and issues raised in the discussion. But the motivating phenomena form only one strand of our intellectual activity. Lucas [1977, 1980] repeatedly emphasized in recent years the role of analytical techniques in the development of ideas. The subtle influence of the analytic evolution experienced over the past decades affected the nature of the discussions, conditioned the range of questions and the formulations developed. Some issues moved probably closer to a resolution, some at least by mutual (and possible tacit) recognition of their comparative irrelevance. Other issues may (one hopes) approach a closer understanding of their nature or a clearer appreciation of the differences in the underlying hypotheses which determine the obvious contrasts among the alternative approaches to monetary policy. It is frequently stated that prevailing differences among economists bearing on aspects of monetary and "stabilization" policy fundamentally reflect corresponding differences in "social values." Such values may indeed motivate some positions in this matter. But

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they cannot account for the central core of the differences which involve substantive and basic cognitive issues. Some of these issues actually reach well beyond the range addressed in earlier disputes and express fundamental aspects of our perception pertaining to man and society.

A central question guiding recent controversies addresses the desirability of formulating monetary policy in terms of a control over monetary growth. Several strands compose this problem and require examination. One strand refers to the choice between policymaking expressed in terms of interest rates or in terms of monetary growth. Another important and separate strand concerns the choice between an "activist" or "nonactivist" strategy of monetary policy formulated either in terms of interest rates or monetary growth. A relevant examination of the case for a "nonactivist" strategy addressed to the control over monetary growth needs thus to consider the alternative options. The case cannot be usefully judged in a vacuum without a comparison with the major classes of strategies seriously considered in our professional disputes.

My argument bearing on the alternative strategies rests on two basic social conditions. One condition characterizes the available level of information about the response structure of the economy. The other condition involves some crucial properties of the political process and most particularly of political institutions. It appears that the choice between an activist or a nonactivist strategy is essentially determined by substantively different assumptions about the available knowledge and the characteristics of political institutions. Our awareness of this connection between knowledge-level supplemented with conjectures of political economy and the rational choice among two major classes of strategies may focus our attention on the nature of the appraisals involved.

An argument advancing the case of monetary policy formulated in terms of monetary control requires attention beyond the nature of our knowledge and the workings of political institutions. A decision in favor of monetary control does not ensure per se any useful execution of such policy. The actual performance of officially announced policies of monetary control in the United Kingdom and the United States reveals the nature of the problem. We confront at this stage two subsidiary questions associated with any decision to follow a strategy of monetary control: *Can* we achieve a "sufficient" control over monetary growth and *how* will such control be assured? The two questions thus merge into the single issue about the fact and technique of controllability. Our attention is thereby directed to the role of institutional arrangements and the choice of implementation procedures. Poorly designed institutions and inappropriate or unreliable implementation procedures convert intentions directed at monetary control into the realization of a random game with shifting probabilities. The decision to pursue a monetary control policy thus involves an obligation to adjust the prevailing institutions and to modify implementation techniques in accordance with the declared purpose of monetary control. The choice of tactical procedures must be adjusted to the strategy selected.

II. Monetary Policy under Full Structural Information

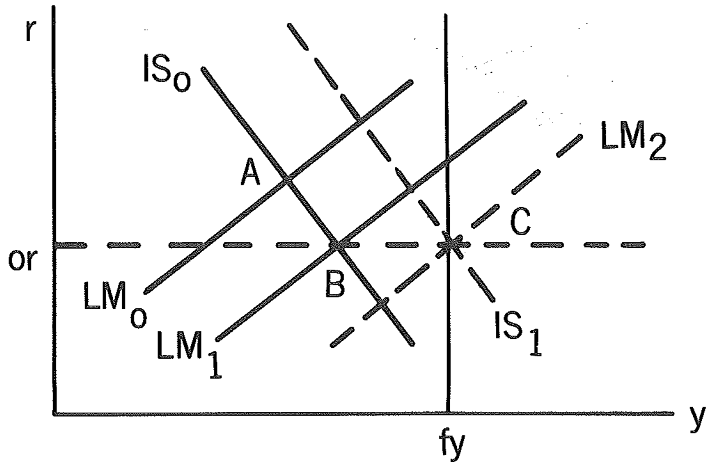
A. The Choice of Strategy under Full (Nonstochastic and Stochastic) and Asymmetric Information by the Policymaking Agency

1. The Argument for an Interest Targeting Approach Based on the Keynesian Dichotomy

Central banks of the developed industrial nations traditionally favor policies associated with interest rates. The Federal Reserve authorities in particular followed over many decades a conception emphasizing the guiding role of money market conditions [Brunner-Meltzer, 1964]. These conditions were originally summarized by the banks' indebtedness to the central bank, subsequently represented by free reserves, and ultimately characterized by some short-term interest rates. Neither the original conception of the Federal Reserve System nor its specific evolution over subsequent decades was much influenced by exposure to economic analysis. It emerged very much as a "home-baked" affair determined by the vision of a commercial bank's money desk. The central relations characterizing the basic structure of the vision were actually incompatible with economic analysis. The central bank's emphasis on interest targeting, i.e., its disposition to proceed with strategies implemented by setting some or controlling other interest rates, did thus not emerge as a result of any particular Keynesian infiltration. Keynesian formulations and ideas, conditioned by the IS/LM apparatus, appear to have influenced eventually the guiding conceptions of monetary policymaking essentially because they allowed justification of accustomed behavior with a wider resonance over the range of potential articulators in the public arena. The standard analytic frame expressed by the IS/LM diagram yields usefully exploitable arguments in support of an interest targeting approach.

The essential aspect of one particular argument is represented with the aid of diagram I. The IS and LM lines are drawn in the usual mode in a plane defined by a vertical r-axis and a horizontal y-axis. Full employment income is indicated by the vertical fy. The initial position is at point A determined by the intersection of LM_0. and IS_0. At this stage the "Keynesian dichotomy" enters our argument. A frequent construal has fiscal policy determine the position of the IS line with no effect on the position of the LM line. Similarly, monetary policy determines the position of the LM line without any direct effect on the IS line. This dichotomy naturally conditions an assignment distinguishing between the strategic roles appropriate for fiscal and for monetary policy [Horwich, 1969]. The strategic division of labor assigns fiscal policy the task to manipulate the IS line and monetary policy is responsible for the LM line. The purpose of this assignment is further developed in terms of an optimal rate of interest "or" indicated by the horizontal in the diagram. The choice of this interest rate is governed by considerations of the desired division of total output between consumption and investment available for absorption by the private sector. The choice reflects thus considerations of optimal capital accumulation. Any changes in the conditions

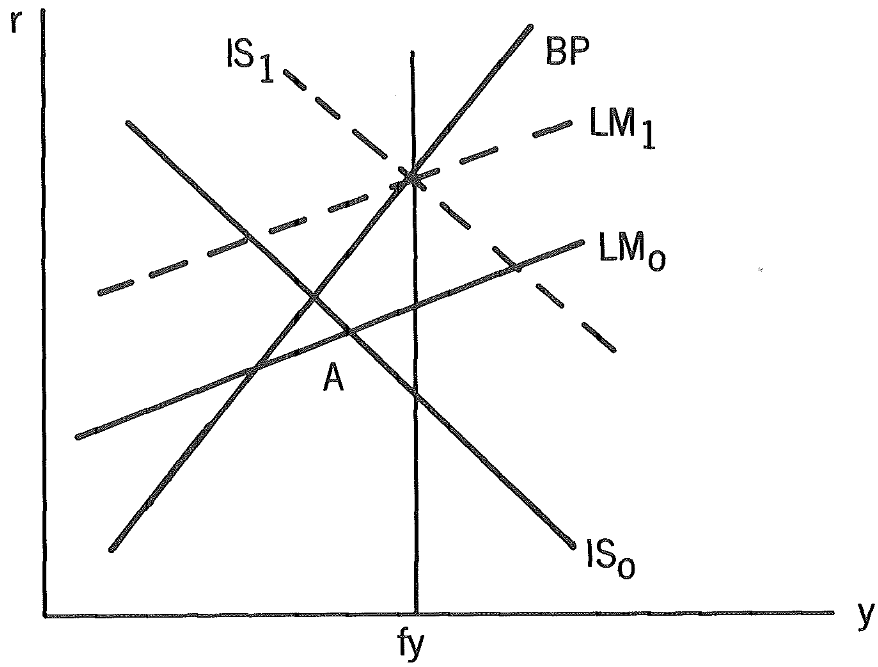
Figure 1



affecting the desired rate of accumulation modify under the circumstances the optimal rate of interest. The central banks are thus instructed to maintain the actual rate of interest at the optimal level "or." With the actual state initially at point A central banks are obliged to expand the money stock until LM is pushed to intersect IS_0 at point B on the or line. Enter now the fiscal authorities. They are instructed to adjust the fiscal magnitudes in order to maintain full employment. For a state resting at B this instruction is translated into an expansion of the government sector's net spending sufficient to move the expenditure line from IS_0 to IS_1. The magnitude of the shift is determined by the requirement that the IS line ultimately intersect the full employment line at the point determined by the choice of an optimal interest rate. The central bank accommodates under its assignment the fiscal expansion and maintains the targeted interest rate. This accommodation is expressed by the shift of the LM-line from LM_1 to LM_2.

This assignment problem can be extended in order to include the case of an open economy. The IS/LM diagram needs to be augmented in this case with a balance of payments line BP as in diagram II. This line summarizes all combinations of r and y satisfying a condition of "international equilibrium." Under a fixed exchange rate system the choice of interest rate is determined by the desired position of the balance of payments expressed for our purposes by the intersection of the BP and the full employment line. The optimal interest rate need not be consistent however with full employment combined with a persistent balance-of-payments equilibrium. Considerations of domestic capital accumulation may induce a choice of interest rate on the full employment line below the balance-of-payments line. Whatever the motivations involved may be, they will be expressed within this general approach by

Figure 2



the choice of an interest rate level. The central bank is moreover instructed to maintain this interest rate by means of suitable monetary accommodations. The fiscal authorities remain responsible for the maintenance of full employment. This means that in diagram II, with an initial position at A, the monetary authorities need to shift LM from LM_0 to LM_1 by means of a monetary contraction. The fiscal authorities increase on the other hand the fiscal impulse sufficiently in order to manipulate IS from IS_0 to IS_1. An explicit inclusion of exchange rate policy widens the opportunity for a selection of an optimal rate of interest more attuned to considerations of domestic capital accumulation. But the essential characteristic of the argument supporting an interest targeting approach is not affected by such extensions.

A related but still somewhat different argument emerged among "Keynesian circles" in the early 1960s. This argument permeated mostly the public discussion with little spillover into the canonical literature of the profession. An important strand of Keynesian thinking, at least in the United States, centered the crucial linkages of the monetary transmission mechanism in the housing sector. A dominant version of the Keynesian framework concentrates the transmission of monetary impulses on the play of interest rates associated with financial assets. It seemed to follow therefore that monetary impulses were transmitted in accordance with the relative borrowing costs prevailing over the spectrum of activities represented by expenditure categories in national income accounts. It appeared that housing operates within this spectrum with the largest relative borrowing costs. Major expenditure categories showed little, if any, serious exposure to the impact of borrowing costs according to this view. Countercyclic variations of the money stock imposed under the circumstances a heavy burden on a sector of the economy satisfying "social or political priorities." This social evaluation combined with a Keynesian view of the transmission mechanism implied that fiscal policy was assigned the task of offsetting the exogeneously initiated cyclic fluctuations. The monetary authorities on the other hand were assigned an "accommodative" role expressed by targeting an interest rate attuned to the "social priorities of the country."

The story seems plausible enough and the case for an interest targeting approach almost obvious. As a matter of fact, the case is so obvious that one is bound to wonder what went wrong. According to the story optimal stabilization should (any time) be just around the corner. But our experience overwhelmingly suggests that we hardly turned the corner. There is of course always an opportunity to adduce some conspiracy. More relevant would be the irrelevance of the "goodwill" or "public interest theory" of government implicit in this assignment. This aspect will be suspended, however, for the moment and reserved for consideration in a later section of the paper. At this stage we concentrate on the nonoperationality of the argument and some highly questionable aspects of the underlying view bearing on the economy's structure. The nonoperationality follows from the information level implicitly slipped into the argument. The policymaking agencies know fully and with certainty the structure of the economy and of all the relevant underlying conditions. They *know* in particular the structural conditions shaping the form and dynamics of the IS and LM lines. They also *know* the evolving conditions modifying the positions of the IS and LM lines or the conditions relevant for the selections of an optimal interest rate. In the context of such perfect knowledge available to the policymaking agencies reenforced with a "public interest" theory of government, the argument operates with a plausible strength. An activist stance naturally emerges under the circumstances in reference to intermittent variations in underlying conditions modifying the optimal level of the interest rate. Perfect knowledge of these variations is immediately translated into corresponding revisions of the targeted interest rate to be maintained by the central bank. The apparent strength of the argument dissolves however once we seriously recognize the irrelevance of the information level presumed to be (monopolistically and asymmetrically) possessed by the policymakers.

The questionable aspects of the underlying view are closely associated with a specific "Keynesian" tradition. The substitution of money is either narrowly confined within a range of financial assets or the analysis remains confined to episodes with variations in the price level dominating changes in relative yields of financial and real assets [Brunner, 1971]. Under the first interpretation policy analysis proceeds with an empirically untenable conjecture about the transmission of nominal impulses, and relies under the second interpretation on a "special case" hardly characteristic for the mass of cyclic patterns defining the stabilization problem confronting policymakers. The disregard of aggregate supply and the usual omission of price behavior worsen the questionable nature of the transmission mechanism underlying the "Keynesian dichotomy." These neglects closely mirror, as will be emphasized subsequently, the implicit assumption that perfect knowledge enjoyed by the public sector is balanced by ignorance suffered in the private sector.

2. The Choice between Strategic Control Variables in the Context of Full Stochastic Information for Policymaking Agencies

The contribution developed by William Poole [1970] essentially modified the nature of the discussion pertaining to the choice between monetary strategies. His analysis moved beyond the range of perfect deterministic knowledge available to the policymaking agencies. The analysis admitted a measure of incomplete information. The authorities are still supposed to possess perfect information about the deterministic and the stochastic structure of the process. They also know all the past realizations of the stochastic process but are unable to foresee the particular values of the realizations. The relaxation of full information pertaining to ongoing realizations still proceeds within a format determined by the IS/LM apparatus with the standard interpretation. The crucial elements of the argument can be presented as follows: Let equations (1) and (2)

$$(1) \qquad y = -ar + u_1$$

$$(2) \qquad m = -br + cy + u_2$$

represent the IS and LM relation with y indicating income, r the nominal rate of interest and m the money stock. The stochastic shocks u_1 and u_2 are governed by specific processes. They include in particular the operation of all omitted variables and thus operate with a nonvanishing expectation. Suppose furthermore that the money stock is determined by a process characterized by (3) with β a deterministic policy variable

$$(3) \qquad m = \beta + sr$$

and s a policy parameter. The policy problem is defined by the optimal choice of β and s with a view to minimize the fluctuations of income around a desired target y^*. The choice is specifically determined by the usual goal function

$$(4) \qquad G = E(y-y^*)^2$$

The optimal value of β is obtained for every time period by setting $y = y^*$, i.e.

$$(5) \quad \beta^*_t = \frac{b+s+ac}{a} y^*_t + Eu_{2t} - \frac{b+s}{a} Eu_{1t}$$

The setting of β thus shifts with the target and the expectations of the stochastic elements driving the economy. The second component of the strategy is fixed by the first order condition for a minimum of the goal G. This goal function is equivalent to the following expression after replacing β with β^*

$$(6) \quad \left(\frac{a}{b+s+ac}\right)^2 V(u_2) + \left(\frac{b+s}{b+s+ac}\right)^2 V(u_1)$$

$$- 2\frac{a(b+s)}{(b+s+ac)^2} Cov(u_1,u_2)$$

where V denotes the respective variances and Cov the covariance. The first order conditions yields expression (7). The covariance term was deleted in order to avoid some complications which actually reenforce however the subsequent argument bearing on the relevant execution of "accommodating" policies.

$$(7) \quad s^* = \frac{a}{c} \frac{V(u_2)}{V(u_1)} - b$$

We may interpret the parameter s as the degree of monetary accommodation. This degree increases with the variance of the money market disturbance. With a dominant pattern of money market shocks an optimal strategy requires a high degree of monetary accommodation expressed by a large value of s. The money stock responds under the circumstances quite sensitively to variations in interest rate. The analysis thus establishes that the optimal strategy appears "in general" in the form of a mixed case. It involves setting simultaneously a pure monetary component β^* and a degree of monetary accommodation to interest rates. A pure monetary control policy emerges when the money market disturbance vanishes, whereas a vanishing output market disturbance determines a pure interest rate policy.

The framework used provides an alternative interpretation of the "coordination" between fiscal and monetary policy frequently discussed in the policy literature. This coordination was assured in the previous context by the assignment of different tasks. "Coordination" occurs in the present context on the other hand with a somewhat different meaning. Fiscal policy is implicitly impounded into the stochastic term u_1. This would express the fact that monetary policymaking proceeds under substantial uncertainty with respect to the evolution of fiscal policy over the relevant period governing the choice of strategy. We note in particular that a pronounced unreliability of fiscal policy would *lower* the degree of accommodation built into an optimal strategy. "Coordination" could thus mean that fiscal policy be arranged with greater assurance and smaller variability. A small adjustment in equation (1) reveals the nature of the issue. We enlarge the IS relation with fiscal policy terms summarized for simplicity by government expenditure g. We replace thus (1) with (1′)

$$(1') \quad y = -ar + \alpha g + \bar{u}_1$$

where $\bar{u}_1$ is now the adjusted shock satisfying $E(\bar{u}_1) = E(u_1) - \alpha Eg$. "Coordination" requires under the circumstances that Treasury and central banks jointly set the optimal values for g^* and β^* in response to the selected target y^* so as to satisfy the reduced form

$$(8) \quad y^* = \mu_1\beta^* + \mu_2 g^* + \mu_3 E(\bar{u}_1) + \mu_4 E(u_2)$$

The essential purpose of such coordination is however the attempt to produce a more predictable fiscal policy and lower the variance of $\bar{u}_1$ below the variance of u_1. The execution of effective coordination would thus raise the degree of monetary accommodation built into the optimal strategy.

The strategy procedure also determines the required degree of activism. The setting of β^* needs adjustment whenever g^* or the expectations of $\bar{u}_1$ and u_2 change. In the context of the institutions typically governing fiscal policy-making we can hardly expect g^* to be rapidly adjustable over shorter horizons in response to evolving expectations about the underlying stochastic process. Financial coordination can at best lower the uncertainty with little adjustability in the shorter run. Evolutions in the stochastic processes are reflected under these conditions by the monetary setting β^*. The extent and magnitude of "activist adjustment" is completely determined by the frequency and magnitude of shifts in underlying processes.

The previous discussion implicitly attributed all shocks operating in the money market to money demand behavior. Equation (3) proceeds as if the setting of β combined with the prevailing interest rate produces a deterministic money stock. This seems hardly compatible with our knowledge of the facts. Suppose therefore that $\bar{u}_2 = u_2 - u_3$ where u_3 represents the stochastic component of the process governing the money stock. Consider also that the variance of u_3 contributes substantially to the variance of $\bar{u}_2$ with little covariance between u_2 and u_3. Such a state suggests an extension of strategic consideration to the institutional arrangements governing the money stock process. Our accumulated experience indicates that the role of the stochastic component u_3 may substantially change with rearrangements of the prevailing institutions. An appropriate choice of arrangements bearing particularly on reserves and liabilities of the banking system could be expected to lower both $V(u_3)$ and $V(\bar{u}_2)$. An application of strategic considerations to the choice of institutions may lower simultaneously the variance of output and the required degree of optimal monetary accommodation.

The basic framework traditionally used for the analysis represented by equations (1) and (2) impounds some major issues and complexities into the stochastic process. Two aspects implicitly included into the stochastic terms deserve our attention. Once we accept substitutability of money over the whole spectrum of assets the use of a single money market equation to represent portfolio allocations restricts the application of our argument to episodes with high rates of inflation. A more extensive representation of financial markets implies moreover that both (1) and (2) appear as semi-reduced forms with all other asset yields, except a single interest rate r, solved out of the system with the aid of the partial solution made over the remaining equations describing portfolio allocations. It follows that the stochastic terms u_1 and u_2 occur in general as linear combinations of random terms including an array of "financial disturbances." The resulting positive contribution to the covariance $Cov(u_1, u_2)$ complicates the analysis in terms of the specific information required. Contrary to some Radcliffian ideas it does not necessarily raise the degree of optimal accommodation.

Various games could be pursued at this stage involving block diagonality, recursiveness and similar properties of the system's matrix of asset-yield coefficients in order to derive from wide ranging financial markets either a dominant $V(u_1)$ or a dominant $V(u_2)$ with corresponding consequences for the required degree of monetary accommodation. The combination of a Fed type money demand (depending on a single short rate) with the occurrence of a broad array of asset yields operating on aggregate demand for output would raise $V(u_1)$ relative to $V(u_2)$. The focus on a broader range of interacting financial markets enlarges moreover the range of the strategy problem. It involves also the optimal selection of the asset yield guiding the degree of monetary accommodation. A Tobin q may emerge (possibly) under one particular pattern of circumstances represented by the deterministic and the stochastic structure as the best choice governing the required degree of monetary accommodation to the prevailing shock structure.

The omission of explicit price behavior and supply patterns has been another feature of the traditional analyses. But such behavior may be impounded into the stochastic expressions similar to the operation of wider ranging financial markets. A simple extension of (1) and (2) with a supply equation

$$p = \gamma y + \epsilon$$

and a random term with possibly nonvanishing expectation magnifies the optimal degree of monetary accommodation. Money demand includes under the circumstances a price term p. It follows that the variance of the money market reflects the stochastic properties of money demand, money supply and price behavior (ϵ). Large real shocks expressed by a large variance $V(\epsilon)$ thus induce a large measure of monetary accommodation. Moreover, frequent shifts in the stochastic process controlling ϵ would produce frequent and substantial changes in β^* and thus produce the typical pattern of activist policy. But the extension of the argument to impound price behavior into the semi-reduced system (1) and (2) can proceed as a game with diverse exercises producing very different accommodation patterns. The reader's (or writer's) imagination determines the limitations of an inherently unlimited game.

The literature developing this analysis emphasized occasionally the controllability of "interest rates" in contrast to the money stock. It is generally acknowledged that the money stock emerges not deterministically in response to the values of policy instruments imposed on the process. This has been contrasted [Ben Friedman, 1977] with the central banker's ability to set "interest rates" at the desired strategic level by means of suitable accommodations. This assertion neglects both an important institutional fact and some facts of the ongoing discussion. Standard Keynesian analysis assigns different interest rates to the IS and the LM relation. A short-term nominal rate operates according to this view on money demand, whereas a long-term real rate affects aggregate demand for output. The output market and the money market equation need to be connected therefore with a term structure equation $lr = sr + x$, where lr is the long-term rate, sr the short-term rate, and x the random connection between the two rates. When replacing lr in equation (1) with this term structure equation the uncertainty surrounding x is impounded into the variance of the stochastic term operating on the output market. This would seem to lower the required degree of monetary accommodation. But the short rate sr is probably not the relevant interest rate directly addressed by the authorities as a control variable. Suppose we follow the custom observed in the United States and recognize the federal funds rate as the control variable. Another relation is thus required connecting the federal funds rate ffr with the short rate sr, let us say $sr = ffr + z$. The substitution of sr by $(ffr + z)$ in equation (2) in order to produce an explicit occurrence of the relevant policy variable focuses all the uncertainty surrounding the connection between sr and ffr into the money market variance. The occurrence of the stochastic terms x and z modifies the disturbances operating in output and money market. Substitution of lr in equation (1) and sr in equation (2) yields the expression

$$y = affr + \bar{u}_1 \text{ and } \beta = -bffr + cy + \bar{u}_2$$

where $\bar{u}_1 = u_1 - a(x + z)$ and $\bar{u}_2 = u_2 - (b + s)z$. We obtain thus the modified variances

$$V(\bar{u}_1) = V(u_1) + a^2[V(x) + V(z)] > V(u_1)$$

$$V(\bar{u}_2) = V(u_2 + (b + s)^2 V(z) > V(u_2)$$

Once again we disregard the covariances. We also proceed at this stage with a straight comparison between a pure monetary and a pure interest policy. A monetary policy sets the monetary base β and an interest policy the federal funds rate ffr. The parameter s represents in this case a structural response characteristic of the monetary system. The conditional variance of output y under a monetary and an interest rate policy is given by the following expressions

$$V(y|\beta) = \left(\frac{a}{b+s+ac}\right)^2 V(u_2) + \left(\frac{b+s}{b+s+ac}\right)^2 V(u_1) + \left(\frac{a(b+s)}{b+s+ac}\right)^2 V(x)$$

$$V(y|ffr) = V(u_1) + a^2V(x) + a^2V(z)$$

We note that the variance V(2) exerts no effect on $V(y|\beta)$ on the output variance under monetary policy. The following inequality satisfies the condition for a choice of monetary policy over interest rate policy

$$V(y|\beta) < V(y|ffr)$$

This condition is equivalent to the inequality

$$V(u_1) + a^2V(x) + \frac{a}{c}\,\frac{(b+s+ac)^2}{2(b+s)+ac}V(z) > \frac{a}{c}\,\frac{1}{2(b+s)+ac}V(u_2)$$

This expression implies that larger uncertainties built into the term structure of interest rates and expressed by V(x) and V(z) strengthen the case for a monetary against an interest policy centered on the federal funds rate.

The uncertainties associated with the term structure of interest rates, reenforced moreover by the occurrence of a *real* long-term rate in (1) and a *nominal* short-term rate in (2), already pose some difficult questions. But the information or knowledge problem fundamentally affects the whole policy analysis. Two separate strands need be considered: the choice of the accommodation parameter s and the monetary component β. The determination of s requires perfect information about both the deterministic and stochastic structure of the system. The variations in the game alluded to in previous paragraphs produce an unbounded range of optimal settings for the accommodation parameter. Optimal strategy is thus highly sensitive with respect to reliable possession of detailed structural information. The possession of such knowledge certainly yields a definite resolution of the strategy problem expressed by a definite selection of the accommodation parameter. The choice of β^* depends moreover beyond the possession of reliable structural knowledge on the target level of output y^*. This target level remains in the absence of an adequate analysis of supply behavior, precluding propositions assigning permanent real significance to monetary impulses, a purely arbitrary and extraneous magnitude. There is no way to anchor it in the structure of the economic process described by the analysis. Even inclusion of a Phillips curve provides no anchor to the free-floating target level without inclusion of a natural rate hypothesis. A definition of y* in terms of the traditional Keynesian measures of "full employment output" fails to resolve our problem in the absence of an adequate supply analysis. The stochastic processes intermittently produce under the circumstances positive deviations from full employment output. There is moreover nothing in the analysis to prevent perpetuation of such deviations from *any* stipulated level of "full" output. So why not use a *fuller* output as the relevant target level? The analysis offers thus no good reason for the choice of any monetary component β^* and the strategy problem remains partially unresolved and incompletely defined.

3. Optimal Control and Exploitation of Intermediate Information as Paradigm of Activist Policymaking

The procedure examined in the previous section is a special case of a more general technique defined by the theory of optimal controls. This theory initially developed in the context of engineering systems gradually attracted the attention of economists. An excellent paper by Fischer-Cooper [1973] surveyed the development of this analysis over the postwar period. Economists became initiated to these ideas with the work published by Phillips during the 1950s on proportional, derivative, and integral controls. This work was enlarged by Gregory Chow with reference to econometric models and in terms of computational procedures. It apparently promised an operational explication of the strategy problem confronting monetary policymaking. It also defines the meaning of "activist policymaking" and determines the nature and amount of such activist involvement. We require for our purposes here no detailed discussion of optimal controls. The presentation concentrates on common aspects permeating the variations on the theme.

Optimal control procedures are based on two analytic strands. One specifies the goal of policymaking usually in form of a quadratic loss function.

$$(9) \qquad L = E_t \sum_{i=0}^{N} (y_{t+i} - y^*_{t+i})^I P_{t+i}(y_{t+i} - y^*_{t+i})$$

where y_s refers to the vector of endogenous variables determined by the system, y^*_s indicates the proscribed target levels for these magnitudes and P_s is a matrix expressing the "social preferences" in terms of relative weights assigned to the possible deviations from target level. The other strand involves a description of the economic process which controls the evolution of y in response to exogenous inputs and policies selected. We specify thus

$$(10) \qquad Ay_t = By_{t-1} + C \begin{pmatrix} m_t \\ x_t \end{pmatrix} + u_t$$

where A, B, and C are matrices characterizing the deterministic structure, m refers to a vector of monetary policy instruments, x summarizes fiscal policy variables and exogenous inputs into the process. Lastly, the vector u_t contains the system's stochastic terms.

The strategy problem for monetary policymaking can now be defined as the minimization of the social loss L by selecting the best path over time for the policy instruments m_t. This problem can be solved implicitly for a wide class of linear or nonlinear systems. A standard case [Chow, 1975; Kalchbrenner-Tinsley, 1975] offers an explicit solution in terms of a deterministic formula linking the optimal setting of m_t to the past observations of the state and the concurrent values of the remaining fiscal and other inputs x_t, i.e.,

$$(11) \quad m_t = G_t y_{t-1} + K_t x_t + g_t$$

The coefficients of this feedback rule are fully determined by the economic structure (A, B, C) and the social preference matrix P_t. This rule specifies that monetary policy instruments should be set in response to information presented by the system's past state and the current values of inputs x_t. According to this rule the variability in the setting of policy instruments m_t depends on the variability produced by the exogenous processes, the vagaries of fiscal policy, and the magnitude of the shocks represented by the stochastic structure governing u_t, impounded into the evolution of the endogenous vector y_t. This analysis has been extended to classes of processes involving less stringent information levels. The structural patterns may be governed by stochastic processes. With stochastic uncertainty permeating the whole system beyond the additive shocks an opportunity still remains for optimal control procedures [Fischer-Cooper, 1973]. It was also shown in the literature [Kalchbrenner-Tinsley, 1975] that the optimal setting under pervasive stochasticity can be exhibited as a proportion of the setting computed with a deterministic structure. The proportionality factor is a rational function of expectations and covariances of all stochastic coefficients in the structure.

Control theory can be used in this manner beyond the determination of optimal settings for a given array of policy instruments. The structure of the system combined with the admissible monetary arrangements defines a range of alternative options of policy instruments. Each one of the alternative options modifies correspondingly the endogenous vector y and the matrices as representations of the relevant structure. An optimal feedback rule (or simply an optimal solution) can be obtained for each option in the range of feasible combinations of policy instruments. The combination yielding the lowest value for the loss function naturally determines the optimal selection of control variables.

The discussion proceeded so far with the assumption of a very specific information accrual concerning the observable variables y and x. It was implicitly assumed for any unit period t that the values of y_{t-1} and x_t are fully known to the authorities in addition to the structural information required. The monetary authorities experience however a very different information accrual. Some components of the endogenous vector y are known much more rapidly than the component (or components) representing national output. Let us define a unit period as the time period required to obtain measures of output. But for n components of the N-dimensional endogenous vector y information accrues for each of the S subperiods dividing the unit period. The previous description can still be applied to such a state of affairs. The strategy horizon must however be extended to the largest time period required to obtain sufficiently reliable measurements of past output and most particularly for x_t. But the structured information accrual described above offers opportunities to formulate strategies which exploit the available information emerging *within* the unit period without any direct measures about the development of the crucial output variables. A strategy based on optimal control procedures thus involves under the circumstances specified a rational extraction of intermediate information in order to achieve a better adjustment in the setting of policy instruments reflecting immediately ongoing evolutions in the economy's shock structure.

My summary follows closely the original piece presented with admirable skill by Kareken, Muench, and Wallace [1973]. A somewhat simplified version proceeding within the context of an IS-LM framework was recently examined by Ben Friedman [1977]. Let us assume that the final equation for output derived from a system can be exhibited in the form

$$(12) \quad y_t = \pi_0 + \pi_1' x_t + \pi_2 p_t + \pi_3' u_t$$

with y occurring now as a scalar expressing output; x_t is a column vector of exogenous inputs, u_t a column vector of random shocks, p_t is a policy instrument, π_1 and π_3 are column vectors and π_0 and π_2 are scalars. We assume for x_t the same information accrual pattern as for y_t. Exogenous inputs operating during a unit period are only known at the beginning of the next unit period. No direct information about the current values of y_t and x_t are available within the current unit period. With y_{T-1}, x_{T-1} and p_{T-1} known for the past unit period (T−1) policymakers know u_{T-1}. This value and knowledge of x_{T-1} provide an anchor for the information extraction process developed for the "within the unit period" adjustments in the setting of the policy instrument. In order to proceed with the analysis it is further assumed that the (ultimately) observable or computable shocks x and u are governed by first order Markoff processes.

$$(13) \quad \begin{aligned} &\text{(a)} \quad u_t = \rho_u u_{t-1} + \epsilon_{ut} \\ &\text{(b)} \quad x_t = \rho_x x_{t-1} + \epsilon_{xt} \end{aligned}$$

with both ϵ vectors behaving as pure white noises. Some generality is sacrificed at this point by assuming that all components of the vector u (or x) are governed by a Markoff process with identical ρ. This magnitude appears thus as a scalar. The information accrual problem is moreover described with the aid of the following relations

$$(14)\quad \begin{aligned} &(a) \quad u_{t-1} = E_t u_{t-1} + e_{ut} \\ &(b) \quad x_{t-1} = E_t x_{t-1} + e_{xt} \end{aligned}$$

These relations express the fact that neither u nor x are known in subperiod t on the basis of the incomplete information available in t within the unit period. The error vectors e_t are naturally orthogonal to the information impounded into the expectation formation and emerge thus as white noise. With these specifications the expression for output may be rearranged as follows

$$(15)\quad y_t = \pi_o + \pi_1' \rho_x E_t x_{t-1} + \pi_2 p_t + \pi_3' \rho_u E_t u_{t-1}$$
$$+ \pi_1' [\rho_x e_{xt} + \epsilon_{xt} + \pi_3' \rho_u e_{ut} + \epsilon_{ut}]$$

With the conditional expectations available the policy instrument p can be set at a level assuring equality of the sum of nonrandom terms in (15) with the target level y* of y. The variance of y can be stated under the circumstances by the formula

$$(16)\quad V(y_t) = \pi_1' [\rho_x^2 E_t(e_{xt} \cdot e_{xt}') + E(\epsilon_{xt} \cdot \epsilon x_{xt}')] \pi_1$$
$$+ \pi_3' [\rho_u E_t(e_{ut} \cdot e_{ut}') + E(\epsilon_{ut} \cdot \epsilon_{ut}')] \pi_3$$

We note that the coefficient vectors π_1 and π_3 depend on the choice of policy instruments p_t selected by the authorities. The covariance matrices of e and ϵ on the other hand are independent of this choice. This follows from the Markoff process specification in the case of the ϵ's and from the orthogonality of the e's with respect to all information available in t, which includes knowledge of current and past selections of policy instruments. The optimal choice of policy instrument for each subperiod from a range of feasible options is determined in accordance with the minimization of the variance. The optimal *value* of the optimally selected *kind* of policy instrument is then set according to the target equation derived from the deterministic portion of (18), i.e.,

$$y_t^* = \pi_o + \pi_1' \rho_x E_t x_{t-1} + \pi_2 p_t + \pi_3' \rho_u E_t u_{t-1}$$

These choices predicate however that $E_t u_{t-1}$, $E_t x_{t-1}$ and the covariance matrix of the e's are known to the authorities. The derivation of these magnitudes still requires our attention. Let z_t^i be a generic description for any component in the column vectors x_t and u_t. The information for the expectation $E_t z_{t-1}^i$ includes in subperiod t the observations made on the endogenous variables $y_{t-1}^j (j = 1 \ldots n < N)$ which became known *within* the unit period. The structure of the interacting system yields in particular the following final equations for the n endogenous variables observed over subperiods within this unit period:

$$(17) \quad y_t^j = \pi_0^j + \pi_{1j}' x_t + \pi_{2j} p_t + \pi_{3j}' u_t; \qquad j = 1 \ldots n$$

The coefficient vectors depend in general also on the choice of policy p. Rational formation of the expectation $E_t z_{t-1}^i$ with respect to the information y_{t-1}^j and knowledge expressed by (17) is under the circumstances determined by equation (18)

$$(18) \quad E_t z_{t-1}^i = E_{t-1} z_{t-1}^i + \sum_{j=1}^{n} \beta_t^{ij} v_{t-1}^j$$

where

$$(18a) \quad v_{t-1}^j = y_{t-1}^j - E_{t-1} y_{t-1}^j = \pi_{1j}' [\rho_x e_{xt-1} + \epsilon_{xt-1}] + \pi_{3j}' [\rho_u e_{ut-1} + \epsilon_{ut-1}]$$

We note that the information available in t allows the authorities to compute the v_{t-1}^j. The knowledge of the system's structure determines moreover the stochastic structure of the v^j's. This stochastic structure yields the regression coefficients β_t^{ij} as the standard functions of the covariances associated with e and ϵ. These regression coefficients depend thus on the full deterministic *and* stochastic structure of the system. The expectation specified in expression (18) for any subperiod t depends of course on $E_{t-1} z_{t-1}^i$. The latter is however equal to $\rho_z E_{t-1} z_{t-2}$. The expectation $E_t z_{t-1}$, for subperiod t, is thus reduced to the expectation $E_{t-1} z_{t-2}^i$ in (t-1) which corresponds to expression (18) shifted backwards by one subperiod. Repeated backwards shifting anchors ultimately the regression of the current subperiod expressed by equation (18) in the first subperiod of the current unit period with the relation $E_1 z_0^i = z_{T-1}^i$, i.e., the full information about y and x from the past unit period anchors the sequence of expectations developed over the subperiods within the ongoing unit period.

The expectational components in equation (15) required to determine the optimal *value* of any p in each subperiod are thus fully specified in terms of available observations and the system's fully known structure. The choice of the optimal *kind* of p still requires the derivation of the covariance matrix $E[e_{zt}, e'_{zt}]$ of assessment errors. The specifications laid down yield after some substitutions and rearrangements equation (19).

$$(19) \quad e^i_{zt} = \rho_z e^i_{zt-1} + \epsilon^i_{zt-1} \beta'_t V_{t-1} \qquad \text{for any i, z}$$

where β is a column vector with components β^{ij}_t and V_t is a column vector with components v^j_{t-1}. This expression implies that the covariance Cov (e^i_{zt}, e^j_{zt}) must be a function of $Cov(e^i_{zt-1}, e^j_{zt-1})$ derived from the right-side expression, and the covariances of the V-components. The elements of the covariance matrix summarizing the stochastic structure governing the assessment error e in subperiod t concerning the shock variables x and u are thus computable from a recursion formula involving the system's stochastic and deterministic structure. The covariance matrix Cov_t of the e's is thus reduced to Cov_{t-1} of the covariance in (t−1) and eventually connected by finite steps to Cov_1. This initial covariance matrix is necessarily a zero matrix according to the specification $E_1 z^i_0 = z^i_0$. This implies that e^i_1 is equal to zero. We may summarize at this stage the procedure characterizing the rational exploitation of intermediate information with the following constitutive steps: (i) the computation of a covariance matrix governing the assessment error from the underlying system's structure, (ii) with this covariance matrix for subperiod t available the authorities can determine the optimal kind of policy instrument for this subperiod, (iii) the conditional expectation $E_t x_{t-1}$ and $E_t u_{t-1}$ are computed for the subperiod t, and (iv) the selected policy instrument is set at an optimal level in view of the conditional expectations and the target level y*.

The general problem of filtering intermediate information for purposes of macroeconomic forecasting has attracted some attention in recent years. This filtering analysis provides variations on the general theme we hardly need consider for our purposes here. The basic issue remains unaffected by these variations. Our discussion proceeds therefore to some general remarks concerning the intermediate information filtering for purposes of optimal selection and setting of policy instruments. Once the reader worked his way through the sophisticated analytic evolution he may recognize that no definite result really emerges. It offers us a *program of procedures* concerning the choice of instruments (money stock, interest rate, etc.), and bearing on the frequency and magnitude of changes in selection and level of instruments determined by specific properties of the system characterizing the economic process. Once we *know* the system we can establish with the aid of these procedures the (possibly) shifting pattern of optimal control variables and the extent of the optimal short- (or shortest) run activism. It demonstrates conclusively that full information about the system's structure provides a sufficient condition for the rational determination and execution of activist policymaking. It demonstrates moreover that policymaking defined in this manner involving the proper exploitation of intermediate information, is efficient relative to the possession of full knowledge at vanishing social costs. It is in particular more efficient [Ben Friedman, 1977] than any intermediate targeting procedure directed, for instance, at a selection of target paths for monetary aggregates. The full information assumption made about the structure ensures indeed all these demonstrations of efficiency. Intermediate targeting associated with a two-stage procedure would definitely be inefficient and offers under the circumstances no rational basis for policymaking.

Some further aspects require our attention. We refer the reader to equation (13) describing the first order Markoff process governing the exogenous shocks. The processes are presumed to govern the evolution over the subperiods within the unit period. The same applies to equation (14) formulating the best assessment in each subperiod of the recent values assumed by the exogenous shocks. But the process of information filtering is anchored with a known *average* value for the *whole* past unit period, i.e., it is anchored with the vectors u_{T-1} and X_{T-1} and not with the values produced in the last subperiod of the past unit period. The choice of anchor value is thus not consistent with the specification of the stochastic processes (13) and (14). The correct initial values setting the process in motion for the determination of the expectations $E_t x_{t-1}$ and $E_t u_{t-1}$ are thus not observed. It would be more appropriate probably to formulate this issue somewhat differently. The structure of information accrual makes it impossible to obtain the correct choice of initiating values produced by the last subperiod in the past unit period. It is thus approximated with information actually available which contains consequently a measurement error. But the analysis does not acknowledge this measurement error nor errors associated with the actual measurement situation expressed by the fact that repeated revisions of the past unit period data are distributed over the subperiods of the following unit period. This revision of available information should rationally modify the nature of the finely tuned adjustments in selection and settings of policy instruments.

The first type of measurement problem may be resolved (possibly) by restructuring the analysis to infer the stochastic patterns of the measurement error from the stochastic properties of the underlying short- (or shortest) run process. But this raises another issue inherent in this approach. How much sense does it make to speak about national output for one day (not per day), for one week or for one month? We do certainly observe daily, weekly or monthly receipts, but such receipts are poorly related in the very short run with any economically relevant measure of economic activity. The analysis proceeds moreover on the assumption that the same structural (most particularly stochastic) properties hold simultaneously for arbitrary subperiods and unit periods. No doubt, other versions of the information filtering procedure compose in some manner the unit period structure from subperiod structures. But the question raised about the meaningfulness of shortest run (involving daily, weekly or even monthly) variables pertaining to economic activity remains. The sophisticated filtering of dubious information hardly offers rational grounds for finely tuned shortest run adjustment.

B. The Strategy Problem under Full and Symmetric Information for Policymakers and Actors on the Market Place

The traditional strand of policy analyses evolving with increasing technical sophistication over the past decades contained a major asymmetry in its information assumption. The policymaker, his staff, or academic advisor possesses full knowledge. Economic agents on the market place possess either no information about these matters or do not exploit the opportunities offered by the available information. Such asymmetry is hardly justifiable in any relevant terms. The segmentation of information postulated by the analysis surveyed under section II.A. may approximate under one interpretation the state of a totalitarian society but hardly fits the circumstances of western democracies. Another interpretation may assign to economic agents the behavior of a "dumb critter" ("homo boobus"). But this version conflicts with the accumulated facts of human history [Brunner-Meckling, 1977]. The assumption of asymmetric or segmented information rigidly differentiating between the status of the public and private sector fails to conform with important aspects of our reality in more or less open societies.

The acceptance of an approximately symmetric state of information involves however some further reconsideration. Such reconsideration becomes particularly relevant in the context of an analysis generalizing the full information assumption to agents operating in the private sector. Economic analysis proceeds with the assumption that men behave as resourcefully evaluating optimizers in the context of the conditions confronting them. This implies that men, on the average, will exploit available opportunities for their benefit in accordance with their perceptions. But opportunities depend on information and agents tend thus to exploit all obtainable information. Human behavior will be conditioned in specific ways under the circumstances by the available information. This basic theme motivated the emergence of the "theory of rational expectations" initiated by Jack Muth and developed in the last decade by Robert Lucas and others. Inclusion of such information absorption by agents encouraged reconsideration of the inadequate (or occasionally nonexistent) attention to the supply side of output markets. The formulation of supply behavior in the context of aggregative analysis remains at this stage an unsettled issue. But we can hardly avoid coping with this problem in one fashion or another. The assumption of exogenously fixed or moving prices seems hardly consistent with the basic tenets of economic analysis.

Rational expectations supplemented with an explicit aggregate supply in the context of a system with classical homogeneity properties reconciles the "long-run" neutrality of money with its "short-run" nonneutrality. The neutrality property at issue should be properly confined to deviations from the normal output. There are sound considerations to suspect that systematic monetary patterns may affect the path of normal output [Fischer, 1980]. But this particular kind of nonneutrality remains basically uncertain in direction and magnitude and does not really bear on our central problem under consideration. The reconciliation mentioned above is associated with the "irrelevance thesis" pertaining to systematic monetary policy. Fully perceived nominal impulses are impounded by the competitive pressure of resourcefully coping agents into current price-setting. Systematic monetary policy patterns exhibit thus the classical neutrality property and exert no real effects on the economy. The selection among alternative strategies becomes irrelevant and without significance for the pattern of real fluctuations. Only unanticipated monetary impulses modifying the strategy affect the state of real variables.

The basic features of this irrelevance analysis can be summarized for our purposes with a broad outline of the discussion contributed by Sargent-Wallace [1975]. The system used in our context is a conventional IS-LM structure supplemented with a supply function and a real balance effect

$$(20)\quad (a)\quad s(p_t, E_{t-1}p_t, u_{1t}) = d\,[r_t - (E_{t-1}p_{t+1} - E_{t-1}p_t), m_t, p_t, u_{2t}]$$

$$(b)\quad m_t = \lambda[r_t, p_t, y_t, u_{3t}]$$

Equation (20a) describes the output market equilibrium with s denoting the supply function and d the demand function. Equation (20b) represents the money market equilibrium. All behavior functions satisfy the standard homogeneity conditions with respect to all nominal values. The economy's shock structure consists of four shocks (u_1, u_2, u_3, m) governed by some stochastic processes. The u-processes reflect nature and social events whereas the process governing m expresses the explicit or tacit strategic choice exercised by the authorities. No particular specifications are needed for our purpose at this stage. A linear representation of (20) yields immediately the following pseudo solution for the price level

$$(21)\quad p_t = \alpha_0 + \alpha_1 E_{t-1}p_t + \alpha_2 E_{t-1}p_{t+1} + \alpha_3 m_t + u_t$$

where u_t is a linear combination of the u_{it} ($i = 1, 2, 3$) and the α-coefficients are rational functions of the structural coefficients. The homogeneity property of the system implies that $\alpha_1 + \alpha_2 + \alpha_3 = 1$. The same property implies that p_t and $E_{t-1}p_t$ occur in the supply function combined as a difference ($p_t - E_{t-1}p_t$). Inspection of (21) yields immediately

$$(22)\quad p_t - E_{t-1}p_t = \alpha_3\,[m_t - E_{t-1}m_t] + u_t - E_{t-1}u_t$$

The difference between actual and expected price level which determines output according to (20a) depends completely on unanticipated components of nominal and real shocks. Systematic monetary policies are necessarily impounded in the expectational component $E_{t-1}m_t$. Only the stochastic components of the monetary impulses can affect output. The choice of strategy thus becomes irrelevant under the circumstances.

The homogeneity properties of the system also bear on the choice between an interest rate or a monetary targeting policy. Equation (21) can be converted into (23)

$$(23) \quad p_t = \beta_o + \beta_1 E_{t-1}p_{t+1} + \beta_2 m_t + \beta_3 E_{t-1}m_t + \beta_4 E_{t-1}u_t + u_t$$

We note again that $\beta_1 + \beta_2 + \beta_3 = 1$. These coefficients occur as rational functions of the α-parameters in equation (21). In the context of the interest targeting procedure the pseudo solution appears as

$$(24) \quad p_t = \gamma_o + \gamma_1 r_t + \gamma_2 E_{t-1}p_t + \gamma_3 E_{t-1}p_{t+1} + w_t, \qquad \gamma_2 + \gamma_3 = 1$$

where w_t is again a linear combination of the underlying u's and the γ's are rational functions of structural coefficients. Removal of $E_{t-1}p_t$ yields directly

$$(25) \quad p_t = d_o + d_1 r_1 + E_{t-1}p_{t+1} + d_2 E_{t-1}w_t + w_t$$

with the d's occurring as rational functions of the coefficients in (24). Proceeding with the usual forward projection for the derivation of solutions familiar in rational expectations analysis yields after n steps in the case of (23) an expression containing a term with the "terminal" price level, i.e., $\beta_1^n E_{t-1} p_{t+n}$. The same projection applied to (25) yields the term $E_{t-1}p_{t+n}$. Application of the transversality condition to the first case constrains the admissible paths of price movements but violates economic sense in the latter case. We are left with one equation in two endogenous variables, the current price level and the expected (n-period ahead) "terminal" price level. Sargent-Wallace concluded thus that the price level is essentially indeterminate under an interest targeting procedure.

The Sargent-Wallace analysis was not anchored with an explicit information structure characterizing the nature of incomplete information suffered by the agents. This attention to the requirement of incomplete information in order to reconcile the "long-run" neutrality with the "short-run" nonneutrality of money forms however an important contribution of rational expectations analyses. Two distinct information structures have been developed. Lucas applied to his work an idea initiated by Phelps. This idea centered on the differential accrual of local and global information. Agents were confronted under the circumstances with an inference problem bearing on the separation between allocative and aggregative impulses jointly contained in the price signals received. The inference was crucially determined by the relative variances of allocative and aggregative shocks in the system. Comparatively larger aggregative shocks lower in this context the real effect of monetary impulses. But this variance occurs, at least according to some formulations, beyond the systematic pattern defining a strategy. The strategic component would thus become impounded into the prevailing prices. A rather different analysis is required when we proceed in the context of incomplete information bearing on the *composition* of the shocks under uniform contemporaneous information about local and global data [Brunner-Cukierman-Meltzer, 1980, 1981]. The inference problem confronting agents bears in this case on the distinction between "permanent" and "transitory" states among evolving shocks. Agents observe the values of all shock variables, but their composition in terms of "permanent" and "transitory" conditions remains unknown. The resulting inference problem provides a basis for the analysis of comparatively inflexible prices with price setting adjusted to perceived "permanent" conditions. According (at least) to some versions the formulation of a strategy removes the inference problem from nominal impulses. Agents would know not only the total value of the money stock (or monetary growth), but also the transitory and the strategic component. The choice of strategy would again be irrelevant under the circumstances.

The irrelevance thesis seemed to apply a final death sentence to any activist dispositions. But such expectations would surely underrate the resourcefulness of our profession. Stanley Fischer [1977] published an admirably elegant argument demonstrating that feedback rules could be formulated within a system satisfying the conditions of rational expectations. The demonstrations depends on overlapping wage contracts implying the occurrence of the term $E_{t-2}p_t$ in the supply function. The overlapping contractual structure implies that at any particular moment some prices exist which reflect information available at a *prior* period. The new shocks, while fully perceived by agents and monetary authorities, offer an exploitable leverage for monetary strategies affecting the real variables. This new information, not reflected by some of the prices guiding *current* transactions, can be used to formulate a feedback rule modifying the variance of output.

Lawrence Weiss [1980] resurrected the possibility of an activist monetary policy consistent with rational expectations with an alternative argument. His analysis proceeds in the context of a Lucas-type information structure with agents confronted by a local-global inference problem. The result establishing real effects of systematic and fully perceived monetary policies is assured by the adroit imposition of segmented information patterns. Capitalists and monetary authorities know in specific ways more than labor suppliers. They possess actually full information. Labor suppliers on the other hand can observe the local money wage, but must infer the relevant real wage from incomplete information. They do not know the general price level and must infer from incomplete information the contribution of real and nominal effects to changing local money wages. A rigid segmentation of information between social groups produces a system with a specific nonhomogeneity in nominal values. This nonhomogeneity determines the wedge ensuring a real leverage to systematic feedback rules.

The analytic aspects of the demonstrations made by Fischer and Weiss are not contestable. But we may well wonder about the relevance of the analysis. In one context agents possess global information and know the rule guiding the behavior of the authorities. It is not clear why under the circumstances agents would erect the postulated structure of contractual arrangements. It would seem more efficient to formulate employment-wage contracts for each period on the basis of identical information absorbed by all contracts. We do of course observe a wide spectrum of overlapping contractual arrangements. It seems most natural to follow Fischer's example and combine this institutional fact with rationally formed expectations in the context of full information employed by all agents. This combination certainly involves no logical inconsistency. But rational behavior proceeding with the information specified seems not likely to produce such contractual arrangements. Their prevalence would thus suggest some reexamination of the conditions imposed on the analysis motivating Fischer's contribution.

The other context seems substantially more contrived (more "sophisticated"?) without focusing our attention on some fundamental issues. An arbitrary segmentation of information about specific realization of stochastic processes with uniform full possession of structural knowledge by all agents can hardly persist in view of the potential gains to be expected by any supplier of information. The crucial behavior element constituting rational expectations seems hardly compatible with an ad hoc assumption of persistent information segmentation. A more serious challenge to the irrelevance thesis was formulated by Robert King [1980]. The operation of an economy-wide capital market superimposed on the local-global process with its typical information structure opens an additional information channel about global conditions via the rate of interest. King demonstrated that under these structural conditions rational expectations cannot prevent *prospective* monetary feedbacks from affecting the distribution of real variables.

The implication beyond the irrelevance thesis bearing on the price indeterminancy under an interest targeting policy attracted comparatively little attention. It may be argued that this implication offers compelling evidence against the rational expectations analysis, at least when formulated in some prevalent forms. This argument would of course be based on the proposition that some countries, e.g., the United States, did follow over the postwar period an interest targeting procedure with no detrimental effect on price determinancy. McCallum [1980] attempted to reconcile the rational expectation approach with the fact of a somewhat impure interest targeting tainted with monetary consideration in order to preserve price determinancy. But indeterminancy of prices is not a logical consequence of interest rate policies proceeding within a context of rational expectations. We cannot exorcise an interest rate policy by invoking rational expectations. The analysis containing rational expectations was usually developed without regard to stock-flow interactions. An extension of the rational expectation analysis into the realm of stock-flow problems implies however the consistent application of an interest rate policy within a system ensuring a determinate price level. This seems particularly noteworthy as the analysis developed by Brunner-Cukierman-Meltzer [1981] yields this result in a system with highly classical features: the usual homogeneity conditions, a dichotomy between the real and monetary sector in rational expectation equilibrium and a classical production function. The crucial property of the system may be summarized in a compact fashion

(26) $f[y_t, y^*_t, y^p_t, p^*_t, \Delta S, S_{t-1}, r_t, v_t, x_t, m_t] = 0$

The letter f denotes the structure of the system interrelating actual output y_t, planned output y^*_t, permanent output y^p_t, prices actually set at p^*_t, actual changes in inventory stocks ΔS_t, the inherited stock S_{t-1}, the nominal rate of interest r_t, the real rate v_t and the vector of exogenous driving forces x_t consisting of productivity shock and an aggregate demand shock (distributed by Walrus law over other markets). A monetary shock m_t terminates the array. The information problem confronting agents is expressed by the incomplete information concerning the composition of x_t and m_t. They observe both magnitudes without any relevant lags but do not know whether observed changes signify permanent or transitory effects. Prices p^*_t are set relative to the inferred (or perceived) permanent state of the shock variables derived from all available data about current and past values. Current prices are thus *inflexible* relative to *perceived transitory* shocks.

The analysis of the system proceeds in three steps of "ascending levels." We approach first the stock equilibrium as a basic anchor of the system's behavior. This stock equilibrium satisfies the conditions $y_t = y^*_t = y^p_t$; $\Delta S_t = 0$; $S_{t-1} = S^p_t$; $r_t = r^p_t$, $v_t = v^p_t$, $x_t = x^*_t$ and $m_t = m^*_t$.
The stock equilibrium thus ensues when all values including inventory stocks are fully adjusted to the perceived permanent condition expressed by x^*_t and m^*_t. The latter magnitudes represent the perceived permanent values of the shocks and occur as an optimal forecast of x_t and m_t based on all the available relevant information. The difference $(x_t - x^*_t)$ or $(m_t - m^*_t)$ expresses thus the perceived transitory component of the observed shocks. With the stock equilibrium or "permanent values" available we move to the "flow equilibrium values at disequilibrated stocks." These values are obtained by setting:
$y_t = y^*_t$; $\Delta S_t = \Delta S^*_t$; $r_t = r^*_t$, $v_t = v^*_t$, $x_t = x^*_t$ and $m_t = m^*_t$.
The flow equilibrium values, including the price level p^*_t, reflect the perceived permanent state of the shocks *and* the inherited stocks S_{t-1} which generally differ from the permanent stock S^p_t. The flow equilibrium system determines a rational expectations path for S^*_t, y^*_t, r^*_t and v^*_t converging to the respective permanent values. This convergence is directly ensured, without involving an extraneous transversality condition, by the structure of the economic system. Lastly, the actual values emerge by inserting in (26) the values for y^p, y^*_t, and p^*_t from the prior stock or flow equilibrium solution. The prevailing shock values thus determine actual output y_t, actual nominal (and

real) rate of interest, and the actual changes in inventories. The latter feed back into planned production y^*_{t+1} for the subsequent period. The actual values y_t, r_t, v_t, ΔS_t (or S_t) depend thus on inherited stocks S_{t-1} and the actual shock values. This analysis decomposes the observed movement of the output into three components: the evolution of a permanent component y^p_t, the evolution of a component $y^*_t - y^p_t$ reflecting the system's stock disequilibrium, and lastly a component $y_t - y^*_t$ summarizing the impact of perceived transitory productivity, aggregate demand, and monetary shocks.

The imposition of an interest rate policy can proceed within this system without producing any peculiar problems in spite of the full rigors of rational expectations. Suppose the authorities impose an interest rate target $\bar{r}$. The stock equilibrium condition delivers a corresponding (permanent) real rate and determines thus, with the nominal target rate, $\bar{r}$, an anticipated permanent rate of inflation. This implies furthermore that expected permanent monetary growth m^p_t must correspond to this inflation anticipation imposed by the choice of r. The level of the interest rate employed in the context of the interest targeting strategy thus determines the anticipated permanent inflation rate. This rate fixes moreover the permanent monetary growth imposed under the circumstances on the system. The real sector also determines in response to the perceived permanent conditions the expected flow equilibrium profile of the real rate ${}_tv^*_{t+i}$ (i.e., expected on the basis of information in t for t+i). This profile implies a corresponding profile of the flow equilibrium values of anticipated inflation rates ${}_t\pi^*_{t+i} = \bar{r} - {}_tv^*_{t+i}$. With the assured convergence of ${}_tv^*_{t+i}$ to its corresponding permanent value v^p_t the sequence ${}_t\pi^*_{t+i}$ necessarily converges to $\pi^p_t = m^p_t$. The determination of permanent monetary growth fixes moreover the permanent price level p^p_t and its expected profile ${}_tp^p_{t+i} = (1 + m^p_t)_t p^p_{t+i-1}$. These specifications imply furthermore a complete profile for the expected flow equilibrium price-level ${}_tp^*_{t+i}$. It is easily demonstrated that ${}_tp^*_{t+i}$ converges to ${}_tp^p_{t+i}$ as $i \to \infty$. And in a last step we obtain the profile of expected flow equilibrium rates of monetary growth ${}_tm^*_{t+i}$ as an endogenous result imposed on central bank behavior by interest targeting. The system assures the consistency of the expected monetary- evolution. This consistency is expressed by the following equality

$$\lim_{n\to\infty} \prod_{i=0}^{n} (1 + {}_tm^*_{t+i}) = \lim_{n\to\infty} (1 + m^p_t)^n$$

In order to anchor the system it is postulated that the two expressions can be approximated for a finite product over k periods.

The general pattern imposed on the money supply process by interest targeting can be exhibited with the aid of formula (27)

$$(27) \quad m_t = m^*_t + g(x_t - x^*_t,f) = \mu(\bar{r},x^*_t,S_{t-1};f) + g(x_t - x^*_t;f)$$

The actual growth rate in t follows a complicated pattern constituted by two components. The first component, i.e., m^*_t, is determined by the real sector structure contained in f, the inherited inventory stock S_{t-1}, the perceived permanent nonmonetary shocks x^*_t and the interest target $\bar{r}$. The combination (f, x^*_t, S_{t-1}) fixes the flow equilibrium profile of ${}_t v_{t+i}$. This profile combined with $\bar{r}$ yields via the profile of ${}_t p^*_{t+1}$ the profile of ${}_t m^*_{t+i}$ and thus the initial value m^*_t. The second component reflects the operation of perceived transitory nonmonetary shocks operating via perceived transitory movements in desired real balances.

Expression (27) defines the task imposed on the monetary authorities by the commitment to interest targeting. The authorities cannot rely on passive adjustments of money stock or monetary growth to a money demand conditioned by the targeted interest rate for an automatic execution of their policy. Such passive automaticity only applies to the second component in expression (27). But the first component anchors with the determination of the mean the whole money supply process. The authorities must know the structure f and the inherited inventory stocks in order to fix for any time t the mean m^*_t appropriate for any given target rate $\bar{r}$. We conclude thus that a strategy addressed to interest targeting poses no indeterminacy problem in the context of stock-flow interaction in spite of rational expectations. This strategy confronts policymakers however with a demanding information requirement, and most particularly with the question how to institutionalize, in the absence of automatic adjustments, the determination of the shifting anchor value m^*_t of actual monetary growth. An interest targeting approach produces an ever changing level of m^*_t over time as x^*_t and S_{t-1} move over time. It also imposes ever changing levels of anticipated permanent inflation rates. These requirements for a coherent execution of interest targeting probably form the crucial obstacles to this strategy and not any potential indeterminacy.

III. The Irrelevance of Full Information and the Strategy Problem under Diffuse Uncertainty

A. The Dubious Case for an Activist Regime

The case for activist policymaking bearing both on the choice of "control variables" and the setting of their respective values has been well formulated in the context of a literature postulating an asymmetric information pattern. Relying on full structural information monetary authorities can rationally select the best control variables and can also adjust them optimally on the basis of available data information to changing conditions. An activist presumption seemed the rational consequence of this situation. Rational expectations removed this asymmetry of available information implicit in traditional policy analysis initiated with Jan Tinberger [1952]. The symmetric possession of full structural information appeared to destroy the case for activist strategies by rendering the choice of strategy irrelevant. The profession's imaginative resourcefulness quickly responded to this challenge and vindicated in some sense the case for activist policymaking. It is important to understand, however, that this vindication yields a minimal substantive content. It involves simply (a perfectly correct) denial of the proposition that no activist strategy formulated in the context of rational expectation could ever affect the distribution of real variables, and most particularly the distribution of economic activity. But this denial offers, contrary to the impression conveyed in discussions, no rational basis for the activist pursuit of monetary policy. Such pursuit must be justified, by the very nature of the case, relative to a fully specified structural hypothesis about the economic process. This hypothesis must be sufficiently confirmed moreover by critical experience to attract a professional consensus in this matter. We note a similar situation in the case of the traditional policy analysis. The usual policy analysis really establishes upon careful examination the following proposition: A structure exists, such that if policymakers possess full information about the structure, then some activist regime will dominate in terms of relevant performance characteristics a nonactivist regime. But the antecedent clause of this statement conflicts violently with the facts of our world. We do not possess such knowledge, neither do policymakers, their staffs, or academic advisors. The antecedent clause of the proposition summarizing the traditional analysis is falsified by our prevalent uncertainty. The concluding clause, not necessarily false, remains however without operational significance, without justification and without evidential support.

Fischer's emphasis bearing on the pervasive fact of overlapping contractual arrangement should encourage us to reexamine the compatibility of the full (structural) information assumption with this observation. The issue can hardly center on the rational expectation assumption itself. Once we assume full information it seems unlikely that agents would not exploit this information. The problem must lie with the full information assumption permeating our traditional policy analysis. The blatant fact of uncertain and partial knowledge expressed by conflicting propositions and formulations intrudes occasionally on the awareness of various authors in the policy literature. We note in this context that Woglin recently cautioned the reader and argued: "Given a lack of information about the structural parameters, one might justify the 'second best' approach of following a pure money stock rule. . . . " With enough information, however, the monetary authority should choose the optimal monetary instrument by looking at all the structural parameters of the model [1979, p. 95]. The problem is partially recognized but misleadingly described. A strategy adjusted to the fact of diffuse uncertainty is not a "second best strategy." The "best" strategy is simply irrelevant under the circumstances. But the problem reaches beyond the uncertainty of parameters within a fixed framework, most particularly the framework used by Woglin to exercise his analysis. The pervasive fact of diffuse uncertainty is also noted by Kalchbrenner and Tinsley. They observe that "there have been few applications of optimal control design to the prominent large scale forecasting models." The authors continue: "These pilot applications have not caused much excitement because the policy recommendations do not seem to be particularly robust; that is, the instrument solution paths are sensitive to relatively small specification changes in the model or loss function." [1975, p. 14] They also refer to a survey prepared by Christ "observing that the forecast performances of the prominent macro models were similar but the certainty equivalent policy multiplier implications were remarkably dissimilar." In one stunning chart, Christ illustrates that "plots of the final form multipliers of monetary policy . . . estimated by the several structural models almost completely cover the positive orthant." [1975, p. 41] This conclusion is still confirmed by the analysis of alternative macro-models published recently by the Congressional Budget Office [1977].

The discrepancy between the full information assumption and the reality of our knowledge becomes revealed in a variety of ways and forms. Most of the contributions exploring the choice of control variables and opportunities for activist adjustments usually conclude, of course, that the nature of the choices "are essentially an empirical issue." But this conclusion just tells us what we knew already, i.e., that the strategy issue involves questions beyond a purely logical realm. The concluding remark attesting the empirical nature of the issue thus reveals the uncertain range of inconclusive information bearing on the strategy problem. We also note the frequent allusions made in this context to the effect "that the world is complex." The world is indeed "complex" relative to the requirements necessary for the rational determination of an activist strategy. We need detailed knowledge of the structure which is not available in any reliable form. That makes the world unavoidably "complex." It is remarkable however that policymakers, their staffs or academic advisors, after bemoaning this "complexity" still find it possible (by divine intuition not accessible to others) to settle on a finely tuned course of monetary policy justified in very specific historical terms.

Our problem seems also to lurk behind a traditional juxtaposition of approaches to monetary policy, juxtaposing "discretion" and "rules." The evolution of policy analysis selectively surveyed in previous sections would suggest that this juxtaposition falsifies the nature of the issue. The choice appears to be between alternative rules, defining alternative strategies, of conducting monetary policy. The "discretionary" component of the choice, in conjunction with the judgmental intrusions observed in the Fed's actual policymaking procedures, reveals however the true state of uncertain and dubious information pertaining to the requirements of activist policymaking. A judicious vocabulary usefully contributes to the obfuscation of the essential irrationality of the "discretionary" policymaking proceeding against the background of "discretionary information."

Advocates of activist monetary strategies objected in recent years to the more or less implicit information requirements imposed on agents in the rational expectations literature. It is argued that we can hardly expect agents to possess (reliably) the structural information laid out with the analysis. This seems particularly unreasonable in view of the difficulties confronting our profession in this respect. Indeed. But if this assumption is unreasonable for private agents why should it be reasonable for policymakers, their staffs, and academic advisors? The very same groups rejecting the rational expectations literature on grounds of comparatively poor structural information proceed with arguments implicitly attributing to themselves or to policymakers a monopoly of perfect structural information [Ben Friedman, 1977].

The fundamental information problem confronting the rational choice of a monetary strategy may be characterized with the aid of the following schema

$$\text{(28)}\quad \begin{aligned} &\text{(a)}\quad \dot{x}_t = f_t[x_t, a_{1t}, a_{2t}, u_t] \\ &\text{(b)}\quad a_{1t} = d_{1t}[x_t, u^{*1}_t; d^{*1}_{2t}, f^{*1}_t] \\ &\text{(c)}\quad a_{2t} = d_{2t}[x_t, u^{*2}_t; d^{*2}_{1t}, f^{*2}_t] \end{aligned}$$

The state vector x_t evolves over time in accordance with a structure f_t and in response to actions a_{1t} by private agents, actions a_{2t} executed by policy agencies and a shock vector u_t. The actions a_{1t} of private agents depend on a disposition d_{1t} summarizing their decision propensities. These actions depend thus on the current state and the underlying shocks u^{*1}_t perceived by the agents. The decision propensity is moreover conditioned by the agents' perception f^{*1}_t of the structure and of the policy agencies' disposition d^{*1}_{2t}. A corresponding disposition d_{2t} governs the actions of policy agencies. These actions depend in accordance with d_{2t} on the current state and the agencies' perception u^{*2}_t of underlying shocks. The disposition d_{2t} is moreover conditioned by the policy agencies' perceptions f^{*2}, d^{*2}_{1t}, of the structure and private agents' dispositions.

The crucial assumption justifying an activist regime of monetary policymaking specifies that policymakers reliably possess all the relevant detailed information. This means in particular that $f^{*2}_t = f_t$, $d^{*2}_{1t} = d_{1t}$ and u^{*2}_t correspond to the objectively best estimate of shock realizations given full knowledge of f. But these assumptions cannot survive the most cursory examination of our actual state of knowledge. What remains of the case for activist policy procedures? With f^{*2}_t, and d^{*2}_{1t} substantially deviating from the relevant structure f_t and disposition d_{1t} and d^{*1}_{2t} uncertainly shifting in accordance with private agents' perceptions, drifting in response to unclear signals bearing on the policy agencies' behavior, policymaking moves in a murky jungle. There is no assurance under the circumstances that any particular activist course exemplified by choice of d_{2t}, (including a pattern of ad hoc actions motivated by an immediately prevailing state x_t) will improve in any way the evolution expressed by the state path. There is no rational foundation under the circumstances for the policy deliberations characterizing the prevalent literature or the procedures dominating most central banks.

The problem is actually amplified by what may be called the "Lucas effect." Lucas effectively demonstrated [1976] the dependence of d_{1t} on d^{*1}_{2t}. Variations in policy regimes expressed by changes in d_{2t} thus induce modifications in private agents' dispositions governing their actions. This consequence undermines the usefulness of simulating alternative policy regimes in the context of an invariant structure and propensity (f, d_1). John Taylor correctly argued however [1979] that an invariant structure f can be separated from the affected disposition pattern d_1. The latter's dependence on d_{2t} can thus be explicitly recognized. With a reliable estimate of the invariant portion of the total structure, i.e., f, and a reliable formulation of the dependence $d_1(d_2)$ alternative policy regimes can be correctly evaluated with full recognition of the "Lucas effect." But Taylor's argument proceeds again within the context of sufficient information for the purpose at hand. The Lucas effect operates in contrast with a pervasive influence in the context of diffuse information about the structure and also about the nature of prevailing strategies pursued by the monetary authorities. Recognition of changing policy regimes proceeds with uncertain and uneven speed and there will be little basis for the authorities to judge reliably the changes in d_{1t} actually produced. The information problem bearing on the structure f persists moreover. This combination yields no assurance that the more likely outcome of policy regimes d_{2t} sequentially adjusted to perceived private dispositions d^{*2}_{1t} within a dubiously known structure f^{*2}_t would not produce intermittent and perverse destabilization patterns in the time path of the state vector. Once we move however into the realm of uncertain structural information we should also recognize another dimension of a generalized Lucas effect reaching into the structure f_t itself. This aspect was probably recognized on an nonanalytic level by Gordon and Hynes [1970] at a comparatively early stage. These authors emphasized the communications and information dissemination process associated with the operation of the market mechanisms. In the context of incomplete structural information suffered by agents this communications process produces intermittent modifications of the perceived opportunity set. These modifications may be induced by relative price changes, but may involve dimensions beyond the price vector confronting agents. They pertain most particularly to potential transactions disregarded and excluded under prior information states. The emergence of financial innovations on the supply side of financial markets and enlarged horizons (perceived opportunity set) for potential investments by households observed in the United States over the past decades exemplifies my point. The dependence of perceived opportunity sets on the evolution of the state vector under the impulse of stochastic shocks and public actions leads us to reject the idea of an invariant structure convergingly approximated by an ever expanding econometric model. The structure f_t is itself time dependent under the circumstances and well expressed by some of the available pilot studies exploiting the stochastic coefficent approach [Mullineaux, 1980]. This time-variant behavior of f resulting from the information-dissemination process produced by the market mechanism perpetuates the wedge between the different perceptions f_t^* of f_t held by private agents or policy agencies. The information problem confronting the rational formulation of activist strategies remains thus entrenched beyond the hopeful patience for a larger sample or for a larger model with more equations.

The reservations about any activist regime on grounds of diffuse uncertainty about the structure of the economic process extends, as we noted previously, to strategies involving a targeting of interest rates. Equation (27) reveals the options available to a central bank. It either maintains the expectation of permanent inflation by adjusting the target nominal rate $\bar{r}$ concurrently with the real rate $v_t^p = v(x_t^*; f)$, or it holds on to $\bar{r}$ and lets the expectation of permanent inflation move opposite to the changes in the permanent real rate. Agents require under both options full information about the procedure selected. This requires under the second option in particular an immediate adjustment in the public's expected permanent rate of inflation from period to period as the perceived permanent nonmonetary shocks evolve. The load of the information requirement imposed by an interest targeting policy is thus at least as large as for any activist regime. It reaches actually beyond the standard requirement of full information enjoyed by the policymakers. It also includes a requirement of full information by agents on the market place. A "strategy" of interest targeting under diffuse uncertainty about the structure f and the stochastic structure controlling nonmonetary shocks faces under the circumstances described the dangers of potential destabilization discussed with the aid of the expression (28).

B. The Case for a Nonactivist Regime under Diffuse Uncertainty

The description of the strategy problem under diffuse information pertaining to structural detail encourages reservations concerning activist dispositions but yields no clear answer. Milton Friedman made his famous case for a nonactivist strategy of a constant monetary growth (CMG) more than 30 years ago precisely on the basis of diffuse and uncertain structural information [1953]. He formulated the problem on subsequent occasions in terms of long and variable lags built into the process transmitting monetary (and other) impulses. But this apparently somewhat special formulation need not distract us. The emphasis on "long lags" in particular, may be somewhat irrelevant at this stage in view of the results presented by Fisher-Cooper [1973] and also in view of the inherently endogenous character of these lags determined by the markets' information process. "Long lags" may be shortened without alleviation of the state of diffuse information. Friedman's essential argument remains however correct in my judgment. Whatever reservations and objections I have encountered in the literature postulate without exception some levels of reliable information which would rationally justify abandoning a nonactivist policy. But they also fail without exception to provide any support for their specific information levels assumed for purposes of their discussion. Neither have I observed a groundswell of professional concensus around the specific information patterns adduced.

My argument develops Friedman's original idea in the context of an alternative formulation with more explicit attention to the nature of the information problem. We use for the present purpose the language system offered by the quantity equation. This choice need not prejudge our issue. It offers but a useful organization of the analysis with implications ultimately dependent on the patterns of diffuse information and the associated assessment of rules. It will be shown that the interest targeting case familiar from Poole's argument can be subsumed under the strategy cases examined.

$$(29) \quad \phi M\bar{V} + (1-\phi^*)M^*\bar{V}^*x + PG = P(Y - \Delta N)$$

introduces the basic frame expressing aggregate nominal demand confronting the market value of supply. The latter is a product of price level P multiplied by "final sales," i.e., output Y corrected for inventory accumulation ΔN of suppliers. Aggregate nominal demand is the sum of three components. The first term describes the private domestic sector's demand for domestic output. This demand occurs as a product of an allocation parameter ϕ multiplying *total* private expenditures $M\bar{V}$. This magnitude is the product of domestic money stock M and domestic *private* expenditure velocity $\bar{V}$. The parameter ϕ determines the allocation of total private domestic expenditures between domestic and foreign output. This allocation parameter will depend in general on relative domestic and foreign prices and the exchange rate. The second term on the left describes the foreign demand for domestic output. This component is the product of total foreign private expenditures $M^*\bar{V}^*x$, expressed in domestic units by application of the exchange rate x, and the allocation parameter $(1-\phi^*)$. This parameter describes the allocation of total foreign private expenditures to the acquisition of domestic output. Total foreign expenditure is again a product of money stock, i.e., M^* and the appropriate private expenditure velocity $\bar{V}^*$. The last term PG measures the value of the domestic output absorbed by the government sector.

The expression introduced with equation (29) is usefully translated into a more familiar format with a standard velocity expression V. The translation reveals some of the background processes shaping the behavior of the usual velocity measure. It reveals in particular that the use of the standard formula as a language system does not "disregard" aspects of fiscal policy or the position of an open economy. Equation (30) presents the standard formula expressed in

$$(30) \quad \Delta m + \Delta v = \Delta p + \Delta y$$

logarithmic first differences in order to focus on rates of change. The standard velocity V, such that log V = v, is defined under the circumstances by equation (31)

$$(31) \quad V = \frac{\phi}{1-g-n}\bar{V} + \frac{1-\phi T^*}{1-g-n}\frac{M^*x}{M}\bar{V}^*$$

where n and g are proportions of inventory and government absorption characterized by the equations $\Delta N = nY$ and $G = gY$. The standard velocity V multiplying money stock M in order to yield total output at market value appears thus as a linear combination of domestic and foreign private expenditure velocities $\overline{V}$ and $\overline{V^*}$. The coefficients of the linear combination depend on the domestic and foreign parameters allocating total private expenditures between domestic and foreign goods, the proportion of inventory accumulation and government absorption.

We proceed to introduce four more specifications. These are addressed to the supply side. Equation

$$\text{(32)}\quad \begin{aligned} &\text{(a)}\quad \Delta p = \Delta p_1 + \Delta p_2 \\ &\text{(b)}\quad \Delta y = \Delta z + \Delta ny \\ &\text{(c)}\quad \Delta p_1 = E\,[\text{aand} \mid I_t] \\ &\qquad \text{with aand} = \Delta m + \Delta v - \Delta ny - u \\ &\text{(d)}\quad \Delta p_2 = \theta \Delta z + u \end{aligned}$$

(32b) decomposes output into a normal component ny determined by the prevalent "permanent" underlying real conditions of the economic process and a more or less transitory component deviating from the normal level. This formulation expresses the conjecture [Beveridge-Nelson, 1981; Nelson-Plosser, 1980] that most National Bureau time series can be usefully approximated as the sum of a random walk and a stationary process. A corresponding partition is applied to the movement of the price level. The second component, i.e., Δp_2, expresses transitory (i.e., less durable) movements in the price level associated with the transitory output component Δz and reflecting partly a stochastic element u.

The first component of the change in price level approximates the notion of a persistent rate of inflation. Agents adjust the price setting to the perceived momentum of nominal aggregate demand ($\Delta m + \Delta v$) adjusted for changes in normal output and the chance element associated with the second component in price changes. This price setting proceeds in the context of the partial ignorance (or partial knowledge) about the structure of the economic process. It is conditioned by any clues and signals available to agents bearing on the crucial development of the adjusted nominal aggregate demand. The information problem is moreover reflected by the circumstance that the expectation E differs from the objective expectation E* corresponding to the prevailing stochastic structure governing the economic process. The expectation E is thus formed according to the very incomplete information about the structure of the relevant processes conditioning the signs watched by the agents. It follows that even with a constant E* the "subjective" expectation E will change with shifting information bearing on the process determining E*.

The price setting expectation E appears thus relative to the central anchor E* as a random term with a distribution determined in principle at any moment by the structure of underlying processes and the nature of agents' information absorption patterns.

The prevailing state of diffuse structural uncertainty is moreover characterized by a set S of possible states s of the world. These states do not refer to positions of the economic system typically represented by a state vector. They represent the range of structural conditions governing the evolution of the economic process. They subsume in particular also the stochastic structure of all inputs into the process. They subsume moreover a range of possible fiscal policy regimes. Such regimes modify the processes shaping the behavior of Δv and affect over the longer run also the behavior of Δny. The monetary strategy or monetary policy regime will be denoted with π. The combination (s,π) describes thus a definite monetary regime operating in a specific structural state. On the basis of a given inheritance expressed by some initial condition of the economic process the pair (s, π) fully determines the stochastic path of the economic system. To any pair (s, π) a specific pattern of the system's evolution becomes thus associated.

The specification laid down in (32) allows us to rearrange (30) into the following expression (33)

$$(33) \quad \Delta z = \frac{1}{1+\theta}[(aand - E^*) + (E^* - E)]$$

The two expectations E and E* are applied to the adjusted nominal aggregate demand aand. The magnitude Δz expresses the object of stabilization policies. Such policies are addressed to lower the variability of Δz. This variability is well expressed by the variance $E^*[\Delta z - E^*(\Delta z)]^2 = E^*(\Delta z)^2$. Upon application of the expectation E* to the expression in equation (33) we derive after some rearrangement equation (34)

$$(34) \quad E^*(\Delta z)^2 = \frac{1}{(1+\theta)^2}[NV + PV + UC]$$

with the following definition for NV, PV, UC

$$NV = \sigma^2(\Delta v|s,\pi) + \sigma^2(\Delta ny|s,\pi) + \sigma^2(u|s,\pi)$$

$$PV = [\sigma(\Delta m|s,\pi) + \rho_{mv}(s,\pi)\cdot\sigma(\Delta v|s,\pi]^2 - \rho^2_{mv}(s,\pi)\cdot\sigma^2(\Delta v|s,\pi)$$

$$UC = E^*[E\Delta m - E^*\Delta m]^2 + E^*[E\Delta v - E^*\Delta v]^2 + E^*[E\Delta ny - E^*\Delta ny]^2$$

The notation $\sigma^2(x|s,\pi)$ refers to the variance of $x = \Delta m, \Delta v, \Delta ny, u$; ρ_{mv} represents the correlation between Δm and Δv. All variances and the correlation ρ_{mv} depend on the state s and also, particularly those of Δm, Δv and ρ_{mv}, on the monetary regime π. The variances are thus functions of (s,π) and correspondingly conditioned. The parameter θ, while not (necessarily stochastic) depends also on (s,π). The specific dependence of θ on π has been formulated by Lucas [1976]. The reader will note that all covariances with the exception of Δm and Δv, are disregarded at this stage.

Equation (34) partitions the total variance of Δz into three distinct components; the "natural variance NV, the policy variance PV, and the uncertainty component UC." The natural variance emerges from the processes conditioning the behavior of Δv, and Δny and u. We caution however that the term used (i.e., natural variance) should not be misleadingly burdened with metaphysical meanings. It is most probably not independent of policy regimes governing the economic process. Monetary analysis informs us that different choices of π yield different behavior patterns of Δv. The natural variation is moreover exposed to the influence of the fiscal regime impounded into the possible states. The second item, i.e., the policy variation PV, is substantially determined by the choice of monetary strategy in the context of a particular state s. The last term reveals the pervasive structural uncertainty suffered by agents. The nature of the existing uncertainty shapes the behavior of the "estimates" represented by the expectation E relative to the true mathematical expectation E*. This uncertainty component, and most particularly its first term, is quite sensitive to the nature of the policy regime and depends moreover, via the nature of the prevailing institutional regime, on the state s. This aspect will be examined in the following section of the paper.

In order to proceed with some ordering of the possible strategies a criterion function needs to be formulated. The following expression is proposed for this purpose.

$$(35) \quad C(s,\pi) = \frac{E^*(\Delta z)^2}{NV} - \frac{1}{(1+\theta)^2} = \frac{1}{(1+\theta)^2}\left[\frac{PV}{NV} + \frac{UC}{NV}\right]$$

The criterion is clearly a function of s and π. It is defined as the sum of the policy variation and the uncertainty component per unit of natural variation, modified with the expression $(1+\theta)^{-2}$. We disregard for the moment the uncertainty component and reintroduce it subsequently. We obtain under the circumstances a natural zero point for the criterion function at $PV = 0$. Monetary regimes producing a positive value of PV thus destabilize the economy, whereas regimes generating negative values for PV actively stabilize the process. Regimes satisfying $PV = 0$ may be characterized as neutral regimes.

The criterion function defines a decision matrix. The columns of the matrix may be linked to the possible states. The rows are associated on the other hand with strategies available to the monetary authorities. Each row represents a particular regime π. The broad structure of this matrix determines our argument. One particular property of the matrix is obtained by reflecting on the optimal choice of π for any given specific state s. The expression for the policy variation in equation (31) determines the condition for an optimal selection of π as follows

(36) $\sigma(\Delta m | s,\pi) = -\rho_{mv}(s,\pi) \cdot \sigma(\Delta v | s,\pi)$

The criterion function acquires under the circumstances the following form

$$(37) \quad C(s,\pi) = -\frac{1}{(1+\theta)^2}\rho^2_{mv}(s,\pi)\frac{\sigma^2(\Delta v|s,\pi)}{\sigma^2(\Delta v|s,\pi) + \sigma^2(\Delta ny|s,\pi) + \sigma^2(u|s,\pi)}$$

All terms on the right side constituting the product are positive. We obtain thus a negative criterion value. We recognize according to (37) that there exists for every feasible state of the world a monetary regime π which effectively stabilizes the economy. This optimal regime $\hat{\pi}(s)$ lowers the total variability of Δz below the reference point formulated in terms of the "natural variance." We also note that all three terms of the product defining the optimal criterion value assume values in the open unit interval. This is immediately obvious for the first and third term. The middle term reflects the association between Δm and Δv in a genuine stochastic context precluding the emergence of a perfect correlation $|\rho_{mv}| = 1$. It follows therefore that every column of the matrix possesses some negative elements. These negative elements are however all bounded from below and exceed algebraically minus one. States producing comparatively smaller ρ^2_{mv} and $\sigma^2(\Delta v/s\pi)$ or comparatively larger $\sigma^2(\Delta ny|s,\pi)$, $\sigma^2(u|s,\pi)$ or θ raise the minimal value in the respective columns nearer to zero from below. These structural conditions attenuate thus the net stabilizing effect of an optimal regime.

A special case contained in Poole's analysis may be examined for a moment at this point. Suppose we omit all considerations of supply behavior according to the traditional IS-LM procedure. This implies the following conditions: $\sigma^2(\Delta ny|s,\pi) = \sigma^2(u|s,\pi) = \theta = 0$. Assume furthermore that the variance of the output market disturbances vanishes. Poole's analysis determines under the circumstances that an interest targeting strategy lowers the variance of output to zero. A monetary regime addressed to the proper targeting of interest rates achieves perfect stability. This means that in terms of the framework used in this section, and with the conditions imposed, the optimal policy regime satisfies the conditions

(38) $\sigma(\Delta m|s,\pi) = -\rho_{mv}(s,\pi) \cdot \sigma(\Delta v|s,\pi)$ and $\rho_{mv}(s,\pi) = -1$.

These conditions, combined with the conditions characterizing the omission of supply behavior yield the perfect stability expressed by $E^*(\Delta z)^2 = 0$. This special case may possess its educational virtue for classrooms but can hardly contend for admission in the feasible range of considerations.

A second property of the matrix directs our attention to values of the criterion function in each row. We recognize that for each policy regime π feasible states exist which convert π into a destabilizing process. In other words, for every π there occurs s, such that the pair (s,π) produces a variance of Δz exceeding the natural variance. The existence of this property can be demonstrated with the aid of simple examples or with the aid of simulation exercises executed with various models.

A last property needs to be presented. The matrix exhibits at least one row containing only zeroes. We note in other words the existence of at least one strategy π satisfying the condition

$$(39) \quad \sigma(\Delta m | s,\pi) = \rho_{mv}(s,\pi) = 0 \text{ for every s}$$

These conditions imply that PV = 0. The matrix contains thus rows characterizing the operation of a neutral regime. An effective policy of constant monetary growth would clearly satisfy the condition (39). Other monetary regimes involving variations in monetary growth could "in principle" satisfy the same conditions. But the information requirement associated with alternative regimes would raise the uncertainty component UC beyond the level determined by a strategy of constant monetary growth. This aspect will be considered in a subsequent paragraph.

The general structure of the decision matrix crucially influences the choice of a strategy. The matrix informs us that we could "luck in" and select a regime ensuring a stabilizing effect on the time path of output. But we do not know the actual state s within the feasible range of uncertainty. We can therefore not ascertain an optimal π precisely geared to the prevailing s. Whatever policymakers, their staffs, or academics may tell us, the idea that we know s and can therefore appropriately select π is a grand illusion. But every activist strategy runs the risk of a destabilizing performance. There is no assurance that the perceived or believed state s guiding the choice of π is anywhere near the relevant structural condition s. The risk is moreover not symmetric. The "positive risks" of "lucking in" are bounded from below. The net stabilization effect may frequently be comparatively modest. Whatever the situation may be however, the net stabilization effect remains a fraction of the natural variation. The destabilizing potential is on the other hand much larger and could push the actual variance to a substantial multiple of the natural variance. The history of monetary policy in the United States, Germany, or Switzerland over the past 60 years should reveal with its unfortunate experiences some aspects of the asymmetry in risks associated with activist strategies. The choice of a nonactivist strategy, expressed by a constant monetary growth, effectively avoids the asymmetry of positive and negative risks associated with any activist regime. The selection of this neutral regime assures us that

$$PV = 0 \text{ and } E^*(\Delta z)^2 = \frac{1}{(1+\theta)^2} NV$$

This regime precludes the destabilization potential inherent in all activist strategies. It also forfeits on the other hand potential stabilization effects. We should not expect that a neutral strategy proceeds without any costs. But in my judgment the asymmetry of risks tilts the balance very definitely towards the pursuit of nonactivist monetary control strategies.

The case for a nonactivist strategy receives additional support from three aspects neglected so far. We already noted the dependence of $\sigma^2(\Delta v | s,\pi)$ and $\sigma^2(u| s,\pi)$ on the policy regime. The reliable execution of a policy maintaining a constant monetary growth would probably also lower the variance of Δ v and of u. Monetary regimes cultivating an unreliable course with frequent shifts raise most likely the variance of both Δ v and u. The removal of at least this component of uncertainty imposed by the monetary authorities contributes to constrain $\sigma^2(\Delta v| s,\pi)$ and $\sigma^2(u| s,\pi)$.

The operation of the generalized Lucas effect also deserves our attention. Whatever the initial state may be, the choice of π will induce a shift in s according to the narrower Lucas effect and the process explored by Kydland-Prescott [1977]. This shift is reenforced over time by the more general effect discussed above and generated by the information dissemination aspects of the market mechanism. It follows that the relevant cell in the matrix will drift along any particular row determined by a prevailing regime. This pattern increases the uncertainty confronting policymakers and raises the risks associated with an activist regime. An argument advanced by Sir John Hicks refers to aspects of the economic process generating a similar pattern of shifts along any row of the matrix [1974]. Hicks discusses the sensitivity of the multiplier process with respect to the pattern of initial conditions most particularly represented by the distribution of inventories. He notes that the magnitude of the multiplier effect triggered by autonomous expenditure shocks (or monetary policy for that matter) varies with the initial conditions. Variations in initial conditions can be expected under the circumstances to be associated, for any given fiscal or monetary action, with substantially different values of Δv over the subsequent periods. These differences in initial conditions contribute to the distinction between the possible states s defining the matrix columns. Activist regimes experience under the circumstances crucial difficulties in systematically avoiding destabilizing impulses.

The behavior of fiscal policy also reenforces, as we may note in passing, the case for a "neutral regime." The history of fiscal policymaking in the United States and possibly some other countries, is burdened with shifting uncertainties and unexpected twists and turns, modifications, revisions, etc. The political economy of fiscal policymaking should prepare us for such patterns. The neat resolutions of Pareto-optimal tax structures or efficient expenditure programs may be useful devices to evaluate reality, but they certainly do not describe the product of reality. Fiscal policymaking thus supplements the shifts along a row in the decision matrix already produced by the extended Lucas effect.

Our last point to be considered involves probably the most important element discriminating between activist regimes and a neutral strategy. It weighs, most likely, more heavily in the ultimate balance affecting the choice between the two classes of strategies. We omitted so far any considerations of the uncertainty component UC. The diffuse state of information discussed in the previous paragraph of this section assures the occurrence of positive values for all three terms constituting UC. This implies that the reference point of the decision matrix moves beyond zero into the positive range. It also follows that the minimal value $C(s,\pi)$ in each column s moves closer to zero. The relevant magnitude of "lucking in" expressed by the relative net stabilization effect thus declines. The recognition of UC twists the asymmetry of risks still further against the adoption of activist regimes.

The nature of this uncertainty terms requires some attention. Agents perennially face the world with woefully incomplete information. They note the changing conditions affecting their position. Their self-interest naturally drives then to look for signals bearing on the future evolution of crucial conditions. But whatever the array of observations available to agents, they still need to make inferences about the nature of the variations observed. They will respond in general very differently to more or less transitory changes or to more permanent changes. Agents will rarely ever know whether any particular modification in surrounding conditions is permanent or transitory. But in order to make decisions and to act they will need their best judgment in this matter. The perceptions determined by this inferential judgment hardly coincide with the actual state. The perceived permanent and transitory conditions will differ from the actual conditions even in the context of full stochastic structural information [Brunner-Cukierman-Meltzer, 1980]. The larger the operation of transitory variations, expressed in terms of relative variances, the larger looms the agents' inference problems. Their perception of both permanent and transitory conditions affecting their operations becomes less reliable under the circumstances. Even major changes in permanent conditions require substantial time before they will be incorporated in the agents' perception. They tend thus to be misconceived for a time, depending on the relative noise in the observation, as essentially transitory occurrences. The inference problem continuously confronting agents coping with their social environment suffers a "quantum jump" once we move beyond the realm of full knowledge of the stochastic process. The "noise-level" in the data is substantially enhanced. Perceptions tend to diverge markedly from the true values. They also tend to be more volatile than in the context of a known stochastic structure. These patterns produced by a pervasive inference problem, imposed on agents by a fate of diffuse uncertainty, dominate the uncertainty component UC occurring in the total variance of output. The shifting sample of incomplete information pertaining to data and their interpretation determines the components in UC cast up by the economic process, i.e., $E^*[E\Delta v - E^*\Delta v]^2 + E^*[E\Delta ny - E^*\Delta ny]^2$. These components may be conditioned to some extent over a longer run by aspects of economic policymaking. The nature of the fiscal policy regime should be expected to exert some influence in this respect. The prevailing monetary regime on the other hand would dominate the first term, i.e., $E^*[E\Delta m - E^*\Delta m]^2$ and probably to some extent also the velocity term.

The uncertainty associated with activist regimes reaches beyond the state of the world. Such regimes do not operate in the manner described by an analysis of optimal controls. The subsequent discussion of the political economy of monetary policymaking elaborates the irrelevance of activist regimes formulated in accordance with optimal control procedures. This kind of "activism" will hardly be tolerated by the forces shaping the behavior of political institutions. Activist policymaking usually emerges in the form of a "discretionary" practice. This practice creates uncertainties beyond the location of the true column in the decision matrix. It confronts agents on the market place with an additional uncertainty pertaining to the course followed by the monetary authorities and the specific actions to be expected. The pervasive nature of this supplementary uncertainty is reflected by the hordes of well-paid people interpreting the last signals and clues contained in recent actions and utterances of central bank officials or embedded in the last observations. A variety of indicators would suggest that, even with a comparatively constant coefficient of determination of monetary growth, the uncertainty about the course of policy in the 1970s substantially increased beyond the level prevailing in the 1950s or early 1960s. Discretionary policies contribute thus to raise the uncertainty component. They raise the first term directly and also the second term indirectly via supplementary and difficult to infer shorter run variabilities in velocity. This result is produced by the exposure of agents to complications of their information problem beyond the uncertainties produced by the "state of nature" and fiscal policy. The choice of an nonactivist strategy of constant monetary growth removes the information problem artificially imposed by discretionary policymaking. A reliably executed strategy of constant monetary growth lowers the first term in the uncertainty component UC to the vanishing point and most likely moderates the second term in the uncertainty component for the reasons indicated above.

We noted previously that a strategy lowering the policy variation to zero could conceivably still exhibit substantial variations in E^* over time. But such variations unavoidably burden agents with additional information problems. A short-run pattern of moving E^* values expresses again an activist disposition operating under the usual institutional arrangements within a substantially discretionary context. This strategy pattern is thus bound to generate a nonvanishing first term in the uncertainty component. This argument bears with particular significance on proposals advocating a return to the gold standard. The dependence of a major source component of the monetary base on the balance of payments impounds disturbances from all over the world into the domestic monetary growth. This is amplified by the uncertainty associated with the relation between the domestic credit and foreign reserve sources of the base. A return to the gold standard produces under the circumstances a positive PV component and a positive term $E^*[E\Delta m - E^*\Delta m]^2$. A return to the gold standard offers no particular assurance of a stable price level or of a substantially lowered policy variation PV or uncertainty component UC.

Two aspects of the argument advanced in support of a nonactivist regime need to be distinguished. Our cognitive endeavors typically begin with some more or less articulated idea bearing on some phenomena or problem. The explication of this idea, i.e., its translation into a more developed argument or formulation, is seldom uniquely determined. This applies to our case. The argument advanced in this section may not be the most effective explication of the basic idea governing the case for a nonactivist regime. There are always grounds to hope for a more adequate formulation of the central issue. One aspect of the argument advanced may be reexamined however at this stage. For any given pair (s,π) there is in principle a well-defined expectation E^* of the adjusted aggregate nominal demand aand. This need not apply necessarily to the "subjective" expectation E summarizing the agents' inference problem under a state of diffuse uncertainty. This aspect may deserve some further attention. Consider for our purposes the movement of a specific price, say of the i'th good. The supplier of such a good conceivably looks at his price in the context of the general price movement. The change of price i at time t, expressed by $\Delta p(i,t)$ is partitioned under the circumstances into two components

$$\Delta p(i,t) = a(i,t) + s(i,t)$$

where a(i,t) describes the i'th market's assessment of the aggregate price movement common to all specific prices, i.e., for all i. The second term denotes in contrast the i'th market's perception of specific or relative price movements. Both aggregate and specific terms are a sum of (perceived) permanent and transitory terms indicated by the subscripts 1 and 2. We obtain thus

$$\begin{aligned}\Delta p(i,t) &= [a_1(i,t) + s_1(i,t)] + [a_2(i,t) + s_2(i,t)] \\ &= \delta(i,t) + \tau(i,t)\end{aligned}$$

The first term (i.e., δ) expresses the i'th market's assessment of permanent conditions, whereas τ summarizes the perceived transitory movements. Aggregation over all markets yields

$$\Delta p = \delta + \tau$$

The second term (i.e., τ) corresponds with the component Δp_2 and is linked with more or less transitory output movements. The first term reflects the agents' prevailing assessments of the persistent trend in underlying conditions. This assessment may be influenced by a wide variety of signals and clues observed by the agents. The relevant information set used by the agents may in particular not be related explicitly with the components of adjusted aggregate nominal demand. It would thus appear that δ (i,t), the generic component of δ , is formed as the projection of $\Delta p(i,t)$ on the relevant range of perceived permanent condition, a projection shaped by some information set I(i,t) affecting suppliers on market i.

Several aspects of this modified argument bear on our problem. We note first that absence of any explicit recognition of the components of aand does not disconnect the subjective assessments from the agent's perception of aand. The competitive drive of self-interested agents tends to link over time their best assessment of $\Delta p(i,t)$ via δ (i,t), with the perceived evolution of aand. The modified story implicitly loosens however the connection somewhat. It also directs attention to the sensitive exposure of δ (as an average over all markets) to possibly volatile shifts in the composition of the distribution of $\delta(i,t)$. Neither aspect affects the policy variation PV, but they do bear importantly on the uncertainty component UC. The latter need be expressed under the circumstances as $E^* [E(\Delta p| I(i,t) - E^*aand]^2$ where the first term represents the average over all markets of $\delta(i,t)$ based on I(i,t). The modified story actually reenforces the relevance of the uncertainty component. It reenforces also, so it would appear, the importance of lowering the information burden imposed on agents. A strategy of constant monetary growth would create certainty in one realm of pertinent information influencing the agents' price-setting behavior. Lastly, the portion of volatile shifts in the distribution of the δ (i,t) affecting δ generated by shifting perceptions of the stance assumed by discretionary policies could be effectively removed. The net effect essentially involves an increase in the information level with a corresponding improvement in the inferential patterns. The consequence is a lower contribution of the uncertainty component to the output variance.

IV. Aspects of Political Economy and Institutional Policy

The prevalence of diffuse uncertainty determines an important strand in the case on behalf of a strategy anchored with a constant monetary growth (i.e., CMGS). An examination of the array of arguments advanced in justification of discretionary and potentially activist policies reveals however a second strand. It involves in particular a specific view of the political economy of political institutions. But attention to this second strand does not yet complete my arguments. There remains the question of controllability and the practical feasibility of controlling monetary growth. This question involves several issues under the general heading of an institutional policy which still requires the readers' attention.

A. Aspects of the Political Economy of CMGS

Advocates of a discretionary policy invoke beyond the required information level possessed by policymaking staffs also a "goodwill" or "public interest theory" of the operation and behavior of political institutions. This means essentially that we can reasonably expect the staffs of policymaking agencies to concentrate their efforts on the rational exploitation of their fully available information for the maximization of some appropriate social welfare function. The personnel of the political institutions, liberated from the social pressure of the market system's compelling attention to self-interested behavior, would know no other incentive but to serve (responsively and responsibly) the public interest.

This section raises some delicate issues. Many professionals are easily disposed to attribute *any* position or view bearing on socio-political issues to an ideological commitment. Others seem ever ready to impugn ideas deviating from their views as an expression of "narrow and ideological" positions. This pattern of "media fallacies" is however singularly shallow. Our approach to the evaluation of a political institution is conditioned by two alternative hypotheses about man and his basic behavior: the sociological model of man and the model of a resourcefully evaluating maximizing man introduced by the Scottish moral philosopher of the 18th century into the social sciences [Brunner-Meckling, 1977]. The two alternative conceptions involve radically different and ultimately assessable assertions about our world. The "public interest theory" permeating much of the interventionist literature appears essentially as a special case of the sociological model of man. I contend that the alternative hypothesis offers as a matter of empirical fact a more relevant explanation of man's behavior in the context of both market *and* political institutions. The difference between the two conceptions sharpens the conflict surrounding the choice of strategy resulting from the analysis of prevailing information levels.

A systematic application of economic analysis to the realm of political institutions reveals a basic ambivalence of political structure. The emergence of political structure is a necessary condition for a civilized society. The social productivity of political structure which removes a particular form of negative sum game of social interaction is well understood. But the institutions constituting a political structure also create new opportunities for different forms of more or less regulated negative sum games. Every political institution can be characterized by the opportunities offered for new areas of self-interested exploitation. These opportunities will condition the behavior of the staff operating the political agency and also the behavior of agents in the market place with potential exposure to the institution. The correlation between motivating intentions and actual performance becomes quite haphazard under the circumstances. The staff, following the basic pattern of human behavior, will explore opportunities for self-interested self-expression over a wide range of forms and actions. The staff's supply behavior is encouraged by the prospect of potential transactions with a demand emerging from "outside" groups of agents exploring the potential opportunities associated with the political institution [Kane, 1980]. A choice of activist strategies is therefore not translated into a well-established and generally understood pattern described by optimal control procedures or optimal techniques of information extraction. Some special study groups tolerated by the organization at a safe distance from the policymaking centers may be committed to such exercises. The incentive structure of the organization conditioning the staffs' behavior, reenforced by the pervasive state of diffuse uncertainty implicitly acknowledged in the discussions and procedures characterizing the interaction between staff and policymakers, converts activist dispositions into the reality of "discretionary policies." Such policies produce, almost without exception, substantial uncertainty about the course actually pursued by the monetary authorities. This uncertainty is well expressed with the secret maintained by the authorities over many years about their decisionmaking. It is also expressed by the Fed's disregard of Congressional recommendations and resolutions, and the large number of people gainfully employed to watch and interpret the Fed. Activism thus means in the institutional context of our world a regime lowering the agents' information level and thus burdening economic operators with a larger inference problem in their decisionmaking. The political economy of a political institution exemplified by a central bank thus tends to raise the policy variation PV beyond the minimum level achievable under a social optimum in each column. The same circumstances also raise the uncertainty component.

We should also note an interesting connection with the information problem discussed in previous sections. The policymakers' and their staffs' "entrepreneurial behavior," expressed in "discretionary explorations," would be severely limited under full symmetric information about the structure. The full information would foster feedbacks from groups of agents constraining such explorations. This feedback would operate against the survival of patterns producing large and persistent surprises. This political feedback mechanism would be suspended however in a system contrasting a public sector monopoly of full information with a passively ignorant private sector. These circumstances would allow the authorities to trade off performance degrees of achievable stabilization for important arguments in their utility functions. Policymaking enters under the circumstances the realm of relevant agency problems. The analysis of such problems informs us that agents' behavior will diverge from the principals' interests as a function of the principals' information and monitoring costs [Jensen-Meckling, 1976]. "Discretion" thus enters the traditional formulation of policy analysis. This situation means that optimization exercises are descriptively irrelevant even in the most favorable context of full information monopolistically enjoyed by the authorities. They will not be used, the private sector in its ignorance cannot use them to compute its social loss, and the authorities will hardly be interested to know this loss. The discretionary element is further strengthened under the symmetric case of diffuse uncertainty dominating the world we live in [Brunner, 1975]. This information level offers policymakers and staff ample opportunities to feel that "discretionary procedures" are really in the public interest.

A strategy of constant monetary growth is well designed to break this pattern conditioned by the incentive structure and opportunities characterizing a political agency. But we cannot expect in general that this strategy will spontaneously emerge from within a central bank. Exceptions occur, and I refer in particular to the Swiss National Bank. These exceptions offer actually useful information about the general aspects of the political economy discussed above. But the spontaneous emergence usually involves special features of a temporary management. Without a firm institutionalization of a constant monetary growth rule central banks will eventually persist with a "discretionary policy." The commitment involved by the neutral strategy must be imposed by explicit legislative action supplemented with appropriate conditions or dismissals from office (for policymakers and staff) for repeated nonperformance.

The commitment would have to contain two important strands. One strand addresses the accepted inflationary trend and the other specifies rules for revising the level of constant monetary growth imposed on the central bank. The first strand is required in order to anchor the level of constant monetary growth. In the 1920s economists discussed in some detail the "best" choice among alternative paths of price and wage levels. Milton Friedman renewed the discussion with his analysis of the optimal money stock [1969]. This theoretical argument seems however hardly relevant under diffuse uncertainty in a world with a complex array of distortionary taxes. The "pragmatic proposal" made by Milton Friedman seems more relevant for our purposes, viz., that monetary policy should maintain over time a stable price level. This choice minimizes in my judgment the "invitations to accommodate" associated with policies anchored by the inherited inflation. The estimate of the noninflationary level of monetary growth involves furthermore estimations of the trend in velocity and the pattern exhibited by normal output. This task is not insoluble and is actually less demanding than the large scale econometric modeling executed in the past. Undoubtedly the procedure involves errors in setting the benchmark for monetary growth. These errors are however small compared to the magnitude of the problem confronting us over the past 15 years.

Still, the occurrence of such errors directs our attention to the importance of the second strand. This attention is reenforced by the possible changes in underlying conditions shaping the trend in velocity and of normal output. The monetary rule must allow some flexibility to recognize changes in relevant circumstances. We note in this context an obligation of the central bank under this procedure to invest the staff work necessary for an intermittent assessment and monitoring of the relevant course in velocity and normal output. The flexibility needed for adjustments in the benchmark level of monetary growth must be severely constrained however and the procedures need be subjected to public examination. The rules of revision should prevent frequent and arbitrary changes and impose a heavy burden of evidence on policymakers in order to lower the likelihood of accommodation to transitory events. Stanley Fischer [1980] argued recently that monetary policy should proceed with a constant monetary growth in the face of "minor disturbances" but accommodate or respond to large actual or potential disturbances. This proposal could essentially coincide with the proposal advanced above, once it is supplemented with a "revision rule" assuring a cautious filtering of information in order to extract reliably the innovations permanently built into the economic evolution. Fischer's proposal, as it stands, without clarification of the nature of actual disturbances and the open-ended reference to potential disturbances, would impose no serious constraints on the discretionary explorations and accommodations by an established bureaucracy. Fischer buttresses his case with the argument that the Federal Reserve authorities have probably learned their lesson by now so that their tragic mistake during the Great Depression would not be repeated. But our recent experience suggests not so much a learning as a reversal in the kind of failure. The failures of the 30s and the failure of the 70s spring ultimately from the same source: the Federal Reserve's conception revealed by their interpretations and the procedures used to implement discretionary policy [Brunner-Meltzer, 1964].

B. Institutional Aspects of Monetary Control

The most compelling case for a CMG policy based on diffuse uncertainty and aspects of the political economy of political institutions does not establish its feasibility. There still remains the question bearing on the controllability of monetary growth. This question addresses essentially two requirements almost systematically neglected by central banks. Monetary control and the degree of controllability (or uncontrollability) does not emerge from "autonomous or inherent social patterns." The achievable degree of controllability, expressed by the variance of the distribution of monetary growth conditioned on variables directly controllable by the central banks, is substantially influenced by the institutional arrangements governing the monetary system and the internal implementation procedures applied by monetary authorities. The controllability issue thus involves ramifications which can be subsumed under an institutional policy combined with suitable implementation procedures.

1. The Control Problem: The Requirement of Institutional Policy

The potential significance of an institutional policy and the need for monetary authorities to direct active attention to this issue can already be recognized in the essentially hostile landscape of rational expectations analysis. Sargent-Wallace demonstrated the irrelevance thesis for deterministic feedback rules. The distribution of output was clearly independent of any monetary strategy under the circumstances. But strategies strictly confined to purely deterministic patterns hardly form the stuff of our reality. Even the best laid and explicit strategy beyond the range of "discretionary policies" will suffer a stochastic margin of unpredictable deviations. It follows under the circumstances that the distribution of output is influenced by the stochastic component of the money supply process with the irrelevance thesis confined to the systematic component of this process. The stochastic element of the money supply process impounded into the distribution of output results from two distinct sources. One source involves the relative indefiniteness of discretionary policymaking conditioned by the quality of the implementation procedure. The other source pertains to the pattern of prevailing institutions affecting the supply of liabilities and the acquisition and holding of various assets by financial intermediaries. We recognize thus that even in the world of rational expectations, formed in the context of full symmetric information, monetary policymakers can substantially influence the distribution of real variables by means of an institutional policy. Thus an opportunity emerges to lower the conditional variance of monetary growth and correspondingly lower the variance of output by appropriate institutional structuring. It would appear that the problem is actually more serious in our world of diffuse uncertainty with the pervasive inference problem imposed on agents. An institutional restructuring effectively lowering the conditional variance of monetary growth improves the information content of the social signaling system, lowers the likelihood of eventually falsified interpretations and inferences made about the course of monetary affairs.

The problem may be usefully organized by partitioning monetary growth into the multiplier component $\Delta \mu$ and the monetary base component Δb:

$$\Delta m = \Delta\mu + \Delta b$$

The variance of Δm and the first term in the uncertainty component appear now in the form

$$\sigma^2(\Delta m|s,\pi) = \sigma^2(\Delta\mu|s,\pi) + \sigma^2(\Delta b|s,\pi) + 2\rho_{\mu b}(s,\pi)\sigma(\Delta\mu|s,\pi)\cdot\sigma(\Delta b|s,\pi)$$

and

$$E^*[E\Delta m - E^*\Delta m]^2 = E^*[E\Delta\mu - E^*\Delta\mu]^2 + E^*[E\Delta b - E^*\Delta b]^2 + \text{covariance term}$$

In the context of our formulation institutional policy means that the system should be confined to a particular subclass of all possible states which satisfy the requirement of the institutional policy. A well-chosen arrangement lowers the variances of both $\Delta \mu$ and Δb and also compresses the first term of the uncertainty component. A neutral strategy thus imposes on the central bank an obligation to examine thoroughly the changes required in order to minimize the two expressions above.

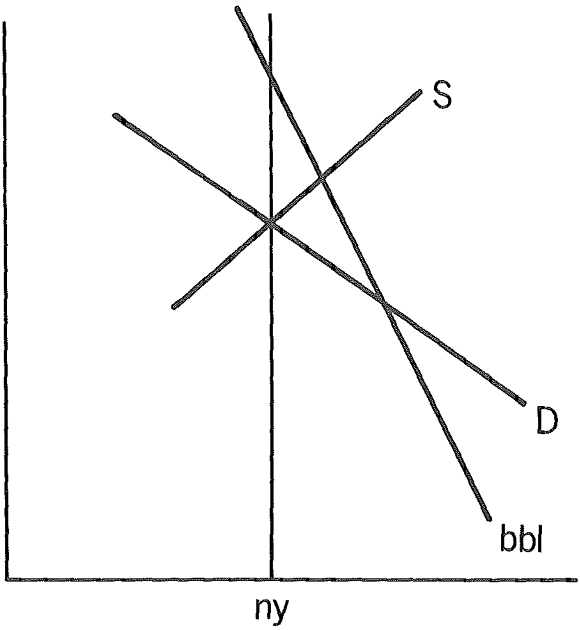
The partition of the variances into the multiplier and the base component indicates two directions for the required institutional policy. One direction addresses the customs and procedures of the central bank bearing on the supply of base money. These supply conditions are completely determined by the conditions governing the accrual of assets and nonmonetary liabilities to the central banks' balance sheet. Among these asset accrual conditions may be noted the structuring of float, the practices of the discount window or the range of "eligible assets" and their respective acquisition conditions. Most of the central banks I have observed could, by suitable modifications, lower the variance $\sigma^2(\Delta b|s,\pi)$. This applies in particular to the Bank of England, Bundesbank, the French and Belgian National Banks. The operation of the central bank also affects the variance of the multiplier. This effect is clearly demonstrated by the experiences in the United States during the 1930s. Part of the most glaring variability of the multiplier observed over the decades was mostly due to unexpected variations in the currency ratio. These movements were moreover mostly due to some policy failure of one kind or another (1930–33 and Carter's credit control measures of March 1980). Apart from such policy failures our problem centers the choice of a subclass of possible states by an adroit institutional policy applied to the structuring of financial intermediaries. The variance of the multiplier with the corresponding term in the uncertainty component usually involves structural aspects of the financial system. It would appear that neither the supply conditions of liabilities nor the arrangements governing reserve holding or reserve adjustments prevailing in many countries are well designed for the execution of an CMG policy. Central banks possess ample resources for an effective examination of this problem and thus can obtain reliable guidance for proper action in the range of institutional policy. It is remarkable to note however that this issue was systematically neglected by the monetary authorities. Unfortunately, the professional literature also neglected this issue until the most recent years [Gehrig, 1980]. The neglect of an institutional policy adjusted to the interests of monetary control forms actually a natural product of the political economy of policymaking. Institutional policy usually proceeded without any attention to *monetary* policy, or the controllability of monetary growth, essentially as an instrument of wealth redistribution. It follows under the circumstances that *existing* arrangements are at the very best randomly adjusted to the purposes of monetary control.

Two objections to a policy of monetary control need be considered here. Christ [1979] and McCallum [1980] explored the dynamic stability of the stock adjustment process in the case of dominant bond financing of government deficits. It appears to follow that a CMG rule which shifts the burden of financing budget deficits to bond issues would inject an unstable pattern into the system. Several aspects need attention in this respect. We note first that this stability (or instability) issue is logically separate and independent from the "internal stability of the system" expressed by a natural rate hypothesis and reflected by the system's movement relative to normal output. Secondly, the potential (or actual) instability of the system's adjustment of financial stocks offers really, upon further consideration, no serious problem. It is an analytic nicety derived in an incomplete context without pragmatic significance for monetary control policy. All the available pieces of analysis agree that the response of the aggregate demand line in the price output plane to an increase in outstanding government debt is of small order of significance compared to the shift produced by a monetary action. An unstable pattern of the debt adjustment process revealed by possible divergence of the state point from the balanced budget locus [Brunner, 1976] essentially produces a negative contribution to the velocity trend. But a 1 percentage point contribution to this trend requires, on the basis of some broad estimates made on previous occasions, a massive deficit never observed in peace time (so far) in this country. Whatever the negative contribution to trend may be however, the benchmark level of monetary growth can be correspondingly adjusted. Moreover, even a moderately rising normal output with a progressive tax schedule offsets the potential instability injected by bond financing.

The problem may be outlined with the aid of a diagram used in our earlier studies bearing on this issue [Brunner-Meltzer, 1976]. Four lines are drawn in the price output plane: the normal output line ny, aggregate demand D, aggregate supply S and the balanced budget line bbl (locus of p–y combinations balancing the budget). The graph shows the state point, determined by D and S, to the left and below the balanced budget line. The prevailing state thus produces a deficit. Stock instability means that the aggregate demand line is pushed by the increasing stock of bonds to the left or rises less than the balanced budget line. A positive normal growth moreover means that the cluster consisting of D, S, and ny moves jointly to the right. This clearly lowers the gap between the state point and the balanced budget line. The required noninflationary benchmark level of monetary growth adds an additional offsetting rightwards push to the aggregate demand line. This offset is moreover geared to a benchmark level reflecting any negative trend in velocity produced by an "unstable" bond financing process. One last point remains to be considered. Suppose one would abandon the CMG rule on grounds of the Christ-McCallum argument. But the alternative to the CMG policy would still be a discretionary policy satisfying under the circumstances shifting accommodation pressures to finance the deficit.

Another objection to a CMG policy invokes the persistent occurrence of measurement errors. Our profession has indeed become sensitive to the measurement errors in monetary aggregates. Financial innovations and the evolving multiplicity of financial assets with shifting substitution relations conditioned over recent years intermittent measurement problems. The "new view" provided in this context a relevant emphasis, fully recognized in previous work however, that an analysis of money supply processes needs to incorporate the play of relative yields on asset markets. A more faddist component of the "new view" merged with a Radcliffian heritage stressing the (almost) impossible task of separating money from nonmoney financial assets. The facts of measurement problems are clear and obvious. It is also clear that many of the monetary authorities substantially neglected this problem. But there is no inherent impossibility of approximately separating all items typically satisfying the characteristics of a "transaction dominating" asset from other asset items held in the public's balance sheet. The public's behavior reveals moreover, quite clearly, that it barely suffers under the great difficulties professed by economists of discriminating between money and nonmoney financial items. In contrast with economists' rhetoric, the public demonstrates a clear recognition of the difference between "money" and "credit." There remains however an ineradicable measurement error. But this error seems modest compared to the current magnitude of the problem to be addressed by monetary control. Countries with a potentially larger mea-

Figure 3



surement problem, as for instance Switzerland, found it quite possible to obtain measures offering an adequate basis for the execution of monetary control at a low inflationary level. The contribution of any virtuous cycles to the anti-inflationary course was essentially induced by the determined adherence (with the exception of five months in the winter 1978/79) to a monetary control policy. Lastly, the financial innovations experienced in the United States evolved to a large extent in response to public and particularly to monetary policies. The joint occurrence of accelerating inflation and various prohibitions on liability supplies by financial intermediaries encouraged a search both by suppliers and demanders for new forms of transaction-dominating assets or for substitutes involving modest transaction costs. Removal of these conditions via suitable institutional policies and a monetary control policy with CMG would probably lower the rate of financial innovation to a gradual pace contributing to the basic trend in velocity. These aspects were well covered by Stanley Fischer [1980] and they reenforce the need for a rule, governing revisions in the benchmark level of monetary growth. Lastly, with measurement errors of the money stock most likely independent of errors in measures of output or the price level, the error is impounded into a corresponding error for velocity with the opposite sign. With a dominantly white noise character over shorter periods the error poses no serious threat. A maintained error basically requires a corresponding adjustment of monetary growth to the observed velocity trend reflecting this error. Somewhat more difficult are errors with uncertain and moderate persistence structure. Still, such persistence would be impounded in the patterns of observed velocity and thus influence the proper choice of benchmark level. The measurement problem needs to be seriously explored and a policy of monetary control would invest more systematic intelligence and effort than observed in the past to some regular monitoring of the measurements. But there is little ground for asserting that the measurement problem precludes monetary control. What would be the alternative? Either discretionary policy protected by ignorance of the relevant facts or an interest rate policy. The consequences of the first choice are sufficiently known. The second choice depends heavily on a narrow subclass of all possible states exhibiting dominant money market disturbances supplemented with a total disregard of the controllability issue discussed in earlier paragraphs. In either of the two alternatives to a policy of monetary control we risk the potential dangers of erratically permanent inflation and the potential threat of destabilizing monetary regimes.

2. The Control Problem: The Requirement of Suitable Implementation

The tactics associated with the strategy of a constant monetary growth have been characterized as a two-stage procedure [Ben Friedman, 1977]. This description means that policy does not work "backwards" directly from the ultimate goal variables (output, unemployment, employment, possibly inflation) to the required setting of the policy instrument. This one-stage procedure typically characterizes the standard policy analyses. Tobin formulated this position as follows: "There is really no substitute for making policy backwards, from the desired feasible paths of the objective variables that really matter to the mixture of policy instruments that can bring them about. . . . The procedure requires a model — there is no getting away from that. Models are highly imperfect, but they are indispensable. The model used for policymaking need not be any of the well-known forecasting models. It should represent the policymakers' beliefs about the way the world works and it should be explicit. Any policymaker or advisor who thinks he is not using a model is kidding both himself and us. He would be well advised to make explicit both his objectives for the economy and the model that expresses his view of the links of the economic variables of ultimate social concern to his policy instruments" [Tobin, 1977, p. 763].

The two-stage procedure differs in several important aspects from the policymaking process recommended by Tobin. First, it interposes an "intermediate target" between the policy instruments of the central bank and the "ultimate goals with social significance." The policymakers are instructed to adjust their "gears and levers" in order to maintain monetary growth within a tolerance centered around the target path. The argument in prior sections should have made clear that using monetary growth as an intermediate target does not follow from any particular "social value" assigned to money. It is considered the best strategy ensuring a tolerable performance of the monetary authorities in the context of our political realities and in the face of a diffuse uncertainty. Secondly, the determination of the benchmark level of monetary growth does not aim at an inherently impossible task, viz., to produce even approximately a specific time path of the ultimate goal variables. It is aimed at a stable price level (in the average over a sufficient horizon) and is adjusted to the *average* behavior of velocity and normal output. The two-stage tactic appears thus as a part of the necessary implementation of our neutral strategy. It follows thus directly from the information and political conditions governing the choice of strategy. The crucial difference with Tobin lies precisely in these conditions. They do not involve social values. Tobin's argument would be quite valid and empirically relevant if we possessed reliable and detailed knowledge of the structure and if we could accept the goodwill theory of political agencies as an empirically relevant description of political institutions. It presents the standard case for "rational activism." The tactical procedure of two-staging would indeed be inefficient as demonstrated so lucidly by Ben Friedman. Contrary to Tobin, it would offer a substitute, but a poor one indeed, to the procedure exemplified for our purposes by the information extraction approach. But Tobin's description does not relevantly bear on our world. He offers no evidence that we possess the required knowledge. The reference to *some* (any?) model required for the policymaking procedure remains programmatically empty. Or should we seriously commit ourselves to whatever specific beliefs about the economy policymakers, their staffs, and academic advisors would hold at any particular time? There is substantial evidence that the optimal control settings are not robust with respect to variations over a spectrum of models. This result holds even if we remain within a class of models cast in a Keynesian mold. Tobin's argument could be seriously discussed once we were shown that the wide variations in conjectures bearing on detailed structural properties exert a comparatively small influence on the consequences of activist policymaking. But all the information we possess at this stage would reject this claim. And can we really expect a political agency committed to prior beliefs of dubious cognitive status to examine critically, beyond the details of specific formulations, its basic preconceptions? The history of the Federal Reserve System, or of the Bank of England, or of other central banks, offers ample evidence rejecting such expectations. Under the circumstances actually prevailing in our life the two-stage tactic has been presented as the most efficient solution. It is useless to judge it in a context which violates the prevailing conditions surrounding actual policymaking.

Tobin's recommendation has never been accepted by the Federal Reserve authorities. They proceeded over the years with one form or another of a two-stage tactic. We need not describe at this stage in any detail the complex procedure developed by the Federal Open Market Committee. A recent study by Lombra-Moran surveyed the material in some depth [1980]. Two strands of the Federal Reserve's policymaking require our attention however: the relevant conceptions governing evaluations and decisions and the implementation procedures applied. The staff's conception has been well described by Lombra-Moran as a traditional Keynesian view centered on the multiplier mechanism and the Phillips curve, with long lags for monetary effects and shorter lags for fiscal policy, and with inflation dominated by the movement of unit labor costs "remotely related" to monetary policy or monetary evolutions. It is thus basically a conception which easily justifies a wide range of accommodating patterns for monetary policymaking. It easily justifies in particular that monetary policy should accommodate any inherited rate of inflation. Such a policy would avoid, according to the ruling conception, the high social cost of disinflation with little danger of accelerating inflation. It is moreover a conception encouraging an activist disposition in policymaking. It naturally invites recommendations of income policies in any attempt to curb inflation.[1]

The staff's conception should not necessarily be attributed to the policymakers. At this date it is difficult to judge the views of the world, or at least of their assigned corner of the world, held by members of the FOMC. This was not always the case. The works published by Riefles and Burgess in the 1920s conveyed a clear sense of the theory used by the Fed's top managers in order to interpret their world. One may conjecture however that the Keynesian vision supplied by the staff provides a "gravitational center" with substantial variations on the basic theme occurring between a shifting membership and also over time for specific members.

In the context of the Fed's tradition the basic theme influences the general nature of the procedure. The detail changed over the decades and particularly over the past 15 years with the pressures brought on the FOMC to become more attentive to the evolution of monetary aggregates. Congressional resolutions and legislation compelled the Fed over the past five years to formulate "longer run" target paths for monetary growth covering four quarters. We note that Lombra-Moran find this horizon unconvincing in the context of the staff's view of the (exogenously imposed?) length of lags controlling monetary impulses. But the continuous execution of policy requires a short-run procedure. This is centered on the demand for money as visualized and formulated in a specific way by the staff. This money demand specifies the dependence of money stock on the federal funds rate and national income. The latter magnitude is essentially predetermined for short-run implementation by the longer run projections prepared by the staff. With income fixed in this manner the money demand function yields a relation between money stock and the federal funds rate. Shorter run targets for monetary growth serve to link the ongoing process with the four-quarter target horizon. Implementation of the near-term targets is based on the relation between money and the federal funds rate prepared by the staff for the meetings of the FOMC. The staff's central relation associates with any given target path of the money stock a specific level of the federal funds rate. Once

[1] This aspect was emphasized by Robert Weintraub during the discussion at the Conference.

the FOMC decides on the target path there emerges thus an appropriate federal fund rate guiding the account manager's actions over the near future. It is noteworthy at this point that the FOMC frequently modifies the staff's best estimate of the crucial relation between the money stock and the federal funds rate. Lombra-Moran observed that "in 20 out of 37 meetings the FOMC either lowered the staff's projected federal funds rate for a given money stock, or lowered the targeted money stock growth for a given federal funds rate, or lowered both the staff funds rate and money stock projection" [pp. 44/45, 1980]. The authors note, moreover that "the motivation of the FOMC seems clear. First, the modifications helped to secure a clear conscience; and secondly, they desired to control the money stock, but without generating large interest rate fluctuations. What is not clear is the FOMC's rationalization for deviating from the staff's projections" [p. 45, 1980]. The FOMC shows thus substantial unwillingness to rely on a specific model. It exhibited on the contrary a remarkable disposition to impose frequent modifications evolving from a convergence of subjective judgments. This convergence starts moreover from the model's product already containing more or less extensive judgmental manipulation by the staff. One wonders under the circumstances about the nature of the convergence and the extent it is really dominated by immediate political conveniences or the particular incentives confronting individual members operating in this organizational context.

One wonders of course most particularly about the quality of the performance observed under this procedure. Lombra-Moran find the quality of "nonfinancial forecasting" quite respectable and difficult to fault in comparison with alternative forecasting performances. In a similar vein Brunner-Meltzer found in their study of Federal Reserve policymaking prepared for a Congressional Committee [1964] that the FOMC's record in recognizing turning points of the business cycle was difficult to improve upon. But there remains the fact, particularly over the last five years under the acknowledged obligation to control monetary growth, that this magnitude moved unreliably beyond an acceptable target band. The findings of Lombra-Moran and a preliminary investigation made by Karnowsky leads us to conclude that the low quality of monetary control cannot be attributed to the forecasting record bearing on nonfinancial variables. It emerges as an inevitable consequence of the demand-oriented implementation of a presumed policy of monetary control. This procedure relies on an essentially unreliable relation involving a variety of loose ends governed by stochastic processes difficult to perceive adequately. The incorporation of an interest rate structure into a "Poolean" analysis in a previous section reveals the problem. The disturbances operating on money demand are augmented by the variance V(z) of the term structure element in the relation connecting a short rate with the federal funds rate. This augmentation of the variance beyond the genuine money demand disturbances lowers the quality of the estimated function used by the staff for its monetary control purposes. The procedure contributes in this manner to its unreliable performance as an instrument of monetary control.

As matters stand, the Fed's procedures allow in the light of the observed performance two radically distinct interpretations. One is suggested by the Fed's perennial disposition to attribute persistent or any uncomfortable deviations from the targeted path to shifts in money demand. This excuse is a natural consequence of the demand-oriented procedure in the context of the ruling paradigm and offers, in addition, substantial political advantages to the policymakers or, most particularly, to their staff. It also offers an opportunity to argue, along the lines suggested by a "Poolean" analysis, that the "demand-determined errors in monetary growth" are innocuous and actually represent a stabilizing response by the Federal Reserve authorities. But this argument really implies that the FOMC's implementation produces a demand-determined money stock. The target path would be satisfied just in case the vagaries of the public's money demand produced, purely by chance, such a result. This interpretation implies of course that the FOMC has really no meaningful monetary target. They are a rhetorical device to cope with the outside pressures confronting the Fed without any real significance however. Another interpretation suggests that the Fed more or less sincerely attempts to cope with a targeted path for monetary growth. The tactical implementation of this new strategy is however conditioned by an undigested tradition of interest rate targeting and a conception still dominated by a Keynesian vision of the relevant processes.[2]

This implementation, probably well adjusted to a wide class of more or less accommodative or activist strategies, is poorly designed for the execution of a monetary control policy. The Federal Reserve's tactical procedure actually combines in a crucial way diverse strands which tend to produce an essentially unreliable performance surrounded with persistent uncertainty. It relies on a very specific relation provided by a money demand function, with little justification that this particular money demand, or any particular money demand so far specified, can bear the heavy burden imposed on it by the requirements of policymaking. The vested interests of the staff have been clearly visible in their attitudes pertaining to this critical ingredient of existing policymaking. The significant injection of judgmental operations on the staff and the FOMC level involve on the other hand an implicit admission of the actually prevailing state of diffuse uncertainty. Lombra-Moran commented in their examination of Federal Reserve procedures on the FOMC's unwillingness to commit themselves to the discipline Tobin wishes to impose on them. Their attitudes reveal that they recognize, at least more or less implicitly, the nature of our diffuse uncertainty. But they fail unfortunately to cope with this uncertainty and to draw the logical conclusion from this fact. The result is an execution of occasionally adequate actions perennially threatening us with the swamp of an unreliable and unpredictable "discretion" in the context of a strategy producing a potential destabilization with a built-in inflationary bias.

[2] Denis Karnowsky stressed these alternative interpretations at the occasion of a discussion of these issues in Rome.

Monetary control requires thus beyond an institutional policy also a well formulated tactical procedure adjusted for purposes of efficient execution of the neutral strategy. A tactical procedure designed for this purpose has been proposed for many years by the Shadow Open Market Committee. Over the past three years James Johannes and Robert Rasche developed in detail some crucial technical aspects of the procedure [1979, 1980]. A very similar procedure has been used over the past years by the Swiss National Bank [Schiltknecht, 1978, 1980]. The results drawn from the Swiss National Bank and the Johannes-Rasche work establish that the proposal outlined is probably superior to the Fed's traditional procedure and also superior to the old procedure modified for the new operation allegedly introduced last winter.

The procedure begins with the determination of the benchmark level of monetary growth discussed above. A second step determines the link between money stock and monetary base. This link is constituted by the monetary multiplier. The staff needs to prepare this groundwork along the lines pioneered by Johannes-Rasche or the Swiss National Bank. The required statistical work traces the profile of the multiplier over the next four quarters. Once equipped with this profile the staff moves to the third step and derives the resulting profile for the monetary base. The portion for the next quarter ahead is singled out as an immediate guide for action. The FOMC instructs at this stage the account manager about the required increase in the monetary base. This increase can be achieved any time with suitable asset acquisitions (or disposals) by the Federal Reserve authorities. The staff at the Federal Reserve Bank of New York would have to prepare weekly estimates for all the source items of the base except the volume of Federal Reserve credit (net of float). They would also report weekly on the previous week's outcome. This information flow will guide the account manager's actions addressed to the required modification of Federal Reserve credit. Lastly, with the accrual of weekly and monthly data the staff should recheck the best estimate of the multiplier profile. The FOMC should refrain however from revising instructions on such a short-run basis..

The technical work required for this tactical procedure is actually less complex than for the procedure actually in existence. It also involves more reliable patterns than used by the demand-oriented technique developed by the Federal Reserve staff. The work assigned moreover to the staff of the Federal Reserve Bank of New York has been routinely carried out for many years. It would simply be redirected for another purpose.

The procedure proposed may quite properly be juxtaposed, as a "supply-oriented" procedure, to the Fed's "demand-oriented" procedure. This juxtaposition should avoid however the analytically untenable associations with "new or old views." Both approaches are based on an equilibrium analysis of the money supply process in the context of an asset market interaction [Brunner, 1971, 1973]. The "demand-oriented" approach remains however confined to a two-asset world with a Keynesian vision about the nature of the transmission mechanism. The "supply-oriented" approach is based in contrast on an asset market interaction involving substitutions between financial and real assets. This implies that targeting errors under the demand-oriented approach are necessarily imputed to disturbances of money demand. The alternative formulation of an equilibrium system would recognize that under an interest targeting procedure of monetary control the control errors reflect disturbances of *all* the relevant asset markets. The two approaches differ in particular in terms of the crucial strand selected for control purposes. The "demand-oriented" approach relies on the structural money demand relation. The "supply-oriented" version uses the multiplier connection in the sense of a solution of the equilibrium system containing however a conception of money demand distinct from the Fed's Keynesian view. The difference determines in my judgment a more reliable tactical procedure substantially less exposed to the danger of very loose and judgmentally arbitrary relations centered on a very narrow view of money demand.

The potential feasibility of the "supply-oriented" approach can be noted, apart from the successful execution of an anti-inflationary policy by the Swiss National Bank, by the results of a recent experiment conducted by Johannes and Rasche. This study compared the approach outlined above involving adjustments in the monetary base directed to produce the desired monetary growth with the newly evolved tactics proposed last winter by the Fed. The Fed's new procedure links in a crucial step the money stock with the banks' volume of nonborrowed reserves. Whatever the role of the federal funds rate and the inherited "demand orientation" may be in this process, the procedure, if actually carried out, would involve some shift in the direction of a "supply-oriented" approach. The crucial question must then be addressed to the comparative qualities of the alternative linkages, one expressed by a base multiplier and the other by a reserve multiplier. A comparison of the two multipliers reveals that they respond very differently to underlying changes. The reserve multiplier is in particular quite sensitive to variations in the currency ratio. A preliminary computation shows moreover that the reserve multiplier is systematically more sensitive to variations in the proximate determinants expressed by an array of allocation parameters than the base multiplier. Tables 1 and 2 summarize the results of the comparison based on the 12 months January 1979 to December 1979. The same statistical procedures were used to obtain one-month and two-month ahead forecasts for the respective multipliers. The computations were carried out for two sets of estimates of the relevant reserve variables, one provided by the Board of Governors and one by the Federal Reserve Bank of St. Louis. Table 1 (for M-1) demonstrates a clear superiority for the monetary base, measured either way, over the reserve control procedure when expressed in terms of both mean error or the root mean square error of the respective multiplier forecast. The pattern is repeated for money stock M-2 in Table 2. The relative differences are actually quite remarkable in both tables. The results also suggest moreover that some attention to the operation of the discount window could improve the controllability of monetary growth at least moderately even in the United States.

Table 1
Comparison of Summary Forecast Error Statistics for BOG and St. Louis Defined Reserve Aggregates

M1								
	Reserve Aggregate							
Statistic	Total Member Reserves		Nonborrowed Member Reserves		Monetary Base		Net Monetary Base	
	One-Month Forecasts							
	BOG	StL	BOG	StL	BOG	StL	BOG	StL
ME	-.0207	-.0059	-.0033	.0067	-.0017	-.0012	-.0003	.0002
RMSE	.0872	.0877	.0988	.0971	.0127	.0131	.0130	.0139
RMSE/$\bar{m}_1$	.0099	.0100	.0109	.0107	.0050	.0051	.0051	.0054
	Two-Month Forecasts							
ME	-.0219	-.0116	.0131	.0091	-.0014	-.0004	.0013	.0019
RMSE	.1251	.1091	.1582	.1473	.0177	.0168	.0203	.0202
RMSE/$\bar{m}_1$	.0142	.0124	.0174	.0162	.0070	.0066	.0079	.0079

ME = mean error, RMSE = root mean squared error, $\bar{m}$ = average money multiplier (actual)

Table 2
Comparison of Summary Forecast Error Statistics for BOG and St. Louis Defined Reserve Aggregates

M2								
Statistic	Total Member Reserves		Nonborrowed Member Reserves		Monetary Base		Net Monetary Base	
	One-Month Forecasts							
	BOG	StL	BOG	StL	BOG	StL	BOG	StL
ME	-.0384	-.0101	.0027	.0298	-.0015	-.0026	.0021	.0040
RMSE	.1977	.1853	.2333	.2292	.0275	.0229	.0293	.0294
RMSE/$\bar{m}_2$	.0092	.0087	.0106	.0104	.0045	.0037	.0047	.0047
	Two-Month Forecasts							
ME	-.0388	-.0134	.0451	.0741	-.0004	.0009	.0064	.0099
RMSE	.2722	.2262	.3530	.3223	.0399	.0342	.0454	.0427
RMSE/$\bar{m}_2$	.0127	.0106	.0160	.0146	.0065	.0055	.0073	.0068

ME = mean error, RMSE = root mean squared error, $\bar{m}$ = average money multiplier (actual)

The proposal developed by the Shadow Open Market Committee may not offer the most appropriate procedure under all circumstances. The initiation of the procedure may be obstructed by inadequate data about the money stock or insufficient staff work available for this purpose. These problems associated with a serious reexamination of the monetary strategy hardly matter in the context of modest changes in the price level accompanied by minor fluctuations in economic activity. They may confront us in a relevant sense however as a result of a massive inflationary heritage. The situation in the United Kingdom offers probably a good example in this respect. But the very magnitude of the problem suggests a solution. The monetary authorities should be advised to concentrate on controlling the monetary base and move its growth path to a noninflationary benchmark level. This control over the monetary base offers no technical problems. It may require some changes in customs and prevailing arrangements. In several cases, most particularly among European central banks, the custom of operating as a "lender of *first* resort" must be abandoned and replaced by a "lender of *last* resort." This change in discount policy provides the technical facility to hold even the weekly magnitude of the monetary base close to the desired path. A persistent and large decline in the growth rate of the monetary base unavoidably lowers, on the *average*, also the growth of any relevant monetary aggregate. These aggregates may shift around in divergent ways and exhibit all sorts of countermovements over shorter periods. None can run away on a persistent course however with the monetary base held along a path of low growth.

The information level required for the execution of such a policy may be compared to the information used by a car driver in order to ensure undamaged survival. Hardly any driver knows the numerical relation between speed and the pressure on the gas pedal. This relation varies between cars and varies over time for any given car. But the driver knows that at any time and for any car an increase in the pressure on the gas pedal raises the speed and a lower pressure reduces the speed. This knowledge supplemented with a corresponding information about the brake suffices for most of us to avoid chaos on the streets. Many other examples with a similar information level, most particularly from medicine, could be adduced for our purpose. But the point should be clear. Whatever the average growth rate of relevant monetary aggregates may be, a persistent retardation in the monetary base will lower their growth. It follows that the average growth rate of any relevant monetary aggregate can be lowered by sufficient deceleration of the monetary base. The experience of the Swiss National Bank demonstrates moreover that with a credible policy of maintaining the monetary base along an announced path the public essentially disregards temporary gyrations in the growth rate of important monetary aggregates. Such variations are viewed by agents in the market place as transitory noise with little significance for the movement of the price level and the exchange rate over time. Lastly, with a control over the monetary base under way and inflation subsiding a central bank should set its staff to work on the preparations required to improve monetary control.

V. Conclusions and Summary

The arguments advanced in support of activist monetary policymaking follow from two crucial assumptions. It is postulated that policymakers possessing *full and reliable knowledge* about the economy's response structure can naturally be expected to exploit this information in the "*public interest*" for purposes of economic stabilization. The first assumption does indeed justify the application of an activist regime. The second assumption assures us moreover that the opportunity guaranteed by the first assumption will be efficiently and reliably exploited. Advocacy of an activist regime is unavoidable once we accept the two fundamental postulates. Both postulates are however blatantly false.

We suffer neither under total ignorance nor do we enjoy full knowledge. Our life moves in a grey zone of partial knowledge and partial ignorance. Most particularly, the products emerging from our professional work reveal a wide range of diffuse uncertainty about the detailed response structure of the economy. This fact persists whatever the subjective feelings of any policymaker or academic may suggest. We may be inclined moreover to disregard the variation in structural patterns obtained over the whole range of our professional work and peddle *our* result as the only relevant product competing (unfortunately) with counterfeit products x. Such attitudes probably express a rational wealth maximizing posture but hardly reflect a rational cognitive commitment. Our existing knowledge thoroughly fails under the circumstances to satisfy the information level required for the successful execution of an activist regime. Inspection of any one of the formulae defining the required monetary regime demonstrates this point. Any activist regime, optimally specified relative to *some* state of affairs, *destabilizes* the economy in the context of *alternative* states. Activist regimes offer a *chance* at stabilizing the economy, but also run a *risk* of destabilization. There is unfortunately no way to remove the risk and realize the chance. The risk and chance combination is moreover not symmetric. The chance is limited and the risk open-ended. A nonactivist regime emerges under the circumstances characterized by a diffuse uncertainty as the safest strategy. It does not assure us that economic fluctuations will be avoided. But it will assure us that monetary policymaking does not impose additional uncertainties on the agents operating on the market place. It assures us moreover that monetary policy does not destabilize an economy in the manner observed during the 1930s or over the past 15 years. A neutral regime will effectively avoid any major deflation and inflation.

Considerations of important aspects of the political economy of nonmarket institutions reenforce the case for a nonactivist regime. An activist regime under diffuse uncertainty suffered by policymakers and the public produces the quagmire of a "discretionary policy." One is quite unlikely to find political agencies operated according to any sense of a "public interest." This assertion is advanced, as the previous assertion bearing on the crucial information level, as an assessable statement about our world. The pervasive information problem confronting the citizen's evaluation of political agencies offers opportunities to trade off the citizen's interests for political and personal advantages enjoyed by the personnel in the agencies. The historical pattern of activism will not be shaped therefore according to the neat and predictable pattern elaborated by an optimal control approach. It emerges in the form of a "discretionary procedure" attuned to political incentives and pressures with shifts, turns, and twists involving erratic movements enlarging the agents' inference problem. The imposition of a nonactivist regime constrains the private exploitation and social misuse of an activist disposition. This regime lowers the political temptation built into the monetary agency.

The choice of a nonactivist strategy rationally requires the selection of well-suited tactical procedures. These procedures bear on institutional arrangements facilitating monetary control and the implementation exercised by a central bank. The latter aspect is probably more important in most countries at this stage. Two procedures are proposed which differ according to the required information level. Both are operational and can be applied if and when the political will exists. Moreover, both require inputs of low information levels compared to the requirements imposed by an activist regime.

It is unfortunately not obvious however why the political will should ever exist. The same analysis based on the political economy of political institutions which reenforced our case on behalf of a nonactivist regime also implies that under most circumstances we should expect a determined opposition by the monetary agencies and their staffs to such regimes. Such opposition can effectively block under a screen of sympathetic rhetoric the execution of a monetary control policy. The consequences of this political failure will be familiar. We will continue to experience permanent and erratic inflation with intermittent episodes of stagflation or international currency crises.

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Discussion

Henry Kaufman*

I think it is very difficult for anyone to follow Karl Brunner and certainly very difficult for me coming from the market place. I have spent quite a bit of time reading Karl's paper, trying to summarize it and trying then to put down on paper what I thought his broad arguments were in favor of a neutral monetary posture. I think Karl supports a nonactivist role for monetary policy expressed, of course, by a constant money growth role. He says that this kind of posture reduces the variance of money velocity and uncertainty of the output that it produces. He also claims that an activist view of policy depends on a rather naive sense of political institutions. This view holds that policymakers and staff people seek to maximize social welfare and not their own self-interest.

Finally Karl says that he feels that a supply approach is more direct over a broad menu of financial assets. Then he gets down to what he really proposes and that is this constant monetary growth. He goes on to suggest that very strict Congressional or legal limits be imposed on certain types of monetary variables and he even goes on to suggest that people in this room be fired or dismissed for nonperformance. Therefore the Federal Reserve's role should be a very passive one, presumably eliminating many of the regional banks, perhaps having just clerks run the central reserve system.

There are a number of problems in this paper. Karl of course focuses on a transaction variable, money narrowly defined, instead of what I would tend to favor and that is a broader measure of credit. The information gap makes it rather difficult to determine the proper growth rate of money in order to achieve stable prices. My problem is to know what money is. It seems to me that we as market participants and practitioners in the field constantly update our definition of money and what we put in to our current definition is a perception not necessarily of current events but at least of something that happened in the past. In the early part of this year, the central bank admitted that its concept of money was incomplete and we went from M-1 and M-2 to M-1A, M-1B and a redefinition of M-2 and M-3 and so on.

I believe that financial innovation accelerates in an environment in which we try to establish targets for money and where the burden of fighting inflation is extraordinarily large on monetary management without assistance from other arms of government. The innovative process in the financial market just intensifies. We therefore, I believe, create more near-money assets. We shorten the liabilities structure, the maturity structure tends to shrink or we create financial assets that remove the risks. For example, it should not be surprising in hindsight to anyone why we have created variable

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interest rate mortgages, why we have a floating prime rate and why we have variable floating rate notes in the domestic and particularly in the international markets. This is a movement towards liabilities or financial assets from which we tend to remove risks as well as move closer to a date of maturity. And therefore we move closer to a concept of credit that is not distinguishable from money. Now this concept has some repercussions because ultimately it changes the financial system and the problems of managing money no matter how we define it. As we move on with this kind of an approach, I believe that the ultimate consequences will be to decrease the role and importance of the open market and increase the role of the commercial banking system. Just a little page out of near history will tend to suggest this. In the last 12 months interest rates have been extraordinarily volatile. Part of this volatility is due to the effort by the central bank to move towards a monetarist approach. The volatility of interest rates, once interest rates were going down, resulted in a rush to issue long bonds and the moment interest rates moved up in the summer months the issuance of long bonds stopped. In turn, the reliquification stopped, and the importance of the commercial banking system as an institution in the credit market increased. This kind of volatility seems to indicate that investors buy bonds not for their traditional purpose to assure a contractual income but basically for their potential of price gain. As a consequence, we modify a bond, reduce its significance, and shift the entire lending arrangement between institution and lender rather than the open market, and thus create more near-money assets, not assets over which risks are perceived.

There are other problems associated with money. One is just in implementing the monetary procedure which some people here are going to talk about. Namely, how do we control a monetary aggregate over a short-time span and seasonally adjust it? In the period ahead, we are going to rely very importantly on monetarism to stabilize our economy because other arms of the government are not working. What do we find? We find we have NOW accounts, ATS transfers, repurchase agreements, money market funds all sitting in the monetary aggregates which we seasonally adjust weekly and monthly and for which we set targets. We seem to do this with an air of certainty but it can't be done because the seasonal adjustment factor is improper and incorrect in the final analysis. Why therefore should we have that great confidence that this procedure over the next 12 months is going to be adequate?

Next, let me indicate my other problem. Even if the monetarist approach were the correct one as it is now stated, it would seem to me that there is one aspect that monetarists do not adequately bring to the fore. That is monetarism alone should never be the full stabilizing arm of policy. In the period ahead or in the recent past we would have had a far different environment if other arms of government had come into the battle against inflation. If you assume that monetarism has to carry the burden from here on, you set a target for monetary growth, you set a target then for GNP growth, you then in turn also have a clear-cut indication of how much real growth we probably will have and most of the underlying force will be inflation. There is an assumption that following this policy we will ultimately wring out the inflationary problem. I believe underlying that however is the likely consequence that we will have stagflation. The will of the people, of consumers, of businessmen, of institutional leaders does not seem strong enough to endure a monetarist squeeze of the inflationary problem. Traditionally, reliance mainly on monetary policy over this period makes it quite obvious, if fiscal policy remains aggressive as it has been, that the role of government will increase and the role of the private sector will decrease. With more concentration within the financial system and within a number of institutions, it is the private sector that will diminish in importance. It is the governmental sector that will remain important because there is no way out under this approach that government will be denied money. It won't. The private sector is the one that will be denied in this approach if large deficits persist.

In dealing with our problems, it is a credit system that should be addressed. It isn't a monetarist system, it isn't the money system. Who distinguishes today between money and credit? The two are just not talked about in that fashion anymore in the real world. It would seem to me that monetary policy at some point in time has to focus on the instability of the credit system. It is very understandable why the credit system is volatile and so responsive to changes. We live in a free market society. There is no reason to assume that monetarism or a credit system can be highly stable. I don't think it can be. But I do think we have to focus beyond M-1A and M-1B. We have to think about managing credit. This is where the innovative edge is of the private market, and this is where the influence has to be from the Central Bank — on the credit system and not on the monetary aggregates per se.

Discussion

James Tobin*

Clearly I was not asked to discuss Karl Brunner's paper in anticipation that I would agree with it. That would not have been a rational expectation. Because I do intend to fill my assigned role, I should like to preface my critical remarks by acknowledging the debt that all of us in monetary theory and macroeconomics owe Karl Brunner, both for his own contributions to our knowledge and for his leadership in promoting and publishing research and policy debate on both sides of the Atlantic. No one has been more intensely and continuously dedicated to the advancement of the field. The powerful and formidable paper before us today is characteristic of Karl's work in several respects. He tackles fundamental and important issues, knows the relevant literature thoroughly, seeks conclusions of ambitious generality, and pursues the logic of his argument fearlessly and rigorously.

Although Karl and I frequently disagree in policy conclusions, we agree in many features of our theoretical models of asset stocks and flows, monetary and nonmonetary. Ben Friedman (1978) has pointed out, accurately I believe, the qualitative similarities of Brunner-Meltzer and Tobin or Tobin-Brainard models. I have never understood how Brunner and Meltzer could derive monetarist conclusions about monetary and fiscal policies from multi-asset models. But that is not our topic today.

The central thesis of the paper is that monetary policy should generate a steady path of money supply, paying no attention to the current state, recent history, or projected future of the economy. In the course of my comments I shall express my doubts that this proposition can be proved or disproved deductively. I know also the difficulties of resolving the issue by appealing to empirical evidence, ambiguous as it is bound to be.

Nevertheless, in an effort to place some burden of proof on Karl and other advocates of nonreactive policy, I begin by calling attention to a striking chart I have borrowed from Martin Baily (1978, p. 14). It shows that the year-to-year volatility of changes in real GNP was smaller and average growth greater after 1946 than before the second world war. Moreover, performance by these two counts was much better in the 1960s than in the 1950s and 1970s. (The chart ends in 1976, but adding more recent years would only reinforce its telling point.) It is generally agreed that compensatory countercyclical macroeconomic policy, based on information "fed back" from the economy to policy-makers, was more important after 1946 than in earlier peacetime periods. It is generally perceived that, for better or worse, reactive policy was especially important in the 1960s.

In 1970, responding to years of monetarist criticism and to the demands

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of Congressional committees influenced by monetarist staff, the Federal Reserve began expressing its policies in terms of targets for monetary aggregates. This shift in policy did not usher in an era of greater stability of either output or prices. Neither did similar swings to monetarism in other countries. The coaches make the usual excuse: the players on the field, the central bankers, did not follow the game plan. (President Johnson didn't follow the game plan of his Keynesian coaches in 1966 either, but this has not saved the "New Economics" from blame for the Vietnam war inflation.) The monetarists argued that the use of the federal funds rate as a week-to-week control instrument undermined the Fed's control of monetary aggregates.

A year ago the Fed surrendered to this criticism, but that monetarist victory too has turned sour. The new procedures, focused on reserve supplies and allowing wide swings in interest rates, have not stabilized monetary aggregates or more important and remote macroeconomic variables. Karl says there is a procedure that will do better, but to me it doesn't look enough different from what the Fed is doing now. The endemic problem, extensively documented in papers for this Conference, is that the money-supply-multiplier is very volatile in the short run. Quarter-to-quarter rates of change of Ms are almost wholly uncorrelated with quarter-to-quarter rates of change of reserves or base money.

The next line of defense is, as Karl has proposed in this paper, to make the world over, imposing a design that gives monetarist propositions a better chance to work. The recipe includes abolition of interest rate ceilings even on demand deposits, making reserve requirements uniform and contemporaneous, relaxation of regulatory constraints on asset portfolios of banks and other intermediaries, floating the Federal Reserve discount rate, and other reforms in the same free market spirit.

In my opinion, the design does not go far enough to make the world safe for monetarism. I think Henry Simons understood better than his modern quantity theory descendants what would be required: 100 percent reserves on demand deposits, none on other liabilities, no government debt instruments shorter than consols, no central bank lending. To those items I would add: no government insurance of any liabilities other than 100 percent reserve deposits. Simons' idea is to create as wide a gulf as possible between "money" and everything else, letting free markets and *caveat emptor* reign in all nonmonetary financial markets and intermediaries. I strongly doubt that stability of 100 percent money in a Simons world would mean *economic* stability, but anyway "*the* money supply" could be stabilized and then we could see. To avoid misunderstanding, I stress that *I* am not advocating reconstruction of financial institutions and markets along these lines, only suggesting to monetarists what they should advocate.

Karl Brunner offers us a meta-theory in support of his recommendation that economic policy-makers eschew feedbacks from the economy affected by their policies. As I understand it, his argument is that a "nonactivist" policy is the choice that minimizes maximum loss. We don't know which of many, many possible structures characterizes our economy. For any activist policy rule, there is at least one possible structure in which the policy spells disaster; but there is no structure in which "doing nothing" spells disaster. He says, "every activist strategy runs the risk of a destabilizing performance." I think that is true, but I don't see why it is not also true of every nonactivist strategy. I just do not follow the argument, and in any case I don't see how an issue of this kind can be resolved by *a priori* reasoning or with such great generality. Surely an agnostic list of possible structures and states of the world must include some in which markets and expectations, unassisted and unfettered, are unstable.

The definition of "doing nothing" is in any practical situation intrinsically arbitrary and slippery. Let me give you an example. As we all know, the Federal Reserve has suffered much blame for the Great Depression because M-1 and M-2 fell from 1929 to 1933. If stability of policy, "doing nothing," is defined by those aggregates, the Fed appears to have caused and prolonged the Depression by active deflationary policy (though quite the opposite of an active countercyclical feedback rule!). But by other measures it is not true that the Fed did nothing. The monetary base rose in every year (2.1 percent, 8.6 percent, 3.8 percent, 3.4 percent), and the supply of bank reserves, though it fell slightly in 1931, was the same at the end of 1932 as at the end of 1929. (Friedman and Schwartz, 1963, pp. 739–740). Only by a definition of policy in terms of monetary aggregates that reflect a large component of endogenous feedback from the economy can it be said that the Fed followed an activist policy of deflation.

Karl Brunner describes the formidable information requirements of using feedback rules to set monetary instruments for economic stabilization. But the quantities of transactions money he wishes to stabilize — and not to vary in response to observations or projections of the state of the economy — are endogenous variables, many steps removed from the instruments the central bank controls directly and precisely. Controlling endogenous Ms, given their connections to economy-wide developments, imposes qualitatively the same informational requirements on the Fed as more ambitious macroeconomic objectives. The other papers at this Conference tell us that the informational requirements are quantitatively formidable too. Karl has rightly reminded us that demands for monetary aggregates depend on opportunity costs relative to a host of alternative assets, from Treasury bills to consumers' durable goods. (Incidentally, I of course agree with the reminder, a correction to mindless application of simple two-asset textbook models. What I never understand is why monetarists regard this point as supporting their policy conclusions.) This means that money demand is hopelessly enmeshed with the whole economic process, so that the aggregates cannot be controlled without information that far transcends financial institutions and markets. Why can't Karl's own arguments be used to argue that attempting to control Ms with subscripts bigger than zero will more likely destabilize than stabilize, and to conclude that consequently the minimax strategy is simply to fix the amount or the growth rate of base money, or even better, of the Fed's portfolio, not seasonally adjusted? Some language in Karl's paper, and certainly recent statements of the Shadow Open Market Committee, go in this direction. But then, as my Great Depression story illustrates, the economy can slip away from the policy-makers.

What is Karl's bottom line, his ultimate policy recommendation? He thinks the Fed does not, can never, know enough to be issued a driver's license, and he wouldn't trust the Open Market Committee with one anyway. Presumably, given his theory of the political process, his respect for the cognition and motivation of Presidents and Congresses is even lower. Does he then favor a Constitutional amendment fixing the rate of growth of some monetary aggregate, and prescribing in the amendment or entrusting to the Supreme Court the definition and measurement of the aggregate and the procedures for revising the rule in changed circumstances (he mentions changes in long-run trends of real growth and velocity)? Speaking of instabilities, I suspect that economists might have a hard time convincing the intelligent lay public that we should freeze into constitutional stone money supply rules that assume a trend in velocity that we cannot explain, much less guarantee to continue. Moreover, transition to the new noninflationary regime will alter the real demand for money, increasing it as open-market nominal interest rates fall, especially if all deposits are allowed to bear market-determined rates. Some provision for the transition would be necessary.

Can democratic governments, in the waning years of the twentieth century, forswear all responsibility for real macroeconomic outcomes? Can they confine themselves to providing a certain ration of base money, or transactions money, and leave performance in terms of production to markets, collective bargaining, and other activities of private agents and institutions? This is what Karl Brunner is recommending, and it is a sharp reversal of commitments made in the Employment Act of 1946, reaffirmed in the Humphrey-Hawkins legislation, and entrenched even more strongly though informally in contemporary American politics. I do not think the reversal is either realistically feasible or wise.

I turn now to some general comments on the issues of policy activism. I do not believe that the case for "activist" macroeconomic policies — by which I mean policies that depend on observations of the current and past state of the economy and on conditional projections of future states — depends on the policy-makers' possession of full structural information, whether by "divine intuition" (Brunner's phrase) or other means. It does depend on the policy-makers' possession of information, whether generally available and understood or not, to which private agents individually and collectively will not quickly adjust through markets or other channels. That information is often provided by current and recent observations, given the serial persistence of economic shocks. There are surely times when one doesn't need very precise knowledge of structure to see that the risks of moving the economy the wrong way or too far the right way are very small — the 1930s, the early 1960s, the late 1960s.

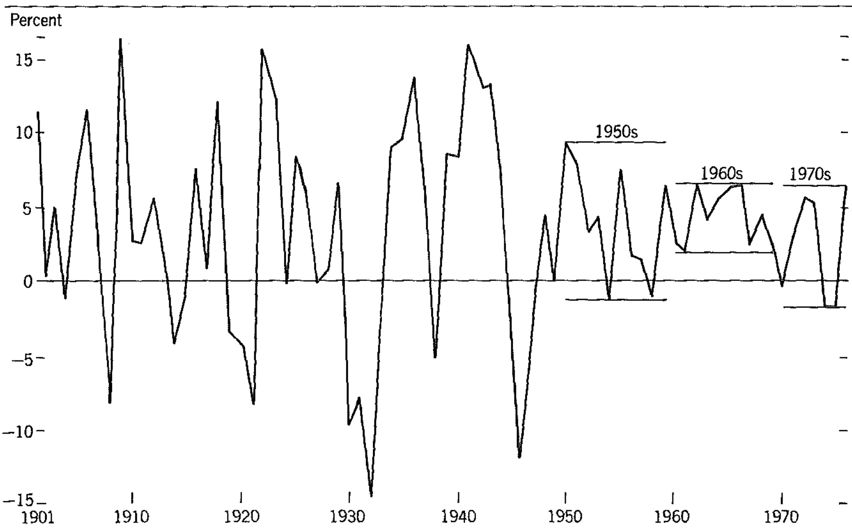
Nature sometimes jumps, contrary to Marshall, but the surprises are not quickly reversed. The central bank may or may not be better informed than some private agents. But it differs from all private agents in other important respects. Its operations are not limited by past commitments or by liquidity or by credit limitations in the capital markets. Its objectives are not those of a private firm or household or bank. These differential characteristics are the reasons for the original and traditional role of the central bank as lender of last resort and guarantor against panic. As Henry Kaufman reminds us from his experience, financial markets are not immune to waves of destabilizing irrational speculation. The central bank is in a position to take a longer and more fundamental view, to provide an anchor so that the actions of private agents in the markets can be stabilizing rather than destabilizing. This is true in foreign exchange markets as well as other financial markets. One implication of Brunner's hands-off policy is neglect, whether benign or not, of the foreign exchange markets. He does not discuss this implication, which seems especially serious for so large an actor in the world economy as the United States.

"Fine tuning" was an unfortunate phrase, a caricature of activist policy. A good helmsman does not overwork the tiller, and an amateur shower-taker suffers cycles of scalding and freezing water. Undoubtedly the economy generates a lot of noise policy-makers do best to ignore. I don't think their task is well or completely described as one of offsetting the errors in well-behaved normal processes whose mean values are perfectly satisfactory. Among the possible structures in Karl's s vector are some that have multiple equilibria, or persistent departures from unique equilibrium paths. The Keynesian message to policy-makers is that they should help the economy get to the best equilibrium path. It may not be fashionable these days to admit that market economies can get stuck on far-from-optimal tracks, but it is certainly not their recent performance that supports current fashion. The likelihood of macroeconomic market failures arises clearly enough from the incompleteness of markets: savers do not place specific orders for delivery of future consumption goods on definite dates in particular states of the world, workers are not able to communicate their readiness to buy the goods they would produce if they were employed. Some of these failures are inextricably tangled with the institution of money, and indeed are part of the price societies pay for the greater efficiency of monetary exchange compared to barter. Even "rational expectations" do not reliably fill these gaps, and it is the task of macro policies to ameliorate these market failures, no less than the analogous public function Brunner recognizes in microeconomics.

Brunner cites, in partial support of his thesis, the policy-ineffectiveness theorems of the rational expectations school, the "new classical macroeconomics." But in the end he does not rest his case on these propositions, which would after all say that any known policy rule, whether feedback formula or blind constant growth, is neither better nor worse than any other. (On this basis, the spirit of Brunner's minimax strategy suggests using a feedback rule, on the outside chance that Keynesians might sometimes be right.) Moreover, in the absence of continuous market clearing by price as assumed in new classical theory, the anticipation of policy does not always negate it but may reinforce it. As Martin Baily (1978) shows in the article from which I excerpted Figure 1, response of investors to compensatory countercyclical policy does a lot of the work of the policy itself.

Rational expectations theorists have rightly directed our attention to the incentives for private agents to adapt their behavior to the policies they perceive governments to be following. As Karl Brunner observes, we have no justification for assuming that private agents will not learn both what policy-makers know and what they systematically do. At the same time, we should not attribute miracles of optimization to households and businesses. Imagine that Karl was writing a memo for a large corporation, say GM or IBM, rather than for the Fed. Like all of us, such a company faces an unknowable environment. Imagine the stable policy he would recommend to the management: do nothing, for the risks of doing something are always larger. More seriously, I think Herbert Simon and Sidney Winter are right that any decision-maker in a situation of diffuse uncertainty relies on some simple but not eternal rules of behavior rather than reoptimizing every day. These rules likely contain feedback elements as well as elements of stability designed to avert overreactions to transient information. Although they assume certain features of the general macroeconomic environment, including monetary policy, they will change, but change only slowly, on evidence that the environment has changed. For runs of significant length, but not forever, macroeconomic policy-makers can and should assume these rules to persist and make policy

Chart 1 The Rate of Growth of Real Gross National Product, 1901-1976



Sources: U.S. Bureau of the Census, *Historical Statistics of the United States: Colonial Times to 1970*, pt. 1 (Government Printing Office, 1975), series F3; *Economic Report of the President, January 1977*, p. 188; *Survey of Current Business*, vol. 57 (July 1977), table 1.2.

accordingly. After decades of compensatory policy, a shift to inactive policy would be a surprise to which it would take private agents some time to adapt.

Karl begins his paper with an account, maybe a caricature, of what he calls a standard Keynesian view of monetary policy. I don't know whose views this account is meant to describe; they are certainly not mine. I think the issue of interest targeting has been greatly overblown ever since the great Accord of 1951. The use of a temporary and variable interest rate target for week-to-week operations is not the same thing as pegging. I would not have the Fed stick with any target, interest rate or monetary quantity, without regard to the projected and observed economic consequences. I regard interest rates and monetary aggregates as joint and simultaneous endogenous outcomes of the interaction of Fed operations in financial markets with private demands and supplies. It is not correct, in my view, to regard the transmission process as a linear chain from Fed operations to monetary aggregates to financial markets and the real economy.

I shall conclude by repeating here my view that the Fed should abandon the monetary aggregates and express target brackets for one to three years ahead in terms of growth of nominal gross national income. It would be better, perhaps, to avoid the implied point-for-point tradeoff between real growth and inflation by stating a rectangle of brackets for the two components. Anyway the Fed would simply be committing itself to adjust its instruments so as to bring about a desired course of macroeconomic variables of true concern, without committing itself to any particular tracks of intermediate variables. Both consistency of policy and credibility require that the Fed's targets be also those of the Administration and Congress in budget-making. One advantage would be that, for a transitional period of disinflation, these targets would mean a lot more to the businesses and unions who make prices and wages than multiple targets for esoteric monetary aggregates. The Chairman of the Federal Reserve may be threatening the economy with Thatcher-like austerity, but his message does not get across as clearly as that of the Prime Minister.

This is the third conference the Bank has sponsored on Controlling Monetary Aggregates. I think the general verdict of this one is against this method of making monetary policy. Maybe the next one could be on Controlling Nominal and Real Income.

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Abandoning Monetary Aggregates

Neil G. Berkman*

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:

$$1n(M_t/P_t) = a_0 + a_1\, 1n(Y_t/P_t)$$

$$+ a_2\, 1n\,(RTB_t) + a_3\, 1n(RCBPASS_t) + a_4\, 1n(M_{t-1}/P_t)$$

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	$\bar{R}^2$	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 aggregation 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.

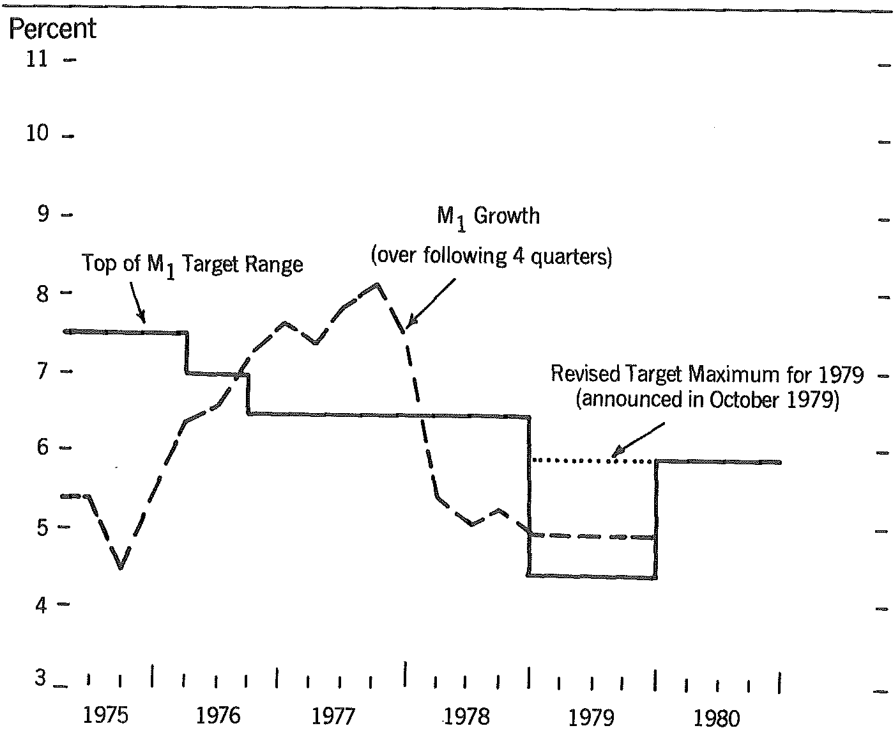
In 1980 the top of the range for M-1A was set at 6 percent. Despite an overall decline in real GNP during the first three quarters of 1980 and a major downward shift in money demand in the spring, M-1A is now at the top of its target range. With rapid growth in nominal GNP projected for the remainder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



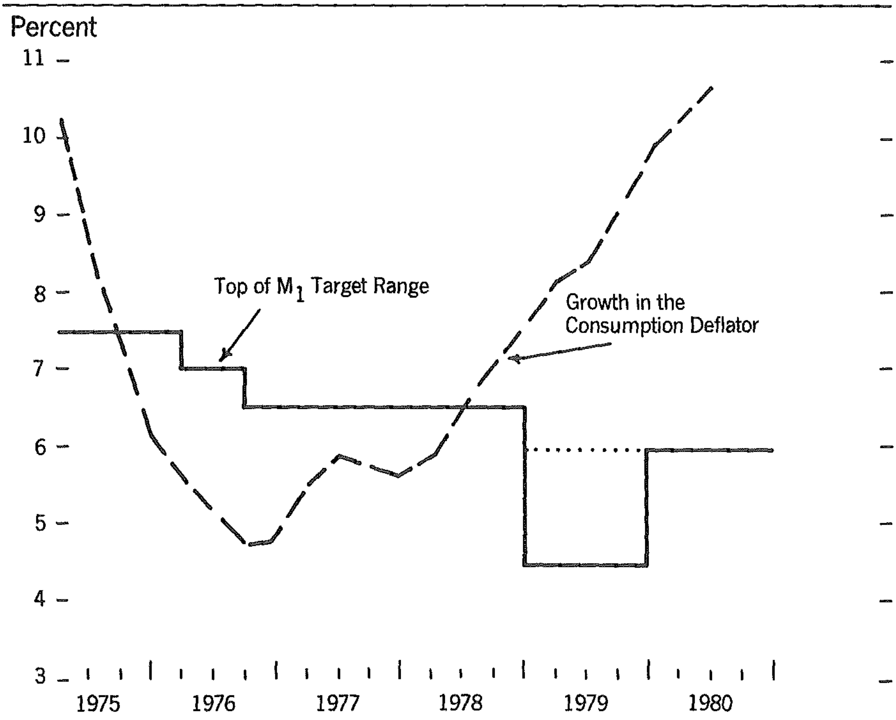
1980 similarly shows a tendency for money growth to be maintained near or above the top of the announced target ranges.

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.

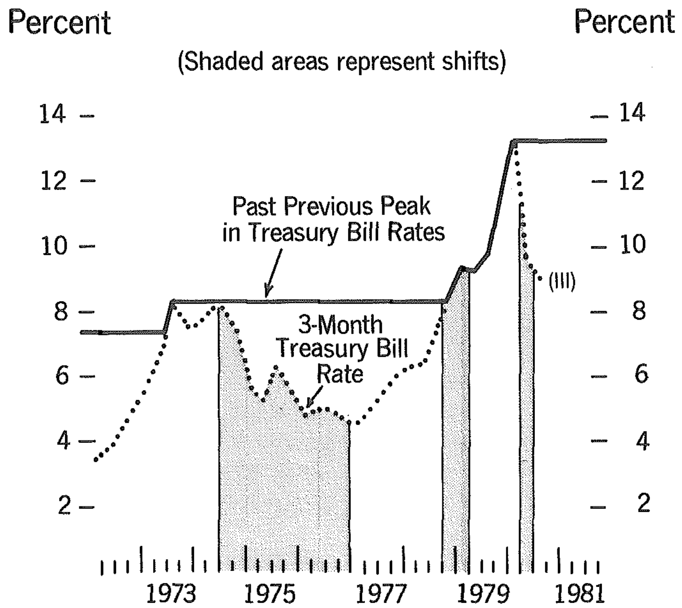
Unfortunately, even a downshift in money demand will not really save the Fed. It will only postpone the day of reckoning. The breakdowns in the relationship among money, GNP, and economic activity in the 1970s were generally initiated by a bout of record high interest rates, as is demonstrated in Chart 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.

The Structure of Financial Markets and the Monetary Mechanism

Franco Modigliani and Lucas Papademos*

I. Introduction

The objective of this paper is to reexamine the monetary mechanism, that is the mechanism through which the monetary authority by controlling certain financial variables achieves (more or less) effective control over nominal income. We propose to argue that the view of the monetary mechanism which has been widely accepted, at least until very recently, by both monetarists and Keynesians and which focuses on the role of the money supply has in reality but limited applicability since it neglects many other possible and practical forms of this mechanism. We will be concerned with the nature of such alternative mechanisms and how their functioning is related to the structure of financial markets and with deriving implications from this analysis for the choice of intermediate targets for monetary policy. The need for a careful reexamination of the monetary transmission mechanism has become evident in the light of recent developments in both the practice and theory of monetary policy and in the presence of pervasive and continuous changes in the structure of financial markets.

An important development in monetary policy in recent years has been the gradual adoption of monetary and credit aggregates as the primary targets in the formulation and implementation of policy by the monetary authorities of most major countries. The inflationary environment of the '70s impaired the usefulness of interest rates as instruments and/or targets of monetary policy and contributed to the shift towards greater emphasis on monetary aggregate targets. The abandonment of the system of fixed exchange rates also motivated the formulation of policy in terms of aggregates which were often viewed as conditioning, at least in part, the inflationary expectations of the public.

The adoption of monetary targets has not proved a panacea either for achieving the major policy goals of eliminating inflation and fostering output growth or for improving the formulation and implementation of monetary policy. Most monetary authorities have, in fact, followed a rather flexible approach both in selecting specific quantitative targets and in pursuing them. The flexibility or eclecticism of central bank policies reflects two major con-

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siderations. First, it reflects the realization that a rigid adherence to a narrowly defined monetary target can entail substantial economic and social costs in terms of high unemployment and lost output. Second, it reflects the existence of important conceptual and technical difficulties in the formulation and successful implementation of policy on the basis of monetary aggregate targets in a world of uncertainty regarding the stability of economic behavioral relationships and in the presence of innovations in the financial markets. These difficulties include the problem of choosing "appropriate" monetary or credit aggregates as intermediate targets and the problem of achieving short-run controllability of these targets without inducing excessive and perhaps destabilizing variations in interest rates.

An important conceptual problem which must be faced in formulating monetary policy in terms of monetary or credit aggregates is the choice of which monetary aggregate to control and, more generally, whether to aim at controlling a specific type of bank liability performing a medium of exchange function, such as M1, or the broader class of liabilities including those of all depository type intermediaries, or to focus instead on the assets of intermediaries (credit) whether narrowly or broadly defined. There is wide disagreement regarding the answer to these questions which is reflected both in the opposing opinions of professional economists and in the wide variety of targets actually pursued by the monetary authorities in various countries. For example, within the United States the views range from proposals to focus control on the monetary base (favored in particular by the shadow Open Market Committee) to proposals to control the broadest possible measures of aggregate liquidity or credit such as the old M7 or the new liquidity measure L (Henry Kaufman). Across countries, the targets pursued have included central bank money (Germany), M1 (United States, Canada), M2 (United States, Japan, France), M3 (United Kingdom) or total domestic credit (Italy).[1] Credit has been a primary target in the practice of monetary policy in many smaller countries and its importance has been stressed by the International Monetary Fund in its standby agreements.

The problem of choosing a monetary or credit aggregate as a policy target has been complicated by the evolution of new financial markets and instruments.[2] Recent financial innovations, most notably in the United States, have progressively blurred the distinction between the set of instruments which have traditionally been labelled as "money" and a variety of other instruments which possess most, if not all, of the economic characteristics which define "moneyness." These innovations, which have been spurred in part by a desire to circumvent the effects of regulation by the monetary authorities, have led to the creation of numerous assets with almost indistin-

[1] See Organization for Economic Cooperation and Development (OECD), *Monetary Targets and Inflation Control*, Monetary Studies Series, 1979.

[2] The effects of recent financial developments on the behavior of monetary aggregates and the effectiveness of monetary policy are examined by Phillip Cagan [1979]. For a collection of papers dealing with various aspects of the evolution of financial markets and some of their implications for monetary policy see William L. Silber [1975].

guishable characteristics of liquidity and risk which are interest bearing and which can be employed directly as, or easily substituted for, transactions balances. The mushrooming of the newly created assets not only made difficult the identification of the quantity of money traditionally defined as a medium of exchange but, more importantly, resulted in a conspicuous and unanticipated perturbation of the historic relations between nominal income and the monetary aggregates under the control of the central bank. In monetarist terminology, these financial innovations affected both the stability and the predictability of the velocity relating M1 to nominal income.

These developments led the Federal Reserve to redefine the monetary aggregates twice during the last two years in an attempt to group together those monetary assets which possess similar characteristics and functions. Although these redefinitions have resulted, at least for the time being, in a better identification of the quantity of money immediately available as a means of payment (M1B), their usefulness as indicators or targets of monetary policy is subject to some of the old and some new limitations.[3] The redefined aggregates provide a more complete and consistent set of monetary statistics, but they obviously do not resolve the problem of choosing which is the "most appropriate" measure as target/indicator of policy; nor is there any guarantee that new financial innovations will not affect the stability or predictability of the relationships between nominal income and the new monetary aggregates and thus result in their eventual obsolescence.

Conventional monetary theory of both the "monetarist" and "Keynesian" schools offers no criteria for the selection of an intermediate target for monetary policy other than M1. In fact, as we will discuss briefly in the following section, it tends to treat financial flows and stocks other than the money supply as essentially superfluous to its formalization of the monetary mechanism. The choice among alternative monetary aggregates has primarily been based on empirical analysis aimed at establishing the stability or predictability of their relationship to nominal income and judgments as to the "degree of moneyness" of different components. But the available empirical evidence is both conflicting and difficult to interpret. Although M. Friedman had previously established that historically M2 has exhibited the most stable relationship to GNP, more recent studies suggest that this conclusion is unwarranted. The evidence presented by B. Friedman [1980] and H. Kaufman [1979] suggests that broader measures of credit bear more stable (velocity) relations to GNP; and the empirical tests of N. Berkman [1980] show that it is impossible to identify a unique aggregate whose relationship to GNP is uniformly superior relative to others over different sample periods. More importantly, however, the relevance of this kind of empirical evidence for the choice of a monetary aggregate target is highly

[3] For example, as Berkman [1980] has pointed out, the aggregation into the new broader aggregates of financial assets which are not very close substitutes for all transactors in the economy (households, firms), implies the potential instability of the relationships between these aggregates and nominal income.

questionable for at least two reasons. The first reason, already noted, is that the predictability of the GNP-M_i relationships depends upon the structure and stability of the economy's financial markets which cannot be expected to be invariant over time. A second, and perhaps more basic, reason is that the observed historical stability of these relationships is not independent of the actual policies pursued by the monetary authorities over the sample period. Indeed, a policy which aims at stabilizing the rate of growth of a particular aggregate can be expected to tend to undermine the stability of its (velocity) relation to GNP. Consequently, the future stability of estimated empirical regularities cannot be guaranteed under alternative future monetary strategies or rules.

It is our opinion that the important conceptual and operational problems encountered in the formulation of monetary policy require a reexamination of the nature of the monetary transmission mechanism within a framework broader than the one usually employed by conventional monetary theory. This framework should take explicitly into account the role of the structure of financial markets in transmitting the effects of monetary policy to the actions of lenders and borrowers in the financial markets and the consequent effects on the spending behavior of firms and households. And it should enable us to understand the conditions which determine the optimal choice of monetary or credit aggregate targets and how the economy's financial structure affects these conditions. It should also help clarify why it may be optimal for different economies characterized by different financial structures to pursue different financial targets and strategies. This paper is a first attempt in developing such a framework and in analyzing these issues.

The paper is organized as follows: Section II reviews the traditional view of the monetary mechanism incorporated into the conventional frameworks of both the "monetarist" and "Keynesian" schools. Section III discusses what we perceive as the major limitations of the conventional view and offers an overview of the broader framework for the description of the monetary mechanism. In Section IV we present a macroeconomic model which incorporates a simple financial structure and in Section V we describe alternative forms of achieving monetary control of nominal income. Section VI examines the problem of choosing intermediate targets under uncertainty. We consider how the stability of behavioral relationships in the product and financial markets and the structure of financial markets affect the effectiveness of alternative targets such as M1, M2, bank credit or interest rates. The concluding section summarizes the main results and policy implications of our analysis.

II. The Conventional View of the Monetary Mechanism

The monetary mechanism is broadly defined as the mechanism through which monetary policy affects aggregate economic activity and specifically aggregate nominal income. Traditional monetary theory, of both the "monetarist" and "Keynesian" schools, has tended to assign the central role in the determination and control of nominal income to the interaction of the supply of "money," identified by its primary function as a medium of exchange, with a well defined and stable demand for money. The major differences between the monetarist and Keynesian versions of conventional monetary theory can be traced to different views or empirical assessments regarding: (1) the nature and major determinants of the demand for money and (2) the nature of the "price mechanism" or, equivalently, the way the supply of aggregate output responds to changes in aggregate demand. The "price mechanism" or "aggregate supply function" essentially determines the way in which the effects of monetary policy on nominal income are divided between changes in real output and changes in wages and prices.

The conventional view of the monetary mechanism can be formalized in a very concise fashion by the model presented in Table 1 which, for simplicity, abstracts from the effects of the government and foreign sectors. The first six equations represent the standard Keynes-Hicks reformulation of the classical Quantity Theory as formalized by Hicks [1937]. Equations (1) and (2) are the saving and investment functions respectively, while equation (3) defines the equilibrium or market clearing condition in the commodity market. The aggregate demand functions for saving and investment could be written in more general form, allowing respectively for the effect of the real interest rate, r, and aggregate real income, Y, but these generalizations are

Table 1
The Conventional Macroeconomic Model

(1)	Aggregate Saving	$S = S(Y)$
(2)	Aggregate Investment	$I = I(r)$
(3)	Commodity Market Equilibrium	$I = S$
(4)	Demand for Money	$M^d = PL(r + \pi, Y)$
(5)	Supply of Money	$M^s = \overline{M}$
(6)	Money Market Equilibrium	$M^d = M^s$
(7)	Aggregate Supply Function	$F(P, Y) = 0$
	(a) Perfect Price Flexibility	$Y = \overline{Y}$
	(b) Absolute Price Rigidity	$P = \overline{P}$

Definition of Symbols

Y = Aggregate real output
$\overline{Y}$ = "Full employment" aggregate real output
P = Aggregate price level
$\overline{P}$ = "Received" price level
S = Aggregate real saving
I = Aggregate real investment
M^d = Demand for money
M^s = Supply of money
r = Real interest rate
π = Anticipated inflation rate

not essential for our argument. Equations (1) to (3) contain four unknowns and can be solved to express real income Y in terms of the real interest rate thus yielding the Hicksian IS schedule for equilibrium in the commodity market. Equation (4) defines the real demand for money (the nominal demand for money deflated by the price level P) which is a function of real income and the nominal interest rate which is expressed as the sum of the real rate of interest and the anticipated inflation rate π (Fisher's Law). Equation (5) represents the effects of a monetary authority which has the power of fixing "exogenously" the nominal money supply through techniques which need not be specified at this point and equation (6) defines equlibrium in the money market. Equations (4)–(6) together define the Hicksian LM schedule, the combination of values of real output and interest rate which clear the money market for given values of the price level and inflationary expectations.

The "price mechanism" or "aggregate supply function" is formalized by equation (7) which relates the price level to real output. Equations (7a) and (7b) represent two well-known special cases of this mechanism. The first corresponds to the case of complete price flexibility — no matter what the value of nominal income, the price level always adjusts so as to insure the maintenance of full employment output, denoted by $\bar{Y}$. It corresponds to the "classical" assumption and it is representative of some "monetarist" views. More generally, it corresponds to a situation characterizing the long-run equilibrium in more general models in which prices adjust gradually over time. Equation (7b) formalizes the diametrically opposite case of complete price rigidity. This assumption is close to Keynes' original hypothesis, but it can also be usefully regarded as a short-run approximation to the behavior of prices in an economy in which the adjustment of prices to excess capacity is slow — at least as long as output is below full employment.

The centerpiece of the monetary mechanism in this conventional framework is the demand for money function, equation (4), combined with the power of the monetary authority to exogenously fix the supply of money. In the monetarist view, which can be regarded as a generalization of the classical "quantity theory of money," the working of the mechanism rests on the proposition that the "real demand for money," i.e., the demand for money expressed in terms of purchasing power over commodities, is a "real" phenomenon, independent of the nominal quantity of money or the price level. Combining this proposition with the classical view that the volume and composition of real output is also a real variable independent of the money supply, (equation 7a), one reaches the conclusion that the price level is proportional to the stock of money — at least once money demand has fully adjusted to money supply, which is supposed to occur quite promptly. Under the additional assumption that the demand for money function takes the special form $M^d = PL(r + \pi, Y) = k(r + \pi)\,YP$, nominal income is also proportional to the stock of money, the proportionality factor $v(r + \pi) = 1/k(r + \pi)$ being the velocity of money. Note that this theory does not assume, or require, that the proportionality factor be constant in time. On the contrary, it may be expected to change in response to both changes in real factors and the economy's financial structure. What is essential is that the real demand for money is independent of the nominal quantity of money. A more modern monetarist version retains the hypothesis that the demand for money is proportional to nominal output but it accepts the Keynesian view that in the *short run* prices may not be perfectly flexible. Accordingly, while *nominal* output is still seen as determined by the interaction of money demand with the money supply, the change in money income arising from a change in the stock of money may take partly the form of a change in real output rather than exclusively of a change in the general price level (i.e., M. Friedman [1974]).

The main difference between this monetarist formulation and the Keynesian one is that the latter stresses that the demand for money depends not only on money output but also in an essential way on the opportunity cost of carrying money. An index of this cost is the spread between the short-term market rate of interest and the rate, if any, paid on money or components thereof (such as demand deposits). This "liquidity preference" effect that causes the demand for money to depend on market interest rates is, in principle, acknowledged also by monetarists but it is usually disregarded as empirically trivial. Keynesians, on the other hand, consider this dependence to be not only empirically important but also of major conceptual importance. In their view it provides the key to understanding the monetary mechanism — that is, the mechanism by which expansion or contraction of the money supply engineered by central bank policy produces variations in aggregate money output.

This mechanism is rather vague in the elementary monetarist formulation which disregards liquidity preference. One description of the mechanism argues that as the money supply first expands, the public must find itself with more money than it wants to hold, given its initial income, and hence will respond by promptly spending that money on goods. (In Professor Samuelson's words, "the extra money burns holes in pockets.") The additional expenditure in turn raises income and the demand for money until it matches the new supply. But this simplistic view disregards the fact that in an advanced financial system, the money supply typically expands through the "monetization of debt," i.e., through the acquisition by the banking system (including the central bank) of debt from the private sector, against newly created money. Clearly, this transaction does not change in any way the wealth of the private sector (or its income, at least to a first approximation). Furthermore, since the acquisition of the additional money by the public is the result of an entirely voluntary transaction, one cannot argue that the public holds more money than it wants to or that it has any inducement to get rid of it by buying commodities.

The mechanism relating an increase in the money supply to a rise in nominal output envisaged by the Keynesians can be described along the following lines. First, to induce the public to exchange debt instruments for money, the banking system must initially bid down the interest rate (or, equivalently, bid up the price of the debt instruments). In turn, the fall in market rates, though it might initially center on short-term instruments which are the closest substitutes for money, will eventually spread, as the public endeavors to shift to longer maturities whose yield has become more attractive relative to shorter maturities. The fall in the rate structure will eventually make it profitable to exchange money fixed assets, including newly created debt, for physical assets or equities. The first operation increases demand for investment goods directly. The second, by bidding up the value of shares, makes it attractive for firms to acquire capital goods whose market valuation rises relative to the acquisition cost at current prices. Finally, the decline in the market rate should lead banks to lower their loan rate, inducing an expansion of borrowing. The expansion may be expected to contribute directly to nominal demand as the seller of the newly created debt is likely to largely spend the proceeds on goods and services rather than to add significantly to his cash balances.

The two versions of the traditional view of the monetary mechanism can be summarized formally as follows. The simple model described by equations (1) to (7) consists of six behavioral equations plus the conventional "policy" equation (5) describing the role and power of the monetary authorities in controlling the money supply. These equations contain eight endogenous variables: (Y, P, r, π, S, I, M^d, M^s) and a policy variable, M, under the control of the monetary authority.

Under the classical-monetarist assumption of perfect price flexibility (equation 7a), aggregate real output is always maintained at the full-employment level $\overline{Y}$ and the first three equations form a closed subsystem determining all the real variables including the real interest rate. This is the so-called classical dichotomy. Given the equilibrium values for Y and r, equilibrium in the money market between the exogenously determined supply of money and the demand for real money balances leads to the determination of the price level and thus of nominal income given the anticipated inflation rate. For the elementary version of the quantity theory in which the demand for money, and thus the velocity of money, is independent of the anticipated inflation rate, equilibrium in the money market is sufficient for closing the system and determining the price level. For the more general versions of this theory, it is necessary to specify the mechanism which determines the formation of inflationary expectations. Various possibilities exist including the limiting case of "perfect foresight" which corresponds to a special form of the hypothesis of "macro-rational" expectations. According to this hypothesis, anticipations of the inflation rate are determined on the basis of the model describing the determinants of the actual inflation which in this case consists of the equilibrium condition in the money market together with the (known) equilibrium values for the real interest rate and full-employment output.

Under the Keynesian assumption of absolute price rigidity, there is no simple dichotomy in the determination of real and nominal variables. There is also no distinction between real and nominal interest rates since the assumption of a fixed price level presumably implies that $\pi = 0$. Aggregate real output and the interest rate are determined through the simultaneous interaction of the commodity and money markets.

One further significant implication of price rigidity is that control of aggregate demand need not rest on fixing the money supply: the monetary authority may instead opt to fix the interest rate. Formally this policy would be represented by replacing equation (5) $M^s = \overline{M}$ by (5)′ $r = \overline{r}$. This policy would directly determine investment (equation (2)) and income (equations (1) and (3)). Equation (4) would then determine the demand for money which the monetary authority would have to be prepared to satisfy (by putting the banking system in the position to do so). This alternative approach has at times been favored by the Keynesians, though of late it has tended to lose favor because of problems created by inflation that must be bypassed here as not being essential to our argument.

The choice between M and r as the control instrument is not a significant issue if the relevant equations of the system held precisely and the monetary authority has a reliable estimate of them. The point is that, even though in principle the monetary authority can set either M or r at will, in practice it must be presumed to do so in order to achieve a desirable or target level of income, say $\overline{Y}$. But the standard model implies that to $\overline{Y}$ corresponds a unique target value of M and r, say $\overline{M}$ and $\overline{r}$. One could therefore indifferently choose either $\overline{M}$ or $\overline{r}$ as a target level and the other would also achieve the desired value — indeed, one could not tell which target was being enforced. The problems posed by uncertainty are postponed until Section VI below.

III. Toward a Broader View of the Monetary Mechanism

The conventional view of the monetary mechanism outlined in the previous section, far from being a general one, is really highly specialized. In the following sections of this paper we will argue that (1) a large array of possible forms of the monetary mechanism and corresponding intermediate targets exists other than the monetary liabilities of the banking system; (2) one of these alternatives is distinctly more relevant than the traditional one at least for many countries other than the United States; (3) other intermediate targets can also be more effective, depending in part on the degree of development of the financial structure and the relative stability of behaviorial relationships; and (4) the monetary mechanism corresponding to different intermediate targets and financial structures is best described by paradigms rather different from the classical or Keynesian-Hicksian one.

The usefulness of the conventional paradigm of the monetary mechanism, both from a descriptive and cognitive point of view, and the effectiveness of money as an intermediate target depend on the realization of a rather specific set of circumstances, to wit: (1) that there exists some instrument identifiable as money in the sense that it performs primarily the function of a medium of exchange and is thus clearly distinguishable from other stores of value not having this property (one institution that clearly contributes to a sharp distinction is the prohibition of interest on money); (2) that the monetary authority is in a position to control the money supply and chooses to do so; and (3) that firms rely to a substantial extent for their financing on market instruments held directly by the public or by nonbank intermediaries.

These conditions appear to have been broadly satisfied for the United States, at least until fairly recently, and this may explain why the above paradigm has a distinct Anglo-Saxon flavor. But these conditions have been increasingly breached even in the United States as other stores of value have acquired at least a partial medium of exchange properties, as the spreading of interest payments on checkable deposits has increased the role of money as a store of value and as the central bank focus has shifted from money to broader aggregates. But the inadequacy of the paradigm both as a cognitive device and as a basis for policy is particularly evident for the economies of other countries. In the case of Italy, for instance, the distinction between banks and thrift institutions and between demand and savings deposits has always been quite blurred; both deposits pay interest and, indeed, there have been times when, for complex technical reasons, interest on time deposits has been lower on the average than on demand deposits; and, what matters most, much of the time the two types of deposits have been subject to the same reserve requirements. As a result, the distinction between different concepts of money is not sharp, and while the central bank may be able to control the total of deposits through reserve requirements, it cannot control the way the public distributes that total between demand and savings deposits, which means that the money stock is demand determined. Moreover, in Italy, as in many other countries, the overwhelming source of firms' debt financing consists of bank loans.

It is thus rather clear that, in order to develop a broader understanding of the monetary transmission mechanism, it is necessary to pay attention to the role of financial markets and the role of financial stocks and flows other than the money supply in the determination of aggregate demand. The proposition that financial markets and institutions are important elements of the monetary transmission mechanism is, of course, not a novel one. It was emphasized some time ago by Gurley and Shaw [1955, 1956, 1960] in their pioneering work which examined the role and implications of financial intermediaries on the saving-investment process; it is reflected in the portfolio-balance approach to monetary theory advanced by Tobin, Brainard and other members of the Yale school as well as by Brunner and Meltzer[4]; and it has motivated and shaped the development of both the theoretical and empirical analysis associated with the construction of the MPS econometric model.[5] Much of this analysis, however, remains within the traditional framework in the sense that it is largely concerned with the working of an economy in which monetary policy takes basically the form of control of the money supply. It is concerned either with the way in which M1 control is transmitted through the financial markets on its way to affect spending decisions or it is concerned with the way in which financial markets may thwart the achievement of the

[4] See Tobin [1963, 1969], Tobin and Brainard [1963], Brainard [1967] and Brunner and Meltzer [1972, 1976].

[5] See Ando [1974] and Ando and Modigliani [1976].

authorities' targets through changes reflecting autonomous developments or, worse, a response to the authorities' policy actions.

Our own analysis will focus instead on the question of the feasibility and the advisability of controlling nominal income by relying on the control of variables other than the money supply, and on how the answer is affected by the financial structure of the economy. This task requires developing a framework for monetary analysis which links aggregate nominal output to alternative *intermediate targets and instruments* of monetary policy on the basis of an appropriate specification of the economy's financial structure. By *financial structure* we mean (1) the sources and instruments available to firms and households for financing the acquisition of tangible assets, (2) the menu of financial assets available to households and firms and (3) the structure and characteristics of markets as defined by the degree of competition (quantity versus price rationing) and the nature and extent of regulation. Such a framework allows (a) tracing the channels through which the control by the monetary authority over some intermediate target achieves control of aggregate demand and how these channels are affected by alternative financial structures and (b) specifying how the alternative intermediate targets can be tracked by the monetary authority by maneuvering the variables under its direct control.

An overview of the financial structure of an economy can be presented with the help of a flow-of-funds matrix which shows the balanced sources-and-uses-of-funds statements for each sector in the economy, the interrelations among the sectors and the aggregate totals of saving, investment and net changes in financial assets, liabilities and money balances for the economy. The flow-of-funds matrix provides the basic accounting framework underlying any general model of the monetary mechanism. Table 2 presents the flow-of-funds associated with a fairly general (although not the most general) representation of an economy's financial structure. The economy is divided into four sectors: households and noncorporate firms (h), corporate firms (f), the banking system (b) and the government (g). The government sector represents the consolidated accounts of the federal, state and local governments and the monetary authority (government-sponsored agencies and mortgage pools are not considered). The major simplifying assumption of this table is the exclusion of the rest of the world (foreign) and the private nonbank financial sectors and of all the financial instruments characteristic of these two sectors.

The matrix contains 10 major transaction categories. The first two (1) saving (S) and (2) investment (I) represent real transactions (except that in general saving will include capital gains). The remaining eight represent financial transactions in (3) currency and demand deposits (M1), (4) savings and time deposits (SD), (5) bank reserves (R), (6) equity of firms (E), (7) bank loans (L), (8) government bonds (B_g), (9) bonds issued by corporate firms (B_f), and (10) bonds issued by banks (B_b). (The term "bonds" is used to denote any form of marketable debt instrument).

The nonzero elements in the matrix indicate the flow of saving and real

Table 2
Flow of Funds Accounts

	Sectors							
	Households (h)		Corporate Firms (f)		Banking System (b)		Government and Monetary Authority (g)	
Transaction Category	U	S	U	S	U	S	U	S
(1) Saving		S_h						S_g
(2) Investment in Real Assets	I_h		I_f					
(2)′ Net Financial Investment (3–10)	IF_h		IF_f					
(3) Demand Deposits and Currency	$\Delta M1_h$		$\Delta M1_f$			ΔDD		ΔCUR
(4) Savings and Time Deposits	ΔSD					ΔSD		
(5) Bank Reserves					ΔR	ΔRB		ΔRU
(6) Corporate Equity	ΔE			ΔE				
(7) Bank Loans		ΔL_h		ΔL_f	ΔL			
(8) Bonds (Government)	ΔB_{gh}		ΔB_{gf}		ΔB_{gb}			ΔB_g
(9) Bonds (Firms)	ΔB_{fh}			ΔB_f	ΔB_{fb}			
(10) Bonds (Banks)	ΔB_{bh}		ΔB_{bf}			ΔB_b		

investment for each sector (rows 1 and 2) and the net changes in financial assets and liabilities that have taken place over the specified period (rows 3 to 10). The symbol ΔX_i denotes the change in the value of the stock X_i of an asset or liability held by the i-th sector during the period. Consequently, the flows represented by the elements of the flow-of-funds matrix reflect both the change in the quantity of financial assets held and the change in the prices at which these assets are valued (capital gains or losses). The absence of a subscript (a second subscript for bonds) means that the symbol represents the total stock or flow obtained by summation over all sectors.

The saving of each sector equals the change in its total assets minus the change in its liabilities and it thus equals the change in its net worth (W_i). Alternatively, the saving of each sector equals its investment in real assets plus its *net* financial investment (IF_i). The latter consists of the net change in financial assets (lending) minus the net change in liabilities (borrowing). Thus for the i–th sector

$$S_i = I_i + IF_i = \Delta W_i$$

A surplus sector with saving greater than its investment in real assets must have a positive net financial investment ($IF_i > 0$) increasing its holdings of financial assets (lending) and monetary assets (hoarding) and/or reducing its debt. A deficit sector with real investment greater than its saving must have a negative net financial investment ($IF_i < 0$) increasing its debt (borrowing) and/or reducing its holdings of financial assets and money. Although each sector's net financial investment will not be zero in general, as is well known the sum over all sectors of net financial investment will be zero since surplus sectors provide the financing of deficit sectors. For the entire economy, aggregate saving equals aggregate investment in real assets.

The flow-of-funds matrix then provides a complete summary of (1) the economy's financial structure (which is represented by the nonzero elements of the matrix), (2) the budget constraints which restrict the demands and supplies of each sector (which correspond to equality of the sum of uses and sources for each sector) and (3) the conditions for market equilibrium in the financial markets (obtained by equating the sum of uses to the sum of sources over all sectors for each transaction category).

To complete the description of the financial structure exhibited in Table 2 would require specifying the determinants of four major decisions: (a) the consumption/saving and the investment/portfolio decisions of households (including noncorporate firms) which will determine the demands for equity and for five financial assets by that sector, (b) the investment, portfolio and financing decisions of corporate firms, the latter determining the proportions of investment financed via retained earnings, issuing of new shares and borrowing from the bank sector or directly from households, (c) the portfolio allocation decision and management of liabilities by banks, and (d) the government's decisions on how to finance its budget and what fiscal and monetary instruments to employ in order to control aggregate output and the price level. Monetary policy takes as given the fiscal decisions regarding government spending and the tax system and thus the implied level of the government deficit ($-S_g$). It aims to control nominal income by varying the monetary base (CUR + R), that is the amount of government debt (and possibly other debt) which it monetizes. Although open market operations constitute the main instrument of monetary policy, the monetary authorities, in order to tighten the link between the monetary base and the total supply of money in the economy, often employ reserve requirements on the liabilities of banks and vary the direct lending to the banking system possibly by changing the interest rate at which banks can borrow from the central bank.

According to the conventional view of monetary policy, the monetary authority manages the monetary base and related variables (the instruments) to enforce a behavior of the money supply (the intermediate target) needed to achieve the desired nominal income (the final target). The financial structure of Table 2 brings out the fact that there are many financial stocks and flows besides the stock of (or change in) M1. In the following sections we argue that from a formal point of view any of these financial variables could in principle replace M1 as the intermediate target. We give some illustrations of the mechanism through which specific targets such as M2 or bank credit control aggregate demand, and we discuss the considerations that are relevant in choosing among alternatives.

IV. A Macroeconomic Model with a Simple Financial Structure

In this section we present a macroeconomic model which is intended to illustrate in a simple way how the structure of financial markets affects the nature of the monetary mechanism and the effectiveness and optimal design of monetary policy in controlling aggregate income. In order to focus our attention on the essential features of the monetary mechanism, we consider an economy which is closed and without a government or a corporate sector. Thus there is no net government debt or credit so that all money is "inside" money and the sum of net aggregate nominal assets is zero. The economy is divided into two sectors — a private nonbank sector and a bank sector. We examine a limiting type of financial structure in which there are no marketable debt instruments and, consequently, the only type of credit available to the nonbank sector consists of bank loans (L). Correspondingly, the nonbank public can hold three assets; physical capital (K), money (M1), and savings and time deposits at banks (SD). There are three interest rates in this economy, the (borrowing) rate on bank loans, r, and the lending rates on demand deposits, r_d, and savings deposits, r_s.

Economic units in the nonbank sector make two decisions each period, a consumption/saving decision and an investment/portfolio decision. Since we are abstracting from the corporate sector, we do not find it useful to disaggregate the nonbank sector into "households" and "firms"; instead we formalize the investment and financing decisions of the nonbank public in terms of the behavior of "surplus" and "deficit units" which will be defined below. The determinants of saving, investment, and the demand for money (M1) are taken to be the same as in the conventional macroeconomic model and they are shown in Part A of Table 3 which is identical to Table 1 except that we have allowed for the independent effects on investment and the demand for money of the other interest rates and we consider the response of aggregate output for the limiting case of absolute price rigidity. The flows of investment and saving depend, of course, on the initial stock of capital (or wealth), which can be taken as given in the short run and thus does not appear explicitly as an argument of the investment and saving functions. The decisions of the public are restricted by a budget constraint which requires that the value of all uses of funds equals the value of all sources of funds during the period. The sources-and-uses-of-funds statement for the nonbank sector is given by equation (8) in Part B of Table 3. There are two sources: saving and

Table 3
A Macroeconomic Model with a Simple Financial Structure

A.	The Standard Model	
(1)	Aggregate Saving	$S = S(Y)$
(2)	Aggregate Investment	$I = I(r, r_s)$
(3)	Commodity Market Equilibrium	$I = S$
(4)	Demand for Money (M1)	$M1^d = \underline{PL}(r, r_d, r_s)$
(5)	Supply of Money	$M1^s = \overline{M1}$
(6)	Money Market Equilibrium	$M1^d = M1^s$
(7)	Aggregate Supply Function	$P = \bar{P}$
B.	Financial Structure	
(8)	Source and Use Statement for the Nonbank Sector	$S + \Delta L^d = I + \Delta M2^d$
(9)	Demand for Borrowing (Bank Loans)	$\Delta L^d = B(r, r_d, Y)$
(10)	Total Demand for Bank Liabilities	$\Delta M2^d = L2(r, r_d, r_s)$
(11)	Source and Use Statement for the Bank Sector	$\Delta M2 = \Delta L$
(12)	Loan Market Equilibrium	$\Delta L^d = \Delta L$
(13)	Bank Liabilities Market Equilibrium	$\Delta M2^d = \Delta M2$
(14)	Interest Rate Determination	(a) $r_d = \bar{r}_d$
		(b) $r_s = f(r) = r - d$

Definition of Symbols

Y	=	Aggregate real output
P	=	Aggregate price level
$\bar{P}$	=	"Received" price level
S	=	Aggregate real saving
I	=	Aggregate real investment
$M1^d$	=	Demand for money
$M1^s$	=	Supply of money
$M2^d$	=	Demand for bank liabilities
$M2$	=	Supply of bank liabilities
L^d	=	Demand for bank loans
L	=	Supply of bank loans
r	=	Interest rate on bank loans
r_d	=	Interest rate on demand deposits
r_s	=	Interest rate on savings and time deposits

net borrowing from banks (change in the quantity of bank loans), and three uses: investment in physical capital and investment in money ($\Delta M1$) and savings deposits (ΔSD). The sum of the last two components is the increase in total liabilites—monetary and nonmonetary—of the banking system ($\Delta M2$).

The nonbank public can be divided into two groups consisting of "surplus units" and "deficit units." These units are defined in terms of stocks held at the end of each period. A surplus unit is one whose end-of-period wealth is at least as large as its holdings of real capital and of money (M1), and, consequently, its holdings of nonmonetary financial assets (savings deposits) exceed or are equal to its debt. Under the further reasonable approximation that surplus units do not hold debt to finance their holdings of savings deposits, a surplus unit will be characterized by zero debt and positive (or zero) holdings of savings deposits.[6] A deficit unit has insufficient terminal wealth to finance its holdings of real capital and money; it holds a positive amount of loans and has no savings deposits.[7] The flow demand for (net) borrowing or credit during a period which is given by equation (9) of Table 3, can then be thought of as representing the difference between the investment and saving of the set of all units which end up as deficit units plus the change in their holdings of money.[8] Thus the (net) demand for borrowing is given by

$$\Delta L^d = B(r, Y) = I_d(r) - S_d(Y) + \Delta M1_d(r, Y) \qquad (4.1)$$

where the subscript d is used to denote the deficit units. The flow demand for borrowing and the flow demands for other assets and liabilities defined below correspond to end-of-period stock demands, given the actual stocks held at the beginning of the period. The reason for expressing the demand for borrowing as a function of the borrowing rate only is that this is presumably the only rate relevant for the deficit units. For the M1 component the yield on demand deposits would also be relevant, but in our analysis we rely on the common assumption that r_d is a constant. The demand for borrowing is a decreasing function of the interest rate and it may be an increasing or decreasing function of income. An increase in the interest rate leads to an unambiguous decrease in borrowing since both investment and the demand for money by deficit units decline. An increase in income gives rise to two

[6] The net worth of each unit is given by $W = K + M1 + SD - L$. In general, for a surplus unit $W > K + M1$ so $SD \geq L$ and for a deficit unit $W < K + M1$ so $L > SD$. We assume that for a surplus unit $L = 0$ and $SD \geq 0$ and for a deficit unit $SD = 0$ and $L > 0$. Clearly during a period it is unreasonable to assume that a surplus unit will borrow funds in order to finance additions to its holdings of savings deposits which in a free market will yield a rate lower than the borrowing rate. But, of course, in general the *stocks* of L and SD may be both positive due to past deficits financed at a lower average rate and because of the presence of contractual arrangements regarding the repayment and refinancing of loans.

[7] Since a positive quantity of money (M1) is necessary for transactions to take place in a monetary economy, deficit units will have to borrow to finance a higher demand for M1 as determined by this period's income and interest rates and last period's stock of money.

[8] If the borrowing function is stated in terms of the demands of deficit and surplus units at the beginning of the period, it must take into account the marginal cases of initially surplus units turned into deficit units as a result of the saving/investment decisions during the period.

opposing effects: it increases saving and hence the capacity of self-financing which reduces borrowing, but it increases the demand for money which raises the demand for borrowing. Thus:

$$\partial B/\partial r < 0 \quad \text{and} \quad \partial B/\partial y \lesseqgtr 0 \quad \text{if} \quad dS_d/dY \gtrless \partial \Delta M1_d/\partial Y. \tag{4.2}$$

The relative magnitudes of the marginal propensity to save and the marginal income effect on money for deficit units cannot be settled on a priori grounds. But it is certainly possible that the net income effect is negative. For example, if the demand for money is given by $M1_d = k_d(r)Y$, a negative income effect would result if $dS_d/dY > k_d(r)$ which is not unlikely.

Having specified the determinants of the demand for borrowing by the deficit units and the aggregate demands for investment and saving, the source-and-use statement for the nonbank sector, equation (8), implicitly yields the demand for the total flow of liabilities of the banking system, $\Delta M2^d$, which is displayed as equation (10) in Table 3. The total demand for bank liabilities — both monetary and nonmonetary — represents the excess of saving over investment of the surplus units plus the change in the money balances of the deficit units, that is:

$$\Delta M2^d = L2(r, r_s, Y) = S_s(Y) - I_s(r_s) + \Delta M1_d(r, Y) \tag{4.3}$$

where the subscripts s and d denote surplus and deficit units respectively. The demand for investment by surplus units is a function of the savings deposit rate, r_s, which may be taken as measuring the opportunity cost of investment in physical assets for surplus units. We will assume, however, that this rate can be expressed in terms of the borrowing rate, r, as we discuss below. The demand for total bank liabilities is unambiguously an increasing function of income and may be an increasing or decreasing function of the interest rate:

$$\partial L2/\partial Y > 0 \quad \text{and} \quad \partial L2/\partial r \gtrless 0 \quad \text{if} \quad |dI_s/dr| \gtrless |\partial \Delta M1_d/\partial r| \tag{4.4}$$

It is likely, however, that the interest sensitivity of investment by the surplus units is greater than the interest sensitivity of the demand for money by the deficit units, so that an increase in the interest rate will increase the total demand for bank liabilities.

The flow demand for savings deposits by the surplus units follows from the demand for M2 and the demand for money (M1) and represents the difference between the saving and real investment of surplus units minus the change in their holdings of money:[9]

$$\Delta SD^d = J(r, Y) = S_s(Y) - I_s(r) - \Delta M1_s(r, Y) \tag{4.5}$$

[9] The flow demand for savings deposits can be derived directly from the end-of-period stock demand for savings deposits by surplus units which is given by $SD^d = W_s - (K_s + M1_s)$ where W_s, K_s, $M1_s$ are the end-of-period net worth and stocks of capital and money held by surplus units respectively. Under the assumption of fixed prices it follows that

$$\Delta SD^d = \Delta W_s - \Delta K_s - \Delta M1_s = S_s - I_s - \Delta M1_s.$$

It is an increasing function of the interest rate, but it may be either an increasing or decreasing function of income:

$$\partial J/\partial r > 0 \quad \text{and} \quad \partial J/\partial Y \gtrless 0 \quad \text{if} \quad dS_s/dY \gtrless \partial \Delta M1_s/\partial Y. \tag{4.6}$$

Finally, the demand for equity investment by the nonbank public equals the flow of real investment minus the flow of borrowed funds employed in financing that investment and it is equal to the sum of the saving of the deficit units plus the investment of the surplus units:

$$\Delta E = E(r, Y) = I(r) - \tilde{B}(r, Y) = S_d(Y) + I_s(r) \tag{4.7}$$

where $\tilde{B}$ is total borrowing minus that portion of borrowing employed for financing the desired change in the stock of money by deficit units:

$$\tilde{B}(r, Y) = B(r, Y) - \Delta M1_d(r, Y) = I_d(r) - S_d(Y) \tag{4.8}$$

The demand for equity investment is a decreasing function of the interest rate, as a rise in r decreases the self-financed investment of surplus units, and an increasing function of income, as a rise in income increases the self-financing of the deficit units:

$$\partial E/\partial r < 0 \quad \text{and} \quad \partial E/\partial Y > 0 \tag{4.9}$$

The source-and-use statement of the consolidated banking system (including the central bank) is given by equation (11) of Table 3. It states that the total increase in liabilities equals the increase in bank loans, the only assets available to the consolidated banking system. Equation (12) states the condition for equilibrium in the loan market; total borrowing equals the lending of the only lenders, namely banks. Similarly, equation (13) states the condition for equlibrium in the market for the total of bank liabilities. The remaining equations (14) describe the determinants of the two lending rates r_d and r_s. Equation (14a) represents the conventional case when there is a ceiling (possibly zero) on the rate on demand deposits. Equation (14b) relates the (lending) rate on savings deposits, r_s, to the (borrowing) rate on bank loans r. It is assumed that competition among banks keeps stable the spread between the borrowing and lending rates r and r_s at a level reflecting the cost of intermediation. The analysis in this and the following Section V are based on this hypothesis, although in Section V we also examine monetary control when both lending rates are institutionally fixed.

If we exclude the policy equation (5) in Table 3, we observe that the enlarged system of Parts A and B contains 14 equations in 13 unknowns, and we have added eight equations and six unknowns (ΔL^d, ΔL, $\Delta M2^d$, $\Delta M2$, r_d,r_s) to the original six equations (excluding equation (5)) in seven unknowns. But two equations are redundant: Walras' Law implies the redundancy of one of the market clearing equations, and the budget constraint of the nonbank sector implicitly determines the demand for M2 given the demands for investment, saving and borrowing. One more equation is thus needed to close the system. In the standard monetarist-Keynesian paradigm, the additional equation is of course equation (5) and accordingly the monetary mechanism can be described by the equations of Part A alone.

It should be readily apparent, however, that condition (5) — exogenously fixing the money supply — is by no means the only way of closing the system. Indeed, from a formal point of view, all that is required is an equation of the form $Z = \bar{Z}$, where Z could be any nominal variable of the system, and in particular any of the nominal financial variables, as long as it is controlled by the monetary authority. In our illustrative system, e.g., eligible variables would include money, $\Delta M1$, savings deposits, ΔSD, total bank liabilities, $\Delta M2$, bank loans, ΔL. Once such a variable (or linear combination of variables) has been fixed, all other financial variables will be endogenously determined. In particular, the money supply will be given by (4) and hence will be demand determined — and yet nominal income will be uniquely determined. It is also possible to show that if we drop the assumption of price rigidity and go to the limiting case of perfect price flexibility and assume the absence of any money or inflation illusion, then the quantity of money theory of the price level can be replaced by the more general proposition that the price level is proportional to the value of any appropriately chosen nominal stock.

We have thus established a first interesting proposition. The purpose of the monetary mechanism — the determination and control of nominal income can be achieved without exogenous control of the money supply and requires instead only exogenous control of some financial "aggregate," or of a linear combination of such aggregates. An obvious corollary of this proposition is that the traditional monetarist-Keynesian paradigm of the monetary mechanism cannot have general validity.

To be sure, for this implication to have empirical content the monetary authority must be in a position to control other monetary aggregates as well as the money supply. But it should be obvious that this possibility exists, at least in principle. Even in the case of the United States, for instance, the Federal Reserve has made extensive use of targets such as M2 or even broader aggregates. However, many other possibilities exist and in the next section we will illustrate this possibility with examples inspired by the experience of other countries.

V. Alternative Paradigms of Monetary Control

There can be little question that one aggregate the monetary authority can control is total bank credit, ΔL. One simple device to accomplish this — though by no means the only one — is that of imposing reserve requirements against bank credit. In this case, the policy equation closing the system becomes:

$$\rho \Delta L \leq \Delta \bar{R} \qquad (5.1)$$

where ρ is the reserve coefficient against bank credit, and $\overline{\Delta R}$ is the change in bank reserves, exogenously supplied by the central bank (say in the process of making loans to firms). Assuming that bank reserves yield less than the market rate, and allowing for profit maximization by banks, the above constraints can be replaced, to a good approximation, by the equality:

$$\Delta L = \frac{\overline{\Delta R}}{\rho} = \overline{B} \tag{5.2}$$

This equation closes the system but it does not do so by exogenously limiting the money supply since, as is apparent from equation (11) in Table 3, it constrains only the sum of bank liabilities. For given total bank credit, the public is free to hold all the money it wants (as long as savings deposits are nonnegative). Hence we see again that the standard paradigm does not help. How, then, does control of bank credit succeed in controlling aggregate demand?

A. The Bank Credit (Bank Asset) Paradigm

One possible way to understand the relevant mechanism is along Hicksian lines. Equations (1) to (3) yield a relation between income and the interest rate which is consistent with equilibrium in the commodity market and is the standard IS schedule:

$$I(r) = S(Y) \tag{5.3}$$

Then substituting (4.1) and (5.2) into the equilibrium condition (12), we obtain a second relation between Y and r

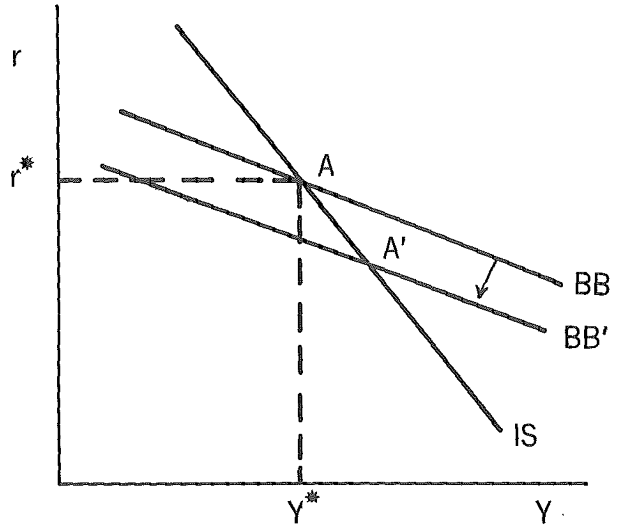
$$B(r, Y) = I_d(r) - S_d(Y) + \Delta M1_d(r, Y) = \overline{B} \tag{5.4}$$

It represents the set of (Y, r) values consistent with equilibrium in the market for bank loans, given the exogenous constraint on bank lending. It will be referred to as the BB schedule (or curve) and replaces the LM schedule. The simultaneous solution of the two equations (5.3) and (5.4) yields the equilibrium values of Y and r and of all the remaining variables including the money supply. The solution is exhibited graphically in Figure 1. The BB curve is the graph of (5.4). Its slope is given by:

$$\left.\frac{dr}{dY}\right|_{BB} = -\frac{B_Y}{B_r} = \frac{dS_d/dY - \partial[\Delta M1_d]/\partial Y}{dI_d/dr + \partial[\Delta M1_d]/\partial r} \tag{5.5}$$

where B_Y and B_r are the partial derivatives of the borrowing function (5.4) with respect to income and the interest rate respectively. The slope of the BB curve can be either negative or positive: for, while the denominator is necessarily negative the numerator can be of either sign depending upon the relative magnitudes of the marginal propensity to save and the marginal effect of income on the demand for money for the deficit units. Figure 1 illustrates the case when the BB curve, like the IS, has a negative slope. The slope of the BB

Figure 1



curve is expected to be less steep than the slope of the IS curve which is given by

$$\left.\frac{dr}{dY}\right|_{IS} = \frac{dS/dY}{dI/dr} \tag{5.6}$$

as shown in Figure 1. This proposition will hold in the limiting case when deficit units hold no money balances, since borrowing comes from the deficit units and their response to a change in r relative to a change in Y would tend to be larger than for the population at large. As the size of $\partial[\Delta M1_d]/\partial Y$ increases relative to dS_d/dY, the BB curve becomes flatter with the curve rotating in a counterclockwise fashion.

The intersection of the IS and BB curves at point A determines the equilibrium values Y* and r*. The equilibrium will be stable as long as the slope of the BB curve is algebraically larger than the slope of the IS curve. A sufficient condition for stability is that $\partial[\Delta M1_d]/\partial Y \geq dS_d/dY$ which implies that the slope of the BB curve is nonnegative.[10] But this condition is unnecessarily restrictive, since the equilibrium is stable even when the slope of the BB curve

[10] This, of course, assumes that the IS curve has a negative slope as it is usually assumed. If the IS has a positive slope, then the (positive) slope of the BB curve must be larger than that of the IS for a stable equilibrium (this is consistent with the general stability condition stated in the text). Clearly, if the BB curve has a negative slope and the IS has a positive slope, the equilibrium is unstable. The implications of a positively sloped IS curve for the effectiveness of monetary policy in the IS-LM framework are examined in W.L. Silber [1971].

is negative as long as it is less steep (algebraically larger) than the slope of the IS as illustrated in Figure 1.

What is the effect of the monetary authority allowing banks to increase lending from B to say B′? Clearly such a policy does not affect the IS, but the BB curve must shift. The shift is downward as shown in Figure 1 since, with income held constant, to induce a larger borrowing requires a lower r. The shifted BB, denoted BB′, intersects IS at point A′ to the right of A. Thus, as one might expect, the expansion of bank lending results in a lower interest rate and a higher income. The mechanism behind this result may be described roughly as follows. Banks, in order to expand loans, must bid down the interest rates so as to induce an expansion of investment and the demand for credit. The expansion of investment results in higher income and saving to match the increased investment (though the rise in income moderates the expansion in loan demand).

The change in the equilibrium level of nominal income induced by a change in the amount of available bank credit is given by

$$\frac{dY}{dB} = \left[B_Y + B_r \frac{S_Y}{I_r}\right]^{-1} \tag{5.7}$$

which can be referred to as the "bank credit multiplier." Note that the condition for a stable equilibrium implies that $dY/dB > 0$. The value of the multiplier will be greater than one if

$$\frac{1 - B_Y}{S_Y} > \frac{B_r}{I_r} \tag{5.8}$$

A nececessary (but not sufficient) condition for the above inequality to hold is that $B_Y < 1$ or, from (4.1) that $\partial \Delta M1_d/\partial Y < 1 + dS_d/dY$. For given values of the slope of the IS curve and the marginal effect of the interest rate on the demand for credit, B_r, the expansionary effect of an increase in bank credit on investment and income decreases as $B_Y = \partial[\Delta M1_d]/\partial Y - dS_d/dY$ increases. In other words, if the income generated by the increase in bank credit increases the deficit units' demand for money balances by more than it increases their saving, then the "bank credit multiplier" declines.

The main point of this analysis, however, is to show that in this type of financial structure, the functioning of the monetary mechanism could take a form quite different from that described by the standard paradigm: the monetary authority can control income by controlling bank credit (or bank assets) which in turn controls the rate of investment and thus finally income (and prices, if flexible).

1. Bank Credit and the Demand for and Supply of Investment Funds

This conclusion can be supported by an alternative graphic apparatus which is also useful for examining the consequences of relaxing the assumption of competitive bank behavior and allowing for such frequent phenomena as ceilings on deposits and/or loan rates, with associated credit rationing. For this alternative analysis, it is convenient to replace the demand for borrowing function (4.1) by the equity investment function (4.7) and to distinguish between the loan rate, r, and the rate on the nonmonetary liabilities of banks (savings deposits), r_s. The supply of equity funds is given by

$$\Delta E = E(r_s, Y) = I_s(r_s) + S_d(Y) \tag{5.9}$$

which is expressed as a function of r_s because it reflects the investment of surplus units, for whom the opportunity cost of direct investment is clearly the savings deposit rate; furthermore, it is a decreasing function of r_s as a rise in r_s will shift funds from investment toward bank liabilities. From equations (4.7), (4.8) and (5.4) we also have that

$$I = E(r_s, Y) + \bar{B} - \Delta M1_d(r, Y) \tag{5.10}$$

where $\bar{B}$ is the total flow of bank credit controlled by the monetary authorities. Equation (5.10) may be thought of as giving the supply of funds available for investment — equity funds plus that portion of total borrowing which is not employed in financing a change in the desired stock of money by deficit units. Note that, given the total amount of credit controlled by the central bank, a decrease in the stock of money held by the deficit units over the period increases the supply of funds available for investment. Equation (5.10) is a function of the two interest rates and income; but the income variable can be eliminated employing equations (1) and (3) which imply that

$$Y = S^{-1}(I) \tag{5.11}$$

Substituting (5.11) into (5.10) and solving for I yields

$$I = \Phi(\bar{B}, r, r_s) \tag{5.12}$$

which is an increasing function of B and r and a decreasing function of r_s. This can be readily seen by differentiating totally (5.10) subject to (5.11) to get

$$dI = \gamma\,[(\partial E/\partial r_s)dr_s - (\partial \Delta M1_d/\partial r)dr + dB]$$

$$\text{where } \gamma = S_Y[S_Y - \partial E/\partial Y + \partial \Delta M1_d/\partial Y]^{-1} > 0 \tag{5.13}$$

$$\text{since } \partial E/\partial Y = dS_d(Y)/dY < dS/dY = S_Y$$

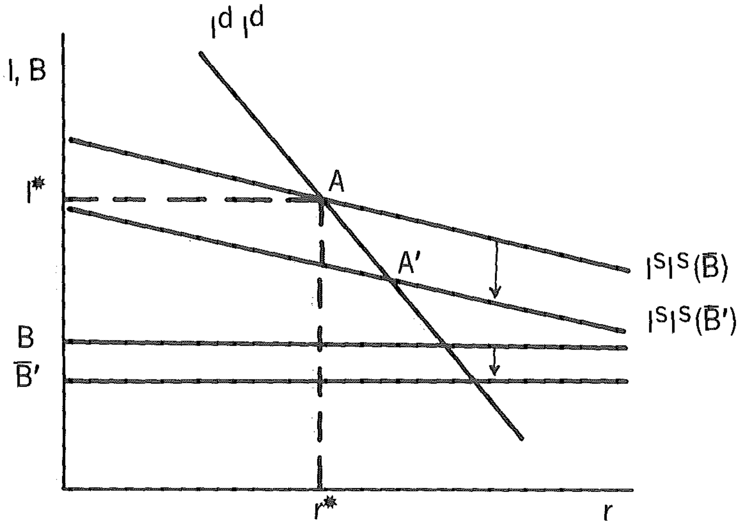
$$\partial E/\partial r_s = dI_s(r_s)/dr_s < 0$$

Note that the marginal propensity to save of all deficit units out of *total* income is less than the aggregate MPS even when all individual units have identical income elasticities of saving.

Equation (5.12) shows the supply of funds available for investment at different levels of bank credit and for values of the interest rates which are consistent with equilibrium in the commodity market. This equation together with equation (2), which expresses the demand for investment funds, and equation (14b), which relates the two interest rates, form a complete system which determines the equilibrium values for I, r, and r_s. The equilibrium level of income is then obtained from (5.11).

In Figure 2 we show the determination of the equilibrium level of investment and the interest rate for the case of competitive markets, already examined in Figure 1. The curve labeled I^dI^d is the graph of the investment function (2), or demand for investment funds. To graph the supply function (5.12) we express r_s in terms of r using (14b). As can be seen from equation (5.13), the *net* effect of an increase in the interest rate on the supply of investment funds can be either positive or negative depending upon the relative magnitudes of $\partial E/\partial r_s$ and $\partial \Delta Ml_d/\partial r$. Figure 2 illustrates the case when the net interest rate effect is negative. The curve I^sI^s represents the graph of (5.12) for a given increment of bank credit $\overline{B}$ fixed by the monetary authority. It represents a weighted sum of the exogenous supply of bank credit represented by the horizontal $\overline{BB}$ curve and a second component which represents the supply of equity funds net of any accumulation of money by the deficit units, which is a decreasing function of r. The intersection of I^dI^d and I^sI^s, at point A determines the equilibrium value of I and r (from which r_s and Y can be inferred).

Figure 2



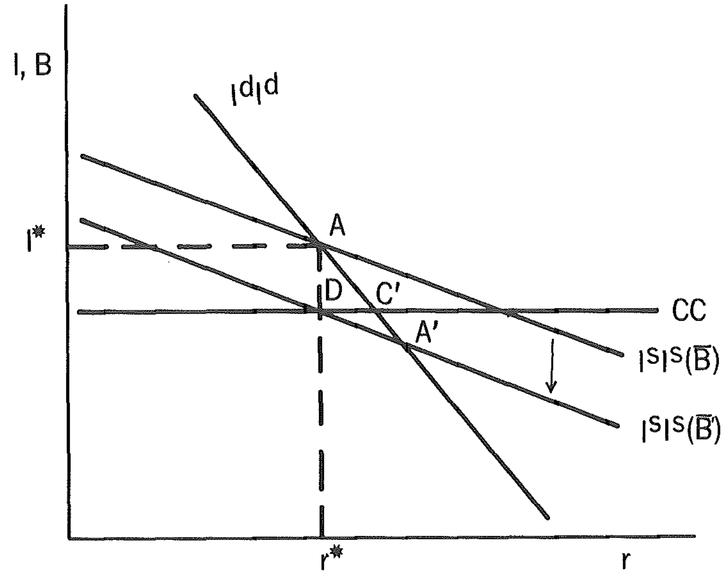
It is apparent from Figure 2 how control of nominal income can be achieved through the management of bank credit, which affects directly the debt financed investment, and indirectly, the equity financed component. An expansion (reduction) of bank credit shifts the I^sI^s curve up (down) leading to an expansion (reduction) of the equilibrium level of investment and income. Figure 2 illustrates the effect on investment and the interest rate of a reduction of bank credit from $\overline{B}$ to $\overline{B}'$. This leads to a downward shift of the I^sI^s resulting in a higher interest and lower investment at point A′. The downward shift of the I^sI^s curve will be greater than the downward shift in the B curve if the resulting fall in income reduces equity funds by a greater amount than it decreases the accumulation of money balances by the deficit units. As can be seen from (5.13), in this case, when $\partial E/\partial Y > \partial \Delta Ml_d/\partial Y$, the marginal effect of bank credit on the supply of funds for investment, γ, is greater than one. This is the case illustrated in Figure 2.

2. Interest Rate Ceilings and Credit Rationing

We examine next the effects of a change in bank credit on investment when there is an effective ceiling on the savings deposit rate at some level $\overline{r}_s$ smaller than its equilibrium value $r_s^* = r^* - d$. It is seen from equation (5.12) that under these conditions the supply of investment funds depends only on the two policy variables $\overline{B}$ and $\overline{r}_s$, and is no longer a function of r. In terms of Figure 2, the I^sI^s curve becomes a horizontal line. One interesting implication is that the ceiling may make investment less responsive to the change in bank credit decreed by the monetary authority. In terms of our figure, suppose the system was initially at point A with $B = \overline{B}$, and no ceiling on r_s. Suppose that the monetary authority reduces bank credit to $\overline{B}'$ but at the same time it requires banks to hold the deposit rate at the initial level $r^* - d$. The new supply function is then given by the horizontal line CC going through the point of intersection of I^sI^s, with the perpendicular through A. This is shown in Figure 2A. If I^dI^d were unchanged, the equilibrium would be at point C′ instead of A′, at a lower interest rate and at a higher level of investment (and thus income) than without the ceiling. Actually, the I^dI^d curve may also be expected to change because it depends in principle on both r and r_s. If r_s is constant, the interest response will be reduced, as a rise in r will not affect the investment of the surplus units which respond to r_s. In terms of Figure 2A the interest ceiling will cause I^dI^d to rotate counterclockwise around A. The intersection of CC with this new line will be to the right of C′ — implying a somewhat higher interest rate — but the equilibrium level of investment is the same as at point C, and therefore larger than without the ceiling.

The reason that in this case a ceiling reduces the effectiveness of credit policy can be readily understood. Indeed, holding the deposit rate artificially below $r^* - d$ tends to encourage the surplus units to shift away from bank deposits toward physical capital. It thus encourages disintermediation, and when the supply of bank credit is fixed by the monetary authorities, disinter-

Figure 2A



mediation increases total investment and is therefore expansionary. By the same token, the elimination of ceilings on deposit rates, with a fixed credit policy, is contractionary.

The above analysis also provides the basis for understanding the effects of credit rationing. To see this, suppose again the system starts with $B = \bar{B}$ and no rationing, so the equilibrium is at A, and let the monetary authority reduce B from $\bar{B}$ to $\bar{B}'$, while at the same time preventing banks from raising the lending rate above the initial level r*. Under these conditions, the deposit rate itself must be fixed at the initial level, and we can immediately conclude that the supply function must again become CC as shown in Figure 2A. Since at the initial rate r_s^*, the demand for investment funds is given by the ordinate of point A, we can infer that the distance of A from CC or DC′ measures the extent of unsatisfied demand, or credit rationing. Finally, it is apparent from Figure 2A and the previous paragraph that credit rationing, just like interest ceilings can reduce the effectiveness of credit policy — quite aside from its negative effects on the allocation of available credit. It is worth noting that this conclusion that rate ceilings and credit rationing reduce the effectiveness of a given change in bank credit is diametrically opposite to the results that have been reported for the case in which the intermediate target variable is M1 (See e.g., Modigliani [1963]). In that case in fact ceilings tend to reduce the variation in market rates that accompany a given reduction in income, which in turn reduces the required change in M1.

B. The Bank Deposits (Bank Liability) Paradigm

There is an alternative way of looking at the monetary mechanism associated with the control of bank credit, which may be labelled the bank liability paradigm. The monetary authority can impose a limit on the total amount of liabilities that banks can create each period:

$$\Delta M2 = \overline{\Delta M2} \tag{5.14}$$

where $\Delta M2 = \Delta M1 + \Delta SD$ is the increase in the sum of all claims on banks. Such a constraint can be enforced directly by imposing uniform reserve requirements against all bank deposits. But for the simple financial structure of our model, when the monetary authority controls bank credit, it implicitly imposes a limit on $\Delta M2$ as can be inferred from equations (11) and (12) of Table 3.

In Section IV, we derived the demand function for total bank liabilities, equation (4.3), which under the assumption that r_s and r are related by a constant spread, is given by

$$\Delta M2^d = L2(r, Y) = S_s(Y) - I_s(r) + \Delta M1_d(r, Y) \tag{5.15}$$

It represents the excess of saving over investment of surplus units plus the change in the stock of money (M1) held by deficit units over the period. Equations (5.14) and (5.15) yield the relation

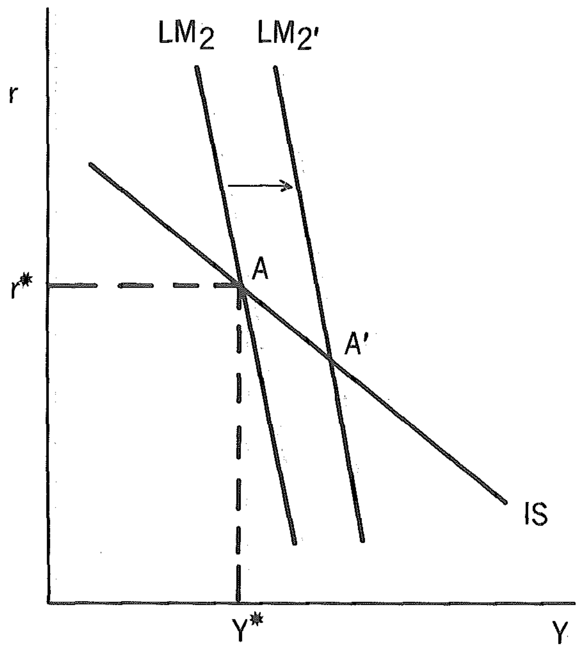
$$L2(r, Y) = \overline{\Delta M2} \tag{5.16}$$

which defines the set of all combinations of interest rates and income levels for which the demand for a change in total bank liabilities equals the exogenously fixed supply. We will refer to this equation as the LM2 equilibrium schedule or curve. Combining the LM2 schedule with the IS schedule yields a system of two equations in Y and r which determines their equilibrium values and consequently the equilibrium values of all the other variables in our model summarized in Table 3. Figure 3 exhibits graphically the determination of the equilibrium values, Y* and r*, for the case when the LM2 curve has a negative slope like the IS. The slope of the LM2 schedule is given by

$$\left.\frac{dr}{dY}\right|_{LM2} = -\frac{L2_Y}{L2_r} = \frac{dS_s/dY + \partial[\Delta M1_d]/\partial Y}{dI_s/dr - \partial[\Delta M1_d]/\partial r} \tag{5.17}$$

and may be either positive or negative depending upon the relative magnitudes of the two terms in the demoninator both of which are negative. Figure 3 shows the LM2 curve when $|dI_s/dr| > |\partial[\Delta M1_d]/\partial r|$ i.e., when the demand for M1 is less sensitive to changes in the interest rate than investment demand. When the LM2 has a negative slope, the equilibrium is stable provided that slope is algebraically smaller than the slope of the IS, that is if

Figure 3



the LM2 curve is steeper than the IS as shown in Figure 3. When the LM2 has a positive slope, the equilibrium is necessarily stable. Note that a positively sloped LM2 curve will always be steeper than the standard LM curve whose slope is given by $-(\partial M1/\partial Y)/(\partial M1/\partial r)$.

The effect of an increase in the flow of total bank liabilities on the equilibrium level of income and the interest rate is illustrated in Figure 3. The increase in $\Delta M2$, from $\overline{\Delta M2}$ to $\overline{\Delta M2}'$, shifts the LM2 curve to the right since, for a given interest rate, a larger income is necessary to induce a larger saving and thus a larger demand for bank deposits. An expansion of bank liabilities just like an expansion of bank assets yields a new equilibrium at point A' with a lower interest rate and higher income.

But what is the underlying mechanism causing the shift from A to A'? One might be tempted to account for it along the lines of the conventional IS-LM paradigm. In order for banks to take advantage of the profitable opportunity of expanding deposits from $\overline{\Delta M2}$ to $\overline{\Delta M2}'$ they must induce the public to hold more of $\Delta M2$ and this is accomplished through the lower interest as well as the higher income resulting from higher investment. But in reality this explanation is unacceptable. In the first place, the demand for M2 in contrast to that for M1, is an *increasing* function of r; thus banks would have to raise rather than lower r_s (and thus r) to induce larger deposit holdings. But, this would clearly move the system in the wrong direction, because the fall in Y resulting from the higher r would end up reducing the demand for ΔM2. In the second place, there is no need for banks to change r_s to induce the public to hold more deposits because, under our simple financial structure and a closed economy, if banks expand their deposits, the public has no choice but to hold them.

We suggest that, in reality, to make sense of the monetary mechanism through bank liabilities, one must fall back on the bank credit paradigm recognizing that deposits and loans are in a one-one relation, and that the only way the bank can in fact expand liabilities is by buying assets, i.e., increasing bank loans. It then follows that to expand M2, the banking system must induce the public to expand its borrowing, which it can only do by lowering r; this expands investment and therefore also income and saving. It is the rise in income and saving that finally raises the demand for total bank liabilities more than the offsetting fall generated by the rise in r and r_s. These considerations suggest that the graphical analysis of Figure 3 is purely formal. Whether the control is exercised through bank liabilities or bank assets, the underlying mechanism can adequately be understood only through the bank credit paradigm of Figures 1 or 2.

A different way of interpreting the mechanism at work, which is less obvious but perhaps more suggestive rests on the observation, already noted above, that in our stripped down financial structure, households cannot save in the form of money fixed claims except insofar as banks are permitted by the monetary authority to create such claims against themselves in the process of providing credit to the private sector. When an individual increases his savings deposits by transferring "money" to his savings account, he does not thereby enable the bank to expand credit since the operation creates no excess reserves. Thus, saving in the form of deposits is entirely analogous to hoarding; in order to become a source of funds for investment it must be accompanied by a simultaneous expansion of bank liabilities. Only then is the circular flow maintained. According to this interpretation, the equilibrium level of income, Y*, can be seen as the only level of income for which the rate of "hoarding" coincides with the rate of creation of deposits and lending; for a larger Y, hoarding would exceed the rate of lending and the income could not be maintained.

C. The Markets for Bank Loans and Liabilities

Our analysis up to this point has examined how the quantity of bank loans or the quantity of total bank liabilities affects aggregate income by considering the determination of simultaneous equilibrium in two markets, the markets for goods and bank credit or the markets for goods and bank liabilities. Of course, the budget constraint $S + \Delta L^d = I + \Delta M2^d$ implies that in each of these cases the equilibrium values of income and the interest rate which clear any two markets will clear the third market as well. We will now discuss an alternative paradigm for describing the determination of equilibrium which highlights the interaction of the two financial markets in response to a change in monetary policy and, in a certain sense, synthesizes the previous analysis.

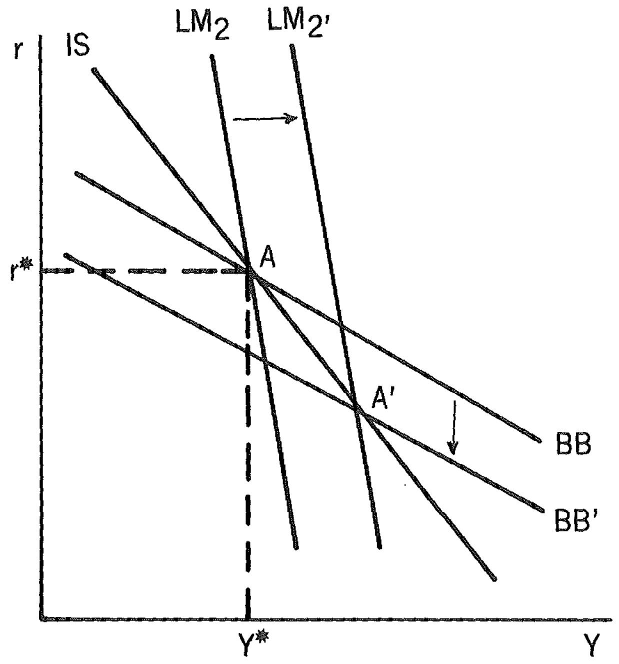
This paradigm focuses on the conditions for equilibirum in the two financial markets: the equilibrium condition (5.4) in the bank credit market and the equilibrium condition (5.16) in the bank liabilities market. Recalling that, for a given credit target, $\bar{B}$, controlled by the monetary authority, $\Delta M2 = B$, these equilibrium conditions are rewritten as:

$$B(r, Y) = I_d(r) - S_d(Y) + \Delta M1_d(r, Y) = \bar{B} \quad (5.18)$$

$$L2(r, Y) = S_s(Y) - I_s(r) + \Delta M1_d(r, Y) = \bar{B} \quad (5.19)$$

The simultaneous solution of these equations determines the equilibrium values of income and the interest rate which clear these two markets as functions of the policy variable, B. The determination of the equilibrium is illustrated in Figure 4. The curves BB and LM2 represent the equilibrium conditions (5.18) and (5.19) respectively. They are both drawn with a negative shape, as in Figures 1 and 3, although, as we discussed earlier, both curves may have a positive slope. It can be shown, however, that whatever the slope of the two curves, the slope of LM2 can be expected to exceed that of BB in

Figure 4



absolute value. This can also be inferred from our earlier discussion which showed that, when the two curves have a negative slope, the equilibrium is stable when the BB curve is flatter than the IS curve and the LM2 curve is steeper than the IS curve. The equilibrium level of income and the interest rate, corresponding to the exogenously fixed bank credit $\overline{B}$, is given by the intersection of BB and LM2 at point A with coordinates (Y*, r*). Moreover, the budget constraint of the nonbank sector implies that for these equilibrium values, aggregate saving is equal to aggregate investement so that the IS curve intersects the two other curves at point A as shown in Figure 4.

Equations (5.18), (5.19) and Figure 4, offer a yet different perspective on the mechanism through which control of bank credit results in control over nominal income. It can be roughly described as follows: for a given level of income, the flow of bank credit fixed by the monetary authority determines the borrowing and investment of the deficit units and the interest rate in the loan market. This rate determines the deposit rate which controls the rate of investment of the surplus units. Finally, the sum of the investment of the two groups determines in the usual fashion the level of income at which saving matches investment.

We examine next how aggregate income responds to an expansion of bank credit from $\overline{B}$ to $\overline{B}'$. We know from our previous discussion, illustrated in Figures 1 and 3, that an increase in $\overline{B}$ shifts the BB curve down and the LM2 curve up. Consequently, as shown in Figure 4, the intersection of the new equilibrium schedules BB′ and LM2′ generates a new equilibrium at point A′ characterized by a lower interest rate and a higher investment and income. Note that the IS curve is not affected by the expansion of bank credit and that it must intersect the other two schedules at point A′ since, at the new equilibrium, aggregate saving equals aggregate investment. Note also that control over nominal income is achieved without direct control over the money supply which is endogenously determined by the demand of the public. That demand is, of course, also determined in the last analysis by bank credit which determines both of the arguments of the demand for money, Y and r.

It should be obvious that the equation and graphs we have used above to explain the working of a bank credit target apply directly to a target consisting of all bank liabilities, or M2, in our streamlined financial structure. Indeed, within that structure the two alternatives are simply indistinguishable. From a formal point of view one has merely to replace $\overline{B}$ by $\overline{\Delta M2}$ in (5.18) and (5.19). It follows from this that there is also a unique relation between nominal income and M2, a relation which would provide the basis for the choice of an M2 target. As we discussed in Section V.B, however, for the purpose of understanding the mechanism through which an increase in M2 or bank liabilities is accompanied by an expansion of income, the relevant paradigm is the bank credit paradigm developed above. This is because, in our system, bank liabilities can be created or destroyed only at the initiative of banks in the process of expanding or contracting bank loans.

This proposition is of considerable interest in that it brings into question a common view, that has been commanding growing support recently, that an increase of M2 is expansionary because it somehow increases "the liquidity" of the economy and/or because the non M1 part of M2 is also endowed with moneyness properties and thus may be a better measure of money than the conventional M1. According to our paradigm, instead, a rise in M2 is expansionary because it is the unavoidable accompaniment — the other side of the coin — of a process of credit expansion. It is the credit expansion and resulting demand for investment that is expansionary, both directly and through consumption multiplier effects, and causes the positive association between M2 and nominal income.

VI. The Choice among Alternative Intermediate Targets

A monetary authority confronted with a simple financial structure like the one described by our model could elect to enforce any one of a number of alternative intermediate targets and, in particular: (a) the interest rate, (b) M1, (c) bank credit, and (d) M2 (which in our model is equivalent to bank credit). If the monetary authority knew all the behavioral relationships without error, then it would be immaterial which of the three intermediate targets it would choose to pursue; indeed, provided these targets were chosen consistently, they could be enforced simultaneously. But in the presence of uncertainty, whether due to instability of behavior or ignorance on the part of the monetary authority, any intermediate target chosen will fail to achieve precisely the final target value of income, since income is a random variable. Moreover, the "failure" of the intermediate target, which can be measured by some function of the deviation between the target and realized income, will be different for each intermediate target. Consequently, in the presence of uncertainty the monetary authority faces the substantive problem of choosing the "optimal" intermediate target, that is the target that can be expected to result in the best performance. In this section we examine considerations which are relevant for the choice of an intermediate target and, in particular, the way the financial structure of the economy, the values of certain behavioral parameters and the relative stability of the behavioral relations affect this choice.

To examine these questions we consider a linearized version of the behavioral equations of the model presented in Section IV under the assumption that the uncertainty of the system can be described by additive stochastic disturbances:

$$S = s_0 + sY + u_s \qquad s_0>0, s>0 \qquad (6.1)$$

$$I = i_0 + ir + u_i \qquad i_0>0, i<0 \qquad (6.2)$$

$$M1^d = k_0 + k_1 Y + k_2 r + v_1 \qquad k_0>0, k_1>0, k_2<0 \qquad (6.3)$$

$$M2^d = h_0 + h_1 Y + h_2 r + v_2 \qquad h_0>0, h_1>0, h_2>0 \qquad (6.4)$$

$$L^d = b_0 + b_1 Y + b_2 r + \eta \qquad b_0>0, b_1 \gtrless 0, b_2<0 \qquad (6.5)$$

The model is linearized at the target level of income, $\bar{Y}$, and the associated interest rate which clears the commodity market, $\bar{r}$. Consequently, the parameters of the linear model are the values of the derivatives of the general functions shown in Table 3 evaluated at $(\bar{Y}, \bar{r})$. The financial asset demand equations have all been expressed as demands for terminal stocks; thus the constant terms in these equations incorporate the lagged values of these assets which are taken as known and the stochastic terms represent the errors in the demands for the end-of-period stocks. It is assumed that the lagged values of the financial variables imply income and interest rate values reasonably close to their target values so that the linear approximation is a valid representation of the system.

It should be apparent from our discussion of the model in Section IV that both the parameters and the stochastic disturbances of equations (6.4) and (6.5), which define the demand for M2 and bank loans, are not independent of the parameters and stochastic disturbances of equations (6.1) to (6.3) which define the aggregate demands for saving, investment and money (M1). It will be convenient for the subsequent analysis to summarize here certain relationships between the equation parameters:

$$h_1 = \frac{dM2}{dY} = \frac{dS_s}{dY} + \frac{dM1_d}{dY} = s_s + k_{1d} \tag{6.6}$$

$$h_2 = \frac{dM2}{dr} = -\frac{dI_s}{dr} + \frac{dM1_d}{dr} = -i_s + k_{2d} \tag{6.7}$$

$$b_1 = \frac{dL}{dY} = -\frac{dS_d}{dY} + \frac{dM1_d}{dY} = -s_d + k_{1d} \tag{6.8}$$

$$b_2 = \frac{dL}{dr} = \frac{dI_d}{dr} + \frac{dM1_d}{dr} = i_d + k_{2d} \tag{6.9}$$

where s_d and s_s are the marginal propensities to save out of *total* income of deficit and surplus units respectively; k_{1d}, k_{2d} are the marginal effects of total income and the interest rate on the demand for M1 by deficit units; and i_d, i_s are the marginal effects of the interest rate on the investment of deficit and surplus units respectively. Thus, in principle, differences in the behavioral responses of surplus and deficit units would affect the equilibrium of the model and the stabilization efforts of the monetary authorities. We will assume, however, that deficit and surplus units have the same income and interest rate *elasticities* of saving, investment and money demand at least as a first approximation. This hypothesis allows us to express the sectoral marginal income and interest rate effects as proportional to the corresponding aggregate parameters with the proportionality factors reflecting the relative shares of saving, investment and money of deficit and surplus units:[11]

$$
\begin{aligned}
s_d &= w_s s \quad \text{and} \quad s_s = (1-w_s)s \quad \text{where} \quad w_s = \frac{S_d}{S} \\
i_d &= w_i i \quad \text{and} \quad i_s = (1-w_i)i \quad \text{where} \quad w_i = \frac{I_d}{I} \qquad (6.10) \\
k_{1d} &= w_m k_1 \quad \text{and} \quad k_{2d} = w_m k_2 \quad \text{where} \quad w_m = \frac{M1_d}{M1}
\end{aligned}
$$

The proportionality factors w_s, w_i, w_m are the values of the relative shares evaluated at the target state of the economy. We assume that these relative shares do not change appreciably for small variations of Y and r around the target state and can be taken as constant.

The stochastic disturbances added to equations (6.1)–(6.5) are also interdependent because of the structural dependence of the behavioral equations implied by the budget constraints. Given the stochastic disturbances of the first three equations, and denoting by u_s^+, u_s^-, u_i^+, u_i^-, v_1^+, v_1^- the disturbances affecting the saving, investment and money demands by surplus (+) and deficit (–) units, we have that

$$
\begin{aligned}
v_2 &= u_s^+ - u_i^+ + v_1^- \\
\eta &= u_i^- - u_s^- + v_1^-
\end{aligned} \qquad (6.11)
$$

If we make the reasonable assumption that the disturbances affecting the demands of surplus and deficit units are proportional to the aggregate disturbances with the proportionality factors reflecting the relative shares of these two groups in each market, we can write

$$
\begin{aligned}
v_2 &= (1-w_s)u_s - (1-w_i)u_i + w_m v_1 \\
\eta &= w_i u_i - w_s u_s + w_m v_1
\end{aligned} \qquad (6.12)
$$

The above equations imply the relationship

$$u_s + \eta = u_i + v_2 \qquad (6.13)$$

which is consistent with, and an implication of, the aggregate budget con-

[11] For example, the marginal propensity to save out of total income of deficit units, s_d, can be written as $s_d = dS_d/dY = (dS_d/dY_d)(dY_d/dY) = e_d(S_d/Y_d)(dY_d/dY)$ where e_d is the income elasticity of saving of deficit units. The aggregate marginal propensity to save can be written as $s = dS/dY = e(S/Y)$ where e is the aggregate income elasticity of saving. If $e_d = e$ and the elasticity of Y_d with respect to Y is unity, it follows that $s_d = (S_d/S)s = w_s s$.

straint of the nonbank sector. We have thus expressed the random disturbances affecting the demands for bank credit and M2 as linear combinations of the three disturbances affecting the commodity and money markets (u_s, u_i, v_1). It is assumed that these three random variables have the following properties:

$$E[u_s] = E[u_i] = E[v_1] = 0$$

$$E[u_s^2] = \sigma_s^2,\ E[u_i^2] = \sigma_i^2,\ E[v_1^2] = \sigma_{v1}^2 \tag{6.14}$$

$$E[u_s u_i] = E[u_s v_1] = E[u_i v_1] = 0$$

The variances and covariances of the remaining disturbances can then be expressed in terms of the above employing (6.12). It is perhaps worth reemphasizing that the relations between (v_2,η) and (u_i, u_s, v_1) summarized by (6.12) reflect two hypotheses which can be relaxed in a more general model: (1) that there are no additional disturbances affecting the behavior of deficit and surplus units other than aggregate disturbances u_i, u_s, v_1 and (2) that these disturbances are distributed proportionally between the two groups with proportionality factors which are invariant to changes in income or the interest rate.

When the monetary authority chooses a particular financial variable as an intermediate target and sets it at a given value, its action determines a corresponding set of values for all the other variables of the model, the target income variable and the remaining financial variables. In a stochastic setting, all the endogenous variables are random variables, and thus the "reduced-forms" relating each endogenous variable to the intermediate target are functions of the various stochastic disturbances affecting the system. Clearly the effects of these stochastic terms on the target income variable will be different under alternative intermediate targets since alternative targets result in different reduced forms. The reduced forms relating aggregate income to each of the intermediate targets defined in our model [r, M1, M2 or L] can be readily determined by solving simultaneously an appropriate subset of the equations of the model. Employing the condition for equilibrium in the commodity market, we combine (6.1) and (6.2) to get a linear representation of the IS schedule,

$$Y = a_0 + a\,r + u \tag{6.15}$$

where $a_0 = (i_0 - s_0)/s$, $a = i/s < 0$ and $u = (u_i - u_s)/s$
When the monetary authority chooses the interest rate as the target, the above equation also represents the reduced form relating income to this intermediate target. Thus when $r = \bar{r}$, the random variations of income are solely due to the disturbances affecting aggregate saving and investment, and we can rewrite (6.15) as

$$Y|_{\bar{r}} = a_0 + a\bar{r} + u \tag{6.16}$$

When the intermediate target is M1, the reduced-form equation relating income to that target is obtained by solving simultaneously (6.3) and (6.15), which yields

$$Y|_{\overline{M1}} = \beta_1[a(\overline{M1} - k_0) + a_0k_2] + \beta_1[k_2u - av_1] \tag{6.17}$$

where $\beta_1 = (ak_1 + k_2)^{-1}$.

Similarly, the reduced forms for income when M2 or bank credit are the intermediate targets can be obtained by solving simultaneously (6.4) and (6.15), and (6.5) and (6.15) respectively to get

$$Y|_{\overline{M2}} = \beta_2[a(\overline{M2} - h_0) + a_0h_2] + \beta_2[h_2u - av_2] \tag{6.18}$$

where $\beta_2 = (ah_1 + h_2)^{-1}$

and

$$Y|_{\bar{L}} = \beta[a(\bar{L} - b_0) + a_0b_2] + \beta[b_2u - a\eta] \tag{6.19}$$

where $\beta = (ab_1 + b_2)^{-1}$

If the objective of monetary policy is to minimize the variance of income about the target value $\bar{Y}$, then the optimal intermediate target Z is the one which minimizes

$$V(Y|Z) = E[(Y - \bar{Y})^2|Z] \tag{6.20}$$

It is well known that for this kind of quadratic objective function and with a linear model incorporating additive disturbances the value of each intermediate target which minimizes the variance of income is given by its value which achieves the income target under certainty. In other words, the optimal value for each intermediate target under uncertainty is its "certainty equivalent." It follows that when the intermediate target is set at this optimal value, the expected value of income is equal to the target level of income. Thus, for example, the optimal value of M2 is given by $M2^* = [\bar{Y}/\beta_2 + ah_0 - a_0h_2]/a$ and when $M2 = M2^*$ we have that $Y|_{M2^*} = \bar{Y} + \beta_2[h_2u - av_2]$ and $E[Y|M2^*] = \bar{Y}$. Consequently, when each intermediate target is set at its optimal (certainty equivalent) value, the resulting expected value of income will be the same under all alternative intermediate targets, but the resulting income variances will differ and will be equal to the variances of the stochastic terms of the reduced forms (6.16)–(6.19):

$$V(Y|r^*) = E[u^2] \tag{6.21}$$

$$V(Y|M1^*) = E[\beta_1^2(k_2u - av_1)^2] \tag{6.22}$$

$$V(Y|M2^*) = E[\beta_2^2(h_2u - av_2)^2] \tag{6.23}$$

$$V(Y|L^*) = E[\beta^2(b_2u - a\eta)^2] \tag{6.24}$$

The conditions which determine when M1 is a more appropriate intermediate target than the interest rate have been derived by W. Poole [1970] in a well-known article and will not be repeated here. Instead we will concentrate on examining the conditions which are relevant in deciding whether bank credit or M2 are superior to M1 and r as intermediate targets. Since in this model controlling M2 is equivalent to controlling bank credit, it is sufficient to limit our comparison to one of these aggregates.

To assess the relative magnitudes of the variances of income under an M1 and an M2 target, we first determine the relationships between the parameters and error terms in (6.22) and (6.23). Using equations (6.6)–(6.7) and (6.10) we find that

$$\beta_2 = [ah_1 + h_2]^{-1} = [i(w_i - w_s) + w_m i(\frac{k_1}{s} + \frac{k_2}{i})]^{-1} \tag{6.25}$$

It can also be readily verified that $\beta = \beta_2$.

Since $\beta_1 = [ak_1 + k_2]^{-1} = [i(\frac{k_1}{s} + \frac{k_2}{i})]^{-1}$, it follows that (6.25)

$$\beta_2 = [i(w_i - w_s) + w_m/\beta_1]^{-1} \tag{6.26}$$

Note that β_2 and β_1 are proportional to the M2 (or bank credit) and M1 "multipliers" which are given by $dY/dM2 = a\beta_2$ and $dY/dM1 = a\beta_1$. Note also that the magnitudes of β_2 and of the ratio $\beta_2\beta_1$ depend on characteristics of the economy's financial structure which are reflected in the "weight terms" (w_i, w_s, w_m). The term $w_i - w_s = I_d/I - S_d/S = (I_d - S_d)/I$ represents that portion of investment which is financed by borrowing, but $I_d - S_d$ represents only a component of the total change in bank credit (which is also affected by the change in the money balances held by deficit units).

Employing the relationships specified by (6.6–6.7), (6.10) and (6.12) we find that the stochastic component of income when M2 is the intermediate target, which appears in (6.18), can be expressed as

$$\epsilon_{Y|M2} = \beta_2[h_2u - av_2] = \beta_2[w_m(k_2u - av_1) - a(w_i - w_s)u_s] \tag{6.27}$$

Observing that the stochastic component of income under an M1 target is equal to $\epsilon_{Y|M1} = \beta_1[k_2u - av_1]$ and that the parameters β_1 and β_2 are related by (6.26), it follows that

$$\epsilon_{Y|M2} = \lambda\,\epsilon_{Y|M1} + (1-\lambda)(-u_s/s) \tag{6.28}$$

$$\text{where } \lambda = w_m \frac{\beta_2}{\beta_1} = w_m[w_m + \beta_1 i(w_i - w_s)]^{-1} = [1 + \beta_1 i\phi]^{-1}, 0 \leq \lambda \leq 1$$

$$\beta_1 = [i(\frac{k_1}{s} + \frac{k_2}{i})]^{-1}$$

$$\phi = (w_i - w_s)/w_m$$

since $\beta_1 \leq 0, i \leq 0, 0 \leq w_m \leq 1, 0 \leq w_i - w_s \leq 1$

It can also be shown that the error term in the reduced form for income under a bank credit target $\epsilon_{Y|L} = \beta[b_2u - a\eta]$ is equal to $\epsilon_{Y|M2}$ as is expected for our model. Thus the stochastic component of income under an M2 or bank credit policy is a weighted average of two random variables: the stochastic component of income under an M1 target and the random disturbance of the aggregate saving function. The weight term λ depends on the same behavioral parameters which determine the effectiveness of an M1 policy (k_1, k_2, i, s) and on the parameter $\phi = (w_i - w_s)/w_m$ which summarizes the characteristic elements of the economy's financial structure.

The stochastic component of income under an M1 target can be also expressed as a weighted average of the stochastic component of income under an interest rate target and the random disturbance of the money demand function (normalized so that income is the dependent variable):

$$\epsilon_{Y|M1} = \beta_1(k_2u - av_1) = \mu\,\epsilon_{Y|r} + (1-\mu)(-v_1/k_1) \tag{6.29}$$

$$\text{where } \mu = \beta_1 k_2 = k_2[ak_1 + k_2]^{-1} = [1 + \frac{i}{s}\frac{k_1}{k_2}]^{-1}, 0 \leq \mu \leq 1$$

and $\epsilon_{Y|r} = u = (u_i - u_s)/s$ as shown in (6.15)

The variance of income under the alternative intermediate targets are given by

$$V(Y|M2^*) = V(Y|L^*) = \lambda^2 V(Y|M1^*) + (1-\lambda)[1 - \lambda + 2\lambda\mu]\sigma_s^2/s^2 \tag{6.30}$$

$$V(Y|M1^*) = \mu^2 V(Y|r^*) + (1-\mu)^2\sigma_{v1}^2/k_1^2 \tag{6.31}$$

$$V(Y|r^*) = \sigma_u^2 = (\sigma_i^2 + \sigma_s^2)/s^2 \tag{6.32}$$

In deriving (6.30) we have used the fact that (6.14) implies that $E[\epsilon_{Y|M1} u_s] = -\mu\sigma_s^2/s$. A bank credit (M2) target will be superior to a money target (M1) if $V(Y|M2^*) < V(Y|M1^*)$, that is if

$$(1-\lambda)[1-\lambda+2\lambda\mu]\sigma_s^2/s^2 < (1-\lambda^2)\,V(Y|M1^*)$$

which reduces to the requirement that

$$\frac{\sigma_s^2}{s^2} < \alpha\,[\mu^2\,\frac{\sigma_i^2}{s^2} + (1-\mu)^2\frac{\sigma_{v1}^2}{k_1^2}] \qquad (6.33)$$

$$\text{where } \alpha = [(1-\mu)(\mu + \frac{1-\lambda}{1+\lambda})]^{-1}$$

Thus a bank credit (M2) target will be preferable to an M1 target if the variance of the saving function is smaller than a multiple of a weighted average of the (normalized) variances of the investment and demand for money functions. The proportionality factor α depends upon the characteristics of the financial structure of the economy as well as upon behavioral parameters and it is greater than or equal to one.

The conditions which are relevant for judging the superiority of a bank credit (M2) policy can be best discussed by considering a number of limiting cases regarding the relative stability of behavioral relationships and the nature of the economy's financial structure.

Consider first the case when the saving function is much more stable than the investment or money demand functions. In fact suppose that $\sigma_s^2 = 0$. It immediately follows from (6.30), that in this case a credit target is preferable to a money target since $\lambda < 1$ as long as at least part of investment is financed through bank credit, so that $w_i - w_s > 0$. This is a case of "strong dominance" of a credit target policy over a money stock target policy. And the superiority of a credit target is independent of the relative stability of the investment and demand for money functions. The superiority of the bank credit policy relative to a money target policy increases as the proportion of bank financed investment increases and as the money holdings of deficit units decrease.

Consider next the case when the demand for money (M1) function is stable while the investment and saving functions are not. It follows from (6.33) that a credit target is preferable to an M1 target if the ratio of the variances of the real disturbances is smaller than a constant whose value depends upon behavioral and financial structure parameters:

$$\frac{\sigma_s^2}{\sigma_i^2} < \alpha\,\mu^2 \qquad (6.34)$$

This condition will *not* hold when $k_2 = 0$ which implies that $\mu = 0$. Thus if the demand for money is both perfectly stable and totally insensitive to interest rate changes, a money stock policy is superior to an M2 or bank credit policy for any values of the variances of the real shocks and the parameters which define the financial structure.

In the case when the investment function is stable but the saving function and the demand for money function are not, a credit target (M2) is superior to an M1 target if the ratio of the variance of the saving function to the variance of the money demand function satisfies the condition:

$$\frac{\sigma_s^2}{\sigma_{v1}^2} < \frac{s^2}{k_1^2}\alpha(1-\mu)^2 \qquad (6.35)$$

Finally, it is worth noting that when the demand for money function is totally inelastic with respect to the interest rate (so that $k_2 = 0$ and $\mu = 0$), the variance of the disturbance of the investment function does not affect the condition (6.33) which simplifies to

$$\frac{\sigma_s^2}{\sigma_{v1}^2} < \frac{s^2}{k_1^2}(1+\lambda)(1-\lambda)^{-1} \qquad (6.36)$$

The implications of the relative magnitudes of the stochastic disturbances for the choice of an intermediate target can be described concisely for the situation in which one type of disturbance is dominant. For nonextreme values of the parameters which characterize the economy's financial structure and behavior, equations (6.30) to (6.32) imply the following: When the random disturbance of the demand for money function is the dominant source of error (when $\sigma_s/\sigma_{v1} = \sigma_i/\sigma_{v1} \simeq 0$), then an M2 target is superior to an M1 target, but an interest rate target is superior to both. When the dominant disturbance is that of the investment function (when $\sigma_s/\sigma_i = \sigma_{v1}/\sigma_i \simeq 0$), then following a bank credit (M2) target is the best strategy and an interest rate target the worst. Finally, when the disturbance of the saving function dominates the other two (when $\sigma_{v1}/\sigma_s = \sigma_i/\sigma_s \simeq 0$), an M1 target yields the smallest income variance and bank credit is superior to an interest rate target. To sum up, when:

v_1 dominates, then $V(Y|r^*) < V(Y|M2^*) < V(Y|M1^*)$

u_i dominates, then $V(Y|M2^*) < V(Y|M1^*) < V(Y|r^*)$

u_s dominates, then $V(Y|M1^*) < V(Y|M2^*) < V(Y|r^*)$

We examine next the implications of the economy's financial structure, and in particular, the role of debt and equity financing, on the choice of an intermediate target. It is clear from (6.30) and (6.31) that the financial structure affects the variance of income only under a bank credit (M2) target since λ is the only parameter which depends upon $\phi = (w_i - w_s)/w_m$. As noted earlier, at equilibrium the proportion of investment which is financed by borrowing is given by $w_i - w_s$. If all investment is financed through equity, the bank credit and money target policies become equivalent since $\lambda = 1$. In this case all borrowing occurs in order to hold money balances and $V(Y|M2^*) = V(Y|M1^*)$. As the proportion of investment which is financed by borrowing increases, the value of the paramenter λ decreases and the variance of income under a credit target (M2) will decline relative to the variance of income under an M1 target as long as the variance of the saving function is smaller than a weighted average of the variances of the investment and demand for money functions:

$$\frac{\sigma_s^2}{s^2} < \alpha'[\mu^2 \frac{\sigma_i^2}{s^2} + (1-\mu)^2 \frac{\sigma_{vl}^2}{k_l^2}] \tag{6.37}$$

where $\alpha' = \lambda[(1-\mu)(1-\lambda(1-\mu))]^{-1}$

Thus the effect of a change in the proportion of investment which is financed by borrowing on the relative effectiveness of an M2 target depends upon the parameters which define the behavioral relationships and their stability as well as upon the initial value of the borrowing-investment ratio which affects the value of the parameter λ. A comparison of the inequalities (6.33) and (6.37) shows that the condition which determines the effectiveness of an M2 target relative to M1 and the condition which determines when an increase in the borrowing-investment ratio leads to a decline in the ratio $V(Y|M2^*)/V(Y|M1^*)$, that is an improvement in the relative effectiveness of M2 in stabilizing income, are similar except for the multiplying factors α and α'. It can be readily verified that $\alpha > \alpha'$ for all values of μ and λ when $\lambda < 1$. (When $\lambda = 1, \alpha' = \alpha$). From this it follows that if M2 is superior to M1 at a given value of the borrowing-investment ratio and thus λ, then an increase in that ratio can lead to an increase or decrease in the relative effectiveness of M2. If, however, M1 is superior to M2 at the given value of the borrowing-investment ratio, then an increase in that ratio leads to an increase in the effectiveness of M1.

Another limiting case of some interest is when all borrowing is employed to finance investment ($w_m = 0$, $w_i - w_s > 0$ so that $\lambda = 0$). As can be seen from (6.30), in this case $V(Y|M2^*)$ reduces to σ_s^2/s^2 and it is independent of the borrowing-investment ratio. It is interesting to observe that in this situation a bank credit (M2) target is always preferable to an interest rate target which results in an income variance equal to $(\sigma_s^2 + \sigma_i^2)/s^2$. An M2 target is preferable to an M1 target if $\beta_1^2[k_2^2(\sigma_s^2 + \sigma_i^2) + i^2\sigma_{vl}^2] > \sigma_s^2$.

Of course, it is recognized that these conclusions rest on a highly stylized and restrictive model as well as on specific assumptions regarding the nature and properties of stochastic disturbances, the behavior of surplus and deficit units, etc. There are also other relevant considerations for the choice of intermediate targets, which for space limitations are not examined here. They relate to the degree to which monetary authorities can control these alternative intermediate targets and the more general issue of whether controlling monetary aggregates is the most efficient means of conducting monetary policy.[12] But despite these limitations, this analysis points to the type of inter-

[12] For discussions of these issues see Federal Reserve Bank of Boston [1969, 1972] and B. M. Friedman [1975,1977].

relations that exist between the effectiveness of alternative intermediate targets, the relative stability of aggregate behavioral relations and the economy's financial structure.

VII. Summary and Concluding Remarks

The central theme of this paper is that the structure of financial markets plays a crucial role in shaping the monetary mechanism and the effectiveness of alternative intermediate targets of monetary policy in controlling aggregate nominal income. We have argued that the conventional view of the monetary mechanism, both in the monetarist and Keynesian-Hicksian formulation, which focuses on the role of the money supply (M1) as the determinant of nominal income, far from being a general one is really dealing with a rather special case; that there exist aggregates other than the monetary liabilities of banks whose control insures control over nominal income; that paradigms different from the traditional ones may be best suited to describe the function of the monetary mechanism, depending on the financial structure of the economy and on the choice of intermediate targets; and that the effectiveness of alternative intermediate targets depends critically upon the financial structure of the economy as well as upon the relative stability of relevant behavioral relations.

In order to illustrate these propositions, we constructed a short-run macroeconomic model with a conveniently simple financial structure describing a closed economy with no government sector, in which all debt financing occurs through bank intermediaries. The consumption/saving and investment/portfolio decisions of the nonbank public are formalized in terms of the behavior of two groups consisting of "surplus units" and "deficit units." It was shown that in this model i) the monetary authority can control nominal income not only through the two traditional targets — money supply and interest rates — but also through two additional aggregates — bank credit and total bank liabilities; and ii) the functioning of the monetary mechanism is most usefully described by a paradigm, quite different from the traditional one, in which the central role is played by the supply of bank credit through its effect on investment. The role of the interest rate in the transmission mechanism on the other hand depends on the competitiveness of financial markets and could become secondary in the presence of credit rationing or effective ceilings on deposit rates.

The choice among the alternative intermediate targets becomes a substantive problem in the presence of uncertainty. We examined the considerations which are relevant for the choice of an intermediate target under the assumption that the uncertainty of the system can be described by additive stochastic distrubances. In general, the choice of the "optimal" intermediate target depends upon the combined effects of the relative stability of the behavioral relations and the values of parameters which describe the behavior of the public and define the key elements of the financial structure of the economy. The latter is characterized in our model by two ratios, the proportion of investment which is financed by borrowing and the proportion of total credit which is employed in financing investment. We showed how a change in these ratios and how the relative stability of the aggregate saving, investment and money demand functions affect the choice of an intermediate target. We found that a bank credit (M2) target is superior to an M1 target if the variance of the saving function is smaller than a multiple of a weighted average of the variances of the investment and demand for money functions with the multiplying factor depending upon the characteristics of the financial structure. Thus, in broad terms, a bank credit (M2) target will tend to be more effective than M1 when the saving function is relatively more stable than the investment and money demand functions.

The model presented and analyzed in this paper was constructed in order to illustrate, in the simplest possible way, the general propositions discussed earlier regarding the role of the structure of financial markets in shaping the nature of the monetary mechanism and the effectiveness of monetary controls under uncertainty. This model must obviously be generalized in a number of directions before it can acquire prescriptive value. Among various needed extensions, we are currently investigating the following: First, the implications of more complex financial structures which allow for alternative forms of financing of both firms and banks. The central question in this analysis is how and to what extent the existence of nonbank sources of financing, such as direct lending from the public or through nonbank intermediaries, impinges on the effectiveness of monetary policy which controls only a fraction of total credit (bank loans). Our preliminary results suggest that the effectiveness of a credit target could be impaired to the extent that deposit rates are unresponsive to market rates, be it through lack of competition or regulation — and this effect is greater the higher the degree of substitutability among alternative forms of lending and borrowing. A second extension examines the role of government and foreign sectors and the implications of the additional sources of uncertainty which affect the controllability of alternative intermediate targets by the instruments under the direct control of the monetary authority. A third extension is abandoning the hypothesis of short-run price rigidity and examining the control of nominal income under the alternative extreme hypothesis of long-run perfect price flexibility or the more realistic intermediate case of gradual price adjustments. This analysis involves the incorporation of hypotheses regarding the formation of expectations about inflation and their role in influencing the behavior of the public. These generalizations should provide additional insights regarding the role of financial markets in the monetary mechanism and the effectiveness of alternative intermediate targets.

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Discussion

William L. Silber*

Introduction

Two preliminary impressions spring from an initial reading of this paper. First, Lucas Papademos has earned his way into one of the most desirable and exclusive clubs open to monetary economists. I am speaking, of course, of the well-known association called, the Coauthors of Franco Modigliani. Most of you have heard much about this organization — from its founding members, Albert Ando and Merton Miller. Few of you realize the full extent of the responsibilities. They include decoding overseas telephone calls from Franco as well as maintaining a cordial relationship with discussants who anxiously await the stochastic arrival of various components of the paper.

My second impression concerns the contribution of Franco himself. Most of us are vaguely familiar with so-called long waves in economic activity — 50 years is a popular number. Well, I think I have discovered a similar long wave in the writings of Franco Modigliani. It seems that even-numbered decades produce highlight theoretical contributions to the monetary mechanism. The 1940s gave us the celebrated "liquidity preference and monetary theory"; the 1960s yielded the insights of "the monetary mechanism's interaction with real phenomena," and now the 1980s produced "the effects of the structure of financial markets on the monetary mechanism." I can hardly wait for the turn of the millenium to see what special treat Franco has in store for us.

Let me turn to my specific task as a discussant of the Modigliani-Papademos paper. I will divide my comments into two categories: (a) those issues that are inside the paper, and (b) those that are not. My monetary training leads me to group these two into inside comments and outside comments. Actually, the first group of comments are directly focused on the paper by M–P, while the second category of comments speculates on an alternative formulation of the problem.

I would like to say at the outset that the paper articulates in a characteristically clear way the major issues in financial structure and the monetary mechanism. But my job is to comment critically, and I will divide my inside comments into a general overview and then some nitpicking. I will appraoch the general overview with a series of questions and answers.

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An Overview of M–P's Approach

My first question is: How useful are deterministic models in answering the issues raised by M–P, and how much do additive disturbance terms help them achieve their objectives?

The main objective of M–P is to show that alternative aggregates can be used as monetary control variables, and that recent innovations in financial structure lead to the replacement of M1 as an intermediate target with something closer to M2 or bank credit. I am very much in sympathy with the way M–P present the overall considerations. But to achieve this objective, it seems that the deterministic analysis of the first five sections of M–P is not really appropriate. The conclusion that any financial aggregate can be used to control nominal GNP is not especially surprising in this world. And that is because a unique value of nominal GNP or nominal investment corresponds with a unique value of any particular financial aggregate. The authors say as much when they note that any $Z = \overline{Z}$ in the financial sector closes their system of 13 equations in Table 3.

What I thought the authors missed was that a target of nominal $Y = \overline{Y}$ or $I = \overline{I}$ does exactly the same thing as $M1 = \overline{M1}$, $r = \overline{r}$, $M2 = \overline{M2}$ or $B = \overline{B}$. Thus, they could use their model to support their position in Modigliani-Papademos I, their 1975 contribution to the Brookings Papers in which they advocated that the monetary authority set GNP targets.[1] But that statement is perhaps unfair since it implies the ability to control GNP directly, or with less variance than some intermediate target. And that is precisely my point: the authors require a stochastic model with empirical content to answer these issues.

The authors recognize the limitations of deterministic models when they introduce additive stochastic terms to their structural model beginning with Section VI. But I think that additive disturbances are insufficient to capture the essence of what they are after. When M–P say that bank credit will give better, that is, smaller variance, control over nominal GNP than either an M1 or interest rate target *when a larger proportion of total investment is financed by bank loans,* they are assuming that the fraction financed by loans is fixed and predictable. But one of the consequences of financial innovation is to eliminate the fixed coefficients associated with historical financing ratios. To model this requires at least multiplicative disturbance terms (parameter uncertainty). My conclusion is that even the stochastic model of M–P has limitations in shedding light on the relationship between financial innovation and monetary control variables.

My second question is: Can the model omit inflationary expectations formulation?

The paper starts with an excellent overview of the monetary mechanism in the classical/Keynesian framework. Unfortunately, given the potential importance of inflationary expectations in the choice between monetary tar-

[1] F. Modigliani and L. Papademos, "Targets for Monetary Policy in the Coming Years," *Brookings Papers on Economic Activity*, 1975: I.

gets, it is rather limiting to ignore the formulation of such expectations. While some of the new view of rational formation of inflationary expectations rests more with psychology — perhaps parapsychology according to some — there is a gnawing doubt that an important piece has been left out of the M–P model. The authors recognize this in part since they do not really deal with interest rate targets in their framework. I can only urge that they add an inflation expectations sector to their model to see what happens.

My third question is: Are the results surprising?

When the authors claim that their model shows that the monetary mechanism can take a form *quite different* from the standard paradigm (I presume they mean the IS–LM world), I find that statement a bit surprising. In particular, until that point in Section V they have just made a relatively simple transformation between M1 and bank credit. The most interesting feature of their model comes when the authors analyze credit rationing and when they allow the loan rate (r) to vary away from a fixed relationship with the deposit rate (r_s). In fact, until this point, I would argue that the authors have not really introduced a "meaningful financial structure" into their monetary mechanism. The last half of Section V, therefore, is the one you want to pay most attention to. Only then do they allow the intermediary rate versus the borrowing rate differential to vary; and only then is there a meaningful financial intermediary in the model.

Nitpicking Comments

I'd like to expand on this financial structure issue — in particular what is not done in the paper, but first let me provide some traditional nitpicking comments.

(i) There seems to be some confusion over the definition of surplus units and deficit units. Sometimes they are defined in flow terms, sometimes in stock terms.

(ii) It would be helpful to use subscripts to relate end of period wealth to flows of saving *during* a period. Since this process is crucial to M–P's borrowing demand equations, it should be articulated more carefully.

(iii) In footnote 6 it seems inappropriate to argue that a surplus unit will not borrow at high rates to finance holdings of savings deposits at lower rates. In a well-developed financial structure, that kind of behavior is not unreasonable given differences in liquidity. For M–P's specific purposes it may be helpful to ignore this possibility, although I'm not sure what problems emerge if they don't. But in a paper treating financial structure, it may be too restrictive to eliminate this type of liquidity-motivated behavior.

An Alternative Formulation of the Problem

The last nitpicking comment allows me to turn my attention to an alternative formulation of the problem — how we ought to treat financial structure and innovation in these kinds of models. These are my "outside" comments.

M–P argue convincingly that the appropriate intermediate targets for monetary policy could vary with the structure of the financial sector. Financial structure is taken by M–P to mean the sources of funds available to investors, the menu of financial assets presented to households, and the structure and characteristics of financial markets, such as competition and regulation. M–P then go on to proxy this complex financial structure with a model similar to the flow of funds accounts, emphasizing sources and uses of funds for investment and the balance sheet of commercial banks.

While a model must strip away the superfluous detail, there is good reason to suspect that a number of essential dimensions to financial structure must be added to such models if they are to capture the essence of financial innovation that underlies the concern with monetary aggregates. Here are some examples.

The flow of funds approach ignores the contribution of financial market trading to the liquidity of financial assets. By concentrating on intermediaries to measure liquidity, the model ignores the marketplace as a source of liquidity. There is, in fact, a tradeoff between a financial intermediary and a financial market as a source of liquidity.[2] For example, S&Ls that specialize in mortgages and create savings deposits might generate no more liquidity than GNMA mortgage-backed securities that are traded actively in a secondary market. And this trading dimension to liquidity does not appear in our models.

The point is that perhaps financial structure should not be modeled by flows of funds but rather by a security characteristic approach. For example, a parameter for the marketability of securities could be entered into the money demand function. A measure of the maturity of bonds, and the associated price volatility, could also enter the money demand function; the refinancing frequency associated with maturing securities would then enter the investment function. The interaction between these financial characteristics, the level of interest rates, and the activities of the monetary authorities perhaps would capture in a very different way the essence of financial structure on the behavior of macro models and the monetary mechanism.

The next step would be to supplement this structure with more complex interaction between all of these partially substitutable financial characteristics — in a way that would permit the model to capture the essence of financial innovation. In particular, I would like to see a model that allows for variability in financing patterns in response to changes in the level and structure of rates. The choice of intermediate targets in that kind of financial structure is, I am afraid, more complex than M–P's problem. In fact, my intuition sug-

[2] See William L. Silber, "The Optimum Quantity of Money and the Interrelationship between Financial Markets and Intermediaries," *Banca Nazionale del Lavoro Quarterly Review*, March, 1977.

gests that bank credit (as opposed to "other" credit) loses some of its attraction as a target in this world. My guess is that the financial asset with the least parameter uncertainty linkage with the real sector will be the best intermediate target.

I realize that talk is cheap and the approach I have barely outlined here requires significant work. I also think that M–P have pointed us in the right direction. But I think that tinkering with models of financial structure that differ from the conventional flow of funds approach could be rewarding.

Some Issues Involving the Definition and Interpretation of the Monetary Aggregates

Thomas D. Simpson and Richard D. Porter*

I. Introduction

Recently a great deal of attention has been focused on difficulties of interpreting the behavior of the monetary aggregates. The period since the mid-1970s has been characterized by unexpected changes in the relationship between traditional measures of the monetary aggregates and economic activity. Accompanying the disruption of established monetary relationships was an intensified effort by the public to alter the management of its monetary and liquid assets and a highly favorable climate for the promotion and introduction by financial institutions of alternatives to the public's conventional deposit holdings. Many observers have attributed difficulties of interpreting the monetary aggregates to a number of financial assets, such as the emergence of money market mutual funds and the growing use of very short maturity repurchase agreements (RPs), that provide the public with highly attractive alternatives to holding conventional transactions balances and tend to view the resolution of these difficulties largely in terms of the appropriate inclusion of such assets in the definition of money.[1] Some other observers have tended to place more emphasis on the contribution of changes in techniques for managing cash balances and have attached more importance to the need for careful interpretation of the behavior of monetary aggregates.[2]

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[1] For a variety of views on this subject, see *Measuring the Monetary Aggregates: Compendium of Views*, Subcommittee on Domestic Monetary Policy of the Committee on Banking, Finance and Urban Affairs of the United States House of Representatives, 96th Congress, Second session (Washington, D.C.: Government Printing Office, 1980). See also, Gillian Garcia and Simon Pak, "Some Clues in the Case of the Missing Money," *American Economic Review*, vol. 69 (May 1979), pp. 330–40; John Wenninger and Charles Sivesind, "Changing the M-1 Definition: An Empirical Investigation," (Federal Reserve Bank of New York, April 1979; processed); and Peter A. Tinsley, Bonnie Garrett, and Monica Friar, "The Measurement of Money Demand," (Board of Governors of the Federal Reserve System, Division of Research and Statistics, Special Studies Section, November 1978; processed).

[2] See Richard D. Porter, Thomas D. Simpson, and Eileen Mauskopf, "Financial Innovation and the Monetary Aggregates," *Brookings Papers on Economic Activity*, 1:1979, pp. 213–29.

Many, too, have questioned the usefulness of the monetary aggregates as indicators and targets of monetary policy.

For a number of years, evidence had been accumulating that suggested the most commonly watched old measures — M-1 and M-2 — were undergoing changes that reduced their predictability and reliability. The public's demand for the old M-1 measure — currency plus demand deposits — had displayed pronounced downward shifts relative to GNP — primarily in the period from mid-1974 to early-1977 and in late 1978 and early 1979 — that could not be explained on the basis of historical experience. Indeed, by late 1979 standard specifications of the M-1 equation suggested that M-1 relative to GNP was anywhere from 10 to 17 percent lower than predicted using econometric relationships that explained money demand behavior quite well prior to mid-1974.[3] A detailed examination reveals that weakness in old M-1 was concentrated fully in demand deposits, mostly the holdings of nonfinancial corporations — presumably large ones — and, to a lesser extent, households. Because the downward shift in demand deposits was not mirrored in an upward shift in the other components of old M-2, this broader measure also grew less rapidly than predicted on the basis of historical relationships.[4] Nevertheless, until late 1978 the shortfall in M-2 was comparatively small, when adjustments were made for the size of this aggregate. However, in late 1978 and in 1979 the shortfall in the time and savings deposit components of this aggregate widened considerably, as the public redirected some of its liquid assets from savings and small-denomination time deposits at banks to money market mutual funds and, to a lesser extent, thrift institutions. Also, banks tended to rely less heavily on large-denomination time deposits — about half of which were in the old M-2 — and more on other managed liabilities, including Eurodollar borrowings. The estimated shortfall in old M-2 over the period from the fourth quarter of 1978 to the fourth quarter of 1979 was a full 6 percentage points of the level of this aggregate or $54 billion. In recognition of the inadequacies of the old measures of the money stock, the Federal Reserve in early 1980 introduced new measures of money which reflected many of the changes that had been occurring in the financial system.

The newly adopted measures of money have generally been less vulnerable to the shifts that characterized the old aggregates. The new M-1B measure — which contains other checkable deposits at all depository institutions, as well as currency and demand deposits — has registered a smaller shortfall, since some of the weakness in demand deposit growth has been matched by increases in other checkable deposits (mainly ATS and NOW accounts).[5] Indeed, the inclusion of other checkable deposits appears to cor-

[3] These estimates are based on dynamic simulations of money demand equations, fit through mid-1974. For evidence on the reliability of money demand behavior prior to 1974, see Stephen Goldfeld, "The Case of the Missing Money," *Brookings Papers on Economic Activity*, 3:1976, pp. 683–730.

[4] Old M-2 equalled old M-1 plus savings and time deposits at commercial banks other than negotiable CDs at large banks.

[5] The M-1A measure basically equals old M-1, except that it excludes demand deposits

rect for much of the shortfall in household demand deposits.[6] Nevertheless, since the M-1B aggregate does not contain liquid assets that corporations may have acquired with funds released from demand balances, it has been subject to sizable demand shifts over the 1974 to 1979 period.

The new M-2 measure, however, by including overnight RPs and certain overnight Eurodollars does contain two very liquid assets that serve as attractive alternatives holding demand deposits for large corporations. Also included in the new M-2 aggregate are money market mutual fund shares and savings and small-denomination time deposits at all depository institutions — commercial banks and thrift institutions. Thus shifts between savings deposits and money market mutual fund shares are internalized in this aggregate as are shifts of such savings and small time deposits between commercial banks and thrift institutions. Forecasts of the demand for this aggregate, based on historical experience, have been reasonably close to actual behavior during those periods when the demands for some other aggregates demonstrated pronounced tendencies to shift downward. Both the simulated level and quarter-to-quarter rates of growth of this aggregate during the last half of the 1970s were, by conventional standards, very similar to those actually experienced.[7] Nevertheless, while many of the shifts that disturbed the old measures are internalized in the new M-2, shifts out of the demand deposit component cannot fully be explained by the money market mutual fund or overnight RP and Eurodollar components.[8] Indeed, as suggested later in the paper, the nature of the shifts from demand deposits is such that to internalize them adequately requires turning to a very broad aggregate, such as the

owned by foreign commercial banks and official institutions. M-1B equals M-1A plus other checkable deposits. Two M-1 measures were adopted mainly for purposes of interpreting money growth during the transition period following the nationwide extension of NOW accounts. With nationwide NOW accounts, M-1A growth will tend to understate while M-1B will tend to overstate the underlying growth in transactions balances.

[6] Work done by our colleague, John Williams, suggests that most of the shortfall in household demand deposits beginning in 1975 can be attributed to rapid expansion in other checkable deposits.

[7] See David J. Bennett, Flint Brayton, Eileen Mauskopf, Edward K. Offenbacher, and Richard D. Porter, "Econometric Properties of the Redefined Monetary Aggregates" (Board of Governors of the Federal Reserve System, Division of Research and Statistics, Econometric and Computer Applications Section, February 1980; processed). The equations used to produce such forecasts, however, have certain properties that do not conform to those suggested by *a priori* considerations. In particular, the coefficient of the lagged dependent variable seems to be implausibly large. Consequently, the forecasting record for this measure could worsen.

[8] For example, when money market mutual fund shares and overnight RPs and Eurodollars are added to M-1B, the cumulative simulation error over the period from mid-1974 to mid-1980 is lowered from $63.2 billion to minus $12.4 billion. However, one must be careful about attributing a cumulative error in demand deposits to some other liquid assets that have grown in size over the same period. Indeed, the quarter-to-quarter forecasting ability of the equation for such an augmented measure over the 1974:3–80:2 period is poorer than for M-1B; the root mean square error of quarterly growth rates for this augmented measure is raised from 4.3 to 4.9 percentage points.

new liquid assets measure, L, that includes virtually all liquid assets held by the public.[9]

In the remainder of this paper, we focus mostly on the problems associated with the narrow transactions-related measures of money. These are the measures that have generally been most closely related to spending and economic activity and they are the ones that tend to be watched most closely. We attempt to demonstrate that downward shifts in the principal component of these measures — demand deposits — might continue to occur and that, for the most part, any such shifts are likely to be unpredictable, both in terms of timing and intensity. Recent financial innovations are analyzed in the context of an environment of high market rates of interest, regulatory restrictions on the issuance of deposits serving as money, and exogenous technological developments. This analysis yields certain implications for an alternative specification of the money demand relationship — the inclusion of a variable representing the perceived longer term opportunity cost of holding demand balances which directly affects the profitability of investing in money management techniques. On balance, the econometric results for such an alternative specification are encouraging, especially in comparison with efforts to augment M-1 by including very liquid balances such as RPs. Nevertheless, even such an approach cannot be expected to ameliorate uncertainty about M-1 behavior and sizable forecast errors in this aggregate might well continue.

Clearly, further work must be done in this area to better understand money demand — or velocity — behavior in such an environment and to improve the specification of this key relationship. In the meantime, though, a high degree of uncertainty about M-1 velocity appears likely. Consequently, the precision with which an objective for the economy can be achieved solely with M-1 targeting procedures is lowered. In view of these considerations, a case can be made for a wider range for M-1 growth or for more frequent adjustment of that range. Moreover, the case is strengthened for stabilizing interest rates during periods when it is apparent from incoming evidence that shifts are occurring. Also, in such an environment more attention could be placed on the broader measures of money, especially M-2, although a considerable amount of uncertainty also exists about these broader measures.

Three appendixes follow the text. The first demonstrates in a rigorous fashion the tendency for a stronger long-run money demand response to increases in the opportunity cost of holding money balances and interprets cash management developments in the context of such a theory. The second appendix presents further econometric evidence on alternative specifications of the money demand equation and alternative combinations of assets. The third appendix presents and discusses some econometric evidence on the demand for another asset that can be characterized by an inventory process

[9] Between the new M-2 measure and L is redefined M-3. This aggregate equals M-2 plus large-denomination time deposits at all depository institutions and term RPs at commercial banks and savings and loan associations.

— the demand for inventories of physical goods — but which has not demonstrated a pronounced tendency to shift downward like the demand for M-1 balances.

II. The M-1 Issue

A. Financial Innovations

Economic theory and a variety of historical experience attest to the substantial value that the public places on transactions services provided by money balances. Some of the most dramatic evidence can be found in episodes of very high rates of inflation when the public continued to hold relatively large amounts of money balances, despite enormous opportunity costs. However, historical examples also demonstrate that in the face of persistently high opportunity costs the public develops methods for economizing on such balances. Moreover, in some of these examples substitutes emerge after a while that provide many of the same services as traditional money balances, but at more favorable terms. Expressed alternatively, in the short run the demand for traditional monetary assets is somewhat insensitive to changes in opportunity costs but in the long run the response tends to be much stronger as more substitutes are developed and used.

Many financial innovations of the 1970s and the accompanying downward shifts in money demand relative to GNP might be viewed in this long-run versus short-run context. In the 1970s market rates of interest — both short- and long-term rates — reached record levels, suggesting a record-high opportunity cost of holding currency and demand deposit balances and also high opportunity costs of deposits with fixed-rate ceilings. In response, not only did money holders make the usual efforts to economize on cash balances, but the expectation of continued high opportunity costs encouraged investment in new money management techniques that were designed to lower the amount of transactions balances required for a given amount of spending. Also, the expectation of continued high opportunity costs of holding demand balances improved the climate for financial institutions to promote and introduce alternatives to demand balances having transactions-type properties but with lower opportunity costs.[10]

Indeed, in response it appears that commercial banks adopted the practice of offering implicit compensation on demand deposits at rates tied to market yields to their large customers. Qualitative evidence — based on numerous interviews with corporate cash managers and commercial bankers — suggests that by the mid-1970s many banks were offering their larger balance customers implicit compensation tied to money market rates (most often the Treasury bill rate); this compensation has taken the form of below-

[10] Reinforcing this view is work done at the Board, including work done by our colleague John Williams, that suggests that the shortfall in M-1 demand predates large increases in M-1 substitutes such as RPs and money market mutual fund shares. See Thomas D. Simpson, "The Market for Federal Funds and Repurchase Agreements," Staff Studies 106 (Board of Governors of the Federal Reserve System, July 1979), pp. 44–46.

cost credit and cash management services.[11] Thus with such pricing of demand deposits the effective opportunity cost of holding demand balances for many depositors does not vary to the extent that might be expected. Under the most common arrangements, however, the implicit rate on demand balances is adjusted for the cost of reserve requirements. For example, at a Treasury bill rate of 10 percent, the implicit yield on demand balances could be only as high as 8.4 percent, as the marginal reserve ratio on demand deposits at large member banks had been 16.25 percent.[12] Because of the reserve requirement adjustment, however, the difference between the market yield and the implicit yield — that is, the implicit opportunity cost of holding demand deposits — does tend to vary directly with money market yields. Moreover, since the value to the depositor of these services may be less than their cost to the bank, the perceived return on demand deposits may be even lower and thus the opportunity cost even higher than that suggested by such a formula for the implicit yield.

In the face of expectations of a persistently high opportunity cost of holding narrow money balances, depositors can be expected to actively seek ways to modify their deposit management systems to, in a more permanent sense, reduce their deposit holdings. In other words, under these conditions the perceived rate of return rises on investments in new techniques that enable depositors to conduct a given volume of transactions with smaller amounts of money balances. This is to be contrasted with the short-run response to an increase in the opportunity cost of holding money balances in which the depositor is confronted with a given set of money management techniques and attempts to lower money balances within that constraint.[13] Clearly, the long-run response to a given increase in interest rates is likely to be greater than the short-run response.[14] Thus the short-run money demand schedule can be viewed as drawn for a given set of money management techniques, such as computer hardware and software and trained personnel, and relatively inelastic when compared to the long-run demand schedule, along which

[11] Credit services include lines of credit linked to deposit balances. Cash management services include lock boxes, wire transfers, and balance reporting. Customers with smaller balances also tend to receive a return on their balances, but this return often does not vary with balances in the account. Thus, the marginal return to these customers tends to be small and below the average return.

[12] Under the new reserve requirement structure adopted in connection with the Monetary Control Act, the marginal reserve ratio on demand balances at large member banks will decline to 12 percent, after the phase-in of reserve requirements is complete.

[13] These points are developed more rigorously in Appendix A.

[14] An interesting question arises in connection with reductions in the opportunity cost of holding money balances that are expected to persist. Can it be expected that new techniques adopted previously are going to be abandoned or permitted to wear out so that the increase in money balance holdings in the long run is likely to exceed the increase in the short run or can cash managers be expected to retain previously adopted techniques? In the former case, the long-run demand schedule would be continuous but in the latter case it would have a kink as it would be less sensitive to reductions in interest rates than to increases.

money management techniques vary.[15] The short-run impact of interest rate changes, though, is likely to be more predictable, since the long-run response involves the act of investing in new systems and the timing of the investment process is one that typically is difficult to forecast. Moreover, as noted in Appendix A, investments in some cash management techniques, most notably the cash concentration account, have lumpy effects on money demand.

Serving to reinforce this tendency for a stronger long-run interest rate response is the tendency for suppliers of financial instruments to compete more intensely for the public's balances having the highest opportunity costs, especially demand deposits and savings. In an environment of high market rates of interest, financial intermediaries can attract or retain funds by offering financial instruments with characteristics very similar to the (regulated) high opportunity cost ones, but with more attractive yields. Thus new instruments emerge such as money market mutual funds and overnight Eurodollars — as well as new checkable deposits like NOW accounts — and some existing ones such as RPs are more actively promoted, and these serve to attract funds from demand deposits and from savings accounts. Because these new instruments have characteristics that are similar to both transactions balances and other liquid assets, they tend to blur the distinction between transactions balances and liquid investments, which further complicates the interpretation of monetary behavior.

If interest could be paid on demand deposits and required reserve balances, the marginal yield to large balance depositors would tend to be close to that on very short-term open market instruments, such as RPs or commercial paper. As a consequence, a large increase in market rates of interest would not result in the kind of widening of the opportunity cost of holding demand balances that occurs at present. Thus an increase in interest rates would not encourage the kinds of efforts to pare money balances, both in the short run and the long run, that have been characteristic of the recent past. However, even in such an environment the yield on demand deposits that banks would be willing to offer would fall short of the rate paid on short-term market instruments because demand balances can be withdrawn at any time during the day, by the presentation of checks, wire transfers or conversions to currency. As a result, there exists a considerable amount of intra-day uncertainty about closing balances in customers' demand deposit accounts. Thus banks would continue to be faced with the task of actively managing a reserve position that met the dual needs of satisfying reserve requirements and potential withdrawals from their customers' accounts; by contrast, issuers of short-term market instruments, for the most part, do not face such reserve man-

[15] The rate at which new techniques are adopted will depend, in part, on the size of the change in the perceived longer term opportunity cost of holding money balances. A large jump in the opportunity cost, if expected to persist, would tend to encourage a more rapid conversion to new techniques than a small one.

agement costs.[16] Consequently, even in a highly competitive environment, banks would not offer the same return on demand balances that they and others would be willing to offer on overnight instruments.[17] As a result, depositors would continue to have an incentive to invest in money management techniques that enable them to economize on their demand deposit holdings, as there would still be an opportunity cost associated with such balances.[18]

Viewed somewhat differently, one of the important functions that a bank performs by managing the reserve position against its many customer accounts jointly is to lower the overall reserve management costs associated with their aggregate transactions balances. A bank is in a highly favorable position to contend with much of the uncertainty that arises from the daily variability in each of its customer's cash-flow positions, since some of the variability in individual accounts is offsetting in the aggregate and through the pooling of the disturbances of its many customer accounts aggregate variability can be lowered; thus fewer resources are needed than if each account were managed separately.[19] To the extent that all disturbances to individual customer accounts were always offsetting in the aggregate, virtually no resources would be needed to manage the bank's reserve position, since it would be unchanged from one day to the next (and would equal required reserves). As a result, the yield on demand deposits would tend to equal that on short-term market instruments, because required reserve balances against such deposits would, by assumption, have a yield approximating the market rate. However, since such diversification cannot eliminate completely all uncertainty, reserve management is necessary and consequently the associated costs would likely be passed along to the customer in the form of a lower yield. In this way, the customer would be given an economic incentive, in the form of an opportunity cost on demand balances, to pare deposit holdings by

[16] Other instruments that are settled in immediately available funds — including bank issuance of RPs — generally must be arranged fairly early in the day. Money market mutual funds also ordinarily require that notification of wire transfer withdrawals be made fairly early in the day (to be effective that day) and that placements of funds via the wire also be made early in the day (to earn interest on that day). Thus the issuer of such instruments need not maintain more than frictional amounts of deposit balances and need not incur the higher reserve management costs that banks absorb with demand deposits or NOW or ATS accounts.

[17] It is assumed here that excess reserves do not yield interest and that requirements are met on a weekly average reserve basis so that a shortfall on one statement day can be offset with a reserve surplus on a later day, except the last statement day of the week. Thus, the task of the reserve manager is to just meet required reserves on a weekly average basis, given the pattern of stochastic disturbances.

[18] Basically, the same conclusion would emerge if there were no reserve requirements. In this case, the bank would need to maintain a certain amount of vault cash and other balances to meet potential withdrawals. Thus, the customer would receive a return on demand deposits that falls short of money market yields because of reserve management costs to the bank and the absence of a return on at least a portion of its reserve balances that are held voluntarily.

[19] The same set of influences may also be at work in a large corporation that has many geographically dispersed units. A cash concentration system enables firms to pool variability in accounts with many individual banks in a single concentration account and thereby take advantage of offsetting changes among its many individual accounts. See Appendix A, Part III.

applying resources that reduce uncertainty about the customer's own cash-flow pattern or to restructure transactions in ways that smooth cash flows.

Consequently, even in a world of unregulated interest rates on demand deposits and compensation at market rates on required reserve balances, depositors would have an incentive to invest in money management techniques that lower uncertainty about cash-flow patterns, such as improvements in forecasting and balance monitoring.[20]

In addition, exogenous technological innovations that lower the costs of reducing uncertainty and restructuring payments arrangements would add to the profitability of investing in money management techniques, as they do in the present environment. Consequently, such exogenous technological innovations can be expected to reduce the demand for transactions balances relative to spending by an amount that is directly related to their contribution to the profitability of new cash management investments. Moreover, exogenous technological innovations that lower transactions costs associated with investing funds in demand deposit accounts would also reduce the demand for M-1 relative to total spending or GNP.

Exogenous improvements in money management techniques — ones that would have occurred in any event — likely encouraged investments that contributed to the unexpected weakness in the demand for M-1 as did the combination of high market rates of interest, the prohibition on the payment of explicit interest on demand deposits, and relatively high reserve requirements on large member banks. Significant reductions in the real cost of computer and telecommunications systems and greater access to wire transfers have enabled cash managers to keep closer tabs on deposit balances and to more easily place temporary excess balances in short-term investments. In addition, newly trained cash managers bring to their jobs a knowledge of improved forecasting and other money management techniques.

For the most part, it is difficult to discern the relative contribution of exogenous and induced forces on the financial innovations that have been associated with abnormal behavior of the narrow monetary aggregates in recent years. However, the demands for some other economic quantities are similar to the demand for narrowly defined money balances — in the sense that they can be characterized by an inventory process — and would be influenced by many of the exogenous factors that have affected narrow money balances; however, they would generally not be influenced by some of the important factors that may have induced financial innovations, such as deposit rate ceilings and reserve requirements. The evidence on the behavior of the demand for inventories of goods during the last half of the 1970s, which is discussed in Appendix C, suggests that perhaps only a very small downward shift in inventory demand may have occurred, in contrast to the demand for narrow money balances where the downward shift was substantial.[21] Con-

[20] In such a world there would continue to be incentives for cash managers to increase float by slowing down disbursements and speeding up receipts.

[21] However, some of the developments that have facilitated the reduction in demand deposit holdings, such as those accompanying the cash concentration account, are impractical for inventories of goods.

sequently, one might conclude that the impact on money demand of induced factors relating to opportunity costs has outweighed that of exogenous developments.

In sum, an increase in the opportunity cost of holding money balances — which is magnified by the prohibition on the payment of interest on demand deposits and noninterest-earning required reserve balances — encourages the public to economize on its holdings of these balances in the short run — characterized by a given set of money management techniques — but to respond more vigorously in the long run by investing in new money management techniques. In other words, an increase in the opportunity cost of holding money balances adds to the profitability of investing in new management techniques, as do exogenous reductions in the costs of money management techniques. Reinforcing this behavior is the tendency for suppliers of financial instruments to introduce substitutes for money balances which are hybrids, having characteristics of both transactions balances and liquid investments.[22] With the funds released from traditional money balances, the public can be expected to acquire not only these new money substitutes but other financial assets and perhaps also to pay down debt. Even though new money substitutes do not absorb all of the funds released from traditional money balances, the presence of such substitutes encourages a stronger reaction by the public to actively lower its money holdings, as they permit the public to adopt money management techniques that rely on even smaller amounts of ordinary transactions balances. Because these new financial instruments have some of the characteristics of transactions balances, they attract funds that would otherwise be placed in ordinary transactions deposits and thus are balances that are related to aggregate transactions and spending. Also, because these assets serve as liquid investments, the demand for which at times can be strongly influenced by such portfolio considerations as relative yields, their behavior may often not be a reliable indicator of aggregate transactions in the economy. Thus the presence of such hybrid instruments can cause serious interpretation problems since at times their behavior may be related mainly to transactions and spending while at other times they may be predominantly related to their investment properties. It is worthwhile to note that the above analysis does not imply that other liquid assets — other than ATS and NOW accounts — necessarily supplant demand deposits as transactions balances but rather absorb funds released by efforts to pare demand deposits. Thus, even though the behavior of some liquid assets may be correlated with

[22] An alternative way of viewing these developments is in terms of an attempt on the part of the financial system to economize on the aggregate amount of the clearing balances in the form of required reserve balances held with the Federal Reserve. With binding reserve requirements, the actual amount of clearing balances (required reserves) exceeds the optimal amount as seen by individual institutions. Actual clearing balances can be brought closer into line with optimal balances if there is more rapid growth in nonreservable or low reserve liabilities, which is achieved by greater reliance on RPs, Eurodollars, and by more rapid growth of nonmember depository institutions, money market mutual funds, and the like.

unexplained weakness in demand deposits the public may not view such assets as components of its transactions balances.[23]

In the future, some of the conditions that have encouraged the kinds of innovations that have disturbed the behavior of the narrow monetary aggregates and have caused interpretation difficulties may diminish. A general lowering of the marginal reserve ratio on member bank demand deposits — to 3 percent for smaller banks and 12 percent for others — can be expected to reduce the opportunity cost of demand deposits and thus the incentive for innovations.[24] In addition, households nationwide will be able to open NOW accounts on which explicit interest can be paid. Also, the ceiling rates that can be paid on NOW accounts — and other interest-earning deposits — are scheduled to be phased out over a six-year period ending in 1986. Another development that may tend to enhance the attractiveness of ordinary transactions balances is the debit card. With a debit card, the public will be able to make payments for the items presently charged to credit cards directly from demand or NOW account balances. By maintaining larger balances in these transactions accounts, people will be able to avoid interest payments on charges to credit cards.[25] The demand for deposits by businesses, especially those active in cash management, may also be strengthened by new fees charged for Federal Reserve services. In particular, charges for wire transfers of funds and securities safekeeping and transfers will tend to lower somewhat the returns associated with moving funds into and out of cash concentration accounts and the net returns on short-term RPs involving the transfer of securities.

On the other hand, the further development of electronic funds transfers is likely to reduce by even more the transactions costs associated with the transfer of funds between transactions balances and short-term liquid asset buffers, and thus might further weaken the demand for transactions balances relative to spending. For example, if individuals can more conveniently transfer funds between money market mutual fund accounts and transactions accounts, they will be able to hold smaller amounts of transactions balances and will be able to easily tap their money market mutual fund accounts to cover expected or unexpected cash needs. Clearly, the greater is the oppor-

[23] Indeed, even a portion of ATS and NOW deposits may be viewed by the public more as a savings balance than as a transactions balance.

[24] Also, while the Federal Reserve Board has the added authority to impose a supplemental reserve requirement of up to 4 percent on the transactions accounts of all depository institutions, compensation is to be paid on such reserve balances at a rate tied to the yield on the Fed's portfolio.

[25] The relevant comparison for the individual is the return on additional balances held, say, in a NOW account to cover debit card purchases (that otherwise would have been charged to a credit card account) subtracted from the return that could be received on these funds if placed in an alternative investment relative to the full cost of borrowing this amount using a credit card account. Even in cases where the individual avoids ordinary finance charges by remitting the full outstanding balance, an implicit charge fee tends to be imposed because merchants often establish higher costs for those items being charged as the corresponding slips they send to their banks are discounted when they are submitted.

tunity cost of holding transactions balances, the greater will be the impact of reductions of transactions costs resulting from the further development of electronic payment methods. Thus, on balance, it appears that considerable uncertainty about M-1 velocity is likely to remain in the future.

In light of the developments described above and the inadequacy of standard money demand models, it is clear that further research is needed in the area of money demand. It seems likely that the public's underlying demand for transactions services has not undergone the kinds of shifts that are suggested by standard econometric models of the demand for M-1 balances. These services, though, are being provided for in new ways that are not presently being captured adequately by econometric techniques, even when liquid transactions-type assets such as overnight RP and money market mutual funds are added to the M-1 measure. One change in the specification suggested by the preceding discussion is the inclusion of a variable that captures the incentive to invest in money management techniques. Such a variable represents the perceived opportunity cost of money balances over a longer span of time, one corresponding to the economic life of the money management techniques being considered. Some earlier work on this subject can be viewed in this context and some empirical work reported in the next section indicates that such efforts have promise.[26] Alternatively, in view of the proliferation in recent years of very liquid assets available to the public with transactions-type properties, another promising approach to the M-1 dilemma involves the construction of index numbers — such as a Divisia index — for measures of monetary or liquid assets.[27]

B. Empirical Evidence

Magnitude of the Empirical Problem

This section examines the empirical evidence on money demand behavior at some length and offers an alternative method of specifying money demand, one that attempts to capture the incentive to adopt new money management techniques. The motivation for such a new approach is, of course, the rather poor out-of-sample behavior of the standard money demand specification for most narrow money measures over much of the period since 1974.

We begin with two elementary exercises that are designed to convince the skeptic that in the last six years something new has happened to the money demand relationship. Table 1 displays for the last 30 years the annualized growth in income velocity of M-1A and M-1B, a crude estimate of the trend in these velocities, and the average rate of change of the bill rate. The

[26] See Jared Enzler, Lewis Johnson, and John Paulus, "Some Problems of Money Demand," *Brookings Papers on Economic Activity*, 1:1976, pp. 261–80; and Perry D. Quick and John Paulus, "Financial Innovations and the Transactions Demand for Money," (Board of Governors of the Federal Reserve System, Division of Research and Statistics, Banking Section, February, 1977; processed).

[27] See William A. Barnett, "Economic Monetary Aggregation: An Application of Index Numbers and Aggregation Theory," *Journal of Econometrics*, (September 1980).

Table 1
Growth in Velocity and Short-Term Interest Rates

Six-year period	Velocity of M-1A	Velocity of M-1B	Bill Rate	Trend estimate velocity for M-1A*	Trend estimate velocity for M-1B*
		(Average Annualized Rate of Change)			
1950:3-56:2	3.93	3.93	17.9	2.98 (2.54)	2.98 (2.54)
1956:3-62:2	3.33	3.33	13.6	3.02 (3.41)	3.02 (3.41)
1962:3-68:2	2.99	2.98	13.2	2.60 (4.30)	2.59 (4.28)
1968:3-74:2	2.25	2.24	10.2	2.28 (3.42)	2.27 (3.41)
1974:3-80:2	4.60	3.77	5.9	4.48 (6.63)	3.66 (5.37)

* M-1A and M-1B are identical prior to 1963. The series were extended backwards in time using the 1959 average ratio of the new demand deposit series to the old series. The trend estimates are based on a linear regression of annualized rates of growth of the velocity on an intercept and the annualized rates of growth of the bill rate. The trend estimate is the intercept in this regression; the numbers in parenthesis beneath the trend estimates are the t-ratios from this regression.

estimates are presented by six-year segments, which were chosen so that the last one coincided with the significant deterioration in standard demand equations. This table shows that, except for the last period, velocity growth has been directly related to the size of interest rate increases, as implied by standard theory. In the last period, however, velocity accelerated while the advance in the Treasury bill rate slowed. The trend estimates presented in the last two columns show that trend growth in velocity was steady or declined somewhat until the 1974:3–80:2 period when it increased rather sharply. As discussed below, equations for the two principal components of M-1A indicate that the demand deposit component is producing the M-1 prediction errors during this latter period and not currency.

It can also be demonstrated rather convincingly that the prediction errors in the standard demand deposit equation are not, fundamentally, a matter of faulty elasticity estimates for income and short-term interest rates. Table 2 presents demand deposit equation errors that are associated with alternative assumptions of interest rate and income elasticities. The errors presented in the table for the 1974:2–80:2 period remain substantial for all combinations of long-run interest rate and income elasticities shown. For example, in a "monetarist" equation with an interest elasticity of nearly zero and an income elasticity of unity, the implied error is about 35 percent. By

Table 2
Demand Deposit Errors for Alternative Long-Run Income and Interest Rate Elasticities (Percentage (logarithmic) errors)

		β_2 income elasticity							
		.5	.6	.7	.8	.9	1.0	1.5	1.8
β_1 interest rate elasticity	0	-28.4	-29.8	-31.3	-32.7	-34.1	-35.5	-42.6	-46.8
	-.1	-26.8	-28.2	-29.6	-31.0	-32.4	-33.9	-40.9	-45.2
	-.2	-25.1	-26.5	-28.0	-29.4	-30.8	-32.2	-39.3	-43.5
	-.3	-23.5	-24.9	-26.3	-27.7	-29.1	-30.6	-37.6	-41.9
	-.4	-21.8	-23.2	-24.6	-26.1	-27.5	-28.9	-36.0	-40.2
	-.5	-20.2	-21.6	-23.0	-24.4	-25.8	-27.2	-34.3	-38.6

NOTE: This table is based on the long-run demand for money equation

(1) $\ln(M_t) = \ln(p_t) + \beta_o + \beta_1 \ln(r_t) + \beta_2 \ln(y_t) + e_t$

and,

β_1 = long-run interest elasticity of money demand
β_2 = long-run income elasticity of money demand
M_t = nominal demand deposit balances
p_t = the GNP deflator
r_t = 90-day bill rate
y_t = real GNP
e_t = error term

Differencing (1) for τ periods yields

$$\ln(M_t) - \ln(M_{t-\tau}) = \ln(p_t) - \ln(p_{t-\tau}) + \beta_1[\ln(r_t) - \ln(r_{t-\tau})] + \beta_2[\ln(y_t) - \ln(y_{t-\tau})] + e_t - e_{t-\tau}$$

or

(2) $\Delta\ln(M_t) = \Delta\ln(p_t) + \beta_1 \Delta\ln(r_t) + \beta_2 \Delta\ln(y_t) + \Delta e_t$, where $\Delta = 1 - B^\tau$, $B^\tau x_t = x_{t-\tau}$

and B the lag operator, $Bx_t = x_{t-1}$.

The errors Δe_t in the table are computed by rewriting (2) as $\Delta e_t = \Delta\ln(M_t) - \Delta\ln(p_t)$

$- \beta_1\Delta\ln(r_t) - \beta_2\Delta\ln(y_\tau)$

The reported errors are denominated in percent, i.e., they equal $100\Delta e_t$. The (logarithmic) differences are measured from 1974:2 to 80:2.

comparison, assuming an income and interest rate elasticity of one-half implies an error of about 20 percent. Relaxing the requirement that the long-run money demand function be homogenous of degree one in prices and setting it below unity would clearly help to reduce the error over this period of substantial inflation. However, when all other things are assumed to be unchanged, no other assumption seems to make sense.[28]

Results for Standard Specifications

Assessments of the money demand shift have typically been made using the dynamic out-of-sample error performance for an equation estimated through 1974:2 (or 1973:4) and simulated outside this period. We first examine these errors for three standard specifications:

$$(1)\quad \ln(M/p)_t = \beta_0 + \beta_1 \ln(M/p)_{t-1} + \beta_2 \ln(r_{1t}) + \beta_3 \ln(r_{2t}) + \beta_4 \ln(y_t) + u_{1t} = f_t + u_{1t}$$

$$(2)\quad \ln(M/p)_t = f_t + \beta_5 t + u_{2t}$$

$$(3)\quad \Delta \ln(M/p)_t = \Delta f_t + u_{3t},\ u_{3t} = \Delta u_{2t}$$

where M = the monetary aggregate being considered
p = GNP deflator
r_1 = Treasury bill rate
r_2 = commercial bank passbook savings rate
y = real GNP
t = linear time trend variable
u_{it} = random error for $i = 1,2,3$
f_t = the deterministic portion of equation (1)
Δ = the first-difference operator

Equation (1) is, perhaps, the most common specification of M-1 demand. Equation (2) represents a simple way of modifying this specifica-

[28] The price elasticity has the interpretation, of course, of a partial elasticity, measuring the responsiveness of nominal money holdings to changes in prices with all other variables held fixed. Suppose the following occurs: prices double *but* interest rates remain fixed and everyone engages in the same set of real transactions. Clearly, it takes twice as much nominal money balances in the new situation because the same goods in nominal terms are twice as expensive. However, if the increase in prices is accompanied by higher nominal interest rates, and all other things are not the same, an increase in prices may not be associated with an equal percentage increase in nominal money balances. Such an increase in the nominal rate of interest will not only encourage the usual reaction of economization of money balances for a given set of money management techniques, which is captured in the equation by the β_2 term shown in equation (1), below, but may also encourage an investment in new money management techniques, which is not captured in the standard equation.

tion by adding a time trend to (1), to capture changes in cash management techniques and other financial innovations.[29] As with time trends in productivity equations, there is no fundamental reason to believe that this kind of technological progress will bear a simple functional relationship to time. Indeed, the endogenous aspect of investment in money management techniques is central to our analysis and the evidence suggests that the impact of these developments is irregular and occurs in spurts. Nevertheless, the money demand equations with a time trend provide a useful contrast to the more complex specifications discussed below. Finally, the last specification, equation (3), is obtained simply by taking first differences of equation (2). It was included to evaluate whether the first difference specification restores stability to the standard equation.[30]

In Table 3 out-of-sample error statistics for these three demand specifications are presented for the principal component of the narrow measures (demand deposits), M-1B, and an augmented measure (M-1B plus overnight RPs and overnight Eurodollars). The table also displays F-statistics to test the hypothesis that the coefficients are equal in the two subperiods, 1959:4–74:2 and 1974:3–80:2. Appendix Tables B-1 to B-3 provide more complete information on the regression estimates over various periods and the period-by-period percentage errors, as well as information for several other narrow or augmented aggregates.[31] The summary statistics shown for growth rate errors are of two kinds — annualized quarterly errors and yearly errors, the latter being defined for the six one-year periods beginning in 1974:2–75:2 and ending in 1979:2–80:2.

None of the three measures shown appears to be stable in the sense that cumulative percentage errors (the last column) for all of the aggregates tend to be large and the F-statistics indicate rejection of the null hypothesis of coefficient stability in most cases.[32] As may be seen in Table 3, each of the aggregates generates very large errors in the first year, 1974:2–75:2, averaging about 5.4 percentage points for demand deposits, 4.4 percentage points for M-1B and 4.7 percentage points for augmented M-1B. The pattern of errors thereafter diverges with demand deposits and M-1B continuing to make large negative errors in the next two periods, 1975–76 and 1976–77, before stabilizing in 1977–78; by contrast, errors from the equation for the augmented measure tended to stabilize over the period from 1975:2 to 1978:2.

[29] The Board's MPS equation for demand deposits has had a comparatively weak time trend in it — currently 1.5 percent per year of the level of demand deposits — for some time. See also, Charles Lieberman, "The Transaction Demand for Money and Technological Change," *Review of Economics and Statistics*, Vol. 59, No. 3 (August, 1977), pp. 307–17.

[30] R. W. Hafer and Scott E. Hein, "The Dynamics and Estimation of Short-Run Money Demand," *Federal Reserve Bank of St. Louis Review*, Vol. 62, (March 1980), pp. 25–35.

[31] The other measures considered in these Appendix Tables using specification (1) are currency, M-1A, demand deposits plus other checkable deposits (i.e., M-1B less currency), demand deposits plus .6 times other checkable deposits, demand deposits plus overnight RPs and Eurodollars, and M-1B plus overnight RPs and Eurodollars.

[32] At the 10 percent significance level, all F-statistics indicate rejection. At the 1 percent level, two out of the three specifications for each aggregate are rejected.

Table 3
Post-Sample Errors and Stability Tests of Alternative Standard Money Demand Specifications for Demand Deposits, M-1B, and Augmented M-1B

Aggregate	Specification	F-test	Quarterly errors Mean	Quarterly errors RMSE	Annual errors by 4-quarter periods 74–75	75–76	76–77	77–78	78–79	79–80	Annual errors Mean	Annual errors RMSE	Cumulative percentage error in 80:2
Demand deposits	log-level (1) no time trend	2.36	−4.58	6.31	−8.0	−5.6	−4.2	−1.0	−4.0	−5.9	−4.80	5.25	−31.1
	log-level (2) time trend	3.70	−3.56	5.20	−4.8	−4.4	−4.1	−1.1	−3.6	−4.2	−3.72	3.91	−23.5
	first difference (3)	3.50	−3.13	5.01	−3.3	−3.3	−2.3	−.5	−4.4	−5.8	−3.26	3.65	−20.5
M-1B	log-level (1) no time trend	4.47	−2.56	4.27	−6.6	−3.3	−2.2	.1	−.7	−3.5	−2.70	3.45	−16.3
	log-level (2) time trend	3.62	−1.87	3.48	−4.0	−2.7	−2.6	−.1	−.3	−2.1	−1.97	2.41	−11.7
	first difference (3)	1.86	−1.45	3.15	−2.5	−1.6	−1.2	.2	−.9	−3.1	−1.53	1.88	−9.0
Augmented M-1B	log-level (1) no time trend	7.80	−1.99	4.73	−6.1	−2.0	−.8	.7	.8	−5.2	−2.09	3.41	−12.5
	log-level (2) time trend	4.17	−1.55	4.23	−4.4	−1.7	−1.3	.6	1.3	−4.2	−1.63	2.68	−9.7
	first difference (3)	2.06	−1.29	4.15	−3.5	−1.0	−.1	.9	.7	−5.1	−1.35	2.61	−8.0

NOTE: M-1B augmented equals M-1B + overnight RPs and overnight Eurodollars. Error statistics are based on a dynamic simulation of the demand equation starting in 1974:3. Errors are defined as actual minus predicted; predicted growth rates are defined in terms of the predicted level of the aggregate in the dynamic simulation. Annual growth rate errors are defined for six four-quarter periods starting with 1974:2–75:2 and ending with 1979:2–80:2. The F-test is based on regressions for two subperiods, 1959:4–74:2, 1974:3–80:2, and the entire period, 1959:2–80:2; see Henri Theil, *Principles of Econometrics*, (New York: John Wiley and Sons, 1971), p. 147. The cumulative percentage error equals the level error as a percent of the actual level of deposits.

Finally, in the most recent two-year period, the demand deposit equation continued to overpredict by sizable amounts. The overprediction of the M-1B equation was relatively small in 1978–79, but much larger in 1979–80, while the augmented M-1B equation produced a large positive error in 1978–79, but a very large negative error in 1979–80. Overall, although the cumulative percentage error (or mean error) for the augmented M-1B measure is smaller than that of M-1B itself, its out-of-sample root mean square errors are higher; the best annual root mean square for M-1B is 1.9 percentage points compared with 2.6 percentage points for the augmented M-1B measure.[33]

In the second quarter of 1980 all of the equations for these three aggregates — and indeed for six other combinations presented in Appendix B — registered the largest quarterly increase in the cumulative percentage error of the entire six-year period (Appendix Table B-2), ranging from 4 to 5 percentage points (16 to 20 points at an annual rate). For example, the error for augmented M-1B cumulates from –8.2 percent of the level in 1980:1 to –12.5 percent of the level in 1980:2, an error of 17 percent at an annual rate.[34] Thus the argument that the addition of RPs to M-1B will generally internalize errors produced by demand deposits is not confirmed by the econometric evidence.

Moreover, it is not obvious on *a priori* gounds why an M-1 measure that includes instruments such as RPs would be an improvement. While overnight RPs are potentially good substitutes for demand deposits in terms of liquidity, they are also close substitutes for other market instruments, such as Treasury bills and commercial paper, in terms of yield and maturity. Thus, a definition that includes RPs — and perhaps money market fund shares — would have some built-in stability for shifts out of demand deposits into these very liquid alternatives. However, while such liquid assets may have absorbed much of the funds shifted from demand deposits, the public may not regard them as being very suitable for transactions purposes and thus may not view them as transactions balances. Stated differently, some statistical comparisons may favor an augmented measure of transactions balances — since what was released from demand deposits may have been applied largely to assets such as RPs and money market mutual fund shares — although the public may not view such an augmented combination of assets as its transactions balances. Moreover, such an augmented aggregate is likely to be strongly affected by a different set of forces, the attractiveness of its liquid asset com-

[33] As shown in Appendix B, the inclusion of money market mutual funds shares — added both to M-1B and augmented M-1B — increases the root mean square error but lowers the mean error. However, such equations tend to underpredict growth in these measures in the last two years.

[34] A part of the explanation for this unprecedented shortfall may have been the marginal reserve requirement on managed liabilities (including RPs) established in October 1979 and by further increases in that requirement in March 1980. During the period when the reserve requirement was binding, the offering rate on RPs declined relative to other market rates, reflecting this reserve requirement. Thus part of the explanation for the sharp drop in RPs in the first half of 1980 — down by $8 billion from the fourth quarter 1979 level of $47.6 billion — may be the behavior of the own rate on RPs. Since we have not included an own rate on RPs in the equation, the fall-off is partly expected.

ponents relative to other liquid assets. For example, an increase in investors' aversion to interest rate risk may cause shifts out of Treasury bills and notes into overnight RPs that do not have interest rate risk or a decision by corporations to borrow more heavily in the commercial paper market — causing an increase in the commercial paper rate — may result in a reduction in the amount of RPs demanded. To fully internalize all kinds of shifts — those from demand deposits to liquid assets and those among different liquid assets — one could go to a very broad liquid assets aggregate, such as L. While L has shown no evidence of having undergone a shift like that of M-1, it is for all practical purposes uncontrollable using the conventional instruments of monetary policy.

A Specification Containing Money Management Effects

An alternative approach to an augmented M-1, one that is more consistent with the discussion of the previous section, is to respecify the M-1 equation. For example, if, as we have argued, a determinant of money demand is the profitability of investments in money management techniques, then f in equation (1) is incompletely specified. The discussion suggests that the equation should contain a variable representing the perceived profitability of investments in these techniques.

By including a time trend, we have, of course, already taken a step in this direction by considering a slight departure from the standard specification. We believe, however, that there are more attractive alternatives to specifying changes in money management techniques than through the use of a time trend. As noted above, a time trend assumes that the impact of new money management techniques is distributed uniformly over time and the evidence discussed above demonstrates that sustained shortfalls in money demand still occurred during the mid- and late-1970s, even with the inclusion of a time trend variable. One alternative approach that is more closely related to the perceived opportunity cost of holding demand deposits is the past peak in interest rates or "ratchet" approach.[35]

One justification for using the previous peak in interest rates is that there might be an awareness threshold that is related to interest rate peaks and once the previous peak has been surpassed more attention is drawn to the opportunity cost of holding money balances and to the profitability of investing in new techniques. Or, alternatively, if interest rate peaks imply a higher level of rates in the future than prevailed in the past — as would be the case, for example, if rates followed a random walk — then firms might be willing to undertake investments in new money management techniques that were previously judged unprofitable. In essence, this approach suggests that once a past peak has been surpassed, investments are made in new money management techniques that lead to a more permanent effect on money demand,

[35] See Enzler et al., "Some Problems in Money Demand," and Quick and Paulus, "Financial Innovation."

even after market rates have dropped below the previous peak. That is, once the fixed costs of an investment are borne, it remains in place and is not discarded even though rates have declined.

The relationship between peaks in interest rates and the subsequent impact on cash management, and thereby money demand, may be lengthy and somewhat variable for a number of reasons. If the threshold effects are large, the new investments to be undertaken may be more sizable than otherwise and take a longer time to implement. Such episodes may also spur the development of new technologies, new research and development efforts and the promotion of new practices by the suppliers of cash management services. Bringing the new technology in line — learning by doing — takes time as does recruiting the skilled labor force to operate it. Finally, it takes time before the new technology is diffused throughout the industry. To represent these effects we have used a ratchet variable, s_t, that is somewhat more flexible than the past peak representation.[36]

Let ν_t be the relevant opportunity cost for evaluating cash management investments. We define s_t by

$$s_t = \sum_{j=1}^{t} \left(\upsilon_j - \frac{1}{n} \sum_{i=j-n+1}^{i=j} \upsilon_i\right)^+$$

where $(\ )^+$ denotes the nonnegative values of $(\ )$.[37] That is, s_t is the cumulative sum of t nonnegative terms where each term in the sum is the difference between the current value of υ and the n-period moving average of current and past values. If υ_i is larger than this average, the positive difference is added to the sum; otherwise it contributes nothing.

Chart 1 plots the time series for the ratchet variable, s_t, and υ_t, where υ_t is defined as the five-year Treasury bond rate. The chart shows that this ratchet variable moves somewhat closely with the past peak in the federal funds rate and, to a lesser extent, the actual five-year bond rate. In the empirical work, this rate performed somewhat better than a similar flexible ratchet variable using shorter term rates, perhaps reflecting the tendency for cash management investments to be evaluated over a longer horizon than cash flows.[38] Observe from the figure that s_t will ordinarily rise after a peak in the five-year rate is reached.

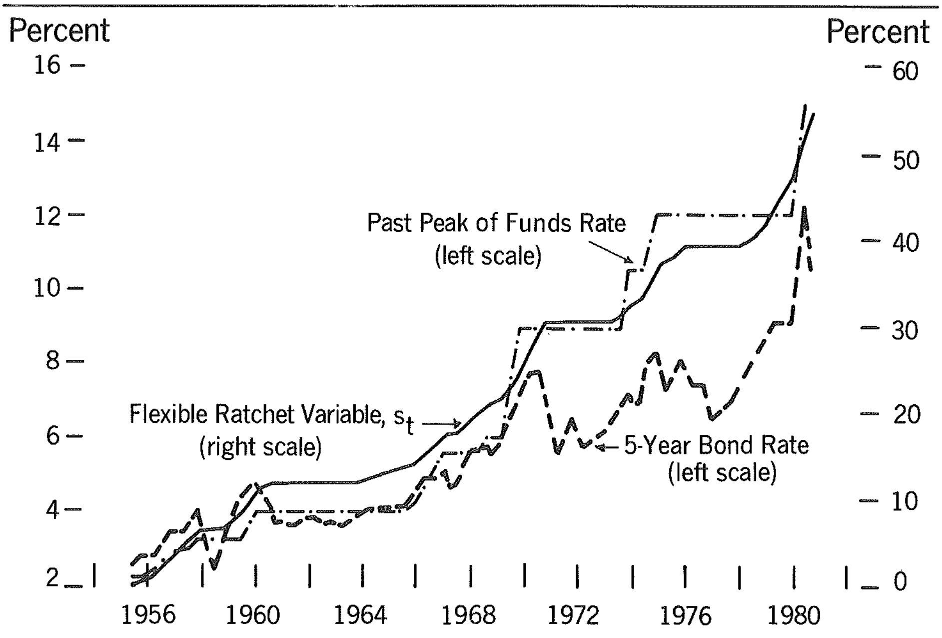
As shown in Appendix A, the long-run interest rate elasticity with cash

[36] A ratchet variable satisfies the property that $s_t \geq s_{t-1}$ for all t.

[37] This nonnegative aspect is, of course, what makes s_t a ratchet variable.

[38] See Milton Friedman, "Time Perspective in the Demand for Money," *Scandinavian Journal of Economics*, 1977, pp. 397–416, for a discussion of the effect of the spectrum of interest rates on cash holdings; and Richard Porter and Eileen Mauskopf, "Cash Management and the Recent Shift in the Demand for Demand Deposits," (Board of Governors of the Federal Reserve System, Division of Research and Statistics, Econometric and Computer Applications Section, November, 1978; processed), pp. 12–15, for a critical assessment of the practical implications of Friedman's results for the demand for money by firms.

Chart 1 Behavior of Bond Rate, Past Peak of Federal Funds Rate and Flexible Ratchet Variable



management is greater in absolute value than the short-run elasticity where cash management techniques are held fixed. Moreover, as interest rates rise, more firms find it profitable to begin adopting new money management techniques. Thus in the aggregate the long-run interest rate elasticity should rise (in absolute value) as rates rise.[39] To account for these variable elasticity effects, three simple functional forms for s_t were estimated. Table 4 displays these forms and terms for the corresponding elasticities.[40] In general, we would expect that the elasticity would increase only gradually as rates go up since increases in the elasticity only take place when new firms cross a cash management threshold. If cash management costs fell abruptly or the rates rose sharply, however, the process might be more discrete and less gradual.

One other modification to the ratchet variable, s_t, was also considered which sets s_t at a positive level in the first period. In the calculations reported, we set s_t equal to zero in 1953:1 and cumulate from there. However, in a sense, s_t represents an index of cash management investments and this index of cash management investments may have been positive in 1953:1, so that we should start with an initial endowment, s_e. Thus in some estimates we use (s_t + s_e) instead of s_t, where s_e is a parameter to be determined by the data.

Appendix B presents further details on the regression specifications that include these cash management variables. Essentially, we employed a Shiller distributed lag estimation technique, using a four-quarter lag for the short-term Treasury bill rate, a three-quarter lag for real GNP and a six-quarter lag for the money management ratchet variable; the passbook rate entered the regression contemporaneously.[41] Except for the ratchet variable, a double logarithmic functional form was used with the dependent variable being measured as real balances. Equation (4) lists the equation used:

$$\text{(4)} \quad \ln(M/p) = \beta_o + \sum_{j=o}^{3} \beta_{1j}^{s} r_{1t-j} + \beta_2 r_{2t} + \sum_{j=o}^{2} \beta_{3j} y_{t-j} + \sum_{j=o}^{5} \beta_{4j} g(s_{t-j})$$

where g is one of the functions in Table 4.

[39] See Appendix A for a further discussion of the analytics behind these points.

[40] Without specifying the distribution of the fixed costs of cash management for various-sized firms, the theoretical specification of the aggregate form of this elasticity cannot be determined. The functions estimated were chosen to cover various simple possibilities.

[41] See Appendix B for additional discussion of the interpretation of the passbook rate in these regressions. The discussion, in essence, suggests that the passbook rate may have acted as a proxy for the money management variable.

Table 4
Alternative Specification of the Variable Elasticity of Money Holdings with Respect to the Ratchet Variable

Form	Function	Elasticity*
1. linear	s_t	$c\ s_t$
2. linear times log	$s_t \times \ln(s_t)$	$cs_t(l + \ln(s_t))$
3. power transformation	s_t^{λ}	$c\lambda s_t^{\lambda}, \lambda>0$

* c is the coefficient of the function in the regression. This coefficient will vary substantially in magnitude from one functional form to another.

A comparison of the in-sample properties of the money management money demand specification (Appendix Table B-4) with the standard specification (Appendix Tables B-1 and B-3) for demand deposits, M-1B, and augmented M-1B (M-1B plus overnight RPs and Eurodollars) reveals several differences. First, the standard errors in the two specifications are about the same in the early period (1955:1–74:2), but over the entire period (1955:1–80:2) the money management specification has a considerably smaller standard error than the standard equation. Second, the long-run elasticities for the three-month bill rate and real GNP tend to be much more stable in the money management specification than the standard specification. Although estimates of the money management ratchet parameters tend to vary somewhat more over the two sample periods than the income and bill rate elasticities, Appendix B indicates one sense in which the money management parameter impacts can be viewed as being about the same in the two sample periods.[42] On the other hand, the ratchet variable does increase in significance as the sample period is extended so that it cannot be concluded that the estimated impact of money management on money demand has been pinned down precisely or that the specifications reported here are capable of restoring the properties of M-1 equations to pre-1974 magnitudes.

The overall improvement of the money management specification over the standard specification can also be seen in the post-sample growth rate statistics — mean errors and root mean square errors — that are displayed in Table 5 for the various specifications of the money management variable. For example, the mean error for the best money management specification for demand deposits is about zero, as compared to a mean error of –3.3 percentage points for the best results of standard specifications; the root mean square errors in these two specification are equal. For M-1B, the best money management specification has a lower mean error (–.8 percentage points) com-

[42] See the discussion in the first full paragraph following Appendix Table B-4. The constant elasticity specification is not, however, satisfactory as the sample period is extended over the period of difficulty. Indeed, this variable is always insignificant when added to the linear or log-product specifications.

Table 5
Post-Sample Errors and Stability Tests of Alternative Cash Management — Money Demand Specifications for Demand Deposits, M-1B, and M-1B Augmented

Aggregate	Specification of functional form of the ratchet variable	F-test	Quarterly errors Mean	Quarterly errors RMSE	Annual errors by 4-quarter periods 74–75	75–76	76–77	77–78	78–79	79–80	Annual errors Mean	Annual errors RMSE	Cumulative percentage error in 80:2
Demand Deposits	linear	6.73	–2.73	5.91	–4.4	–5.9	–3.4	.1	–1.4	–2.1	–2.84	3.46	–17.5
	logarithmic (constant elasticity)	13.9	–3.98	6.32	–7.1	–6.2	–3.2	.2	–3.2	–5.4	–4.16	4.81	–26.6
	linear times log (s_e)	5.60	–2.40	5.69	–4.3	–5.6	–3.3	.2	–1.0	–1.0	–2.49	3.22	–15.2
	power transformation (s_e)	3.94	–.05	6.46	–3.6	–3.8	–2.6	1.1	1.7	6.6	–.11	3.68	–.1
M-1B	linear	4.58	–.95	4.44	–2.8	–3.9	–2.1	.9	1.8	.2	–1.00	2.30	–5.7
	logarithmic (constant elasticity)	7.74	–1.78	4.75	–4.9	–4.3	–2.1	1.2	.9	–2.0	–1.86	2.97	–11.0
	linear times log (s_e)	3.86	–.73	4.33	–2.9	–3.6	–2.1	1.0	2.1	1.0	–.76	2.31	–4.3
	power transformation (s_e)	2.58	–.95	4.45	–2.8	–3.9	–2.1	.9	1.8	.2	–1.00	2.31	–5.7
M-1B augmented	linear	4.27	–.61	4.77	–2.9	–3.0	–1.0	1.6	3.4	–1.8	–.63	2.45	–3.7
	logarithmic (constant elasticity)	7.81	–1.06	5.64	–4.0	–3.3	–.9	2.1	2.9	–3.4	–1.09	2.95	–6.4
	linear times log (s_e)	3.36	–.44	4.51	–2.9	–2.8	–1.0	1.6	3.6	–1.2	–.45	2.40	–2.6
	power transformation (s_e)	6.06	–.93	4.96	–3.2	–3.0	–1.0	1.6	2.7	–3.0	–.97	2.55	–5.7

pared to a mean error of −1.9 percentage points for the best of the standard specifications. Furthermore, the best results for M-1B employing the cash management specification are better in terms of mean error and root mean square error than the results for augmented M-1B employing the standard specification.[43,44]

The results discussed above are encouraging, especially in light of the unprecedented departures of the M-1 equation in the mid- and late-1970s. They suggest that longer term considerations involving a higher perceived opportunity cost of holding demand deposit balances lead to downward adjustments in the amount of demand balances held for a given short-term rate of interest and a given amount of aggregate spending. At a minimum, such a cash management variable can provide the observer with a better indication of those periods during which standard specifications are most likely to undergo downward shifts. Moreover, it is possible that further refinements in this variable — perhaps involving the inclusion of the costs of cash management systems, another determinant of the profitability of money management investments — will enhance the predictability of the narrow monetary aggregates. Nevertheless, it is also possible that even with further improvements there will continue to be a greater amount of uncertainty involved in forecasting the public's money demand behavior; this is because departures from standard equations tend to be associated with the investment process — the timing of which is inherently difficult to project — and involves the adoption of some new systems — such as the concentration account — that tend to have lumpy effects on money demand.

III. Implications

A. M-1

The evidence presented in the previous section indicates that certain improvements can be made to the standard specification of the demand for narrow money balances by including a variable representing the profitability of investing in new cash management systems. Nevertheless, there currently is no satisfactory procedure for lowering the presently large amount of uncertainty about the demand for the narrow transactions measure of money or its velocity to levels of the early 1970s. An augmented transactions measure —

[43] The results for the augmented M-1B measure — as well as augmented M-1B plus money market mutual fund shares — also show some improvement. A three-asset model that describes the joint demand for RPs and deposits as an inventory process is set out in Porter and Mauskopf, "Cash Management and the Recent Shift," pp. 45 to 51. In general, the cash management effects would influence both demand deposits and RPs in somewhat similar ways. The equations reported in Appendix Table B-4, however, do not incorporate an own rate for RPs and cannot be used to test the money management hypothesis in a three-asset model.

[44] The novelty of the approach we have adopted to represent cash management effects has three distinct elements: a variable elasticity, a ratchet property, and a long-term rate. We have seen that the assumption of a variable elasticity appears to be an important ingredient in modeling the cash management process. Appendix Table B-7 shows that neither the inclusion of a simple past peak rate in constant elasticity form nor the inclusion of longer term rates in constant elasticity form restores stability to the function.

that adds highly liquid substitutes such as RPs and money market mutual fund shares — may lower drift but this likely would come at the expense of heightened uncertainty about quarter-to-quarter growth, since the behavior of demand deposit substitutes is at times strongly affected by portfolio considerations that can be very difficult to quantify with any precision. Somewhat more promising is the alternative approach of respecifying the money demand relationship to include a variable that reflects the perceived profitability of investing in new cash management techniques, ones that enable the depositor to conduct a given volume of transactions with smaller amounts of narrow money balances. Nevertheless, the results show that the errors based on this improved specification since the mid-1970s tend to be considerably larger than those based on the standard specification before that time.

Consequently, it appears to the authors that a given rate of projected GNP growth will be associated with a wider range of potential rates of growth in M-1. In other words, for a given nominal GNP growth rate objective, historical relationships embodied in an econometric model can be used to provide a point projection for the monetary growth rate and level of interest rates — and thus velocity — that is consistent with this objective. However, surrounding this point projection of monetary growth is a confidence interval, the size of which depends on uncertainty about the public's money demand or velocity behavior.[45] In view of the shifts that have occurred in the velocity of narrow money since the mid-1970s — ones that have not been adequately captured even with modifications to the money demand specification or with augmented measures of money — it seems clear that the confidence interval for M-1 velocity is now much wider than it has been historically. The out-of-sample root mean square error for the annualized rate of change of M-1 velocity, based on standard equations, appears to have roughly doubled from the early 1970s to more recently.

One method of dealing with this added uncertainty is to establish ranges for M-1 growth that are wider than would be the case if there were less uncertainty.[46] A possible control procedure would be to adjust actual money

[45] More precisely, since the shifts in M-1 demand discussed earlier have all been in the downward direction and the analysis suggests that further downward shifts are likely to occur, the widening of the confidence interval stems from a drop in its lower end. In other words, it is now more likely that a given rate of GNP growth will be associated with M-1 growth that is below the point projection given by standard models.

[46] It is assumed here that the wider range reflects the greater likelihood that a given rate of growth of GNP will be associated with slower growth in M-1 than was the case in earlier times, before pronounced downward shifts occurred in money demand. Consequently, the wider range results mainly from a decline in the lower end of a confidence interval having equal probability tails. Since the probability distribution of outcomes for M-1 growth is likely to be more asymmetric because of potential downward shifts in money demand, the mid-point of the range — between the upper and lower end — will tend to differ from the mean of the probability distribution by more; the mean of the probability distribution represents the rate of growth that can be expected to minimize losses with a quadratic loss function. While there is a case for focusing more on the mean of the probability distribution, under most circumstances the mean and the mid-point will tend to be near each other and we choose, for simplicity, to conduct the discussion in terms of the mid-point of the range. Alternatively, even with an asymmetric probability distribution one could construct a confidence interval having a midpoint that equals the mean of the probability distribution if one is willing to accept unequal tail probabilities.

growth within this wider range during the policy period — say, fourth quarter to fourth quarter — in response to incoming information. For example, if incoming information suggested that economic activity and interest rates were behaving as expected but money growth was weak, it might be inferred that some upward drift in velocity—or downward drift in money demand—was occurring and thus that monetary growth in the lower portion of the target range is most consistent with the GNP objective. In other words, it might be inferred that "effective" money growth — after adjusting for estimated downward drift in money demand — was outpacing actual or measured growth and that no adjustment was necessary, even though actual money growth was near the lower end of the range. Indeed, simulations of money demand based on a generally accepted money demand model and the best available information on the "right-hand side" variables — output, prices, and interest rates — could be used to make estimations of effective monetary growth and determine the extent to which actual monetary growth could fall short of the mid-point of the range. The extent to which desired actual money growth might fall short of the mid-point of the range would thus depend on the estimated shortfall of actual from effective money growth. In the event that complete confidence were attached to the model-based estimate of effective money growth, the adjusted target for money growth could equal the mid-point of the range less the difference between effective and actual monetary growth. However, in practice the usefulness of such a procedure of adjusting monetary growth targets is limited by uncertainty about the specification of the money demand equation and the reliability of early estimates and projections of the right-hand side variables. Nevertheless, with more uncertainty about money demand behavior, the potential shortfall of actual from effective money growth would tend to be greater, suggesting a wider range.

If monetary growth ranges are not sufficiently wide to reflect the enhanced uncertainty of M-1 velocity, then target ranges may require occasional adjustments. For example, if it becomes highly certain that a sizable downward shift in money demand is occurring — one much larger than allowed for by the lower end of the range — the entire range could be adjusted downward by an appropriate amount. Frequent adjustments to the range, however, may cause confusion and could erode the credibility of the monetary authority.

Instead of following such a flexible approach, one could argue that it is inappropriate to establish wider ranges or to adjust monetary growth targets to reflect evidence that a shift in money demand is occurring and that efforts should be directed to hitting the mid-point of a fairly narrow range, regardless of what incoming information suggests. One might justify such a position on grounds that missing the mid-point of the announced range damages credibility, or that preliminary data and standard money demand models can give highly misleading signals, or that any acceleration in effective monetary growth can be absorbed by the private sector with only minimal difficulty. However, if one accepts the proposition that further downward shifts in M-1 demand can be expected to occur, ones that are largely unpredictable, then monetary policy would tend to be more expansionary and GNP growth more variable than suggested by historical experience, if targeted ranges were not adjusted accordingly. If a rigid policy of hitting the mid-point were pursued during those periods when shifts occur, effective monetary growth would tend to exceed the mid-point of the range and GNP growth would tend to exceed expectations. If the private sector is capable of quickly identifying and adjusting to such enlarged variability of effective money growth during these periods, then output would be little affected and the greater variability of GNP growth would be reflected in a more variable inflation rate. However, if the private sector is slow to recognize the increase in effective money growth and is not able to make necessary adjustments readily, then output growth would tend to be more variable than if actual monetary growth were more flexibly adjusted to reflect shifts.

B. M-2 and M-3

In view of the difficulties associated with the narrow measures of money, more attention could be focused on the broader measures — M-2 and M-3. M-2 contains very liquid alternatives to transactions balances — money market mutual fund shares and overnight RPs and Eurodollars — along with savings and small-denomination time deposits. The M-3 measure also contains term RPs and large-denomination time deposits.

It was noted earlier that M-2 behavior in recent years seems to have been closer to that forecast on the basis of historical experience than for the narrower measures — both in terms of registering very little drift and smaller quarter-to-quarter forecast errors — although the sources of its satisfactory performance are not completely evident. The discussion of previous sections demonstrates that the addition of RPs and money market mutual fund shares to an M-1 measure seems to offset some of the downward drift in the demand deposit component. Consequently, some of this drift in the demand deposit component was mirrored in growth of these components of M-2. However, lowered drift in the demand deposit plus money market mutual fund shares and overnight RPs and Eurodollars component of M-2 comes at the expense of larger quarter-to-quarter forecast errors. Thus, on balance, it appears that the relatively favorable performance of M-2 in recent years is attributable more to the savings and small-denomination time deposit component of this aggregate than to the money market mutual fund share and overnight RP and Eurodollar components.[47]

The changing character of the interest-earning component of M-2, however, has added to uncertainty about the response of this aggregate to changes in market rates. A growing proportion of this aggregate has yields

[47] See David J. Bennett et al., "Econometric Properties of the Redefined Monetary Aggregates," pp. 26 to 28.

that vary with market rates — especially money market mutual fund shares and time deposits in the form of money market certificates and small saver certificates. Moreover, interest rate ceilings on all savings and small time accounts are scheduled to be phased out by 1986. Consequently, the relationship between this measure and market interest rates is changing, as a given change in market rates can be expected to have somewhat less effect now on growth in this measure than in earlier times. Ultimately, the nontransactions component of M-2 might be highly insensitive to changes in market rates because own and competing rates likely will move closely together, leaving the differential largely unchanged. Meanwhile, though, reliable elasticity estimates may be difficult to establish. Experience thus far in 1980 would tend to confirm this point. Growth in the non-M-1B portion of the M-2 measure has been about in line with that suggested by historical evidence, even though the fraction of this aggregate accounted for by money market mutual fund shares, money market and small saver certificates, and overnight RPs and Eurodollars had grown to nearly one-third of total M-2 by mid-year. One could conclude from this episode that the interest elasticity of M-2 has not declined by as much as one might have expected or that the behavior of M-2 can at times be influenced by unpredictable shifts in portfolio composition among M-2 and non-M-2 assets.

Nevertheless, the M-2 aggregate has a relatively close relationship with income and is likely to internalize much of the deposit shifts that are expected to accompany nationwide NOW accounts scheduled for the end of 1980. Based on NOW account experience in the Northeast, it is apparent that the public will open new NOW accounts by transferring funds not only from demand deposit accounts but also from savings deposits and other liquid assets. Thus M-1A growth can be expected to fall below the underlying rate of growth of transactions balances while growth in M-1B will tend to overstate such growth. Moreover, in this environment there is likely to be a great deal of uncertainty for a while about the rate at which households will shift to NOW accounts and the corresponding effects on the growth rates of M-1A and M-1B. By contrast, growth in M-2 is likely to be virtually unaffected by the introduction of nationwide NOW accounts, as the accompanying portfolio shifts are likely to affect only its composition.

M-3 might also have some advantages over the narrower measures, especially in an environment of uncertainty regarding shifts in transactions balance demands. However, because its term RP and large-denomination time deposit components play a prominent role in the managed liabilities strategies of commercial banks and thirft institutions, this measure is likely to be more heavily influenced than M-2 by credit demands and the costs of other managed liabilities, such as Eurodollar borrowing. Perhaps reflecting these complications, the demand for the M-3 measure has generally been more difficult to predict than the demands for the narrow measures and M-2.[48]

[48] Ibid., pp. 28 to 30.

C. Control Procedures

With heightened uncertainty about the behavior of the narrow transactions measures of money, there are certain advantages to control procedures that allow more flexibility to adjust monetary growth rates to reflect money demand shifts as they emerge. A set of operating procedures that places primary emphasis on stabilizing short-term interest rates over short periods of time — with adjustments occurring in response to cumulative departures of actual from targeted money growth — would, in comparison with one that produces more steady month-to-month growth in money, tend to provide more opportunity to evaluate incoming information to determine whether departures represent money demand shifts. In other words, in those instances when shifts in money demand occur, effective money growth rises above actual money growth and, if control procedures produce steady month-to-month growth in actual M-1 balances, money market rates would tend to drop, imparting unanticipated stimulus to the economy. Once it is recognized that effective money growth has advanced above target, there may be a desire to return effective growth to the target range by adjusting policy instruments to lower actual growth by the appropriate amount, which might require that money market rates rise above their initial levels, at least for a while. By contrast, with a control procedure that involves relatively slow adjustment of the federal funds rate — and implicitly other money market rates — more opportunity would exist to observe incoming information to determine whether it is desirable for actual money growth to slow. Thus by steadying interest rates when shifts do occur, effective monetary growth would tend to be stabilized and interest rate variability, of course, would be damped. However, when shifts do not occur, this control procedure would tend to add to month-to-month variability in both effective and actual monetary growth and perhaps output and prices.

Consequently, a control procedure that produces relatively steady growth in money in the short run has important advantages when there are disturbances in markets for goods and services, while one that tends to produce more stability in interest rates in the short run has important advantages when there are disturbances to the monetary sector, especially money demand.[49] For example, if economic activity were to weaken unexpectedly at a time when money demand behaved as expected, there would be a tendency for monetary growth rates — both actual and effective — to slow and market rates to soften. A reserve targeting procedure would essentially enable interest rates to fall as efforts were undertaken to return money growth to target. The decline in rates, in turn, would tend to stimulate spending and return GNP growth toward the GNP objective. If, by contrast, the federal

[49] The discussion here parallels the analysis of the choice of an intermediate target of monetary policy. See William Poole, "Optimal Choice of Monetary Policy in a Simple Stochastic Macro Model," *Quarterly Journal of Economics*, Vol. 84 (May 1970), pp. 197–216, and Stephen F. LeRoy and David E. Lindsey, "Determining the Monetary Instrument: A Diagrammatic Exposition," *American Economic Review*, Vol. 68 (December 1978), pp. 929–34.

funds rate were stabilized, this partially corrective decline in rates would be postponed and, if postponed long enough, GNP growth might fall below the objective. Conversely, if, as noted above, the decline in money market rates were the result of a downward shift in money demand, a control procedure that quickly returned actual growth in money to the target range would tend to add to effective monetary growth and could lead to more monetary stimulus than desired, especially if it took a long time to recognize this development and make the appropriate adjustment in actual money growth. However, actual monetary growth would immediately slacken with a control procedure that stabilized money market rates. Indeed, actual money growth would tend to slow by roughly enough to keep effective money growth about unchanged.

The relative merits of alternative control procedures depend importantly on whether there is more near-term uncertainty about the behavior of money demand or about aggregate demands for and supplies of goods. The above discussion suggests that, all else the same, a control procedure that tends in the short run to stabilize money market rates could be preferable to one that yields close short-run control over actual monetary growth during times when there is heightened uncertainty about money demand behavior. However, such a procedure would tend to add to the variability of actual and effective monetary growth during those periods when money demand behaves as expected. Moreover, some of the conditions that have been associated with unpredictable shifts in money demand — particularly high and variable interest and inflation rates — have also been associated with heightened uncertainty about economic activity and inflation expectations. Consequently, in such an environment the precision of any control procedure is weakened.

APPENDIX A
Cash Management and the Demand for Money by Firms

This appendix has three parts. Part I presents an analysis of the demand for money with endogenous cash management under the assumption that all cash management costs are variable. Part II considers two variations of the model presented in Part I. The first allows for some fixed costs of cash management; the second also treats the case where the benefit from cash mangement is based on both current period expenditures and the stock of accumulated cash management "capital." The last section, Part III, examines actual cash management practices in the United States with reference to the analytical discussion in sections I and II.

I. Demand for Money with Endogenous Cash Management: Variable Costs of Cash Management

The classical inventory model of the demand for money by firms posits that firms minimize the sum of opportunity costs (foregone interest) and transaction costs when the day-to-day cash flow (cash inflows less outflows) is uncertain.[50] Transactions costs arise through the exchange of deposits for interest-bearing liquid assets that are alternatives to deposits. The firm is assumed to follow a simple inventory rule of adjusting its cash position by exchanging deposits for the liquid asset when the deposit balance reaches a predetermined ceiling or by selling the liquid asset when the deposit balance hits a predetermined floor. Following the exchange, deposits are always restored to the same level under this rule. If transactions costs are independent of the size of the transaction and daily net cash flows are independent over time with mean zero, the Miller-Orr cube root expresion for average demand deposits is [51]:

$$(A-1)\ M = k(\sigma^2 b/r)^{1/3}$$

where M = nominal demand deposits balances
σ^2 = the variance of daily cash (stochastic) flows
b = the nominal transaction cost
r = the opportunity cost of holding cash
$k = (4/3)(3/4)^{1/3} = 1.21$

The equation can be expressed in real terms by dividing both sides of (A−1) by the price level p,

$$(A-2)\ M/p = k(\bar{\sigma}^2 \bar{b}/\bar{r})^{1/3}$$

where bars over variables denote real variables. The equation predicts that as the scale of a firm's operation increases as, say, indexed by the real standard deviation ($\bar{\sigma}$) of net cash flows, the firm will be able to avail itself of scale economies; optimal money balances increase by 2/3 of the percentage increases in σ. The interest elasticity of the demand for real cash balances is −1/3 and the elasticity with respect to the real brokerage fee ($\bar{b}$) is 1/3.

In the Miller-Orr model, daily fluctuations in the firm's cash position are assumed to be exogenous. However, many of the developments in the cash management field suggest that firms are able to adopt new techniques that enable them to lower the perceived or actual variance of their cash flow.

Increased certainty about net cash flow is achieved through purchasing information about actual cash flow or through the use of various procedures to restructure receipts and payments.

[50] While part of the variability in the net cash flow may be predictable, we can treat the entire variability as being stochastic and assume that the firm has already made the proper response to the predictable portion. Essentially, funds needed to cover predictable outflows can be invested to mature when such outflows are scheduled to occur, provided that the returns exceed transaction costs; also, on the receipts side, predictable inflows can be placed in advance by making a forward commitment.

[51] Merton Miller and Daniel Orr, " A Model of the Demand for Money by Firms," *Quarterly Journal of Economics*, Vol. 80, 1966, pp. 413–435, and Daniel Orr, *Cash Management and the Demand for Money*, New York: Praeger, 1969.

To incorporate this possibility into the Miller-Orr model we assume that by buying λ units of cash management services, the firm reduces the variance of its net cash flows from σ^2 to $g(\lambda)\sigma^2$.[52] Chart 1 provides a particular illustration of the assumed shape of the function g (λ).[53,54]

If we impose a specific form on $g(\lambda)$ such as

$$(A-3) \quad g(\lambda) = \frac{1}{1+\lambda}$$

and assume that the cost of purchasing λ units of cash management services is λe, then optimal cash holdings follow a fourth-root rule

$$(A-4) \quad M = K(\sigma^2 be/r^2)^{1/4}$$

where

$$k = (4/3)(9/8)^{1/4} = 1.373.$$

Thus with endogenous cash management, the transaction elasticity becomes 1/2 rather than 2/3, and the interest elasticity is $-1/2$ rather than $-1/3$. Changes in the cost of cash management will also affect demand for deposits under this more general formulation. Advances in computer technology, in cash management software, in cash management research, in telecommunications and wire transfers, will lower the cost (e) of reducing uncertainty, thereby lowering optimal money balances.

The decline in scale and brokerage fee elasticity and the increase in the interest rate elasticity — as compared with the classical Miller-Orr model — are independent of the specific form of $g(\lambda)$. We show this below.

With endogenous cash management, the expected cost function is given by

$$(A-5) \quad C = \frac{\theta g(\lambda)}{z(h-z)} + \frac{r(h+z)}{3} + \lambda e = c_1 + c_2 + c_3$$

where

$\theta = \sigma^2 b$
h = ceiling on cash balances
z = return point for the cash balance; that is, once the ceiling (h) or floor of zero balances is encountered, the cash balance is restored to z (by selling or purchasing the interest-bearing asset).

[52] More generally, g may be indexed on σ and b. To simplify notation we ignore such complications, but they may be important in aggregating the model.

[53] The function g is assumed to have the following properties:

(a-1) $g(0) = 1$
(a-2) $g'(\lambda) < 0$
(a-3) $g''(\lambda) > 0$

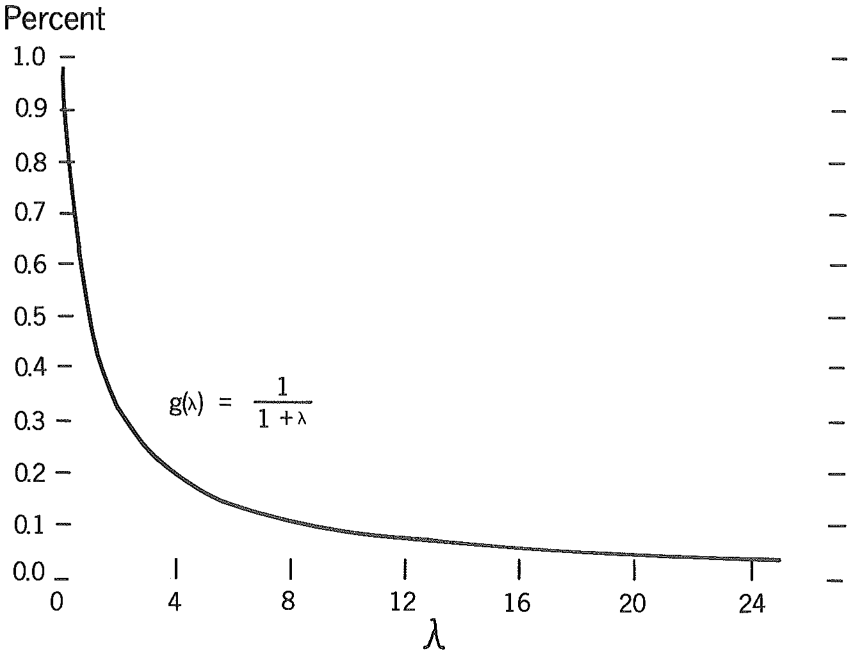
Thus g is a convex function. The second-order conditions for a minimum require, in addition, that

$$(a-4) \quad 3g(\lambda)g''(\lambda) > 2(g'(\lambda))^2$$

at the optimum level for λ. This last condition puts a super convexity condition on g. For example, if $\ln g(\lambda)$ is convex, (a-4) is satisfied.

[54] Cash management purchases which reduce the effective brokerage fee have the same effect analytically and can be considered as part of the same process.

Chart 2 An Illustration of the Function g(λ)



c_1 represents the product of the brokerage fee, b, with the probability of having to incur a transaction,

$$\frac{\sigma^2 g(\lambda).}{z(h-z)}$$

The second term, c_2, is the product of the opportunity cost of holding cash, r, with the expected average cash balances,

$$\frac{h+z.}{3}$$

The last term, c_3, represents the cash management costs which equal the number of units, cash management services purchased, λ, times the price per unit, e.

The inventory problem is to minimize expected costs; that is, to minimize $C = C(z,h,\lambda)$ with respect to the three arguments z, h, and λ. If we let $Z = z-h$, or $h = z+Z$, an equivalent statement of the problem is to minimize $C = C(z,Z,\lambda)$. The first-order conditions for a minimum are:

$$\text{(A-6)} \quad \frac{\partial C}{\partial z} = 0 => \frac{\theta g(\lambda)}{z^2 Z} = \frac{2r}{3}$$

$$\text{(A-7)} \quad \frac{\partial C}{\partial Z} = 0 => \frac{\theta g(\lambda)}{z Z^2} = \frac{1r}{3}$$

$$\text{(A-8)} \quad \frac{\partial C}{\partial \lambda} = 0 => \frac{-\theta g'(\lambda)}{zZ} = e$$

From the ratio of (A−6) and (A−7),

$$\text{(A-9)} \quad Z = 2z$$

Substituting (A−9) into (A−8) and taking the ratio of the resulting equation to (A−6) gives

$$\text{(A-10)} \quad -z \frac{g'(\lambda)}{g(\lambda)} = \frac{3}{2} \frac{e}{r} .$$

Substituting (A−9) into (A−6) gives

$$\text{(A-11)} \quad z^3 = \frac{3\theta g(\lambda)}{4r} .$$

The properties of the model can be determined from (A−10) and (A−11).

At the optimum, $h = 3z$ so that money balances are

$$\text{(A-12)} \quad M = \frac{h+z}{3} = \frac{4}{3} z.$$

Thus the elasticites of M with respect to r, σ, e, or b are the same as the elasticities of z with respect to these arguments.The earlier assertion that the interest elasticity of money demand with endogenous cash management is greater in absolute value than its value without cash management requires our showing that

(A–13) $$\frac{\partial \ln(z)}{\partial \ln(r)} < -\frac{1}{3}.$$

From (A–11)

(A–14) $$\frac{\partial \ln(z)}{\partial \ln(r)} = -\frac{1}{3} + \frac{1}{3}\frac{\partial \ln(g(\lambda))}{\partial \ln(r)}$$

$$= -\frac{1}{3} + \frac{1}{3}\frac{\partial \ln(g)\lambda))}{\partial \lambda}\frac{\partial \lambda}{\partial \ln(r)}$$

$$= -\frac{1}{3} + \frac{1}{3}\frac{g'(\lambda)}{g(\lambda)}\frac{\partial \lambda}{\partial \ln(r)}.$$

Since $g'(\lambda)<0$ and $g(\lambda)>0$ the sign of the second term on the right-hand side of (A–14) will be less than 0 if

$$\frac{\partial \lambda}{\partial \ln(r)} > 0 .$$

Substituting for z from (A–10) into (A–11), and taking logs of the resulting equation, confirms that the latter term is greater than zero.

The elasticity results referred to in the text for σ and b also follow immediately.

II. Fixed Costs of Cash Management

To include fixed costs of cash management in the model we may assume that the purchase of λ units of cash management services costs $e\lambda + \bar{e}$, where $\bar{e}$ represents the fixed costs prorated over the appropriate period of time. If it is optimal to purchase some cash management service, then

(A–17) $C(z^{cm}, h^{cm}, \lambda^{cm}) \leq C(z^n, h^n, o)$,

where the superscript cm denotes the optimal value of the variable when λ is free to vary, and the superscript n denotes the optimal value when no cash management services are purchased, that is, when $\lambda = 0$. Apart from this additional constraint qualification, everything in part I goes through.

The interesting results, of course, concern the relationship of $\bar{e}$ to r, θ and e. It is intuitively clear than an increase in the interest rate, r, will provide incentives for the firm to buy cash management services at higher fixed costs, $\bar{e}$. For example, if $g(\lambda) = 1/(1+\lambda)$, the break-even point is the value of $\bar{e}$ that makes (A–18) an exact equality:[55]

(A–18) $\bar{e} \leq 1.817(\theta r^2)^{1/3} - 2.746(\theta e r^2)^{1/4} + e$

Appendix Chart 2 plots the breakeven point as a function of r for various values of θ under the assumption that $e = 1$.

We can also generalize the model by viewing the firm as purchasing both variable cash management services, λ, and adding to its stock of cash management capital, k:

(A–19) $k = k_0 + i$,

where i denotes the investment and k_0 denotes the initial stock. In general, k is an abstract con-

[55] If this inequality is satisfied, it will pay to purchase cash management services. Equation (A–18) is derived from (A–17). The constants in this expression are approximate, not exact.

cept involving both human and nonhuman elements. Cash management output is then

$$g = g(\lambda,k),$$

where

$$g(o,o) = 1$$

$$g_1 = \frac{\partial g}{\partial \lambda} < 0$$

$$g_2 = \frac{\partial \lambda}{\partial k} < 0$$

and g is a convex function of λ and k. The previous analysis in part I can be viewed as a special case of this model in which k was fixed. The cost function in this more general case is then

$$C(h,z,\lambda,i) = \frac{\theta g(\lambda i + k_0)}{z(h-z)} + \frac{r(h+z)}{3} + \lambda e_1 + ie_2 + \bar{e}$$

where e_1 denotes the unit price of cash management services and $e_2 i + \bar{e}$ denotes the total cost of i, that is, fixed plus variable costs. The analysis for this somewhat more general case proceeds much the same way as before.

III. A Brief Interpretation of Actual Cash Management Practices

A number of popular cash management techniques can be interpreted readily in the context of the model developed above. Included among these techniques are lock boxes, controlled disbursement, information retrieval systems, and improved forecasting techniques. Most of these techniques have both fixed and variable costs. Fixed costs include changes in business operations, the recruitment of specialized personnel, the retraining of existing personnel, the allocation of office space, and the acquisition of specialized electronic equipment such as computers and telecommunications equipment. Correspondingly, variable costs include wages and salaries, per item charges levied by banks (for lock box items or wire transfers), equipment maintenance, and so forth.

Most of the techniques that have been adopted by firms appear to have been directed at lowering uncertainty about day-to-day cash flows. In the context of the formal model, they are aimed at lowering σ^2. Lock boxes can be used to lower uncertainty about the schedule under which items are collected, in addition to generally speeding up collection. For example, the precision of projections of daily collected demand deposit balances can be improved by sorting lock box items on the basis of the location of the bank on which they are drawn and the size of the check, with special handling given to large checks for speedier presentment and collection. Consequently, the firm can more reliably predict the interday pattern of its collections over the next several business days. Controlled disbursement reduces intraday uncertainty about collected balances—in addition to slowing down disbursements—by enabling the firm to know early each day the volume of checks presented against its account. This certainty gain is achieved because the bank used for disbursements typically receives one cash letter each day, usually early in the day. By contrast, when a firm uses a money center bank for disbursements, there is more intraday uncertainty about clearings, as money center banks ordinarily obtain cash letters throughout the day.[56] Information retrieval systems—using electronic telecommunications equipment—permit firms to regularly monitor deposit balances at the firm's many banks throughout the country. This information can be used within the day to modify projections of end-of-day balances. All of these techniques, along with advanced model-based forecasting procedures, greatly assist in

[56] The use of payable-through drafts has many similarities to controlled disbursement. In particular, the firm need not keep balances in its demand deposit account with its payable-through bank; instead, each day it usually funds those items being presented against its account, following notification.

determining the amount of deposit balances that are going to be available for investment each day and the appropriate maturity of such investments. In this way, the cash manager can enter the market early in the day, when more short-term investment opportunities are available and terms tend to be most favorable.

Reductions in certain transactions costs ($\bar{b}$) also appear to have influenced cash management practices, as suggested by the above theory. Some qualitative evidence based on interviews suggests that the cost of investing in large RP lots has tended to decline, in real terms, as a fixed charge per transaction has generally supplanted an *ad valorem* fee. Also, the true cost of making wire transfers apparently has declined—as accessibility has improved and the use of wire transfers has become more widespread—and this has enhanced the ability of cash managers to move funds among accounts and make investments in immediately available funds.

Another important cash management practice, one that embodies many of the techniques discussed above, is the cash concentration account. With a cash concentration account, a firm is able to pool the variability of its many local and regional accounts by transferring funds—using the wire or depository transfer checks—into or out of these accounts to its concentration bank in response to inflows to or outflows from individual accounts. By such pooling, the firm is able to take advantage of disturbances to individual accounts that tend to be offsetting in the aggregate and to make a single (larger) investment from its concentration account. Optimal demand deposit balances under a cash concentration account arrangement can often be substantially below those that would be maintained by managing each individual account separately.[57] Consequently, adoption of a cash concentration system tends to be associated with a substantial reduction in the firm's aggregate demand deposit balances, and the widespread application of cash concentration accounts by firms likely has led to lumpy effects on the money stock.

[57] To illustrate the possibilities, suppose that the consolidation costs are zero. Then, even when net cash flows into individual accounts are perfectly correlated, consolidating the accounts into one cash concentration account reduces the optimal cash balance; see Mauskopf and Porter, "Cash Management and the Mid-Seventies Shift in the Demand for Demand Deposits in the U.S.," forthcoming in *Proceedings of Rome Conference on Monetary and Financial Models*, (Editions ECONOMICA, Paris).

APPENDIX B
Additional Empirical Results and Discussion

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This appendix presents estimates of various equations that were referred to in the text. All simulation results described in the text are based on *dynamic out-of-sample* simulations of these equations. Before examining the results, a few brief comments on the econometric procedure are in order. The regressions containing a lagged dependent variable were all estimated with a first-order Cochran-Orcutt autocorrelation correction.[58] The F-tests reported in the text used to test the equality of coefficients across various periods should be regarded as asymptotic tests because of the presence of the lagged dependent variable. Since the standard errors in the two subperiods appear to be quite different — with the second period standard error much larger than that of the first — this test should, in principle, also be corrected for heteroskedasticity.[59] However, attempts of others to make such corrections have generally not reversed any conclusions and, thus, we have not made any here. Finally, the degrees of freedom correction used in all of the Shiller distributed lag estimates and associated F-tests developed are based on the formula by Paulus.[60,61]

[58] Some comparisons were made using an alternative Hildreth-Lu procedure and the results, in all cases, were very close in terms of post-sample simulations. While the Hildreth-Lu technique has some decided asymptotic advantages to Cochran-Orcutt for the lagged dependent variable specifications, it was decided to use the faster Cochran-Orcutt technique to update results for standard money demand equations. For the money management specification discussed in the text, there is no lagged dependent variable so this problem does not occur.

[59] See Arnold Zellner, "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias," *Journal of the American Statistical Association*, Vol. 57, 1962, pp. 348-68.

[60] Robert J. Shiller, "A Distributed Lag Estimator Derived from Smoothness Priors," *Econometrica*, Vol. 41, July 1973, pp. 78-88.

[61] See John D. Paulus, "Demand Analysis and Stochastic Prior Information," Board of Governors of the Federal Reserve System Division of Research and Statistics, Special Studies Paper No. 32, February, 1973; processed; pp. 36-8.

Table B-1

Appendix Table B-1 displays estimates of equation (1) for M-1B and four of its components — M-1A, currency, demand deposits, and demand deposits plus other checkable deposits, the last measure being the difference between M-1B and currency. Also shown are estimates for four augmented aggregates: (1) demand deposits plus .6 times other checkable deposits,[62] (2) demand deposits plus overnight RPs plus overnight Eurodollars, (3) augmented M-1B consisting of M-1B plus overnight RPs and overnight Eurodollars and (4) augmented M-1B plus term RPs. Over the early period, 1959:4–74:2, the estimates generally are in agreement with the theoretical predictions of the transactions model. For example, the long-run elasticity of demand deposits with respect to overall short-term interest rates, the sum of the passbook and bill rate elasticities, is –.19. The long-run transaction elasticity of demand deposits is .51, indicating substantial scale economies in transactions. These attractive properties, however, disappear when the estimates are extended through 1980:2 as the lagged dependent variable rises to the vicinity of unity for all measures except currency and augmented M-1B. Thus the estimated equation for these measures suggests no simple interpretation over the long-sample period other than that there has been a shift in the equation.

Table B-3

Table B-3 shows estimates of equations (2) and (3) over three periods, 1959:4–74:2, 1974:3–80:2 and 1959:4–80:2, for four measures, demand deposits, M-1A, M-1B, and augmented M-1B. In addition to these equations, three other variants are shown: a first difference equation without a time trend, that is, the equation obtained by taking the first difference of equation (1); a log-level equation which contains a split time trend, one trend for the early period, 1959:4–74:2, and another trend for the later period; and the first difference equation with "split time trends," that is, dummy variables for each subperiod.[63] The columns headed by T_1 and T_2 contain the estimates of the split time trend for both the log-level and first difference specification.

Comparing the estimates in Table B-3 with those in Table B-1 for the same aggregate, we see that the addition of the time trend terms eliminates the most undesirable feature of the estimates in Table B-1, namely the tendency for the lagged dependent variable to rise to unity or greater when the sample is extended to 1980:2. Nonetheless, there is clear cut evidence that neither the addition of the time trend variables nor the introduction of the first-difference procedures resolves very much of the recent problem with the standard specifications.

At first glance the estimates from the first-difference specification seem to be more robust than the log-level specification. There is less tendency for the lagged dependent variable to rise sharply when the sample period is extended to 1980:2. For example, the lagged dependent variable rises from .76 to .97 in the log-level specification for demand deposits, but stays in the .5 to .6 range for the first-difference estimates. However, the F-tests reported in the lowest panel of the table indicate the first difference estimates are all unstable, except for the one equation without an intercept ("no time trend") for all four measures and the one with an intercept for M-1B.

However, inspection of these "stable" estimates and their $\bar{R}^2$'s for 1959:4–74:2 versus 1974:3–80:2 is at odds with impressions given by other statistics. For example, the $\bar{R}^2$ for M-1A in the first-difference equation without an intercept drops significantly and the bill rate takes on the wrong sign in the latter period. Although the F-test for the significance of the overall regression is large enough to indicate that the coefficients are nonzero, the hypothesis that the interest rate and income coefficients have doubled (or halved) is easily accepted. Thus the recorded stability in the equation appears to be associated solely with the stability of the lagged dependent variable, not income and interest rates.

The evidence from the regressions with the split time trends — one for 1959:4–74:2 and a different trend for 1974:3–80:2 — indicates that the time trend has increased sharply (in absolute value) in the post–74:2 period. For demand deposits, the first difference specification indi-

[62] This measure represents the approximate proportion of NOW and ATS accounts which have been estimated to have come initially from demand deposits.

[63] For simplicity, we refer to the dummy variable terms in the first-difference equation as the split time trend. Implicitly, we are thinking of the trend in the integrated (or levels) transformation of this equation.

cates that the annual rate of reduction in demand deposit holdings is 3.32 percentage points per year in the latter period, compared with 1.12 percent in the early period. The comparable figures for M-1A are 2.24 percentage points and .68 percentage points, respectively, and for M-1B 1.60 percentage points and .64 percentage points.

Digression on the Passbook Rate

Before discussing the estimates of the money management specifications, it is helpful to examine more closely one variable that likely has been a proxy for investments in money management techniques in the standard specification, the passbook rate on regular savings accounts at commercial banks. A previous Board staff study using the Demand Deposit Ownership Survey (DDOS) concluded that the passbook elasticity estimates derived from equations for aggregate demand deposits were much higher than might be justified by the disaggregated equations.[64] In this regard, it is noteworthy that the passbook rate appears to be highly correlated with the ratchet variable, s_t, with a simple correlation over .9 in each of the periods 1959:4–74:3 and 1974:3–80:2. Since large increases in the passbook rate (changes in ceiling) have generally come at times when there were large increases in market rates and therefore in the ratchet variable, the passbook rate may have acted as a proxy for cash management activities in the standard equation. This correlation would explain the anomaly of the size of the passbook elasticity between the disaggregated and aggregated estimates.

More recently, the use of the passbook rate in the standard equation can be criticized on the grounds that many households have now substituted money market funds for passbook accounts as their primary buffer for demand deposits.[65] To address both these passbook-rate issues, we have run estimated equations using the money management specification in three different ways:

(1) with a passbook rate
(2) with no passbook rate
(3) with the rate being defined as the maximum of the passbook rate and the average rate paid on money market mutual fund shares.

Table B-4

Table B-4 displays summary regression estimates of the money management specification for two variable elasticity functional forms — the linear and the linear times log — and one constant elasticity specification. As indicated in the text, a Shiller distributed lag estimation scheme of three quarters, four quarters and six quarters, was employed to estimate the impact on real money balances of real GNP, the three-month bill rate and the ratchet variable, respectively. In each Shiller estimate, a first-degree polynomial lag was chosen. The prior distribution on the degree was set to unity ($k = 1$) for all distributed lags except that on the cash management variable where the prior was set to four ($k = 4$). The results reported here use the specification in which the "passbook rate" represents the maximum of the rate paid on money market fund shares and the passbook rate.[66]

The regressions reported in Table B-4 provide reasonable support for the notion that the ratchet variable enters significantly if a variable elasticity specification is used, that is, the results for the linear and the linear times log functional forms for s_t agree with the theory. The ratchet variable for these regressions rose in significance as the period of estimation was extended beyond 1974:2 but its long-run coefficient tended to stabilize rather quickly.[67] The specification using the constant elasticity was definitely inferior to either of the variable elasticity specifications; it generally had the wrong sign as the estimates were extended beyond 1974:2. Indeed, an

[64] Helen T. Farr, Richard D. Porter and Eleanor M. Pruitt, "Demand Deposit Ownership Survey," in *Improving the Monetary Aggregates: Staff Papers*, (Federal Reserve Board, 1979), p. 99. The implied aggregate elasticity was obtained by multiplying the share of deposits of the sector which held savings balances in the period of the study — households — by the disaggregated passbook elasticity.

[65] See, for example, Richard D. Porter et al, "Financial Innovation," pp. 219-24.

[66] Results for the other two specifications — no passbook rate or the actual passbook rate — are not terribly different. In general, the cash management terms are more significant, as might be expected, when the passbook rate is excluded from the equation.

[67] The results for these intermediate sample periods — beginning in 1955:1 and ending after 1974:2 but before 1980:2 — are not shown.

F-test (or t-test) of the hypothesis that the constant elasticity ratchet term should enter as an additional variable in either specification (linear or linear times log) indicates that it should not.

Of the two variable elasticity estimates shown in Table B-4, those for the linear times log specification appear to be more stable over the two sample periods shown. For example, the long-run elasticity of M-1B with respect to the bill rate and real output changes only from -.027 to -.026, and from .53 to .51, respectively, as the sample period is extended. The passbook elasticity, on the other hand, falls sharply from -.039 to -.008. If, as we have suggested, the passbook rate is, in part, a proxy for the cash management effects, this effect may be offset by the estimated increase in the ratchet term. In absolute value, this coefficient increases from .0007 in the early period to .0011 in the later period — corresponding to an average elasticity of -.020 for such cash management effects in the early period compared to -.058 for the entire period. The combined ratchet and passbook elasticity in the early period is thus -.059 compared to -.066 in the later period. Consequently, if we average across these two terms, the equation has remarkably stable elasticities for the bill rate, real GNP and the "cash management impacts" for both the early period and the entire period.

Table B-5

Appendix Table B-5 presents the individual regression coefficients for the remaining money management specification which uses the power transformation. The optimum values of λ reported in this table for 1955:1-74:2 were obtained by searching over a grid of values of λ to find the minimum of the standard error of the regression. Oddly enough, slightly different estimates are obtained if the minimum of the error sum of squares is chosen as the criterion. The mystery is cleared up when it is recognized that the degrees of freedom in the Shiller regression depend on λ.[68] However, as may be seen in Chart 3 for demand deposits these different estimating procedures tend to be very similar estimates of λ. The likelihood function, though, is essentially flat so that λ is very poorly determined by the data.

This raises difficult problems for this model because the value of λ has a direct bearing on the mean error and the root mean square error of the post-sample growth rates. Chart 4 plots the mean growth rate errors for demand deposits against λ. Except for the little dip in the function between 4 and 5, the chart shows that the mean error tends to go from a large negative value to large positive values as λ increases from 0 to 6, with a zero error appearing at about $\lambda = 3$. The quarterly and annual root mean squares, plotted in Chart 5, show that the minimum root mean square errors for both measures reach a minimum at about $\lambda = 2$.

Tables B-6 and B-7

These tables show the summary estimation and post-sample properties, respectively, of modified demand equations for demand deposits, M-1B and augmented M-1B. The modification to equation 4 is accomplished by replacing the ratchet term g(s), with either a past peak rate (the federal funds rate) or a long-term rate (a 5-year or 10-year government bond rate). All rates enter the equation in logarithmic form. The results indicate that all of these variations are inferior to the specifications containing a variable elasticity ratchet term.[69]

Tables B-8 and B-9

These tables display the summary estimation of post-sample simulation properties of equations (1), (2), and (3) for augmented measures containing money market mutual fund shares

[68] The minimum error sum of squares corresponds to the maximum likelihood estimation while the minimum standard error corresponds to the method-of-moments estimator.

[69] Several detailed comments by William White of the International Monetary Fund have prompted us to consider a much wider set of regression and simulation results as a basis for comparing and contrasting the standard specification with our money management alternative. These additional results involve: (1) the use of Koyck (geometric) distributed lags in the money management specification and a Shiller distributed lag distribution in the standard specification; (2) the use of a nonconstant elasticity five-year bond rate without a ratchet transformation and with a past peak ratchet transformation. The results of these further comparisons, which are reported in a forthcoming Board staff study, do not change the basic character of the results discussed in this paper. The additional results do suggest, however, that the flexible ratchet only modestly improves upon the past peak ratchet.

(MMMFs). Like the standard equations used to evaluate augmented M-1B, these equations make no attempt to incorporate appropriate own-rate effects for MMMFs (or RPs) into the equation. The results indicate that the addition of MMMFs to M-1B or to augmented M-1B do not resolve the M-1 problem. Although the mean errors are somewhat smaller than the standard specification, the root mean square errors are worse. Moreover, the pattern of the annual errors (reported in the middle of Table B-9) strongly suggests that the improved mean errors of this aggregate compared to the standard specification for M-1B is coincidental. Other evidence concerning the volume of turnover on MMMF accounts indicates that these accounts resemble passbook savings accounts not demand deposit accounts.[70]

[70] For a discussion of this point, see Richard D. Porter and others, "Financial Innovation," p. 223. Recent evidence on account turnover is consistent with the evidence discussed in this reference.

Chart 3 Standard Error and Sum of Squares for Demand Deposits as a Function of λ

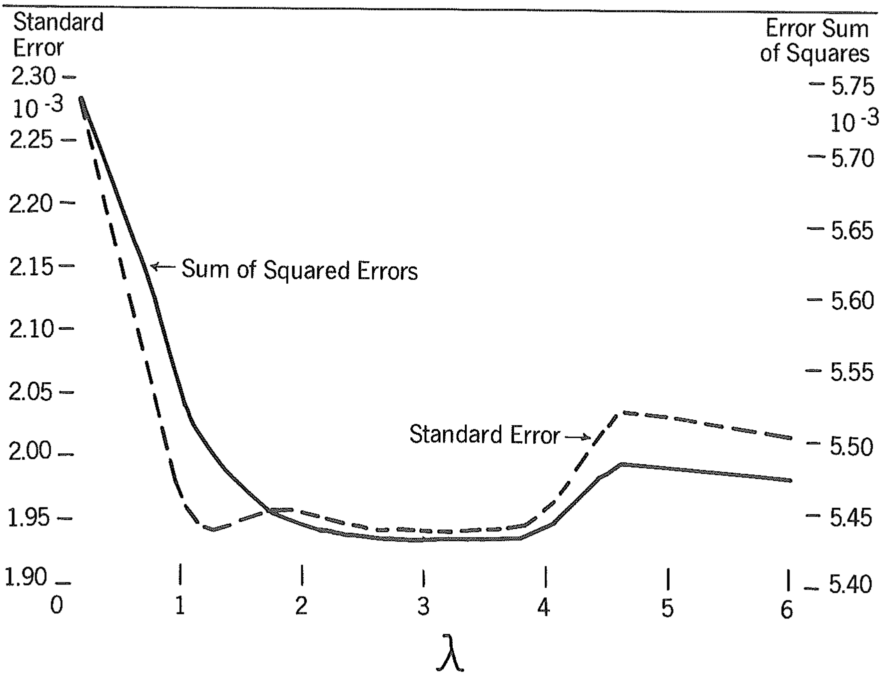


Chart 4 Mean Errors for Demand Deposits as a Function of λ

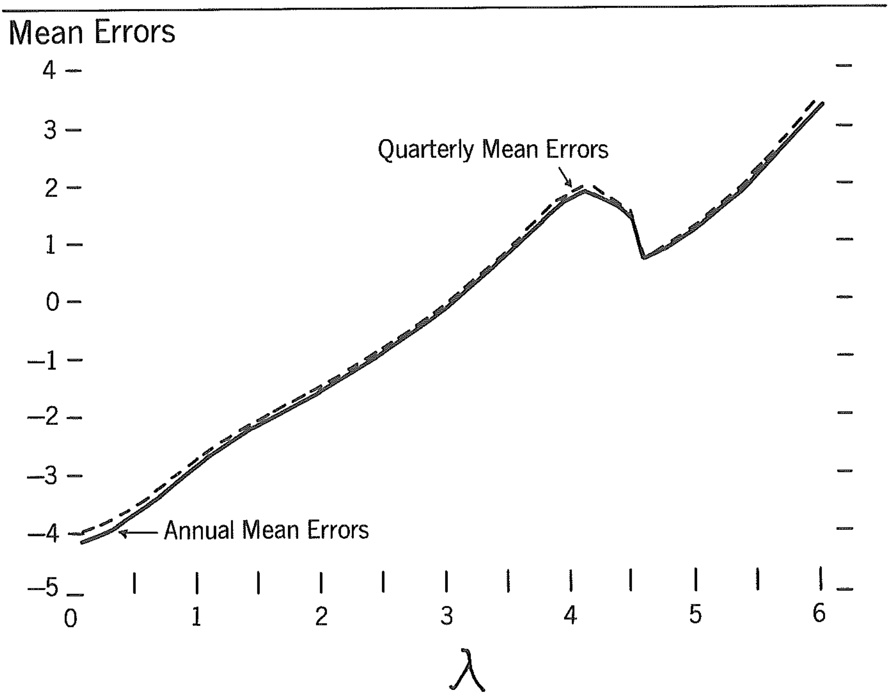
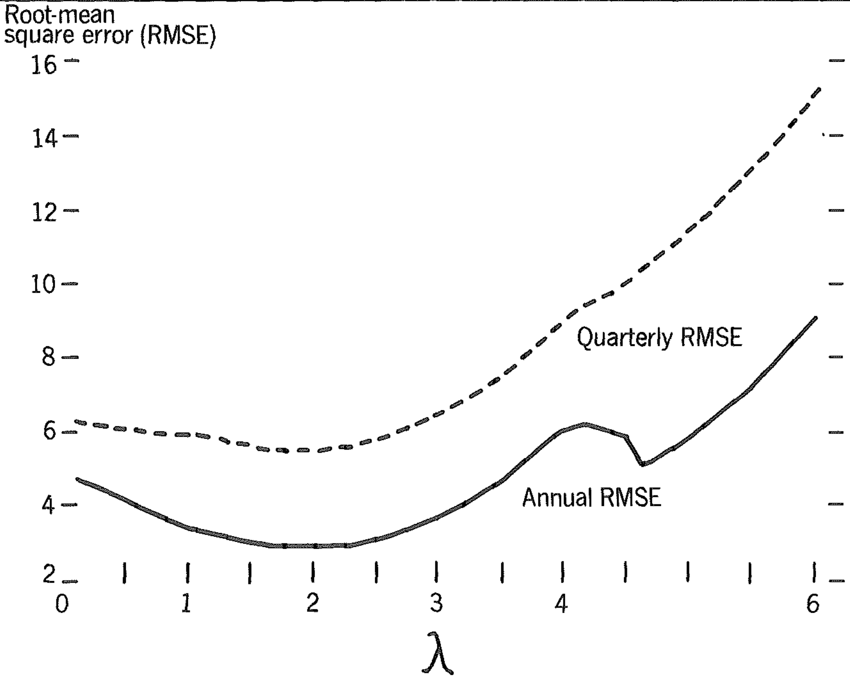


Chart 5 RMSE's for Demand Deposits as a Function of λ



Appendix Table B-1
Estimates of Equation (1) for M-1B, Its Components and Various Augmented Measures

	Constant	Real GNP	Treasury Bill Rate	Commercial Bank Pass-book Rate	Lagged Dependent Variable	$\bar{R}^2$	Standard Error of Regression	RHO	DW
M-1A									
1959:4 to 74:2	.788	.161	-.020	-.018	.660	.992	.0049	.52	1.58
	(1.93)	(3.31)	(-3.59)	(-1.05)	(5.15)				
1959:4 to 80:2	-.383	.020	-.023	-.003	1.05	.982	.0064	.36	1.71
	(-2.28)	(1.18)	(-4.93)	(-.18)	(36.45)				
M-1B									
1959:4 to 74:2	.795	.162	-.020	-.018	.657	.992	.0049	.52	1.58
	(1.95)	(3.34)	(-3.58)	(-1.06)	(5.13)				
1959:4 to 80:2	-.314	.028	-.022	-.007	1.03	.983	.0062	.42	1.72
	(-1.63)	(1.59)	(-4.52)	(-.46)	(28.27)				
Currency									
1959:4 to 74:2	-.101	.180	-.004	.001	.709	.999	.0037	.37	2.01
	(-1.31)	(4.00)	(-1.02)	(.13)	(10.50)				
1959:4 to 80:2	-.177	.217	(-.007)	-.001	.666	.999	.0038	.43	1.99
	(-2.53)	(5.44)	(-2.41)	(-.14)	(11.42)				
Demand Deposits									
1959:4 to 74:2	.441	.116	-.026	-.017	.772	.982	.0058	.51	1.66
	(1.05)	(2.92)	(-4.12)	(-.86)	(6.43)				
1959:4 to 80:2	-.500	.037	-.027	-.011	1.06	.981	.0076	.32	1.70
	(-2.85)	(1.88)	(-5.13)	(-.60)	(44.47)				
Demand Deposits plus Other Checkable									
1959:4 to 74:2	.449	.117	-.026	-.017	.769	.982	.0058	.50	1.65

1959:4 to 80:2	-.451 (-2.28)	.043 (2.15)	-.026 (-4.78)	-.015 (-.85)	1.04 (34.91)	.974	.0073	.39	1.71
Demand Deposits plus 0.6* (Other Checkable)									
1959:4 to 74:2	.446 (1.06)	.117 (2.94)	-.026 (-4.12)	-.017 (-.87)	.770 (6.41)	.982	.0058	.50	1.65
1959:4 to 80:2	-.475 (-2.54)	.040 (2.06)	-.027 (-4.98)	-.013 (-.75)	1.05 (38.88)	.977	.0074	.36	1.71
Demand deposits + Overnight RPs + Overnight Eurodollars									
1959:4 to 74:2	.577 (1.70)	.155 (3.92)	-.022 (-3.93)	-.025 (-1.51)	.695 (6.48)	.988	.0055	.41	1.71
1959:4 to 80:2	-.635 (-3.09)	.041 (1.97)	-.031 (-5.31)	-.015 (-.80)	1.08 (30.34)	.963	.0088	.26	1.66
Augmented M-1B: M-1B + Overnight RPs + Overnight Eurodollars									
1959:4 to 74:2	.852 (2.66)	.201 (4.35)	-.016 (-3.42)	-.026 (-1.76)	.599 (5.42)	.995	.0046	.42	1.66
1959:4 to 80:2	-.203 (-.77)	.043 (1.72)	-.021 (-3.61)	-.015 (-.75)	.992 (16.00)	.985	.0071	.45	1.65
Augmented M-1B + Term RPs									
1959:4 to 74:2	.491 (2.16)	.181 (4.59)	-.016 (-3.59)	-.025 (-1.88)	.691 (8.22)	.995	.0046	.34	1.85
1959:4 to 80:2	1.03 (2.47)	.200 (3.96)	-.003 (-.416)	-.059 (-1.83)	.572 (4.97)	.990	.0073	.81	1.51

Appendix Table B-2
Cumulative Error and Other Summary Statistics from a Dynamic Simulation of Equation (1) for M-1B, Its Components and Various Augmented Measures* (Percent)

	M-1A	M-1B	Currency	Demand Deposits	Demand Deposits plus Other Checkable	Demand Deposits plus 0.6*×(Other Checkable)	Demand Deposits plus Overnight RPs plus Net Eurodollars	Augmented M-1B: M-1B plus Overnight RPs plus Net Eurodollars	Augmented M-1B plus Term RPs
1974:3	-1.5	-1.5	-.72	-1.5	-1.5	-1.5	-1.5	-1.4	-.9
4	-3.4	-3.4	-.81	-3.7	-3.7	-3.7	-4.2	-3.4	-2.9
1975:1	-5.7	-5.6	-.70	-6.7	-6.6	-6.7	-7.4	-5.6	-5.3
2	-6.4	-6.3	-.22	-7.8	-7.7	-7.7	-7.9	-5.9	-5.1
3	-7.1	-6.9	.01	-8.7	-8.5	-8.6	-8.5	-6.2	-5.2
4	-8.8	-8.5	.04	-11.0	-10.7	-10.8	-10.6	-7.7	-6.4
1976:1	-9.6	-9.2	.60	-12.4	-11.9	-12.1	-11.7	-8.3	-6.8
2	-10.1	-9.6	1.5	-13.6	-13.0	-13.2	-11.7	-7.8	-5.8
3	-11.2	-10.5	1.8	-15.5	-14.6	-15.0	-12.7	-8.2	-5.8
4	-11.7	-10.9	1.7	-16.5	-15.3	-15.8	-13.2	-8.4	-6.0
1977:1	-11.9	-11.0	1.4	-16.8	-15.5	-16.0	-13.3	-8.4	-6.0
2	-12.9	-11.8	.88	-18.2	-16.7	-17.3	-13.6	-8.6	-5.8
3	-13.0	-11.9	1.3	-18.8	-17.2	-17.9	-13.6	-8.3	-5.2
4	-12.7	-11.4	1.7	-18.7	-16.9	-17.6	-12.9	-7.6	-4.3

1978:1	-12.4	-11.1	2.0	-18.5	-16.6	-17.4	-12.6	-7.2	-3.8
2	-13.2	-11.8	1.0	-19.3	-17.2	-18.1	-13.3	-7.9	-4.3
3	-13.4	-11.9	.93	-19.5	-17.3	-18.2	-13.4	-7.9	-4.2
4	-14.2	-12.1	.92	-20.6	-17.6	-18.8	-13.8	-7.8	-3.7
1979:1	-16.5	-13.1	.41	-23.8	-18.8	-20.7	-16.0	-8.4	-4.0
2	-16.8	-12.5	.04	-24.0	-17.7	-20.1	-15.1	-7.1	-2.2
3	-16.8	-12.0	.37	-24.0	-17.1	-19.7	-15.1	-6.6	-1.5
4	-17.3	-12.4	.23	-24.6	-17.5	-20.2	-16.5	-7.5	-2.8
1980:1	-18.0	-12.8	-.13	-25.3	-17.7	-20.6	-17.6	-8.2	-4.1
2	-22.2	-16.3	-.68	-31.2	-22.3	-25.7	-24.7	-12.5	-8.5
F-statistics	3.09	4.47	1.38	2.36	3.35	2.83	4.49	7.80	6.28
RMSE	4.86	4.27	1.86	6.31	5.49	5.75	6.71	4.73	5.09
Mean error	-3.39	-2.56	-.12	-4.58	-3.41	-3.87	-3.72	-1.99	-1.36

* The simulated equation for each aggregate was the one estimated over the period 1959:4 to 74:2. The cumulative error in the predicted level is expressed as a percent of the actual level. The RMSE and mean errors are based on the difference between the actual and predicted annualized growth rate of the series; the predicted growth rate is defined from the predicted level path from the equation.

Appendix Table B-3
Estimates of Equation (2) and (3) and Selected Variants for Demand Deposits, M-1A, M-1B, and Augmented M-1B

Aggregate	Period of Fit	Specification	Constant or Time Trend	T_1	T_2	Intercept for Levels Regressions	Treasury Bill Rate	Commercial Bank Passbook Rate	Real GNP	Lagged Dependent Variable	$\bar{R}^2$	Standard Error	RHO	DW
Demand Deposits														
	1959:4–74:2	levels	–.0013			–.438	–.029	–.014	.256	.764	.984	.0055	.36	1.73
			(–2.99)			(–1.02)	(–5.49)	(–.89)	(4.00)	(7.04)				
	1974:3–80:3	levels	–.0100			–.944	–.008	–.125	.739	.330	.958	.0083	.37	1.59
			(–3.96)			(–.71)	(–.68)	(–.54)	(4.26)	(1.46)				
	1959:4–80:2	levels	–.0016			–1.27	–.031	–.001	.219	.973	.984	.0069	.19	1.72
			(–4.34)			(–5.65)	(–7.22)	(–.10)	(4.89)	(36.35)				
	1959:4–74:2	first diff.	–.0011				–.019	–.044	.236	.588	.394	.0064		1.83
			(–.87)				(–2.45)	(–1.49)	(2.13)	(4.50)				

1974:3–80:2	first diff.	−.0125				.003	−.010	.695	.056	.491	.0090		1.69
		(−3.92)				(.14)	(−.05)	(3.66)	(.25)				
1959:4–80:2	first diff.	−.0041				−.013	−.034	.428	.527	.474	.0077		1.72
		(−3.31)				(−1.68)	(−.99)	(4.28)	(4.90)				
1959:4–74:2	first diff.					−.019	−.050	.169	.603	.396	.0064		1.79
						(−2.44)	(−1.76)	(2.13)	(4.66)				
1974:3–80:2	first diff.					.002	−.204	.257	.705	.126	.0118		1.54
						(.10)	(−.72)	(1.27)	(3.44)				
1959:4–80:2	first diff.					−.012	−.062	.205	.667	.408	.0082		1.64
						(−1.50)	(−1.75)	(2.61)	(6.36)				
1959:4–80:2	levels		−.0014	−.0015	−1.03	−.031	−.002	.209	.940	.984	.0069	.16	1.71
			(−3.54)	(−4.12)	(−3.51)	(−7.43)	(−.17)	(4.74)	(23.87)				
1959:4–80:2	first diff.		−.0028	−.0083		−.010	−.050	.450	.378	.512	.0075		1.69
			(−2.12)	(−4.17)		(−1.28)	(−1.47)	(4.66)	(3.19)				

Appendix Table B-3 (cont'd)
Estimates of Equation (2) and (3) and Selected Variants for Demand Deposits
M-1A, M-1B and Augmented M-1B

Aggregate	Period of Fit	Specification	Constant or Time Trend	T_1	T_2	Intercept for Levels Regressions	Treasury Bill Rate	Commercial Bank Passbook Rate	Real GNP	Lagged Dependent Variable	$\bar{R}^2$	Standard Error	RHO	DW
M-1A														
	1959:4–74:2	levels	–.0010			–.060	–.023	–.013	.252	.707	.993	.0047	.37	1.71
			(–2.74)			(–.14)	(–4.83)	(–.90)	(4.12)	(6.00)				
	1974:3–80:3	levels	–.0067			–.365	–.011	–.072	.604	.380	.918	.0065	.31	1.63
			(–3.97)			(–.32)	(–1.16)	(–.39)	(4.43)	(1.85)				
	1959:4–80:2	levels	–.0014			–1.03	–.026	.004	.199	.953	.986	.0057	.22	1.73
			(–4.74)			(–5.56)	(–7.17)	(.34)	(4.96)	(31.33)				
	1959:4–74:2	first diff.	–.0006				–.014	–.042	.209	.575	.395	.0055		1.78
			(–.53)				(–2.07)	(–1.64)	(2.18)	(4.38)				

1974:3–80:2	first diff.	–.0082				.001	.008	.559	.139	.524	.0072		1.76
		(–3.63)				(.04)	(–.05)	(3.69)	(.65)				
1959:4–80:2	first diff.	–.0029				–.010	–.033	.363	.509	.487	.0063		1.72
		(–2.93)				(–1.49)	(–1.18)	(4.43)	(4.81)				
1959:4–74:2	first diff.					–.014	–.045	.175	.578	.403	.0055		1.75
						(–2.06)	(–1.85)	(2.46)	(4.44)				
1974:3–80:2	first diff.					.002	–.134	.242	.621	.234	.0092		1.52
						(.12)	(–.62)	(1.54)	(2.95)				
1959:4–80:2	first diff.					–.009	–.054	.207	.598	.437	.0066		1.60
						(–1.27)	(–1.89)	(3.18)	(5.63)				
1959:4–80:2	levels		–.0012	–.0013	–.760	–.026	.002	.193	.909	.986	.0057	.19	1.72
			(–3.65)	(–4.37)	(–2.87)	(–7.35)	(.18)	(4.98)	(20.34)				
1959:4–80:2	first diff.		–.0017	–.0056		–.007	–.045	.374	.399	.513	.0061		1.70
			(–1.62)	(–3.67)		(–1.15)	(–1.60)	(4.69)	(3.51)				

Appendix Table B-3 (cont'd)
Estimates of Equation (2) and (3) and Selected Variants for Demand Deposits
M-1A, M-1B and Augmented M-1B

Aggregate	Period of Fit	Specification	Constant or Time Trend	T_1	T_2	Intercept for Levels Regressions	Treasury Bill Rate	Commercial Bank Passbook Rate	Real GNP	Lagged Dependent Variable	$\bar{R}^2$	Standard Error	RHO	DW
M-1B														
	1959:4–74:2	levels	–.0010			–.052	–.023	–.013	.252	.705	.993	.0047	.37	1.71
			(–2.73)			(–.12)	(–4.81)	(–.91)	(4.13)	(5.98)				
	1974:3–80:2	levels	–.0047			.436	.001	–.059	.499	.339	.824	.0057	.27	1.55
			(–3.63)			(.41)	(.08)	(–.40)	(4.62)	(1.86)				
	1959:4–80:2	levels	–.0016			–.954	–.024	–.001	.229	.902	.987	.0054	.29	1.72
			(–5.02)			(–5.06)	(–6.39)	(–.05)	(5.37)	(23.77)				
	1959:4–74:2	first diff.	–.0006				–.014	–.042	.210	.575	.395	.0055		1.78
			(–.53)				(–2.06)	(–1.65)	(2.20)	(4.38)				

1974:3–80:2	first diff.	–.0058 (–3.10)				.004 (.31)	.028 (.18)	.482 (3.62)	.209 (1.05)	.549	.0066		1.76
1959:4–80:2	first diff.	–.0024 (–2.65)				–.008 (–1.36)	–.037 (–1.40)	.350 (4.58)	.487 (4.61)	.480	.0060		1.72
1959:4–74:2	first diff.					–.014 (–2.05)	–.046 (–1.86)	.176 (2.48)	.577 (4.43)	.403	.0055		1.75
1974:3–80:2	first diff.					.005 (.33)	–.140 (–.77)	.262 (1.93)	.527 (2.57)	.354	.0079		1.52
1959:4–80:2	first diff.					–.007 (–1.14)	–.055 (–2.07)	.223 (3.62)	.546 (5.09)	.411	.0062		1.59
1959:4–80:2	levels		–.0012 (–3.77)	–.0014 (–4.78)	–.415 (–1.40)	–.022 (–6.23)	–.005 (–.462)	.231 (5.80)	.798 (13.26)	.987	.0053	.24	1.71
1959:4–80:2	first diff.		–.0016 (–1.55)	–.0040 (–2.95)		–.007 (–1.16)	–.045 (–1.66)	.350 (4.63)	.432 (3.92)	.490	.0059		1.70

Appendix Table B-3 (cont'd)
Estimates of Equation (2) and (3) and Selected Variants for Demand Deposits
M-1A, M-1B and Augmented M-1B

Augmented Measure	Period of Fit	Specification	Constant or Time Trend	T_1	T_2	Intercept for Levels Regressions	Treasury Bill Rate	Commercial Bank Passbook Rate	Real GNP	Lagged Dependent Variable	$\bar{R}^2$	Standard Error	RHO	DW
Augmented M-1B														
	1959:4–74:2	levels	–.0006			.107	–.020	–.019	.233	.699	.995	.0045	.31	1.79
			(–1.91)			(.24)	(–4.35)	(–1.42)	(4.70)	(6.50)				
	1974:3–80:3	levels	–.0043			–.648	.0046	–.144	.599	.429	.900	.0076	.31	1.54
			(–2.67)			(–.52)	(.35)	(–.74)	(4.24)	(2.25)				
	1959:4–80:2	levels	–.0016			–.982	–.024	–.012	.279	.847	.989	.0061	.25	1.66
			(–5.47)			(–4.68)	(–5.66)	(–.94)	(6.01)	(16.25)				
	1959:4–74:2	first diff.	–.0002				–.011	–.043	.206	.540	.365	.0055		1.84
			(–.22)				(–1.58)	(–1.69)	(2.19)	(4.03)				

1974:3–80:2 first diff.	-.0049				.012	–.073	.538	.297	.532	.0087		1.69
	(–2.18)				(.71)	(–.34)	(3.13)	(1.34)				
1959:4–80:2 first diff.	–.0024				–.003	–.043	.395	.457	.463	.0067		1.69
	(–2.42)				(–.42)	(–1.44)	(4.69)	(4.07)				
1959:4–74:2 first diff.					–.011	–.044	.193	.539	.376	.0054		1.82
					(–1.58)	(–1.83)	(2.68)	(4.06)				
1974:3–80:2 first diff.					.015	–.246	.356	.456	.445	.0094		1.47
					(.81)	(–1.13)	(2.18)	(2.01)				
1959:4–80:2 first diff.					–.0012	–.062	.274	.484	.430	.0069		1.53
					(–.17)	(–2.08)	(3.92)	(4.14)				
1959:4–80:2 levels		–.0012	–.0014	–.341	–.020	–.022	.284	.722	.989	.0060	.24	1.62
		(–3.36)	(–4.45)	(–.90)	(–4.54)	(–1.63)	(6.27)	(8.91)				
1959:4–80:2 first diff.		–.0016	–.0038		–.002	–.049	.390	.425	.468	.0066		1.68
		(–1.41)	(–2.60)		(–.28)	(–1.63)	(4.64)	(3.66)				

Appendix Table B-3 (cont'd)
F-Tests and Post-Sample Errors from a Dynamic Simulation (All errors are *quarterly* errors at percentage annual rates)

		Equation (2)			Equation (3)			First difference equation without constant	
Aggregate	F-test	mean error	RMSE	F-test	mean error	RMSE	F-test	mean error	RMSE
Demand Deposits	3.70	-3.56	5.20	3.50	-3.13	5.01	1.04	-3.73	5.54
M-1A	3.59	-2.70	4.03	2.67	-2.27	3.82	.72	-2.59	4.10
M-1B	3.62	-1.87	3.48	1.86	-1.45	3.15	.89	-1.77	3.38
Augmented M-1B	4.17	-1.55	4.23	2.06	-1.29	4.15	1.84	-1.42	4.24

Appendix Table B-4
Estimates of Equation (4) for Demand Deposits, M-1B and Augmented M-1B: The Linear, Logarithmic and Linear Times Logarithmic Specifications

Aggregate	Period of Fit	Specification of Ratchet Variable	Constant	Real GNP	Passbook rate	Treasury Bill rate	Ratchet Variable	$\bar{R}^2$	Standard Error	RHO	D-W
Demand Deposits	1955:1–74:2	linear	1.96 (4.78)	.493 (7.65)	–.046 (–2.30)	–.028 (–1.96)	.0038 (–3.31)	.985	.0055	.90	1.32
	1955:1–80:2	linear	2.50 (2.59)	.409 (3.45)	–.007 (–.95)	–.013 (–.89)	–.0078 (–4.47)	.982	.0068	.99	1.30
	1955:1–74:2	logarithmic (constant elasticity)	2.51 (10.54)	.413 (10.75)	–.038 (–1.74)	–.050 (–3.86)	–.0226 (–1.92)	.984	.0058	.85	1.21
	1955:1–80:2	logarithmic (constant elasticity)	–1.19 (–.93)	.784 (5.20)	–.014 (–1.78)	–.042 (–2.58)	.0133 (.03)	.975	.0081	.99	1.03
	1955:1–74:2	linear times log	1.85 –(4.45)	.506 (7.82)	(–.044 (–2.15)	–.030 (–2.40)	–.0010 (–3.30)	.985	.0054	.91	1.32
	1955:1–80:2	linear times log	2.20 (3.09)	.448 (4.55)	–.0010 (–1.27)	–.027 (–2.03)	–.0018 (–5.67)	.983	.0067	.99	1.31
M-1B	1955:1–74:2	linear	2.01 (5.66)	.517 (9.29)	–.041 (–2.37)	–.026 (–2.13)	–.0028 (–2.87)	.993	.0046	.92	1.37
	1955:1–80:2	linear	2.12 (5.18)	.494 (8.04)	–.006 (–1.14)	–.018 (1.49)	–.0047 (–5.16)	.989	.0053	.96	1.32
	1955:1–74:2	logarithmic (constant elasticity)	2.40 (14.00)	.464 (16.81)	–.043 (–2.48)	–.044 (–4.28)	–.0182 (–2.17)	.993	.0047	.80	1.26

Appendix Table B-4 (cont'd)
Estimates of Equation (4) for Demand Deposits, M-1B and Augmented M-1B:
The Linear, Logarithmic and Linear Times Logarithmic Specifications

Aggregate	Period of Fit	Specification of Ratchet Variable	Constant	Real GNP	Passbook rate	Treasury Bill rate	Ratchet Variable	$\bar{R}^2$	Standard Error	RHO	D-W
	1955:1–80:2	logarithmic (constant elasticity)	.97 (1.11)	.611 (5.63)	–.012 (–2.00)	–.030 (–2.55)	–.0095 (–.57)	.986	.0059	.99	1.20
	1955:1–74:2	linear times log	1.93 (5.35)	.527 (9.44)	–.039 (–2.23)	–.027 (–2.59)	–.0007 (–2.83)	.993	.0046	.92	1.37
	1955:1–80:2	linear times log	1.99 (5.13)	.512 (8.78)	–.008 (–1.43)	–.026 (–2.47)	–.0011 (–5.47)	.989	.0052	.96	1.33
Augmented M-1B	1955:1–74:2	linear	1.81 (5.07)	.544 (9.75)	–.036 (–2.14)	–.024 (–2.06)	–.0023 (–2.32)	.995	.0045	.93	1.51
	1955:1–80:2	linear	1.63 (4.31)	.569 (9.77)	–.004 (–.61)	–.014 (–1.07)	–.0048 (–5.50)	.992	.0055	.94	1.42
	1955:1–74:2	logarithmic (constant elasticity)	2.15 (12.53)	.502 (18.11)	–.049 (–2.91)	–.041 (–4.05)	–.019 (–2.25)	.995	.0046	.81	1.37
	1955:1–80:2	logarithmic (constant elasticity)	.428 (.46)	.695 (5.95)	–.009 (–1.41)	–.027 (–2.10)	–.011 (–.61)	.989	.0064	.99	1.24
	1955:1–74:2	linear times log	1.77 (4.90)	.549 (9.85)	–.036 (–2.10)	–.026 (–2.57)	–.0006 (–2.24)	.995	.0045	.93	1.50
	1955:1–80:2	linear times log	1.49 (4.13)	.587 (10.69)	–.006 (–1.00)	–.024 (–2.21)	–.0011 (–5.67)	.993	.0053	.94	1.46

Appendix Table B-5
Estimates of Equation (4) for Demand Deposits, M-1B and Augmented M-1B: The Power Transformation Specification

Variable	1955:4–74:2	1955:4–80:2
Demand Deposits		
β_0	1.77	2.03
β_{10}	–.009	–.012
β_{11}	–.011	–.012
β_{12}	–.010	–.010
β_{13}	–.009	–.007
β_2	–.039	–.022
β_{30}	.210	.234
β_{31}	.171	.155
β_{32}	.132	.076
β_{40}	-1.40×10^{-6}	4.53×10^{-7}
β_{41}	-1.68×10^{-7}	-1.05×10^{-6}
β_{42}	4.80×10^{-7}	5.82×10^{-7}
β_{43}	-1.04×10^{-6}	-2.03×10^{-6}
β_{44}	3.17×10^{-6}	2.08×10^{-6}
β_{45}	-2.52×10^{-6}	-1.66×10^{-6}
Sums of Lagged Coefficients		
β_1	–.039	–.041
	(–4.22)	(–3.99)
β_3	.513	.466
	(8.15)	(5.61)
β_4	-1.47×10^{-6}	-1.62×10^{-6}
	(–3.05)	(–5.89)
λ	3.1	3.1
s_e	1.0	1.0
$\bar{R}^2$	.986	.984
Standard Error	.0054	.0066
RHO	.94	.98
DW	1.40	1.34

Appendix Table B-5 (cont'd)
Estimates of Equation (4) for Demand Deposits, M-1B and Augmented M-1B: the Power Transformation Specification

Variable	1955:4-74:2	1955:4-80:2
M-1B		
β_0	1.95	2.03
β_{10}	-.006	-.007
β_{11}	-.007	-.007
β_{12}	-.007	-.006
β_{13}	-.006	-.004
β_2	-.039	-.008
β_{30}	.203	.212
β_{31}	.175	.169
β_{32}	.146	.126
β_{40}	-.0016	-.0003
β_{41}	-.0007	-.0017
β_{42}	.0003	-.0007
β_{43}	.0009	.0010
β_{44}	.0006	.0009
β_{45}	-.0007	-.0012
Sums of Lagged Coefficients		
β_1	-.026	-.024
	(-2.45)	(-2.24)
β_3	.525	.507
	(9.42)	(8.68)
β_4	-.0013	-.0020
	(-2.84)	(-5.44)
λ	1.2	1.2
s_e	1	1
$\bar{R}^2$	.993	.989
Standard Error	.0046	.0052
RHO	.92	.96
DW	1.37	1.33

Appendix Table B-5 (cont'd)
Estimates of Equation (4) for Demand Deposits, M-1B and Augumented M-1B: the Power Transformation Specification

Variable	1955:4–74:2	1955:4–80:2
Augmented M-1B		
β_0	1.81	1.63
β_{10}	-.006	-.003
β_{11}	-.008	-.006
β_{12}	-.007	-.004
β_{13}	-.004	-.001
β_2	-.036	-.004
β_{30}	.202	.242
β_{31}	.181	.189
β_{32}	.161	.137
β_{40}	-.0024	-.0019
β_{41}	-.0015	-.0037
β_{42}	-.0002	-.0015
β_{43}	.0008	.0019
β_{44}	.0008	.0017
β_{45}	.0002	-.0014
Sums of Lagged Coefficients		
β_1	-.024	-.014
	(-2.06)	(-1.07)
β_3	.544	.569
	(9.75)	(9.78)
β_4	-.0023	-.0048
	(-2.32)	(-5.50)
λ	1	1
s_e	1	1
$\bar{R}^2$	.995	.992
Standard Error	.0045	.0055
RHO	.93	.94
DW	1.51	1.42

Appendix Table B-6
Estimates of Constant Elasticity Money Demand Equations Containing Long Rate or Past Peak Variables

Aggregate	Period of Fit	Variable Added to Standard Equation	Constant	Real GNP	Passbook Rate*	Long-Run Elasticity: Treasury Bill Rate	Long-Run Elasticity: Long Rate or Past Peak	$\bar{R}^2$	Standard Error	RHO	DW
Demand Deposits	1955:4–74:2	Past peak of Federal funds rate	1.96	.505	–.052	–.034	–.085	.987	.0051	.91	1.48
			(6.55)	(10.52)	(–2.68)	(–3.95)	(–4.34)				
	1955:4–80:2	Past peak of Federal funds rate	.20	.637	–.012	–.029	–.076	.978	.0077	.99	1.11
			(.15)	(4.23)	(–1.65)	(–2.56)	(–1.64)				
	1955:4–74:2	5-year government bond rate	2.62	.400	–.058	–.031	–.051	.984	.0058	.84	1.19
			(11.78)	(10.70)	(–3.05)	(–2.08)	(–1.67)				
	1955:4–80:4	5-year government bond rate	–1.14	.694	–.011	–.012	–.087	.978	.0077	1.00	1.13
			(–.77)	(4.71)	(–1.45)	(–.57)	(–1.79)				
	1955:4–74:2	10-year government bond rate	2.57	.409	–.058	–.038	–.050	.984	.0058	.83	1.19
			(11.14)	(10.44)	(–3.15)	(–3.10)	(–1.62)				
	1955:4–80:2	10-year government bond rate	–1.13	.690	–.012	–.020	–.104	.978	.0076	1.00	1.18
			(–.73)	(4.70)	(–1.55)	(–1.12)	(–1.91)				
M-1B	1955:4–74:2	Past peak of Federal funds rate	2.01	.526	–.046	–.028	–.064	.994	.0042	.92	1.56
			(7.84)	(12.87)	(–2.87)	(–3.98)	(–3.84)				
	1955:4–80:2	Past peak of Federal funds rate	1.09	.589	–.009	–.025	–.074	.989	.0054	.99	1.36
			(1.15)	(5.60)	(–1.74)	(–3.16)	(–2.26)				

	1955:4–74:2	5-year government bond rate	2.55 (11.93)	.442 (12.65)	–.050 (–2.87)	–.026 (–1.97)	–.044 (–1.56)	.993	.0048	.90	1.28
	1955:4–80:2	5-year government bond rate	1.44 (1.82)	.558 (5.57)	–.009 (–1.70)	–.004 (–.28)	–.085 (–2.44)	.987	.0057	.99	1.28
	1955:4–74:2	10-year government bond rate	2.51 (11.22)	.449 (12.11)	–.050 (–2.88)	–.032 (–2.96)	–.044 (–1.50)	.993	.0048	.89	1.28
	1955:4–80:2	10-year government bond rate	2.02 (3.02)	.503 (5.74)	–.011 (–1.91)	–.008 (–.70)	–.11 (–3.10)	.987	.0057	.99	1.27
Augmented M-1B	1955:4–74:2	Past peak of Federal funds rate	1.78 (6.69)	.559 (13.35)	–.043 (–2.63)	–.028 (–4.08)	–.055 (–3.26)	.995	.0042	.93	1.67
	1955:4–80:2	Past peak of Federal funds rate	1.87 (4.22)	.545 (8.54)	–.007 (–1.25)	–.022 (–2.47)	–.111 (–4.60)	.991	.0060	.97	1.34
	1955:4–74:2	5-year government bond rate	2.25 (10.21)	.485 (13.75)	–.045 (–2.65)	–.024 (–1.86)	–.046 (–1.66)	.995	.0046	.91	1.43
	1955:4–80:2	5-year government bond rate	2.20 (4.51)	.490 (7.17)	–.008 (–1.23)	.018 (1.16)	–.134 (–4.02)	.990	.0062	.97	1.33
	1955:4–74:2	10-year government bond rate	2.20 (9.51)	.494 (13.12)	–.044 (–2.61)	–.029 (–2.87)	–.046 (–1.58)	.994	.0046	.91	1.58
	1955:4–80:2	10-year government bond rate	2.24 (5.75)	.495 (8.68)	–.009 (–1.43)	.006 (.49)	–.152 (–4.63)	.990	.0062	.96	1.35

* The passbook rate is the maximum of the rate on passbook savings accounts at commercial banks and the rate on money market mutual fund shares.

Appendix Table B-7
Post-Sample Errors and Stability Tests for Equations Containing the Past Peak in the Federal Funds Rate or Long-Term Rates

	Specification	F-test	Quarterly Errors Mean	Quarterly Errors RMSE	Annual Errors Mean	Annual Errors RMSE
Demand Deposits	Past peak in federal funds rate	11.29	-3.62	6.51	-3.76	4.20
	5-year government bond rate	6.68	-3.59	6.86	-3.73	4.42
	10-year government bond rate	7.45	-3.59	6.85	-3.73	4.41
M-1B	Past peak in federal funds rate	8.82	-1.61	4.72	-1.68	2.43
	5-year government bond rate	4.75	-1.54	4.99	-1.60	2.64
	10-year government bond rate	5.73	-1.53	4.96	-1.59	2.62
Augmented M-1B	Past peak in federal funds rate	12.36	-1.15	5.12	-1.19	2.48
	5-year government bond rate	5.63	-1.04	5.37	-1.07	2.76
	10-year government bond rate	9.01	-1.03	5.32	-1.07	2.74

Appendix Table B-8
Estimate for Augmented Measures Containing Money Market Mutual Fund Shares (MMMFs)

Augmented Measure	Period of Fit	Specification	Constant or Time Trend	T_1	T_2	Intercept for Levels Regressions	Treasury Bill Rate	Commercial Bank Passbook Rate	Real GNP	Lagged Dependent Variable	$\bar{R}^2$	Standard Error	RHO	DW
M-1B plus MMMFs	1959:4–74:2	levels				.820	–.019	–.018	.165	.649	.992	.0049	.51	1.58
						(2.03)	(–3.57)	(–1.08)	(3.41)	(5.10)				
	1959:4–80:2	levels				1.08	–.004	–.041	.151	.618	.986	.0064	.88	1.77
						(2.66)	(–.67)	(–1.39)	(3.82)	(7.14)				
	1959:4–74:2	levels	–.0010			–.011	–.022	–.013	.252	.698	.993	.0047	.37	1.71
			(–2.68)			(–.03)	(–4.77)	(–.94)	(4.17)	(5.95)				
	1959:4–80:2	levels	–.0009			.050	–.007	–.024	.205	.744	.986	.0063	.74	1.80
			(–1.77)			(.11)	(–1.08)	(–.89)	(3.11)	(10.06)				
	1959:4–74:2	first diff.	–.0005				–.014	–.042	.208	.569	.392	.0055		1.78
			(–.49)				(–2.05)	(–1.66)	(2.19)	(4.34)				
	1959:4–80:2	first diff.	–.0003				–.005	–.041	.221	.540	.377	.0065		1.76
			(–.35)				(–.72)	(–1.41)	(2.87)	(5.79)				
	1959:4–80:2	levels		–.0005	–.0006	.416	–.006	–.027	.188	.695	.986	.0063		1.81
				(–.84)	(–1.12)	(.71)	(–.84)	(–.98)	(2.71)	(8.30)				
	1959:4–80:2	first diff.		–.0009	.0006		–.005	–.037	.230	.537	.375	.0065		1.77
				(–.75)	(.39)		(–.73)	(–1.25)	(2.96)	(5.74)				

Augmented M-1B plus MMMFs	1959:4–74:2	levels				.852	–.016	–.026	.201	.599	.995	.0045	.41	1.67
						(2.68)	(–3.42)	(1.77)	(4.39)	(5.47)				
	1959:4–80:2	levels				1.19	.001	–.046	.199	.538	.990	.0067	.83	1.78
						(3.28)	(.17)	(–1.52)	(4.83)	(6.05)				
	1959:4–74:2	levels	–.0006			.131	–.020	–.019	.230	.698	.995	.0045	.31	1.79
			(–1.84)			(.30)	(–4.31)	(–1.43)	(4.69)	(6.51)				
	1959:4–80:2	levels	–.0008			.191	–.003	–.034	.245	.668	.990	.0067	.71	1.85
			(–1.70)			(.38)	(–.37)	(–1.26)	(3.78)	(8.45)				
	1959:4–74:2	first diff.	–.0002				–.011	–.043	.205	.536	.362	.0055		1.84
			(–.18)				(–1.56)	(–1.71)	(2.18)	(4.01)				
	1959:4–80:2	first diff.	–.0003				.001	–.047	.276	.434	.341	.0069		1.79
			(–.28)				(.20)	(–1.52)	(3.38)	(4.33)				
	1959:4–80:2	levels		–.0004	–.0005	.616	–.001	–.038	.228	.609	.990	.0067	.74	1.85
				(–.61)	(–.85)	(.99)	(–.08)	(–1.35)	(3.21)	(6.92)				
	1959:4–80:2	first diff.		–.0008	.0006		.001	–.043	.286	.426	.338	.0069		1.79
				(–.66)	(.41)		(.20)	(–1.37)	(3.46)	(4.23)				

Appendix Table B-9
Post-Sample Error and Stability Tests for Augmented Measures Containing Money Market Mutual Fund Shares (MMFs)

Aggregate	Specification	F-test	Quarterly errors Mean	Quarterly errors RMSE	Annual errors by 4-quarter periods 74–75	75–76	76–77	77–78	78–79	79–80	Annual errors Mean	Annual errors RMSE	Cumulative percentage error in 80:2
M-1B plus MMMFs	levels, no trend variable	9.17	.15	5.09	−5.3	−3.4	−2.2	.8	3.5	7.8	.20	4.42	.8
	first difference with intercept	1.64	1.20	4.51	−1.4	−1.9	−1.3	1.0	3.4	8.1	1.31	3.77	6.7
Augmented M-1B plus MMMFs	levels, no trend variable	9.61	.47	4.90	−4.8	−2.1	−.8	1.4	4.7	4.8	.52	3.56	2.6
	first difference with intercept	1.78	1.11	4.49	−2.5	−1.2	−.2	1.5	4.6	4.9	1.21	3.03	6.2

APPENDIX C:
The Behavior of Inventories in the Last Half of the 1970s

Equation (C-1) presents the equation used to explain and predict inventory holdings.

(C-1) $\ln(I/C) = a_0 + a_1 \ln(I_{-1}/C) +$

$a_2 RTB + a_3 (PIN) + a_4 \ln(\sigma/C) + a_5$ trend where

I = real quarterly inventories of all businesses, including farms (in 1972 dollars)

C = real personal consumption expenditure (in 1972 dollars)

σ = an uncertainty term represented by the absolute value of the change in the percentage change in real final sales (included as a measure of the volatility of sales movements) multiplied by the level of real final sales.[71]

RTB = the six-month Treasury bill rate.

PIN = a three-year moving average of the annualized rate of change of the price deflator for inventories

trend = time trend

The variables representing real quantities have been scaled by real consumption expenditures, C. The equation was chosen because of its similarities to a standard money demand equation. Nominal inventory holdings depend on a transaction measure (consumption), an uncertainty measure for aggregate output, $\ln(\sigma/C)$, and the opportunity cost of holding inventories—the gain on investments in financial assets (the six-month bill rate) less a measure of the expected own rate on physical inventories (that is, the "real" rate). Since this opportunity cost measure takes on both positive and negative values, the components representing the real rate were entered separately. Also, owing to the existence of positive and negative values for the rate of inflation on inventories, both variables were entered into the equation in linear, not logarithmic, form.[72]

Table C-1 lists estimates of the equation for 1962:1–74:2 and 1962:1–80:2. In the early period, all variables have the correct sign except for the bill rate. Table C-2 displays out-of-sample simulation results for the 1974:3–80:2 period. While the equation has shown a very mild tendency to overpredict—it has basically been on track.[73]

[71] We are indebted to our colleague Laura Rubin for suggesting this measure. See Laura S. Rubin, "Aggregate Inventory Behavior: Response to Uncertainty and Interest Rates," *Journal of Post Keynesian Economics*, Vol. 2, No. 2, Winter 1979–80, pp. 201–11.

[72] Of course, since the bill rate and inflation rate enter linearly, the opportunity cost measure (the real rate) could be entered directly. Results for this specification were somewhat worse and are not shown.

[73] However, the F-statistic to test whether the coefficients are equal in the two subperiods, 1962:1–74:2 and 1974:3–80:2 is large enough ($F_{6,61} = 5.69$) to reject the hypothesis of coefficient stability in the inventory equation.

Table C-1
Regression Estimates for Real Inventories

Period	a_0	a_1	a_2	a_3	a_4	a_5	Standard Error	$\bar{R}^2$	RHO	D-W
1962:1-74:2	-.076	.908	.0013	.00045	.00092	-.00017	.0035	.975	.26	2.01
	(-2.27)	(28.3)	(1.89)	(.761)	(2.137)	(-1.69)				
1962:1-80:2	-.055	.932	.0007	-.0009	.00006	-.00006	.0046	.978	.45	2.01
	(-1.73)	(28.2)	(1.25)	(-1.72)	(.146)	(-.59)				

Table C-2
Out-of-Sample Simulation Results for Inventories

Period	Actual	Predicted	Percentage Error
	billions of real dollars		
1974:3	300.1	301.7	.54
4	300.8	301.8	.01
1975:1	297.0	303.9	-2.32
2	292.8	289.8	-2.40
3	293.4	296.7	-1.11
4	292.1	296.8	-1.60
1976:1	294.3	295.6	-.43
2	296:7	297.6	-.32
3	298.4	300.4	-.68
4	298.7	301.8	-1.04
1977:1	301.5	302.3	-.26
2	304.8	304.2	.18
3	309.0	308.2	.27
4	311.8	313.0	-.38
1978:1	315.9	315.9	.01
2	319.8	320.3	-.15
3	322.9	324.7	-.55
4	325.9	328.5	-.80
1979:1	328.9	331.2	-.70
2	333.5	334.1	-.18
3	335.3	338.9	-1.09
4	335.6	342.2	-1.95
1980:1	335.7	342.7	-2.08
2	336.5	340.5	-1.18

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Discussion

Benjamin M. Friedman*

It is difficult to read the papers prepared for this conference without remarking at the great contrast between the views that they represent and those that typified the father and the grandfather of this conference, held eight years ago and eleven years ago, respectively. The sharp turnaround in opinion on the appropriate policy role of the monetary aggregates, which has been the subject of all three conferences, has occurred no doubt in large part as a response to the events of the 1970s. In any case, it is striking.

Within a year after the first of the Federal Reserve Bank of Boston's conferences met in 1969 to assess the question of the use of monetary aggregates in formulating monetary policy, the Open Market Committee of the Federal Reserve System initially adopted a policy approach that amounted to targeting monetary aggregates. By 1972, the common assumption reflected by most of the papers presented at the Bank's second "Controlling Monetary Aggregates" conference was that the primary policy issue confronting policy-makers was how best to implement the monetary targets approach which the then-prevailing dominant opinion assumed constituted the best overall policy strategy. Three years later the Congress passed its Resolution 133, further formalizing this "intermediate target strategy" with the monetary aggregates — and, for all practical purposes, the narrowly defined money stock — as the particular intermediate target variable for monetary policy. Indeed, the cutting edge of monetary policy debate by the mid-1970s appeared to be whether, within this overall policy approach, there should be any latitude at all for policy-makers to seek different targeted monetary growth rates as economic circumstances varied.

What has happened within the past few years that has rendered the tone of the papers at today's conference so different? Two separate developments have been primarily responsible. The first, which is not the direct focus of this conference but which bears importantly on its subject nonetheless, was the emergence of what have come to be recognized as important shocks on the supply side of the economy. The view shared by most of the participants at the two earlier conferences was that the economy's aggregate supply of goods and services exhibited a highly stable behavior against which there arose fluctuations in the corresponding aggregate demand. Moreover, some people argued that major historical episodes of aggregate demand instability had been due at least in part to variations in monetary and fiscal policies. Hence in the absence of aggregate demand fluctuations, which to some extent could be eliminated merely by rendering policy less volatile, the economy would experience relatively little instability. The events of the 1970s, however,

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including in particular the two major oil price shocks, have represented a wholly different phenomenon which the theory of monetary policy under monetary aggregate targets was never designed to encompass in the first place. It would always be possible, of course, for policy-makers to allow an identifiable supply shock to occur without seeking to induce any offsetting variation at all on the demand side; but no theory exists showing that that would be the optimal policy, or even a very good one.

The second, and more ironic, aspect of the events of the 1970s that has accounted for this collective change of heart constitutes the central motivation for many of the papers at this conference, and especially the paper by Thomas Simpson and Richard Porter. As the work of numerous researchers has made clear, the adoption of the intermediate target strategy for monetary policy, with a monetary aggregate as the intermediate target variable, rested fundamentally on the presumption of stable financial behavior in general and a stable demand for some readily definable and measurable "money" in particular. As is well documented, however, both in the Simpson-Porter paper and elsewhere, the 1970s saw the emergence of sudden and almost wholly unanticipated shifts in precisely this element of economic behavior. Moreover, as Simpson and Porter emphasize, there is no reason to be confident that these shifts are now in the past; indeed, according to their analysis the worst quarter thus far for money demand behavior was the second quarter of 1980. If anything, monetary policy-makers are just in the midst of, rather than looking back on, what has gone wrong.

As a result of this combination of developments that have gone so deeply against the grain of the presumptions that typified the 1969 and 1972 predecessors of this conference, many policy issues of major importance are once again open for debate. As the papers for today's conference indicate, the set of open questions now includes the reliability of money (however defined) as an "indicator" of future economic activity, the relative usefulness of broad versus narrow monetary aggregates, the inside monetary aggregates versus the monetary base, and so on. These are all centrally important issues for monetary policy, and any policy-maker or researcher who thought that they were settled now needs to think again. In addition, another newly open question less directly confronted in these papers is that of monetary versus credit aggregates. The chief issues here are which side of the balance sheet — the assets or the liabilities — is a better indicator of future economic activity, and which side is more controllable. The consensus in previous years was that, because substitutions were easier and cheaper to make on the credit side of the balance sheet than within the monetary subset on the asset side, money was more useful than credit from both perspectives; but changes in the payments process as well as other financial innovations have now rendered even that traditional presumption open for debate once again.

Finally, as policy-makers and researchers rethink these questions, they will inevitably want also to reconsider whether the intermediate target strategy based on a single target of any kind is indeed the best approach to monetary policy. One reason for questioning this strategy is the controllability issue. Under the intermediate target strategy it is essential that policy be able to control its intermediate target variable relatively closely. Under an alternative conception of the monetary policy process advanced by some researchers — sometimes called the "information variable" approach — whether or not policy can directly control the aggregate or aggregates on which it focuses is of much less consequence. Under this alternative approach policy-makers would monitor such variables for the information that they provide about economic activity both currently and in the future, and policy would respond to the observed movements of these variables, but there would be no presumption of controlling them as if they were the proximate targets of policy. The second reason for questioning the intermediate target strategy is simply the by-now well-understood logical flaw inherent in any two-stage procedure that substitutes a proximate target in place of the more basic economic objectives that policy really seeks to achieve. As James Pierce so aptly puts the point in his paper for this conference, it is unfortunate to waste what few tools policy-makers have by devoting them to the pursuit of intermediate targets at all.

The principal focus of the Simpson-Porter paper is the importance of financial innovation in what has gone wrong in the 1970s under the intermediate target approach based on monetary aggregate targets. Consideration of a few basics readily suggests that financial innovation can occur with relative ease. The financial markets typically have a very different technology from that in other areas of economic activity. In most financial businesses there is a small amount of fixed physical capital, and the labor force is both highly educated and highly mobile, in comparison to other industries. Consequently, the technology in financial markets is extremely well adapted to rapid innovation.

Although it may be tempting to suppose that the rapid and widespread occurrence of financial innovation in the United States in the 1970s has been a unique phenomenon, closer inspection of the historical record suggests otherwise. Even a quick look back to the 1960s immediately recalls that that decade began without a market for negotiable certificates of deposit, without a Eurodollar market, and without a freely functioning market in federal funds. Those innovations that came about in the 1960s were just as important for how the U.S. financial markets function as the NOW accounts, money market certificates, money market mutual funds and repurchase agreements that emerged in the 1970s with well-known consequences for monetary policy that have provided the primary motivation for the papers at today's conference. Furthermore, a look ahead to the 1980s does not require prescience to suspect that some potentially important innovations which have already occurred have not yet had their full effect on how the financial markets function. The increasing prevalence of floating-rate loan agreements in the banking system and pass-through securities in the bond market, and the new markets for traded options and financial futures, are but a few examples. The relationships among financial asset demands and supplies that will evolve as a result of these and other innovations could differ sharply from prior experience.

As a result of the increasing evidence of the importance of financial innovation, views are changing about the stability of money demand relationships in both the short and the long run. A crude dichotomy, oversimplified almost to the point of caricature, nonetheless expresses the general direction of this change in thinking. Until several years ago the almost universally held opinion was that, although money demand might be subject to severe instability in the short run, whatever short-run bounces occurred would average out so that in the long run money demand would be stable. That belief in turn gave rise to a policy prescription, at least for achieving long-run objectives, of simply selecting some monetary aggregate and stabilizing its rate of growth; which specific aggregate to choose was at most a second-order matter in comparison to the main idea of picking one and stabilizing it.

By contrast, a new view which is only just emerging recognizes the possibility that the demand for any specific monetary aggregate may be even more unstable in the long run than in the short run. The reason, very simply, is that in the long run the structural forces of financial innovation have the opportunity to change the whole meaning of that aggregate by changing the roles that the assets it encompasses play within the economic system. An all-encompassing measure like total financial assets, of course, is much less subject to such evolutionary forces. For any more narrowly defined aggregate, however, policy-makers must now face the possibility that the long run is not very sympathetic to the fixed monetary aggregate target approach either. The long run allows short-run random disturbances to balance out, but it also gives the markets the opportunity to innovate out from under the restrictions implied by the control of any specific aggregate. A particular feature of this process that receives great emphasis in the Simpson-Porter paper — and appropriately so — is the erosion by recent financial innovations of the traditional distinction between transactions balances and liquid investments. One fairly direct implication of these innovations, therefore, is that whatever "specialness" money may have had is becoming progressively less significant.

The paper by Simpson and Porter represents a continuation of the work done in recent years on this and related problems by them and their colleagues on the Federal Reserve Board staff. This work has been of high quality throughout, and it has made substantial contributions to the understanding of these subjects, especially at the empirical level. The results it has generated are highly valuable, and other researchers as well as policy-makers are in their debt.

The paper first documents the breakdown of the past relationships between money and economic activity. Much of this material is familiar, and the evidence introduced is fairly straightforward.

The paper then goes on to discuss the motivations for financial innovation. In an especially interesting part of this section of the paper, Simpson and Porter present an argument showing that the zero-interest constraint on demand deposits and reserve balances is not the sole reason for financial innovations of the kind that have recently occurred. Because financial innovation is a big and complex subject, however, the analysis offered here stops well short of developing the kind of full-scale theory of financial innovation attempted elsewhere by William Silber and others. Instead, the object is to point out that, because financial innovation itself is an inherently unpredictable process, the effect of innovation on shifting monetary aggregate relationships is also therefore unpredictable.

The operational part of the paper exploits the concept of financial innovation to offer a new specification of money demand. The novelty that Simpson and Porter introduce here is an "innovation proxy" variable constructed from an interest rate lag structure that is more flexible in some degree than the usual ratchet variable. The reasoning behind this proxy variable is plausible, and the estimated money demand functions incorporating it perform well enough to consider the new variable potentially important. These functions are still subject to a variety of criticisms, but, because most of them concern the usual problems common to standard money demand functions found elsewhere in the literature, there is little need to dwell on them here — with one exception. Surely this paper's emphasis on the recent financial innovations, and especially on the consequent blurring of transactions balances and liquid investments, leads naturally to a portfolio approach to the demand for money. In that case, the money demand function should include either a wealth variable or, alternatively, the lagged holdings of nonmoney assets as a way of representing the nature of the portfolio diversification problem faced by investors. This omission is hardly unique to the Simpson-Porter specification, but in this case it does seem inconsistent with the underlying motivation that they provide for seeking a new specification in the first place.

The one important subject on which Simpson and Porter are less than adequately forthcoming in this paper, in my judgment, is this work's implications for monetary policy. I think it is possible to read this paper in either of two ways. One is that the new money demand specification has satisfactorily proxied financial innovation effects, so that policy-makers may now proceed as if they again have a stable money demand function. Under this reading the intermediate target strategy, with some monetary aggregate as the intermediate target variable, remains the best way to go about designing and implementing monetary policy. By contrast, the second interpretation of the paper — and from their oral remarks I suspect this is the one Simpson and Porter prefer — is that, although their empirical work has documented the importance of financial innovation *ex post*, financial innovation nonetheless remains fundamentally unpredictable *ex ante*. Despite this new empirical work, therefore, policy-makers still do not have a stable money demand function such as is needed to go about the monetary targets approach as before. What should policy-makers do under this reading? Here the limited suggestions made by Simpson and Porter, involving principally the widening of target ranges so to recognize uncertainties, and a vaguely specified injunction to stabilize interest rates within those ranges, are not very satisfactory.

What, then, should policy-makers do? I will conclude with a few remarks about what approach to monetary policy might be consistent with this second interpretation of the Simpson-Porter paper, There is now an accumulating amount of evidence that the credit market plays a role in the determination of economic activity which is not simply the mirror of that played by the money market. This result is not surprising in light of the available economic theory. Karl Brunner, James Tobin and others at this conference — not to mention researchers who are not here — have developed models explicitly representing the credit market separately from the money market. There is no reason at the theoretical level to presume that the credit market is unimportant; that is basically an empirical question. Moreover, two recent sets of empirical findings both suggest an important role for the credit market. Christopher Sims has examined a four-variable system consisting of real output, prices, money and an interest rate, and has found in that system a major causal role associated with the interest rate. In work parallel to Sims', I have examined a similar four-variable system consisting again of real output, prices and money, and in this case a quantity measure of credit liabilities in place of Sims' interest rate. In this system I have found a major role associated with the credit quantity variable. Under the standard interpretation that the interest rate variable and the credit aggregate variable are in effect simply the price and the quantity in the same market, therefore, these two separate strands of research apparently deliver the same conclusion about the importance of the credit market. In addition, further tests show that the information about future economic activity measured in Sims's work by the interest rate and the analogous information measured in my work by the credit aggregate are systematically related, although not with a perfect correlation.

The conclusion that follows from this work is that, in the presence of financial innovations which continually shift the demand and supply relationships for specific assets and liabilities, policy-makers may have to expand to a three-variable, or three-target, approach to monetary policy. The three relevant variables here reflect the independent importance of two markets and the relative price connecting them: in particular, a quantity variable for the money market, a quantity variable for the credit market, and an interest rate representing the relative rate of exchange between the two. It would be convenient, of course, if the world were structured so that all the information needed to conduct monetary policy were embedded in any one of these variables — or, if not any one, then any two. But the evidence warrants increasing skepticism that anything less than a full three-variable approach, based on money, credit and the interest rate, will enable monetary policy to achieve the results for which participants at the two predecessors of this conference had hoped.

Making Reserve Targets Work

James L. Pierce*

"As part of its anti-inflationary program announced on October 6, 1979, the Federal Reserve changed its open market operating procedures to place more emphasis on controlling reserves directly so as to provide more assurance of attaining basic money supply objectives."[1] This announcement seemed to herald the Fed's realization that it must control the growth of reserves if it wants to control money. Apparently, the Fed believes that monetary control is necessary for its "anti-inflationary program," but the central bank was silent about wanting to attain "basic money supply objectives" when it is pursuing anti-recessionary or other programs. Be that as it may, I shall assume that the Fed wants to use reserve targets in all seasons, not just anti-inflationary ones.

There was growing awareness both within the Federal Reserve System, and without, that the old operating procedure in which " . . . the reserve supply had been passively determined by what was needed to maintain . . . a particular level of the federal funds rate . . . "[2] was an ineffective way to control the monetary aggregates. The problem was not so much that the Fed used the federal funds rate as its instrument for controlling the monetary aggregates, but rather that the FOMC did not allow that interest rate to change sufficiently to achieve control over the aggregates.

In a paper prepared for the second conference on Controlling Monetary Aggregates, Pierce and Thomson (1972) showed for the certainty equivalent case that the choice between reserves and the federal funds rate as the more effective instrument for controlling a monetary aggregate depends upon the variance and covariance of money demand and supply. This result had little practical significance, however, because the range of tolerance for the federal funds rate was narrow and the level of the range changed slowly. The range for the federal funds rate was a constraint that frequently prevented control over the monetary aggregates. With that constraint, neither the federal funds rate nor the volume of reserves could be varied actively to achieve "basic money supply objectives."

The real significance of the change in operating procedures was to allow the federal funds rate to vary much more widely from week to week and month to month than had previously been the case. This was understood by the Fed: "Thus, the new procedures entail greater freedom of movement for

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[1] This quote is taken from Appendix B, page B-1 of "The New Federal Reserve Technical Procedures for Controlling Money" in the Federal Reserve's *Monetary Policy Report to Congress Pursuant to the Full Employment and Balanced Growth Act of 1978*, February 19, 1980.

[2] *Ibid.*, p. B-1.

interest rates to change over the short run in response to market forces."[3] Short-term interest rates were allowed much greater freedom of movement by significantly widening the range of allowable federal funds rates. At the FOMC meeting of September 18, 1979 the range of tolerance for the federal funds rate was only 50 basis points, i.e., 11.25–11.75 percent. At the meeting of October 6, the range was 400 basis points, i.e., 11.5–15.5 percent. Since that time, the range has been as wide as 850 basis points.[4]

Allowing interest rates to fluctuate more freely has, I believe, widespread support among economists. Monetarists support the move because it allows closer control over the supply of money. Many economists who put less emphasis on the quantity of money also welcome the policy shift because it allows interest rates to fluctuate procyclically and, hence, to act as built-in stabilizers in the economy, reducing the growth of aggregate demand during booms and stimulating demand during recessions. Thus, one does not have to be a hard-core monetarist to approve of the change in policy procedures.

The extent to which the Federal Reserve has allowed short-term interest rates to vary since October 1979 can be seen by comparing Charts 1 and 2. Chart 1 shows the weekly average values for the federal funds rate during 1974. In that year, the Fed also declared war on inflation and pursued an increasingly restrictive monetary policy designed to reduce growth of the monetary aggregates. From March through July of that year, the federal funds rate rose from about 8.75 percent to over 13.5 percent. The rise in interest rates was considered, at the time, to be very rapid. Beginning in July 1974, as the recession hit and money growth slowed sharply, the federal funds rate declined rapidly and by the end of the year was below 8.5 percent. Evidence of the use of a range of tolerance for the federal funds rate can be seen in the smooth pattern of interest rates from week to week. The funds rate did wobble around a bit from week to week, but within a narrow band.

Chart 2 shows the behavior of the weekly average federal funds rate from August 1979 through August 1980. From August through the first week of October 1979, the funds rate rose but not as rapidly as it had during the first half of 1974. Furthermore, the rise was very smooth indicating the operation of a narrow constraint on fluctuations in the federal funds rate. Then came the shift of policy on October 6, and all hell broke loose. The funds rate rose 122 basis points in a single week and in three weeks rose by 360 basis points from 12 percent to 15.6 percent. Since that time, the federal funds rate has fluctuated widely from week to week, but massive swings have also occurred. From the first week of March through the first week of April 1980, the interest rate rose from 14.6 to 19.4 percent. This rise of nearly 500 basis points over five weeks was unprecedented in size and speed. Even more impressive was the decline in the federal funds rate from its peak of April 5. Over the next five weeks the funds rate fell by approximately 640 basis points

[3] *Ibid.*, p. B-1.

[4] It shall be argued below, however, that at times ceilings and floors have been placed on the federal funds rate and the stated ranges of tolerance were not very meaningful at those times because the funds rate was near, or at, the ceiling or floor.

Chart 1 Weekly Average Federal Funds Rate 1974

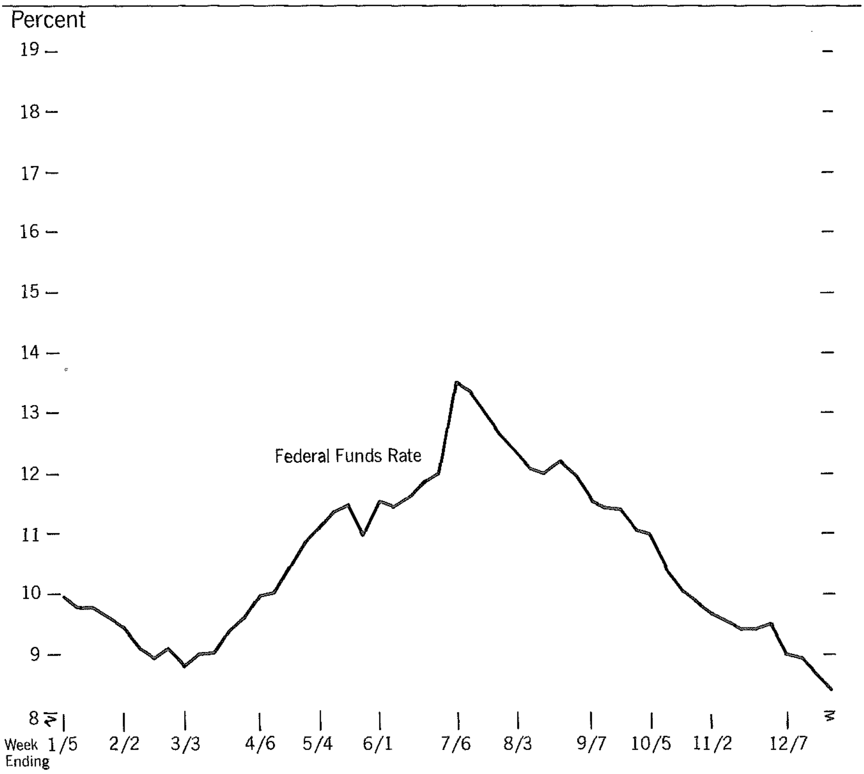
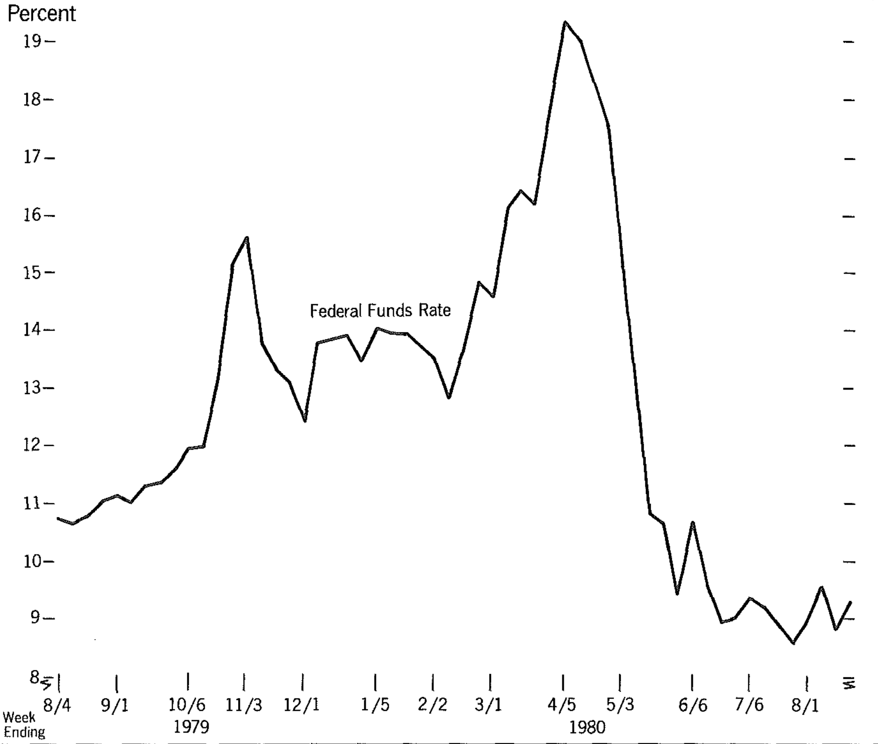


Chart 2 Weekly Average Federal Funds Rate
August 1979 - August 1980



and by the end of March had fallen by nearly 10 percentage points from its April peak.

The behavior of the federal funds rate since October 6, 1979 clearly demonstrates that the Fed abandoned its old habit of limiting movements in that interest rate. It is interesting to observe, however, that during December and January and again in July and August, the federal funds rate varied week to week over a narrow range. This behavior of the funds rate may have been fortuitous or it may indicate a tendency, when conditions allowed, for the Fed to return to the practice of stabilizing the money market. Even if these periods represent lapses from the "new policy," Chart 2 certainly shows that, by and large, the policy is truly new.

By effectively removing the federal funds rate constraint, the Federal Reserve established a necessary, but not a sufficient, condition for closer control over the monetary aggregates. Use of reserves as the policy instrument and adoption of a wide band for the funds rate are not sufficient, however, for close control over the monetary aggregates. Close control also requires a predictable link between reserves and the monetary aggregates.[5] This link is affected by the portfolio choices of depository institutions and of the public, and these choices cannot be closely controlled by the central bank. Before turning to the link between reserves and money, it is necessary to define more carefully the reserve and money concepts that are involved in the policy process.

The Family of Reserve Aggregates

In its domestic policy directive issued to the Federal Reserve Bank of New York, the FOMC is vague concerning the reserve targets that the trading desk should follow. The language in the directive of the meeting for July 9, 1980 makes the point.

> In the short run, the Committe seeks expansion of reserve aggregates consistent with growth of M-1A, M-1B, and M-2 over the third quarter of 1980 at annual rates of about 7 percent, 8 percent, and 8 percent respectively, provided that in the period before the next regular meeting the weekly average federal funds rate remains within a range of 8½ to 14 percent.

The numbers in the short-term directive often change from meeting to meeting, but the same vague language concerning "expansion of reserve aggregates consistent with growth of M1-A, M1-B and M-2" is always present. Furthermore, the discussions at the FOMC meetings summarized in the Record of Policy Actions provide no elaboration on how the trading desk should carry out the directive.

[5] The Fed must also want to improve its performance in achieving closer control over the monetary aggregates. Later on in this paper, the case against intermediate targets such as the monetary aggregates is summarized.

Fortunately, the Federal Reserve has elaborated a little on how it pursues reserve targets.[6] The FOMC first determines the growth in the monetary aggregates that it wants to achieve. After these objectives are set, reserve paths expected to achieve the desired growth in the monetary aggregates are established for a "family" of reserve measures. These measures consist of total reserves, the monetary base and nonborrowed reserves. While never explicitly stated, it appears that the reserve paths themselves are not discussed by the FOMC, but rather calculation of the paths is left to staff technicians.

The methods used by the staff to estimate reserve paths are discussed below, but before turning to that topic, it is necessary to point out that the instructions to the trading desk in New York make it difficult to evaluate the new procedures. The FOMC establishes desired growth rates for M-1A, M-1B and M-2. The staff then calculates the paths for total reserves, the monetary base and nonborrowed reserves that are expected to achieve the desired growth in these monetary aggregates. Given a set of reserve aggregates and a set of monetary aggregates, there is no single measure of how well the new operating procedures work. The various reserve aggregates are hardly independent of each other, so we cannot associate different reserve concepts with different monetary aggregates. Furthermore, it will be argued below that nonborrowed reserves are an instrument of policy and the other measures are either predetermined or affected by the same sorts of portfolio decisions as are the monetary aggregates themselves. Thus, there is one instrument and three targets to hit for the monetary aggregates. Since M-1A, M-1B, and M-2 are not scalar multiples of each other, the three targets cannot be achieved simultaneously. In this situation it is not clear how to evaluate errors, because errors are implicit in the mismatch of instruments and targets. It is possible to describe a vector of errors for the three monetary aggregates, but this vector gives little information in the absence of some scale for evaluating errors among the various aggregates. The FOMC may have preferences concerning the tradeoffs among the various aggregates when misses occur but no evidence is available in published sources. In the absence of objective criteria for evaluating how well reserve targets work, this paper must deal with generalities concerning control over the monetary aggregates.

The Reserve Aggregates

Total reserves, RT, are composed of required reserves, RR, plus excess reserves, RE. Total reserves are also defined as nonborrowed reserves, RNB, plus borrowed reserves, RB. These definitions give the identities RT = RR + RE = RNB + RB. With lagged reserve accounting, required reserves in any week are based on the deposits and other liabilities two weeks in the past. Thus, RR is predetermined and the quantity of excess reserves is simply the difference between the total reserves in the system and the predetermined

[6] See "The New Federal Reserve Technical Procedures for Controlling Money."

quantity of required reserves. Reserves are provided through the discount window and through open market operations. The Federal Reserve restricts access to the discount window, but the volume of borrowed reserves varies with the demand for loans from the Fed. Thus, of all the reserve measures, only RNB is under direct control of the Fed.

Rearranging terms in the identity given above we have, RNB = RR + RE – RB = RR + RF, where RF = RE – RB is commonly called free reserves. Because RR is predetermined in any week, changes in RNB can only affect RE and RB, i.e., can only affect free reserves. In the context of lagged reserve accounting, a target for RNB is equivalent to a target for RF. Lagged reserve accounting forces the Fed to adopt free reserves as its instrument for affecting the monetary aggregates. The monetary base, MB, is simply total reserves plus currency, C. Currency holdings cannot be controlled directly by the Fed so we have MB = RT + C = RR + RE + C = RNB + RB + C and, again, RNB = RR + RE – RB.

The Discount Window

In a world of certainty, the Federal Reserve could always follow reserve paths that are consistent with the desired growth of the monetary aggregates. In this world, the Fed would know the "multiplier" relationships between the family of reserve measures and the monetary aggregates and, therefore, desired money growth could always be achieved. The world in which the Fed operates is highly uncertain. The various multipliers are subject to random variation and the true structure of the relationships between reserves and money is not known. All this uncertainty implies that the Fed cannot hit its monetary targets exactly and that surprises do occur.[7]

In the real world, the discount window performs the function of buffering the effects of stochastic variations in the relationship between reserves and money. This function implies that variations in the use of the discount window affect the relationship between nonborrowed and total reserves. If, for example, the demand for money and credit is stronger than anticipated, given the Fed's paths for nonborrowed and total reserves, interest rates will rise. Given the discount rate, the rise in interest rates induces depository institutions in increase their borrowing at the discount window. Given nonborrowed reserves, the rise in borrowed reserves increases total reserves and with it the volume of money and credit in the economy. Thus, there is more money for a given volume of unborrowed reserves and the multiplier for NBR rises. Now, the Fed must decide whether the unexpected rise in the demand for money and credit is transitory or if it signals a systematic error in the expected relationship between nonborrowed reserves and money. If the rise in demand is transitory, the best strategy is to adhere to the old nonborrowed path. If the rise in demand is more permanent, then the Fed must react if it

[7] It is argued below that use of more modern techniques for forecasting and for controlling money would probably help, but errors would still remain.

wants to achieve its targets for the monetary aggregates. Two reactions are possible. First, the Fed can reduce the path for nonborrowed reserves. This will induce further borrowing at the discount window, but the offset is relatively small and to some degree predictable. Thus, total reserves can be brought back to their original path. Alternatively, the Fed can raise the discount rate, reduce borrowing and reduce total reserves while adhering to the original nonborrowed reserve path. This second method is not used frequently because the Fed has elected to avoid short-term variations in the discount rate.

A similar story can be told for an unexpected rise in the multiplier relationship between RNB and the monetary aggregates coming from an unexpected rise in deposit liabilities. In this case, the higher volume of required reserves that materializes two weeks later produces a rise in interest rates given the path for nonborrowed reserves. Again depository institutions will increase their use of the discount window. The Fed will have the same sort of decision as before concerning whether or not to change the RNB path or the discount rate. In this case, however, it may be impossible to return to the original path for total reserves. The Fed has two weeks notice that a bulge in RR will occur, but sufficient total reserves must be supplied to allow institutions to meet their reserve requirements.[8] This could force the Fed off of its path for total reserves and the monetary base.

It might appear that because the Fed changes the discount rate infrequently, large changes in borrowing occur and these changes greatly complicate the use of reserve targets. This conclusion is not warranted, however. The discount window is heavily "administered" and depository institutions cannot use the window at will. Changes in market interest rates tend to induce relatively small changes in borrowing when market interest rates exceed the discount rate. It is true, however, that the greater the excess of market interest rates over the discount rate the greater the amount of borrowing. Even given heavy administration of the discount window, the higher the profit incentive for institutions to borrow, the more imaginative they are in gaining access to this form of credit. Quantitatively, however, the effects are small. For example, in March of 1980 borrowing at the Fed reached a peak of $2.8 billion. In March, the federal funds rate was over 17 percent and the discount rate was 13 percent. Thus, a differential of 400 basis points produced only $2.8 billion of borrowing. In March, total reserves were $43.4 billion, so borrowing constituted only 6 percent of total reserves, and this percentage is high by historical standards. Tight administration of the discount window implies, however, that a rise in the demand for reserves has a relatively large effect on the federal funds rate. If the upper band of that interest rate is achieved, the desk will supply more RNB and reserve targets will be overshot. If the discount rate were kept in line with market interest rates, the upward pressure on the funds rate would probably be reduced.

[8] There is some flexibility in the system, however, because depository institutions can, to a limited degree, carry reserve deficiencies forward to the next week.

Family Feud

Required reserves, total reserves and the monetary base cannot be controlled in any operating sense, i.e., day-by-day and week-by-week, by the trading desk. Required reserves are determined by events two weeks in the past, and total reserves and the monetary base are affected by the degree of use of the discount window. Nonborrowed reserves can be closely controlled in an operating sense. The control is not perfect, however, because the desk must respond to variations in currency demand, float and other factors that affect reserves. These various factors are observed both frequently and quickly, however, so the desk can engage in open market operations to offset movements in the factors that would make RNB deviate from its target path. The degree of control over nonborrowed reserves is sufficiently close that this reserve measure can be thought of as an operating instrument of monetary policy.

It might appear that similar stories could be told to explain why total reserves or the monetary base can be operating targets. After all, the Fed knows how much institutions borrow from it every day, so if variations in RB cause RT and MB to deviate from their target paths, the desk can offset the effect by engaging in appropriate open market operations. To some extent this can be done, but lagged reserve accounting and inconsistencies among reserve targets get in the way. If RB, RT and MB are growing more rapidly than desired, the desk can offset the effect but only to the extent that there are sufficient reserves in the system to cover the predetermined level of required reserves. This level of RR constrains the minimum values of RT and MB. There is no constraint on the up side because, by definition, total reserves in excess of required reserves simply become excess reserves.

Even if the predetermined volume of required reserves does not pose a binding constraint, the Fed can only have one independent reserve instrument. For example, if it attempts to control RT and MB, the Fed must offset changes in borrowed reserves with changes in RNB. Nonborrowed reserves become endogenous and move inversely with borrowed reserves. Furthermore, at times it is impossible to adhere simultaneously to paths for total reserves and the monetary base. For example, if there is an unexpected increase in the public's holdings of currency, the monetary base is unaffected. The reserves of depository institutions decline but currency rises by the same amount.[9] Total reserves fall, however. If the Fed adheres to its path for the monetary base, the system of fractional reserve requirements will produce a multiple effect on the deposit components of the monetary aggregates, and these aggregates will fall relative to their desired paths. If the Fed adheres to its path for RT, RNB must rise to ward off the contraction in the monetary aggregates, so the monetary base and the monetary aggregates rise by the amount of the rise in currency holdings and, hence, rise above their target paths. Under these circumstances the Fed must, again, decide what to do. As

[9] Assuming depository institutions replace their depleted vault cash.

a practical matter, it tends to accommodate unexpected shifts in currency holdings with offsetting movements in RNB. This at least avoids the exaggerated movements in the monetary aggregates that come from adhering to a path for the monetary base in a world with fractional reserve requirements. If currency shifts prove to be more than transitory, however, the Fed must alter the paths for all the members of the family of reserve aggregates if it wants to achieve its goals for the monetary aggregates.

The use of a family of reserve measures may not be confusing to the Federal Reserve, but it is to me. In a stochastic world, the paths for the family members are not consistent with each other. The Fed can only adhere to one path at a time and must abandon the others when the world proves to be different from the one assumed when the paths were initially set. The system is overdetermined. In practice, the Fed may solve the problem of inconsistent reserve targets by adhering to its target for nonborrowed reserves and occasionally using the behavior of total reserves and other measures to modify that path. This is just a guess, however, there is insufficient evidence available to reach a more definitive conclusion.

Lagged Reserve Accounting

The practice of assessing reserve requirements against the levels of deposits and other liabilities two weeks in the past was instituted as an aid to banks (mainly small ones) that had difficulty keeping track of the composition of their deposits and, hence, their required reserves. The two-week lag apparently gives them time to sort out their affairs and to determine their required reserves. Lagged reserve accounting may be helpful to these banks but it complicates life for the Federal Reserve in its pursuit of reserve targets. For example, if there is a bulge in the amount of deposits or other liabilities during any week, required reserves do not rise in that week but two weeks later. With contemporaneous reserve accounting, the immediate rise in required reserves would inhibit the growth of deposits and other liabilities. With lagged reserve accounting, there is no inhibiting factor and two weeks later there must be sufficient reserves to cover the full expansion of deposits and other liabilities.

This is not to say that the Fed is helpless in offsetting the bulge in deposits. By sticking to a nonborrowed reserve path, it can put upward pressure on interest rates and force banks into the discount window. Because the discount window is heavily administered, banks will retard future expansion of assets and deposits in order to repay their borrowing from the Fed. The higher the value of net borrowed reserves (negative free reserves), the greater the upward pressure on market interest rates as institutions work to retire their borrowing, and the greater the retarding influence on deposit expansion. This is the classic case of using free reserves as a method of achieving monetary control. With contemporaneous reserve accounting the weight of adjustment would not fall totally on borrowed reserves. The initial expansion of assets and deposits would be less and, therefore, the rise in interest rates would be less.

Lagged reserve accounting also produces exaggerated declines in interest rates when there is an increase in reserves. For example, if the public unexpectedly reduces its currency holdings, there will be an unexpected increase in deposits. These deposits will not have reserve requirements imposed against them for two weeks. Thus, the entire deposit increase goes into excess reserves. These reserves can be used by depository institutions to purchase additional assets, but the deposit expansion does not increase required reserves for two weeks. The only way that the banking system can get rid of its excess reserves is to repay its borrowing from the Fed. The same sort of reaction would occur if there is an expansion of reserves as a result of open market operations. Irrespective of the source of the increase in reserves, there is an expansion of deposits and a reduction in interest rates that is greater than would be the case under contemporaneous reserve accounting.

Lagged reserve accounting caused no real difficulties back when the Fed was in the business of stabilizing the federal funds rate. In that situation sufficient reserves were supplied or removed to maintain the federal funds rate. Under a reserve strategy the situation is different. Adherence to a path for total reserves can at times be impossible and adherence to a nonborrowed reserve path can produce sharp changes in interest rates. If the change in interest rates is sufficiently great, even the widened federal funds rate band can be hit and policy forced off of its reserve paths.

It is curious that the Federal Reserve, which historically has shown so much concern for short-run stability of interest rates, should have a reserve requirement scheme that exacerbates the fluctuations in interest rates. The Fed is apparently aware of the problem and has recently announced that "The Board is disposed toward returning to contemporaneous reserve account, possibly by September 1, 1981, if further investigation indicates that such a system is operationally practical."[10] The operational practicality apparently refers to the problems that some banks have in determining their mix of deposits and other liabilities, not to the practicality of conducting monetary policy under contemporary reserve accounting.

It is possible, however, to make too much of lagged reserve accounting. Its elimination would make the execution of policy somewhat easier and the desk would have to stray less often from the established reserve paths. Week-by-week adherence to the paths, particularly for total reserves and the monetary base, could be closer, but so long as the Fed is willing to tolerate wide fluctuations in the federal funds rate and so long as it keeps use of the discount window under control, the FOMC should be able to achieve its monetary objectives. If the Fed were willing to keep the discount rate more in line with market interest rates, the problems of operating under lagged reserve accounting would probably be reduced.

[10] "Federal Reserve Press Release on Regulation D," Board of Governors of the Federal Reserve System, August 15, 1980, p. 9.

Relating Reserves to the Monetary Aggregates in Practice

The Federal Reserve has provided a description of how it establishes and pursues target paths for the various reserve measures.[11] At each meeting, the FOMC establishes its targets for the monetary aggregates over the interval (usually monthly) until the next meeting. These short-run objectives are selected to be consistent with the annual growth targets for the monetary aggregates. Because the monetary aggregates behave erratically from month to month, the short-term targets are set with the expectation that, if achieved, they will "promote" the desired growth over the year. At each meeting, a range for the federal funds rate is also set.

Based on the short-term targets for the growth of the monetary aggregates established by the FOMC, the staff constructs paths for nonborrowed reserves, total reserves and the monetary base that it expects to be consistent with the short-term paths for the monetary aggregate. As a first step, estimates are made of all the factors that will absorb reserves over the period. Thus, estimates are made of total reserves absorbed by private demand deposits, interbank demand deposits, U.S. government demand deposits, large CDs, savings deposits, other time deposits, nondeposit items subject to reserve requirements, and by excess reserves.[12] In making these calculations, estimates are made of the distribution of deposits by member vs. nonmember, by size of bank, and by maturity of time deposits. In these calculations, account is taken of lagged reserve accounting. Estimates are also made of currency outside banks because this measure of currency is a component of all the Ms and also is added to estimates of currency at depository institutions to construct the figures for the monetary base.

In a sense, the staff attempts to determine the growth in reserves required to support the deposit components of a particular monetary aggregate, for example, M-1B, given all the estimated claims on required reserves by items that are *not* in M-1B. Thus, the reserves for the monetary aggregate are determined as a residual, i.e., as an amount in excess of the estimated required reserves against items that are not included within a particular monetary aggregate.

The next step is to estimate the mix of reserves between borrowed and nonborrowed reserves, i.e., use of the discount window is estimated. Total reserves less borrowed reserves gives nonborrowed reserves. The estimated growth of nonborrowed reserves provides a basis for establishing the amount of open market operations the trading desk in New York can expect to make over the period. It is only a basis for establishing an operating target, however, because other calculations must be made. First, the estimate for nonborrowed reserves is deseasonalized. The FOMC makes its decisions based

[11] See "The New Federal Reserve Technical Procedures for Controlling Money."

[12] The story in the text describes current practices. The Fed will presumably make similar calculations of reserves absorbed by the liabilities of all depository institutions as reserve requirements for these institutions are phased in.

on seasonally adjusted values of the monetary aggregates, but the desk must operate in the real seasonal world.

The next step is to estimate the seasonally unadjusted values of all the other factors that will affect reserves over the period (e.g., float). These factors less borrowing give the estimated amount of open market operations that must be conducted over the period. The final steps, which probably receive more attention in New York than in Washington, involve estimation of the weekly and daily patterns of open market operations that are expected to achieve the estimated growth of nonborrowed and total reserves over the interval until the next meeting of the FOMC. These calculations in turn require estimation of the weekly and daily factors expected to affect reserves.

There is no source available that describes how all these estimates are made. It is my impression that many of them are "judgmental," i.e., informed guesses, based on past patterns of the various components. There is no evidence to suggest that the effects of changes in the general level of interest rates or in relative interest rates are taken into account in the various estimates. The only possible exception is the volume of borrowing at the discount window which is apparently assumed to be sensitive to interest rates.

It should be pointed out that the procedures for setting paths for the various reserve measures described by the Fed have been in operation for years. Long before the FOMC switched to reserve targets, the staff prepared reserve estimates that were thought consistent with the short-run targets for the monetary aggregates adopted by the FOMC. One set of estimates was supplied in an official document prepared by the staff, commonly called the Blue Book,[13] and another set of estimates was prepared by the Federal Reserve Bank of New York. The various estimates for the reserve aggregates were used by the trading desk in New York as well as by those within the Fed who monitored the course of open market operations. The estimates were probably of some value, but the reserve paths were not closely adhered to because of the narrow band for the federal funds rate. Reserves were simply determined endogenously as the desk maintained the funds rate within its prescribed band.

It is my impression that the same procedures for estimating reserve paths are used today. If this impression is correct, it means that the techniques hardly represent the culmination of exhaustive research on how best to estimate the relationships between various reserve measures and the monetary aggregates. Perhaps my impression is wrong and the techniques described by the Fed are "best," but there is no way to tell from available sources.

There is no way to compare the estimated reserve paths that come out of the Federal Reserve's complicated process with alternative methods because the Fed does not divulge the estimated paths. Furthermore, there is no way to determine whether or not the Fed has found its estimation procedures to be superior to other techniques. It seems quite possible, for example, that rather

[13] See Lombra and Moran (1980) for a description of this and other colored books.

than trying to impute required reserves to all the judgmentally estimated values of the items that have reserve requirements imposed against them, lower prediction errors would be achieved by simply estimating statistically the relationship between a particular monetary aggregate and the various reserve measures. There is no way to determine if this is the case, however,

The implications of prediction errors of the various "money multipliers" may not be as serious as they appear for making reserve targets work. According to the Fed's description of its new operating procedures, it employs "negative feedback" to correct for errors in the multipliers. Thus, if incoming data suggest that the assumed multipliers are seriously in error, the estimates of the multipliers are revised and paths for the reserve aggregates adjusted accordingly. For example, if the mix of deposits in the "nonmoney" liabilities subject to reserve requirement differs from expectations, the paths for the various reserve aggregates are adjusted to compensate. In practice, these adjustments apparently have been infrequent, however. Given the frequency with which the FOMC meets, it is apparently not necessary to make frequent changes in the reserve paths between committee meetings. At the next committee meeting a new set of paths is developed and any multiplier errors can be taken into account at that time.

It is not clear, however, how the multiplier errors are taken into account either between FOMC meetings or from one meeting to the next. One has the impression that the negative feedback is built somehow into the judgmental process used to construct reserve paths. As the Federal Reserve describes the process: "Given the naturally large week-to-week fluctuations in factors affecting the reserve multiplier, deviation from expectations in one direction over a period of several weeks would be needed before it would be clear that a change in trend has taken place."[14] This statement is not very helpful for understanding the process.

It does appear that the construction of reserve paths and the modifications of these paths are *ad hoc*. This may be the best method available, but that seems unlikely. A large literature has developed in recent years on optimal control, feedback rules, optimal forecasting and filtering techniques that could be applied to the construction of reserve paths and to adjusting the paths over time. These methods are practical — after all, it is possible to land on the moon *and* return — and seem particularly applicable to reserve targeting. Unlike most economic problems where there are long lags between changes in instrument variables and changes in target variables, the lags for reserves are relatively short. Furthermore, a great deal of information pours into the Fed everyday on deposits, reserves, and interest rates that help guide the process. It is surprising that the Fed does not use modern techniques, but rather apparently clings to ancient methods. The penchant for judgmental projections is particularly surprising because several Federal Reserve economists have been leaders in developing the modern techniques. Perhaps these methods have been tried and proved to be inferior to judgment. This is pos-

[14] "The New Federal Reserve Technical Procedures for Controlling Money," p. B-6.

sible. Sometimes old-fashioned methods are superior to high-technology applications, as your neighborhood acupuncturist will attest. At least with acupuncture, however, we have some evidence. With Fed operating procedures, there is no publicly available evidence so there is no means of assessing the quality of the work that goes into constructing and modifying reserve paths.

Do Reserve Targets Work?

The ultimate test of how well the Federal Reserve does with its new operating procedures lies with the degree to which these procedures have helped the Fed to achieve its objectives. Here, there is insufficient evidence to allow any strong conclusions.

In October 1979 the Fed decided it was time to declare war on inflation. Part of the war effort involved slowing the growth of money and credit. Clearly, slower reserve growth and sharply higher interest rates were required to achieve these goals. Pursuit of target paths for the reserve aggregates produced the desired result; interest rates shot up and money growth slowed. In September 1979 the federal funds rate was 11.4 percent; in April 1980 the average for the month was 17.6 percent. The growth of the monetary aggregates fluctuated from month to month during the period, but the growth trend was clearly downward. For example, the growth of M-1B during the first half of 1979 was over 10 percent at an annual rate. The growth from the third to the fourth quarter was 5 percent, from the fourth quarter of 1979 to the first quarter of 1980 M-1B grew at 6 percent, and from the first to the second quarter of 1980, M-1B fell at an annual rate of over 2 percent. M-1B fell sharply in February, March, and April of 1980 and then rose rapidly in May, June, and July.

It is not clear that the sharp fluctuations in money growth from month to month or even quarter to quarter are consistent with successful application of reserve targets to achieve closer control over the monetary aggregates. It is probably unreasonable to expect the adoption of reserve targets to allow the Fed to "fine-tune" the growth of the monetary aggregates. But the degree of fluctuation in money growth, including the procyclical decline in the second quarter, appears to be little different from what was experienced in the past, prior to the adoption of reserve targets. The use of reserve targets does not necessarily imply smooth money growth. After all, the Fed might want an erratic pattern. It is not clear, however, from the numbers or from the Records of Policy Actions that the Fed has achieved closer control over the monetary aggregates. It is clear that adoption of reserve targets allowed the Fed to push interest rates sharply upward and to slow money growth. Once the growth of money slowed, it then shrank before starting to expand rapidly. At this writing, it simply is not obvious that the growth of the monetary aggregates is under control.

It is exceedingly difficult to interpret the behavior of bank reserves or the monetary base since October 1979 because of marginal reserve requirements and because of the behavior of deposits and other liabilities not included in the conventional monetary aggregates, but subject to reserve requirements. The series for total reserves and the monetary base, adjusted for reserve requirements, published by the Federal Reserve Bank of St. Louis show erratic movement in reserves and the monetary base from month to month with a slowing of reserve growth occurring only in the first and second quarters of 1980. The series grew more rapidly in July and August. Judging by the behavior of M-1A, M-1B, and of market interest rates, the Fed was crunching the financial system fairly hard in the fourth quarter of 1979, but the adjusted reserve series do not show this until early 1980. One price paid for operating through reserves is the problem of interpreting actual growth in reserves.

The Federal Reserve certainly demonstrated that it could get the economy's attention, but in what sense did reserve targets "work"? Money growth slowed and interest rates shot up. Isn't this proof enough? If it were not for the experience of 1974, the answer would probably be yes. But in 1974, the Fed was using the federal funds rate rather than a reserve path for monetary policy. Yet in that year interest rates also rose dramatically and money growth declined appreciably. The movements were not so great as in 1980, but they were sizable for the times. It is not clear that the Fed had better control over the monetary aggregates in 1979–1980 using reserve targets that it had in 1974 using targets for the federal funds rate. The major difference between the credit crunches of 1974 and 1979–1980 involved the speed with which interest rates fell following the start of the economic decline. Interest rates declined much more rapidly in 1980 than in 1974. For this we apparently can thank the FOMC and the use of a reserve target.

Yet despite the unprecedented decline in short-term interest rates, the monetary aggregates actually shrank in February, March, and April of 1980. How could this happen using a reserve target? The answer seems to be that the Fed seriously overestimated reserve multipliers. These errors in turn were probably the result of underestimating the effects of record high interest rates on money demand and supply.

It appears that the Fed has on at least two occasions abandoned reserve targets in favor of a federal funds rate constraint. Following its policy shift of October 6, 1979 the Fed maintained a range of tolerance for the federal funds rate of 11½–16½ percent. In March the lower and upper limits were raised to give a range of 13–20 percent and in April the range was made 13–19 percent. The federal funds rate peaked at 19.4 percent for the week of April 5, so the funds rate was at its upper limit. In May the lower limit was lowered to 10 percent and the federal funds rate was at or below this limit during the month. In June the lower limit was reduced to 8½ percent. The behavior of the federal funds rate relative to its ranges of tolerance suggests that the Fed placed a ceiling on interest rates in April, albeit a very high one, and a floor on interest rates in May and June, albeit a low one. If these ceilings and floors were in fact operative, it follows that the Fed was increasing reserves relative to path in April and decreasing reserves relative to path in May and June. In light of the collapse of money growth that occurred in April and the expansion of money growth in June and July, the federal funds constraints apparently helped to reduce the fluctuations in the growth of the monetary aggregates. Perhaps the Fed's feedback rule is more elaborate than it appears in the written document. Be that as it may, the erratic behavior of money growth since October 1979 does not suggest high marks for the use of reserve aggregates as operating targets. Perhaps if the economy encounters more tranquil times, the task will be easier. Unfortunately, a host of institutional and legal changes are underway within the financial system that will tend to make the Fed's job harder rather than easier during the next several years.

New Complications for the Future

Recent changes in the financial system have complicated the execution of monetary policy. These changes have weakened the character of the monetary aggregates and have led to a whole new set of definitions of these quantities.[15] We no longer have good old M-1, M-2, M-3, . . ., M-n; we now have M-1A, M-1B, a new M-2, and so on. The redefinitions resulted from the spread of NOW, ATS and share draft accounts, money market mutual funds, repurchase agreements, overnight dollar deposits held at Caribbean branches of banks, and a number of other factors. The redefinitions suggest, among other things, that the behavior of the old definitions of the monetary aggregates will not be reliable guides for judging the behavior of their newly defined counterparts.

Legislative changes in the Depository Institutions Deregulation and Monetary Control Act of 1980 will make the situation even more confused in coming years. On December 31, 1980 all depository institutions will be authorized to issue NOW accounts. It will be difficult to predict the speed and extent of growth of NOW accounts in future years. The behavior of these accounts in New England will provide some guidance, but economic conditions in various other areas of the country could lead to a different pattern of growth nationwide. In addition, interest rate ceilings on accounts at depository institutions will be phased out and removed over the next six years. As these ceilings are raised and then removed, the portfolio choices of the public concerning checking and savings accounts, time deposits and other liabilities offered by depository institutions will be affected by the interest rates paid on these various assets. The interest rates in turn will, over time, become increasingly influenced by market forces. These forces have not been allowed to operate in the past, and so there is little experience to guide predictions of how the public will respond.

The same legislation also provides the Federal Reserve with sweeping powers to assess reserve requirements on depository institutions that are not

[15] See "The Redefined Monetary Aggregates," Appendix A of *Monetary Policy Report to Congress Pursuant to the Full Employment and Balanced Growth Act of 1978*, Board of Governors of the Federal Reserve System, February 19, 1980.

members of the Federal Reserve System.[16] Thus, nonmember banks, savings and loan associations, mutual savings banks and credit unions all become subject to reserve requirements. More specifically, any depository institution has reserve requirements assessed against its transactions accounts and its nonpersonal time deposits. These changes are to be phased in over time for nonmember institutions that currently have such liabilities outstanding. Furthermore, the first $25 million of transactions accounts is exempt from reserve requirements with future exemptions tied to the total volume of transactions accounts outstanding. The reserve requirements for member banks are reduced for transactions accounts and eliminated for personal time deposits. Finally, the Federal Reserve is granted authority to impose supplemental reserve requirements on transactions accounts of all depository institutions under certain special circumstances.

On top of all this, the Fed is required by September 1981 to put into effect a charge system for its various services including check clearing, wire transfers, and the supply of float. These charges will affect the costs of transactions to depository institutions and their customers. Thus, the pricing scheme will affect the supply and demand of transactions accounts and the behavior of float.

Finally, all depository institutions are allowed access to the discount window. The Fed's administration of the window and its willingness to change the discount rate will be put to the test by this change. It probably will take time to explain the rules of the game to nonmember depository institutions, i.e., that they should be "reluctant" to use the Fed's lending facilities.

The Act represents a great stride forward in removing regulatory constraints on depository institutions, promises significant benefits to consumers and greater competitive equity among depository institutions. It also gives the Fed its long sought after authority to impose universal reserve requirements. There can be little doubt, however, that the provisions of the Act will complicate the execution of monetary policy for years to come. The demand for various monetary aggregates will be difficult to predict as the public adjusts to the wider range of choice of assets and as interest rates on these assets move increasingly with market conditions. The "supply" side of the monetary aggregates will also be difficult to predict. The sweeping extension of reserve requirements to nonmember institutions and the complex phase-in of new reserve requirements will make it difficult to predict the relationship between reserve paths and the growth of the various monetary aggregates.

It is not clear how one makes reserve targets "work" in this environment. It appears that prediction errors will be substantial in the relationships between reserves and the monetary aggregates as well as between the monetary aggregates and economic activity. It does appear that over the next few years the Fed will have to be clever in its use of targets for reserves and the monetary aggregates. Old relationships will no longer hold and information

[16] For a description of the actual reserve requirements in all their complexity, see the Federal Reserve Press Release on Regulation D, August 15, 1980.

from a variety of sources, such as interest rates, prices, and data about real economic activity will have to be used in divining and modifying reserve paths over time.

The Inefficiency of Using the Monetary Aggregates as Objectives of Policy

The comments about the implications of changes in the financial system for the execution of monetary policy, serve to introduce a related issue. It has been shown under quite general assumptions that the use of so-called intermediate targets such as the monetary aggregates is counterproductive to achieving ultimate policy objectives.[17] Monetary policy involves the setting of certain policy instruments, such as nonborrowed reserves, with the objective of achieving desired values of certain target variables such as inflation and real output. This policy process has implications for a host of endogenous variables in the system including the monetary aggregates and interest rates. The behavior of these variables can provide information on how well policy is working to achieve its ultimate objectives. In particular, this information is valuable for determining the extent to which the path of the instruments of policy should be changed. Thus, for example, if the monetary aggregates are growing more rapidly than anticipated, given the paths of the instruments of policy, this rapid growth may be a signal that economic activity is stronger than anticipated and that the reserve paths should be lowered. Whether or not rapid growth of monetary aggregates signals a need to reduce the paths for reserves depends upon a host of stochastic factors in the economy. Only in the trivial case where the aggregates are perfectly correlated with the target variables is it appropriate to use the instruments to control the monetary aggregates. In all other cases, the behavior of the monetary aggregates provides one source of information on how to adjust the instruments to achieve the ultimate targets.

Recent work by Tinsley, Spindt and Friar (1978) demonstrates the benefits of using the monetary aggregates as sources of information concerning the current and future state of the true targets of monetary policy. They demonstrate, however, that more can be learned about these target variables by examining components of the monetary aggregates rather than by using the aggregates themselves. This result is not surprising considering the heterogeneous and rather arbitrary composition of the monetary aggregates. The components of M-1A, M-1B and M-2 are not perfect substitutes and information is lost by simply adding the components together.[18]

[17] For a formal analysis see Kareken, Muench and Wallace (1973) and for a summary of the issues involved, B. Friedman (1977).

[18] Barnett and Spindt (1980) have shown that simple addition of the components of the various monetary aggregates is inappropriate. They demonstrate that by weighting each component by the degree of "money services" it provides, an index is obtained that provides significantly more information than the conventional monetary aggregate.

Recent financial innovations have forced a redefinition of the monetary aggregates, but the new definitions do not provide a solution to the low-information content in aggregations of financial assets. For example, M-1B includes currency and "checkable" deposits at all depository institutions, but excludes overnight repurchase agreements, overnight Eurodollar deposits and money market mutual funds shares. These items, which are very close substitutes for checking accounts, are put into M-2. This practice is harmful to obtaining information because M-2 also includes small (under $100,000) time deposits with fixed maturities, ranging from six months to eight years. It seems unlikely that RPs, Eurodollars or even money market mutual funds shares are close substitutes for small time deposits. M-3 compounds the problem by adding large time deposits of all maturities and "term" RPs.

This is not the place to criticize the new definitions of the monetary aggregates. The purpose of this discussion is to stress the low information content of the aggregates that the Fed is attempting to control. Repurchase agreements, overnight Eurodollar deposits, and money market mutual funds have been major elements in affecting the demand and supply of checking accounts and of short-term time deposits, both large and small. Unfortunately, RPs and other elements are lumped into the heterogeneous category called M-2. Thus lumped, they can provide little information on substitution among assets in the public's portfolios.

The current and prospective situation suggests that the monetary aggregates will not be reliable information variables and that the relationship between reserves and the ultimate targets of policy will be subject to substantial prediction errors. To make reserve targets work in this environment, the Federal Reserve will have to downgrade the importance of the monetary aggregates. The Fed will have to adjust its reserve targets in response to information from a variety of sources, not just from "money."

The structural changes that are underway for depository institutions and the financial system in general suggest that the degree of uncertainty about the relationships between the instruments and targets of policy will be increased in coming years. This uncertainty involves not only the "level" of relationships, i.e., additive errors, but also parameters of the system. Uncertainty about parameters has serious implications for how policy should be conducted. Milton Friedman (1955) has argued forcefully that the growth of the money stock should be constant because the lags in the effects of policy are sufficiently long and variable that a more active policy can be destabilizing. Friedman's proposal appears to be based, at least in part, on the assertion that the parameters of the system linking instruments to targets is highly uncertain. Following Brainard's (1967) pioneering work on policy-making in a world of uncertain parameters, there has been very little work on the problem. When parameters are uncertain, the analytically convenient condition of certainty equivalence is lost and the analysis is difficult for a dynamic model. Some recent work on the problem, both in unpublished form by Tinsley and others of the Federal Reserve Board's staff, and in published form by Craine (1979), shows the implications of parameter uncertainty for the use of reserve targets. Craine, for example, shows the conditions under which a Friedmanian rule is superior to activist policy. Stated loosely, if uncertainty about the effects of policy is sufficiently great, incoming data on the state of the financial system, and the economy in general, provide no information and policy should not depart from a predetermined path.[19] Thus, if uncertainty is sufficiently great, then predetermined growth targets for nonborrowed reserves or other instruments of monetary policy are appropriate.

The analytic results for policy-making in a world with uncertain parameters appear to give some justification for the way the Fed established and modifies operating targets for reserve measures. Long-term objectives for the monetary aggregates are changed very infrequently and reserve paths are established with the objective of achieving these goals for the monetary aggregates. The theory of policy-making under uncertainty, however, does not justify the use of reserve targets to control the monetary aggregates. *All* the analytic results indicate that there is no economic rationale for setting reserve targets with the objective of controlling the monetary aggregates. Both theory and common sense indicate that reserve targets should be designed to influence the ultimate objectives of policy not the monetary aggregates.[20]

Counting Instruments and Targets

The most fundamental problem with making reserve targets work lies with the multiplicity of policy targets. It is well known that if there are more targets than instruments the best that policy can do is to achieve some "least bad" combination of the targets. In a stochastic, nonlinear, and dynamic environment, this can be a complex process. There are real limits to what one can expect of reserve targets.

In recent years, monetary policy has been used to "put out fires." That is to say, the instruments of monetary policy have been used to bring under control whatever the currently most troublesome problem seems to be. Thus, on October 6, 1979 it was decided that the flames of inflation were burning out of control so the Fed's fire fighting machinery was directed against inflation. The abrupt slowing of money and credit growth, coupled with soaring interest rates and a "credit control program," produced the desired result. The economy finally moved into recession. "Something" had been done. With the recession came falling interest rates. They fell very rapidly but soon posed a

[19] This is the limiting case. In general, it does pay to respond to incoming information. The degree of response is affected by the extent of uncertainty about the true parameters.

[20] This discussion has studiously avoided the literature on rational expectations applied to macroeconomic models. According to some of that literature, it is only unanticipated policy changes that affect real economic activity. This is not the place to provide a diatribe concerning this conclusion. However, even a rational expectations model would probably show less variance in real output and inflation if the Fed's policy reacted to actual and prospective inflation and output rather than to other endogenously determined, but stochastic, variables such as the monetary aggregates.

new problem. The dollar declined on exchange margets and fears of a capital flight began to build. The Fed turned its attention to this fire by putting a floor under the federal funds rate and accepting whatever shortfalls in reserve and money growth might result.

This is not an isolated episode for monetary policy. In 1974 the Fed had moved to fight inflation. With a deep recession and a temporary cessation of oil price increases, inflation was reduced. The Fed, and government policy in general, turned to the next fire which involved unemployment of labor and resources. A high rate of economic expansion resulted. By 1979, the fires of inflation were burning brightly, so the Fed turned to that problem. One has the impression that unless the policy-makers exhaust themselves running from one fire to the next, the process will continue without end. Unfortunately, the desire to "do something, and do it quickly" has probably increased the incidence and intensity of the fires.

This fire fighting approach is understandable politically, but it gets in the way of pursuing policies that are sustainable over the longer run. It is probably inevitable, however, that so long as the objectives of policies vastly outnumber the instruments available to achieve them, economic policy will leap from one fire to another. Along with the major issues of inflation, unemployment and fluctuations in real output, monetary policy is also concerned about the housing sector, small business, farmers, international factors, productivity growth, and other factors. That is a tall order for reserve targets.

The politically acceptable strategy for monetary policy has been to jump from one problem to the next. Reserve targets help to control fires, but in the process probably contribute little to economic stability and growth. To the extent that the limited number of instruments can make a contribution to stability and growth, it seems a pity that they be wasted on attempting to control the monetary aggregates rather than the true objectives of policy.

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Discussion

Peter D. Sternlight*

The dates of this Conference — October 5-7 — just happen to surround the first anniversary of that fateful Saturday in October 1979 when the Federal Reserve announced, along with certain other monetary policy measures, a shift in its approach to open market operations. The new technique, described and critiqued in James Pierce's thoughtful and stimulating paper, "Making Reserve Targets Work," has sought to achieve closer control over the Fed's monetary growth objectives by placing greater emphasis on controlling the volume of reserves to support such growth, and less emphasis on interest rate levels. Pierce identifies a number of issues involved in working with the new reserve target approach — some of which may present significant problems, in my view, while in other cases I believe he exaggerates the significance of the questions raised. In some cases, too, I think he may have misconceptions about the reserve targeting approach that has been applied in the past year.

At the outset of his paper, Pierce provides useful background on how the Fed turned to reserve targeting, in its effort to seek better control of monetary aggregates. He states, and I would agree, that the System theoretically could have used a Federal funds targeting approach in seeking to achieve its desired money growth aims more effectively, but in practice rates were not allowed to vary sharply under that approach, so the approach had significant limitations. It is not that rates were held steady under the Fed's early approach; there could in fact be rather substantial moves (witness 1974) but the changes typically were fairly gradual and market participants usually could count on tomorrow's and next week's rates not being too drastically different from yesterday's and today's rates.

Even if abrupt changes in rates were considered quite acceptable, I believe the Fed might have had considerable difficulty, under its previous approach, in deciding how big a change to aim for at a particular time. If money is growing too fast, should rates be pushed up ½ percent? 1 percent? 2 percent? I doubt if we would have had available a credible rationale for just how much to raise rates and how long to leave them high — credible either to ourselves in the Fed or to the rest of the interested world. A reserve objective related to money growth targets sidesteps that question to some considerable extent because within the broad bands the Federal Open Market Committee (FOMC) has set, interest rate levels tend to fall out as a consequence of pursuing the reserve target.[1]

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[1] To be sure, one might ask what is the rationale for a particular monetary growth objec-

Pierce says he is troubled by the multiplicity of monetary growth targets — M-1A, M-1B, and M-2 — as this makes it difficult to judge how well the program is succeeding. As he notes, the FOMC's objectives are not scalar multiples of one another. True, but they are not unrelated either. If all come out fairly strong or weak relative to the Fed's preferred ranges, a clear conclusion can be drawn. Part of the reason for having what some critics have regarded as fairly wide acceptable ranges of growth is to allow for some variability in the relationships among the different Ms. (Another reason is that even if the Fed specified only one monetary aggregate there would be reason for a fairly broad range to encompass some degree of variability in the relationship between that aggregate and the economy.) While as Pierce notes, the FOMC has not stated explicitly an order of preference in reaching the targets for the different Ms, a close reading of the policy record can at times suggest greater concern with one or another of the family members — for example, by indicating an *expected* short-term growth rate for a particular aggregate in conjunction with achieving objectives for certain other aggregates. As for the choice of M-1A or M-1B, the double designation can perhaps be thought of as a transitional sibling rivalry which makes sense in a period when NOW accounts and other checkable interest bearing accounts are just getting started on a nationwide basis.

Pierce provides a good description of the derivation of a total reserve path — building it up from required reserves against the reservable elements in the FOMC's chosen aggregates, plus other revervable items not in the specified aggregates, plus an allowance for excess reserves. I could not follow his reference, however, to deriving the path to support desired monetary growth as a residual, after meeting reserve needs for components *not* in the FOMC's chosen aggregates; it seems to me the path is built up to include the reserves needed for elements both within and outside the chosen aggregates — although to be sure, there is a sense in which one can say that given the total path and taking also as given the volume of reserves needed to support elements *not* in the chosen aggregates, the balance of reserves in the path is available to support the aggregates.

The next step, derivation of a path for nonborrowed reserves, is not quite as Pierce describes it — i.e., as a staff decision — since the FOMC gives a fairly clear indication of an initial assumed level of discount window borrowing which the staff then subtracts from the total reserve path to get nonborrowed reserves. Typically, the initial borrowing level will be set in close relation to recently prevalent borrowing levels, though allowances could be made for special identifiable factors that may have made recent borrowing unusual in some way. Also, the Committee can impart some initial thrust toward greater accommodation or restraint of monetary growth by setting that initial borrowing level lower or higher.

tive, or set of objectives, but I believe we can feel more secure about the relationships of various money measures to the final economic objectives than would be the case with interest rate relationships. Still, there is enough substance to the question that I think we need to be ever watchful that the chosen aggregate objectives remain appropriate.

The handling of the short-term variability of borrowing has proven to be one of the most difficult aspects of working with reserve targets, but before turning to that practical application, let me comment on how things normally proceed after a path for nonborrowed reserves is derived. As Pierce points out, the Trading Desk has to live in the real world of seasonally unadjusted values for weekly nonborrowed reserves. We also get projections of the *supply* of reserves of nonborrowed reserves, which can be affected by the volume of Federal Reserve float, currency in circulation, Treasury balances at the Fed and some other technical factors. Comparison of the weekly nonborrowed reserve objective with the projected *supply* of nonborrowed reserves is the primary determinant of our day-to-day open market operations. Since the projections are always uncertain, in greater or lesser degree, we also try to draw some confirmatory guidance as to the availability of reserves from the state of the money market — including the federal funds market. That rate is no longer closely managed, though, as Pierce's charts and discussion vividly indicate. Of course, if the funds rate is pressing to the top or bottom of the Committee's broad range — 8 to 14 percent in the most recently published policy record — the Desk would have to give explicit attention to the rate as such. Instances of the latter have been rather few and far between during the past year, though; while there have been some periods of relative stability in the funds rate, this has been primarily happenstance as the forces did not emerge to push the rate off a particular perch for a time.

Given a nonborrowed reserve target based on the Committee's specified growth rates for the aggregates, what happens as we proceed through an intermeeting period? If monetary growth stays on track, then aiming for the nonborrowed path should keep borrowing about steady. If money growth speeds up, the banking system will demand more reserves but by staying with our nonborrowed path the extra reserves would have to come from borrowings and in time that would put pressure on the banking system, through higher rates and administration of the discount window, so that money and credit growth would tend to return to path. Where there is a large and persisting excess of demand for reserves above the reserve path, we have sought to accelerate the adjustment process by deliberately lowering the nonborrowed reserve path, so that a greater rise in borrowing is imposed earlier.

The process works the same way in the other direction, too — slower than desired money growth reduces the need for borrowing and this tends to encourage lower rates and renewed expansion. Again the process can be accelerated by raising the nonborrowed path, thus reducing borrowing even more at an earlier stage. The symmetry isn't perfect because there is a lower limit to borrowing, below which additional nonborrowed reserves would simply add to excess reserves; pushed far enough, additions to excess reserves would soon drive the funds rate down to whatever lower bound the Committee had specified. (Likewise, extended and intensifying pressure for increased borrowing could drive the funds rate up to its upper bound.)

Pierce clearly recognizes the Fed's ability to speed reactions of the banking system by raising or lowering the nonborrowed reserve path, but it was not clear to me whether he took into account that some forces tending to return total reserves to path are set up by merely sticking with the initial path for nonborrowed reserves, as deviations in the demand for reserves cause variations in borrowing.

Pierce asserts that because of lagged reserve accounting (LRA), where this week's required reserves are determined by deposit levels two weeks earlier, the System is really on a free or net borrowed reserve target when the Desk aims for nonborrowed reserves. In the context of a single week's objective, this is right, since free reserves plus required (which is fixed, based on earlier deposits) equals nonborrowed. But this definitional identity should not be confused with the old free reserve targeting of some years ago, when the Desk tended to aim week after week for a particular level of free or net borrowed reserves and then shifted policy from time to time by changing that objective. That approach was quite different from the present reserve targeting. That earlier approach sought to keep the level of borrowing about unchanged from week to week, whereas now that level will change as described earlier, when money growth pushes above or sags below the desired path.

Pierce also makes a number of comments about the present system of lagged reserve accounting, to the effect that under contemporaneous reserve accounting (CRA) reserve targeting would work better and interest rate fluctuations would be reduced. I'm not at all sure of these conclusions. His best comment on the subject, I think is the remark that "It is possible, however, to make too much of lagged reserve accounting." For myself, I can see some theoretical advantages in the return to CRA, in terms of slightly speeding the response to deviations of monetary growth from path. At the same time, it could be more difficult under CRA to sort out the bulges in demand for reserves stemming from technical causes that one wished to accommodate from those that reflected underlying monetary growth and hence should be resisted. It is this inability to separate the transient and more persistent aberrations that makes me question whether the course of rates would indeed run smoother under CRA, or whether the Desk's life would really be easier.

Pierce refers a few times to the "tight" or "heavy" administration of the discount window, noting that this keeps the window from becoming an open-ended source of reserves that could frustrate efforts to approach desired total reserve paths. This is certainly so in a broad long-term sense, although in a shorter run the behavior of borrowing can be a complication for the Desk's day-to-day operations. For example, we might start a week aiming for $40 billion of nonborrowed reserves, in anticipation that borrowing would turn out to be $500 million in order for banks to cover their requirements of, say, $40.3 billion and desired excess of $ .2 billion. Now suppose we learn on Monday morning that in this reserve week, which began on Thursday, banks borrowed heavily over the weekend and already have daily average borrowing of $1.2 billion. Even if borrowing fell to zero for the rest of the week, the weekly average would be about $700 million; quite likely, some banks would stay in the window for the rest of the week so borrowing would most likely turn out above that $700 million level for the week. If the Desk stuck by its nonborrowed reserve objective for the week, we would be over-providing total reserves and probably producing a sharp easing in market conditions that might convey misleading signals to the market. In such circumstances there has been a need for modification of the weekly nonborrowed reserve objectives. In part the extent of modifications might depend on what sort of overt actions might have been needed to achieve the path. Thus we might be more willing to undershoot the nonborrowed objective in the example if it would have taken overt action to attain the objective, while if a no action course left too many reserves out there, there might be a tendency to let that happen, at least up to some point. On the other side, if we run into a period when banks are significantly more reluctant to borrow than we had anticipated, there is a case for some upward modification of nonborrowed reserves — as the alternative could be an exceptional tightening in reserve availability at the end of a statement week that could also be misleading and could set a pattern for subsequent weeks that would be out of kilter with what was desired.

Pierce notes the variability of reserve multipliers as a potential source of difficulty in reaching desired aggregates, and this can indeed be a contributing factor, although as he also mentions, we can make short-term adjustments in the expected multipliers, even within an intermeeting period, to allow for variability of that kind. He goes on to suggest that if we really turned to the task with all available econometric techniques we'd surely be able to do a better job of anticipating the multipliers. While I'm not necessarily against "sophisticated techniques," I have real doubts as to whether it would help all that much. I suspect that the efforts to take closer account of shifting multipliers might just produce greater short-term rate fluctuation while achievement of the desired aggregates in the short run still eluded us.

One of the final points in Pierce's paper is to suggest that the Fed might do better to forget about monetary aggregates and just proceed directly from reserve objectives to "ultimate objectives" of policy — presumably such values as economic activity, or prices. The difficulty I find with this is that at any given time a reserve target implicitly embodies some monetary aggregate or set of aggregates and one might as well acknowledge this. At the same time, Pierce had a good point in that one should not blindly pursue a monetary aggregate objective that may be getting us off the track with respect to some more underlying objective. One must remain aware of the possibility of shifts in the demand function for money in its various forms which could change the significance of particular measured aggregates.

Pierce's closing comments about the multiplicity of targets and the tendency of the Fed to jump from one fire to the next — shuttling from the battle on inflation to the battle against unemployment — left me a little puzzled. I would regard the current effort to achieve reasonably steady, moderate monetary growth as the antithesis of that fire-fighting approach. The FOMC selected a money growth objective designed to be consistent with a gradual winding down of inflation, anticipating at the same time a sluggish economic performance. The Fed stayed with a policy of aiming for moderate monetary growth when such growth bulged early in 1980, and rates rose sharply in consequence; the same annual growth objectives were retained through the spring when actual growth turned negative, in turn producing a sharp decline in rates. And the objectives have been maintained in recent months when monetary growth has rebounded, and this has produced a corresponding climb in rates.

The point is that deviations in growth have brought swift responses in the form of changed market conditions that should tend to work the growth rate back to the desired track. As to whether growth will come out reasonably within range for the year, the jury is still out. Just before mid-year, growth looked too low; continuation for the full year of the growth rate in the first several months would have left the growth rate well short of path on the M-1 measures. Since May, there's been a rebound, quite welcome at first, but more troublesome as it continued strong through the summer. Extension of the growth rate of the last few months through year-end would bring the aggregates out too high, but this has been engendering a response that could result in coming out not too badly against the FOMC's objectives for the year.

Monetary Control: Consensus or Confusion

Raymond E. Lombra*

"There is strong shadow where there is much light."

Johann von Goethe

I. Introduction

The literature on monetary control was one of the few things that grew faster than the money stock during the 1970s. As the decade came to a close, the Federal Reserve, seemingly responding to both developments, announced its intention on October 6, 1979 to improve monetary control over economic activity through a reserves-based (or supply) approach to control the monetary aggregates. Failing to give due weight to an abiding eclecticism on the part of policymakers, and the subtleties, ambiguities, and limitations characterizing the various branches of the monetary control literature, many were tempted to conclude that this action indicated that monetarism had become the conventional wisdom guiding policymaker behavior. The subsequent erratic behavior of the monetary aggregate during 1980 has not surprisingly contributed to a much-needed reexamination of both the monetary control literature and what, if any, relationship exists between this literature and current policymaking.

Over the past 15 years, the literature on monetary control moved in several directions. One major branch of research proceeded by collapsing hundreds of years of monetary research into two equations: one linking the Fed's "instruments"[1] to the monetary aggregates — the so-called "intermediate" targets — and the other linking the monetary aggregates to the vector of key macroeconomic variables (e.g., the rate of inflation and the unemployment rate) comprising the "final" targets or ultimate objectives of policy. Purportedly, these correlation derbies reveal both the optimal operating procedure for controlling the various aggregates and the optimal aggregates to control.[2]

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[1] While open market operations, reserve requirements, and the discount rate are the actual policy instruments, this literature usually uses the term instrument to refer to any variable which could be tightly controlled by the Fed. The alternatives usually investigated are a short-term interest rate, such as the federal funds rate, or a reserve aggregate, such as nonborrowed reserves or the monetary base.

[2] It should be noted that some gave new meaning to the term "reduced-form" by accomplishing this all in one equation.

The resulting emphasis on controllability has perhaps inadvertently obscured the original rationale for intermediate targets. As Brunner and Meltzer (1969) argued, intermediate targets *could* be useful as processors of information in a world characterized by uncertainty about structural relationships and lags in the receipt of data regarding the ultimate objectives of policy. More recently, however, Benjamin Friedman (1977) has argued that using "the" money stock as an invariant intermediate target is in general an inefficient way of exploiting the information contained in near-term observations of the money stock *and* other variables. Deviations of the money stock *and* other variables from values thought to be *consistent* with a particular setting of the policy instruments and an expected outcome for the ultimate objectives of policy provide information on the size and source of real and financial disturbances. If policy is being formed optimally, this information should be used to reset the policy instrument and if necessary derive a new consistent relationship between, say, the money stock and income. This burgeoning literature on filtering and optimal control with feedback, which represents another major branch of theoretical and empirical research on monetary control, implies that a policy steadfastly designed to close the gap between the actual money stock and a money stock target invariant with respect to incoming information is suboptimal.[3]

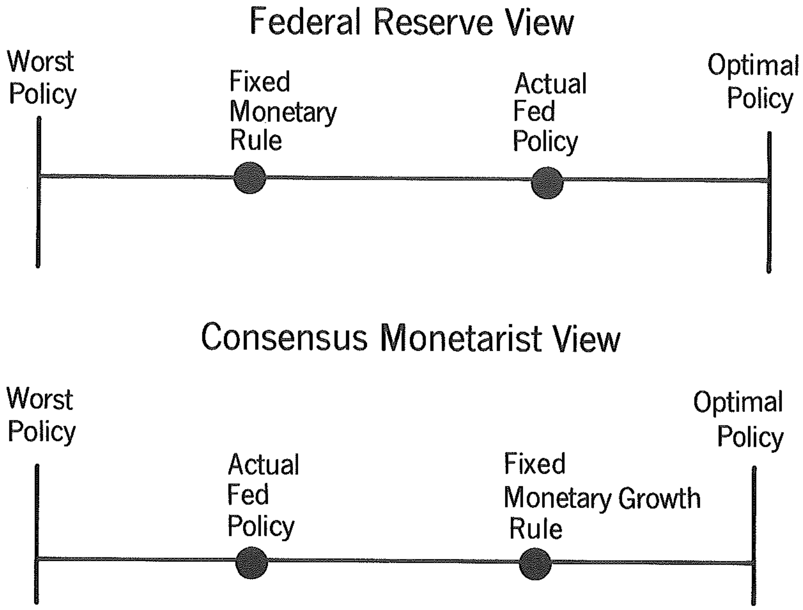
The unenthusiastic reaction to the optimal control approach has been conditioned in part by the considerable knowledge about structural relationships which seems to be required to make the approach operational (Brunner, this volume). Beyond this concern, reactions have also reflected the strongly held views illustrated in Figure I. Milton Friedman, who has long opposed discretionary policy and favored a rule calling for a fixed money stock growth rate, puts it this way:

> Much work has been done inside and outside the System on a highly sophisticated level about the so-called problem of "optimal control." This work is important as well as intellectually fascinating but in my opinion is concerned with effects of a second order of magnitude. The urgent need is to introduce as rapidly as possible the alternative procedure [Friedman's rule] to correct the first order defects of the present procedures. It will then be desirable and possible to proceed at more leisure to refine the procedures along the lines suggested by optimal control theory. We must not in this area as in others let the best be the enemy of the good (1976, p. 563).

Monetary policymakers who obviously favor the eclectic, discretionary policy approach they have been following, have also been unenthusiastic about the optimal control approach, arguing that guiding policy with "flexible" intermediate targets lends quantification and precision to the formulation of policy and facilitates the discussion of, and thus agreement on, particular courses of action (Wallich, 1976; Maisel, 1969, 1973). Milton Friedman's monetary rule is also rejected by the Fed and the "flexibility"

[3] For elaboration, see the papers by Kalchbrenner and Tinsley (1976; 1977), LeRoy (1975), and Palash (1979).

Figure 1 **Spectrum of Views on Monetary Control**



At any point in time there exists a particular policy, given the social welfare function and the true model of the economy, which would be optimal. However, given knowledge deficiencies, it may not be possible to identify this particular policy. The issue then is whether the fixed monetary growth rule favored by many monetarists, or the Fed's approach is closer to the unknowable optimal policy.

built into current procedures through the use of changing target ranges for several monetary aggregates, whose individual importance varies over time, is emphasized (Volcker, 1978). As shown in Figure II, the Fed's approach to policymaking is, in appearance at least, a hybrid of the monetarist and optimal control approaches.

Recognizing that appearances can be deceiving, the dilemmas and disorientation created by such flexibility on the part of the Fed can be summarized succinctly: are the monetary aggregates (individually or collectively) important strategic variables to be controlled or information variables to be used along with other data in setting policy instruments? Distinguishing clearly between these possible roles for the aggregates and the associated scope for policymaker discretion would seem to be crucial for the formulation and implementation of policy. Unfortunately, as the title of this paper suggests, any apparent consensus on monetary control may be more illusory than real.

The appropriate role of the aggregates in the formulation and implementation of policy (a topic covered in some detail in the papers by Modigliani and Papademos, Berkman, and Brunner), is ultimately dependent on a careful analysis of a variety of logically prior issues. The next section examines some of the key conceptual, analytical, and technical issues associated with defining and measuring the money stock (and other monetary aggregates). The third section critically reviews the received literature on money stock determination, including the Federal Reserve's conception of the process, and examines micro and macro aspects of various proposals designed to improve monetary control. The fourth section discusses aspects of the reliability of empirical relationships and several related issues regarding the execution of policy. The final section summarizes the paper and develops the implications of the arguments presented.[4]

II. Measurement: Conceptual, Analytical, and Technical Issues

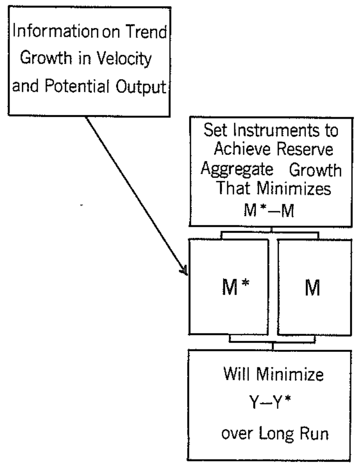
If our theory suggests a particular variable would be a useful intermediate target or information variable, we must be able to measure the analytical construct in order to make our theory operational. Unfortunately, many academic researchers have not paid sufficient attention to the conceptual, analytical, and technical issues involved in defining and measuring the money stock and other monetary aggregates. Many treat definition and measurement as identical issues and as an easily solvable technical problem (apparently best left to the Fed), while others seem to imply that the whole

[4] At the outset it must be emphasized that what follows should not be interpreted as a set of arguments supporting or rejecting any particular role for the aggregates. In general, the analytical and empirical issues examined cut across the various possible roles of the aggregates. I should also note that the literature on monetary control is huge. Given space limitations, full documentation on each issue is obviously impossible. Accordingly, the references should be viewed as illustrative rather than exhaustive.

Figure 2

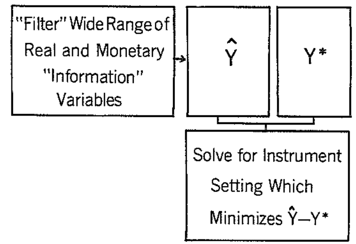
Alternative Policy Approaches

A. Consensus Monetarist Approach - "Rigid" Monetary Aggregates Targeting (No Feed back)



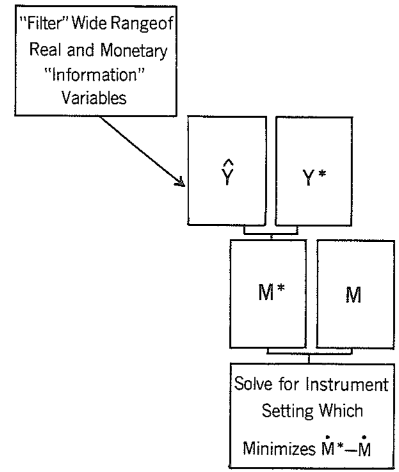
Policymakers should choose a fixed, stable rate of monetary growth (M*) consistent with long-run price stability in light of available information on the likely trend rate of growth in velocity and potential output. Policy instruments (open market operations, reserve requirements and the discount rate) should then be manipulated so as to achieve M*(that is, minimize the difference between M* and the actual rate of monetary growth M). The latter objective is thought to be enhanced by using the instruments to achieve a rate of growth of the monetary base (or other reserve aggregate) consistent with M*. The expected result of the approach is minimal differences between the actual outcomes (Y) for the vector of key macroeconomic variables (e.g., inflation, unemployment and real growth) and the desired outcomes (Y*).

B. Optimal Control Approach - Absence of Monetary Aggregates Targets (Continuous Feedback)



Policymakers should use all relevant information, including recent movements in the monetary aggregates, interest rates, retail sales, prices, industrial production, etc., to produce estimates of the vector of key macroeconomic variables (Ŷ). Given the desired outcomes for these variables (Y*), and the structural relationships linking the policy instruments to the vector Y, the policymaker then solves for the instrument settings which will minimize Ŷ-Y*.

C. Federal Reserve Approach - "Flexible" Monetary Aggregates Targeting - Viewed as Operational Hybrid of A and B (Periodic Feedback)



Use all relevant information to produce Ŷ. Give Y*, select the rate of monetary growth (M*) which minimizes Ŷ-Y*. Given M*, select the instrument setting and operating procedures which minimizes M-M*.

matter is not crucial for their analytical or empirical work — any one of the Ms will do. Both tendencies should be resisted.

Defining and Measuring Money

Definition and measurement are logically distinct processes which have often become conceptually confused in the literature. Many years ago, D.H. Robertson, writing on the appropriate definition of money, argued that "it does not matter very much what meaning we adopt as long as we stick to it" (1964, p. 2). This view, along with the extensive work on the "empirical definition of money," represents a false lead for the profession. As Will Mason has argued, "definitions do make a difference" (1976, p. 530).[5]

Simply put, one's analytical framework and resultant hypotheses and theories — that is, one's monetary theory — is not invariant with respect to the implicit or explicit concept of money underlying the analysis. Obvious examples are general equilibrium theories which, implicitly or explicitly, are based on a store of value ("temporary abode of purchasing power") concept of money, and disequilibrium theories which are primarily based on a means of payment concept of money.[6] Some do recognize the problem; in their survey of money demand studies, Feige and Pearce observe that "implicit in the particular choice of a [money stock] variable are economic specifications concerning the role of prices, population, income, and liquid assets" (1977, p. 443).

It appears that an understandable desire to develop prescriptions directly relevant to the formulation and implementation of policy has contributed to the definition and measurement of money becoming confused with the ongoing debate over the appropriate targets, instruments, and indicators for policy. Thus, Harry Johnson wrote: "unless the demand for money — defined to correspond to some quantity the central bank can influence — can be shown to be a stable function of a few key variables, the quantity of money must be a subordinate and not a strategic element in both the explanation and the control of economic activity" (1966, p. 20).[7]

Johnson's view, which is implicit if not explicit, in much of the literature on monetary control, manifests itself in an emphasis on controllability of the various Ms and the stability of "money demand" functions. Boorman puts it this way: "a demand function for some broader measure of money, one that includes these close substitutes [for currency and demand deposits], would be more stable, i.e., would shift less over time, than a function defined on a narrow money measure. Under these conditions, monetary policy actions that concentrate on the narrower measure of money would be focusing on an

[5] My discussion owes much to a continuing dialogue with Will Mason on these issues over the past decade. See Mason (1976 and 1979) for a fuller statement of his views.

[6] As Clower has pointed out, in timeless general equilibrium models there are no transactions, so money — that is, the medium of exchange — is indistinguishable from all other assets. For his attempt to begin to reformulate such models, see Clower (1977).

[7] See also a similar statement by Boorman (1976, pp. 317-318).

unstable shifting target. Policy actions that focus on broader measures of money would be more appropriate" (1976, p. 319).

Simply put, defining money is related to, but logically separable from, identifying the appropriate or optimal proximate monetary policy target. As Mason has forcibly argued: "An empirical definition of money designed to validate a monetary hypothesis precludes empirical invalidation. Such is the antithesis of scientific procedure. It confuses empirical verification with hypothesization, thus precluding the progression from hypothesis to theory" (1976, p. 532); "Conceptualization and definition must precede hypothesization, and conceptualization must precede definition in order to produce a testable hypothesis capable of empirical verification as a theory" (1976, p. 533).

The circularity involved in defining money, for example, as that collection of liquid assets with a stable demand function, is compounded by the fact that the aggregation of assets or specification of the demand function necessary to achieve statistical stability runs the risk of confounding changes in the supply of money with changes in the demand for money. To illustrate, suppose we adopt an a priori definition of money specifying money as all those things which serve as generally acceptable means of payment. The empirical problem is to first measure the stock of such media and then identify and estimate supply and demand functions for this collection of assets. A popular econometric exercise over the last decade was to fit demand functions for M-1 (so-called narrow money) and M-2 (so-called broad money) and check the stability and dynamic simulation properties of each equation.[8] The demand function explaining the most within-sample variation, exhibiting the least parameter drift, and displaying the smallest root mean square forecasting errors was typically used to decide how money should be defined *and* what particular monetary aggregate (i.e., collection of financial assets) the Fed should seek to control. Not surprisingly, results typically varied with functional form, time period, and estimation procedure. Lacking an adequate conceptual foundation, a clear distinction between factors affecting the supply of or demand for various assets, whether money (means of payment) or near monies (liquid stores of value) was glossed over. For example, time deposits undoubtedly are a good substitute for demand deposits as a store of value although not as a means of payment. As regulations changed over time and financial innovation proceeded, the attractiveness of time deposits relative to demand deposits was altered. By aggregating time and demand deposits (as was formerly the case for M-2), shifts between the two washed out.[9] The implicit assumption was that such shifts, which reflect changes in the demand for near-monies relative to the demand for means of payment, and perhaps supply-side developments as well, were of little analytic significance.

[8] One can predict with great certainty that the Fed's recent "redefinitions" of the aggregates will induce another decade of similar work.

[9] We are ignoring for the time being the reserves released or absorbed by such shifts between classes of deposits.

Even more serious problems can be illustrated. Suppose that as time passes and financial innovation occurs in response to rising interest rates, falling transactions costs, and distortions associated with various regulations (e.g., the prohibition of explicit interest on demand deposits and Regulation Q interest rate ceilings), adaptive behavior on the part of financial institutions and the public expands the stock of those things functioning as media of exchange. At the margin the public will substitute the new components of the stock of circulating media (say, NOW accounts) for the old (say, demand deposits). A central bank pursuing a particular money stock growth target (where the money stock is *not* defined to include the new components) with either a federal funds rate-based (demand) operating procedure or a reserves-based (supply) operating procedure, will observe a decline in monetary growth. The inevitable lag in recognizing what is going on can lead to actions designed to get monetary growth back up to the specified target. Of course, such actions would be most inappropriate given that the stock of money correctly measured was expanding faster than the measure employed. Correctly measuring the stock of money, which is impossible unless the concept of money is specified, would solve the problem. A generally inferior analytic approach to this problem would be to proceed as if "the" demand for money shifted downward (velocity rose). Researchers preferring this route have searched for the set of right-hand side variables which explain the apparent shift. Obviously, *if* the problem is that the left-hand side variable (the money stock) is measured with error because NOW accounts are functioning as means of payment, then shifts in supply are being confused with shifts in demand. In reality, of course, both supply and demand could be shifting over time; in this case both the left-hand and right-hand side variables of money demand and money supply functions need to be reworked (Simpson and Porter, this volume).

Contrary to popular belief all this is not a semantic or tactical issue. Monetary analysis will remain somewhat disoriented if researchers fail to treat the definition and measurement of money as a substantive issue. This does not imply that measuring money — that is, which assets to include and which to exclude — is trivially easy. Classification is important in all sciences. As Otto Solbrig, a noted botanist, has pointed out "grouping like with like is the essence of classification, and without this classification no communication of any sort would be possible, nor would a rational perception of the world" (1970, p. 103). He goes on to stress the ongoing need for *both* empirical and analytical approaches to classification, "if the true biological picture is to be comprehended and the operating evolutionary mechanisms are to be understood" (1970, p. 113).

For economists the message is that defining and measuring money is not a matter of indifference or expediency. The notion that it matters little whether recent experience is treated analytically and empirically as a downward shift in money demand or as an increase in money supply should be rejected. In general, central bank pursuit of monetary targets or use of the money stock as an information variable depends on our ability to distinguish between supply and demand disturbances which are either transitory or permanent. Moreover, the need for such analysis cannot be aggregated away.[10]

Technical Problems Associated with Interpreting Short-Run Variations in the Monetary Aggregates

Even if the conceptual problems discussed above are solved, we are not out of the woods. Many researchers and virtually all critics of the Fed, emphasizing secular and cyclical variations in monetary growth, have often ignored, or downplayed, the Fed's machinations concerning the interpretation and significance of shorter run variations in monetary growth. The Fed, concerned with guiding its day-to-day operations in light of incoming monetary data, has frequently argued that, in effect, the signal-to-noise ratio in weekly and monthly monetary data is quite low. Among other things this implies policy instruments should be adjusted cautiously in response to apparent deviations of monetary growth from expected or targeted levels.

A variety of studies generated within the Federal Reserve System examine various aspects of the problem. The Bach committee (1976) estimated that the month-to-month transitory component of annualized money stock growth rates was quite large; the standard deviation of monthly growth rates due to transitory fluctuations was estimated at 2½ percentage points.[11] In another study, Fry (1976) found that although a variety of alternative seasonal adjustment procedures produced roughly similar trend-cycle movements in the money stock, the various procedures produced annualized monthly growth rates which differed on average by about 7 percentage points! Duncan (1978) analyzed the substantial revisions in preliminary money stock data resulting from revisions of the underlying raw data and the seasonal factors.[12] Taken together the evidence appears overwhelming; as Berkman and Kopcke conclude, "observed rates of change in the money stock, particularly when measured over short-time intervals, may be a very poor indicator of the underlying trend in money growth" (1979, p. 10)

Unfortunately, many of these technical problems associated with filtering and interpreting the data have been unavoidably exacerbated to some unknown degree by the redefinitions of the monetary aggregates, the October 1979 change in operating procedure, and the Depository Institutions Deregu-

[10] Recent work by Barnett (1980) suggests the conventional aggregates (new and old) violate standard postulates of aggregation theory. See U.S. House of Representatives (1980), for a compendium of the profession's views on measuring the monetary aggregates.

[11] The Board staff has since reduced this estimate to around 2 percentage points.

[12] For more on the problems associated with interpreting short-run variations and seasonally adjusting monetary data, see Poole and Lieberman (1972), Kaufman and Lombra (1977), Lawler (1977), and Broaddus and Cook (1977). On the general issue of seasonal adjustment, see Zellner (1978).

lation and Monetary Control Act of 1980. Data on several components of the redefined aggregates have only recently begun to be collected since a number of rapidly growing components have been in existence for only a few years. Obviously, it is unlikely statisticians will be able to pin down the seasonal patterns of these components, and therefore the aggregates, for some years to come. The greater uncertainty concerning the seasonals will be reinforced by the change to a reserves-based operating procedure which, among other things, will probably permit more seasonal fluctuation in interest rates. This in turn should feed back on the seasonal supply of and demand for various components of the aggregates.[13] Finally, provisions of the Monetary Control Act of 1980, (see Board of Governors, June 1980) which alter the types of institutions required to hold reserves, the structure of reserve requirements, and the form in which reserves can be held, can be expected to affect various aspects of the process determining short-run variations in the money stock in ways that, at least initially, will be imperfectly understood by both policymakers and their advisers.

Understandably, the various technical problems associated with measuring and interpreting shorter run variations in monetary data have often dominated discussions by policymakers, both internally and externally. Unfortunately, such concerns also appear to have contributed to policy paralysis at critical junctures.

It is fair to say that the relationship between the definition and measurement problem and the control problem, ignored by some and overemphasized by others, lies at the core of the formulation and implementation of monetary policy. The implications of the above discussion for policymakers and researchers differ somewhat. For policymakers seeking guidance from the profession, they need to recognize that a strong case can be made that the growth of the various monetary aggregates has, in general, been too high and procyclical over the past 10 years regardless of the particular aggregate one chooses. This observation suggests that the economic costs associated with controlling a "suboptimal" monetary aggregate — that is, one lacking an adequate conceptual foundation and suffering from a variety of measurement problems — may be considerably *less* than the costs associated with emphasizing the deficiencies of all the various monetary measures and abrogating monetary control. For researchers, the conceptual issues and measurement problems examined above comprise an important research agenda. Beyond this, reexamining some of the linkages between policy instruments and various monetary variables should go a long way toward helping researchers understand what policymakers do or fail to do and thus contribute to the design of appropriate control strategies.

[13] This so-called policy seasonal is discussed in most of the papers cited in the previous note. A committee of distinguished economists and statisticians, chaired by Geoffrey Moore, was appointed by the Fed in 1978 and charged with reviewing the Fed's seasonal adjustment techniques. The committee's final report is expected to be released in early 1981.

III. Controlling Money: Macro, Micro, and Empirical Issues

Proceeding from the premise that over the longer run inflation is essentially a monetary phenomenon, it is obvious that exercising control over "monetary phenomena" is necessary to control inflation. Since the long run is nothing but a series of short runs, it is logical to begin by assessing what degree of control is feasible or possible over the short run.

The Fed's view over the years has usually been that tighter short-run control over any of the monetary aggregates is probably not possible given the measurement issues discussed above and various stochastic features of our financial system.[14] The Fed has buttressed its position with arguments questioning the desirability of tightening control. Emphasis is usually placed on the size and costs of the interest rate volatility likely to accompany efforts to tighten control (Lombra and Struble, 1979), the minimal effects of short-lived deviations of money growth from target paths on prices and output (Pierce and Thompson, 1972), and the superiority of a "combination policy" which does not necessarily force money to grow along some predetermined path (LeRoy and Lindsey, 1978; LeRoy 1975; B. Friedman 1975, and 1977). In response, many of the Fed's critics have argued that tighter control is possible and that the procyclical variations in monetary growth and the associated economic instability of the 1970s demonstrate such control would be desirable. The problems associated with any attempt to join the argument between the Fed and its critics over the feasibility of achieving tighter control over the aggregates have been vividly demonstrated by the reactions to the considerable variance in money growth and interest rates since October 1979; the Fed points to fiscal policy, instabilities in money demand, and allegedly unpredictable shifts in the relationship between reserve growth and money growth, while the Fed's critics point to the gyrations in reserve growth and conclude the Fed wasn't really trying.

Researchers, recognizing some of the essential unresolved aspects of the control issue, have proceeded by attempting to frame questions in a way that makes them resolvable with the appropriate set of empirical tests. For a variety of reasons discussed below, such tests have not yet proved decisive. The result, I would argue, is that the literature on monetary control has stagnated somewhat in recent years; researchers, who have collectively run all the regressions they can think of, cannot understand why the Fed does not guide policy with their models, while the Fed wonders why researchers persist in framing the problem so naively and incompletely and in overselling the robustness of their results. My own judgment is that the problem is not empirical, but rather a reflection, in part, of a variety of unresolved (or incompletely understood) analytical issues relating to the determination of the money stock.

[14] "Tighter control" should be interpreted to mean making the growth rate of money adhere more closely than in the past to some predetermined target path.

Money Stock Determination[15]

The conceptual approach to money stock determination, as reflected in contemporary textbooks and the financial sectors of econometric models, recognizes the joint influence of the Fed, banks, and the public. In its most basic formulation (which ignores currency, time deposits, nonmember banks, lagged reserve accounting, and other complications), the process can be represented as follows:

(1)	$R = RR + ER$	(1a)	$R = RR + ER = NBR + BR$
(2)	$R = qD + eD$	(2a)	$NBR = RR + FR$
			$NBR = qD + FR$
(3)	$D = \frac{1}{q + e} R$	(3a)	$D = 1/q\,(NBR - FR)$

where R = total reserves
RR = required reserves
ER = excess reserves
q = reserve requirement on demand deposits
e = ratio of excess reserves to demand deposits
D = demand deposits = money stock
NBR = nonborrowed reserves
BR = borrowed reserves
FR = free reserves = ER − BR

Equations (1) – (3), or their more sophisticated counterparts, are usually summarized by the familiar expression:

$$(4) \qquad M = mR$$

where m = the multiplier
R = total reserves or some other reserve aggregate (e.g., the monetary base or nonborrowed reserves)
M = the money stock

Treating R as "exogenous" — which in this context usually means it is under the potential control of the Fed — controlling money then turns on the central bank's ability to estimate m.[16] This multiplier model is usually referred to as a reduced-form approach since money demand and money supply equations are not separately identified and estimated.

[15] The discussion below proceeds in a quite straightforward fashion and I have purposively used the simplest models available. At a minimum, this should help to avoid obscuring or glossing over some of the key issues.

[16] See Johannes and Rasche (1979), the literature cited therein, and various papers in the Federal Reserve Bank of Boston (1969 and 1972).

Within large scale "structural" econometric models, an analogous approach typically employed is to treat an expanded version of equation (3a) as a money supply function. Nonborrowed reserves are again assumed to be determined exogenously and banks' demand for free reserves are hypothesized to depend on various interest rates, loan demand, and other variables (Cooper, 1974; Hendershott and Deleeuw, 1970). The free reserve equation (or excess reserve and borrowed reserve equations taken together) is combined with the money demand equation to yield the equilibrium money stock and market-clearing interest rate.

As is suggested by the simple derivation above, the two approaches proceed from the same analytical foundations and can be viewed as formally equivalent.[17] Unfortunately, this equivalence has often been obscured by the different econometric modeling strategies which have come to be associated with each approach and the tendency to refer to equation (4) as a "supply" function rather than as a reduced-form equilibrium relationship.[18]

The empirical work surrounding the multiplier approach, as represented in equation (4), has typically involved using univariate or multivariate time series methods to estimate the multiplier directly (or its components), or estimation of an equation such as the following:[19]

(5) $M = \alpha_1 + \alpha_2 R + u$
where α_2 = the estimated multiplier.

The results of such work have been widely cited as providing incontrovertible evidence that the multiplier is predictable. Given that the Fed can control R, controlling M is then viewed as a relatively simple task.[20] Johannes and Rasche put it this way: "Our conclusion from the above analysis is that the money stock . . . can be predicted with considerable accuracy over horizons of at least several months using simple time series models . . ." (1979, pp. 323-324).

In general, the empirical applications of the multiplier approach tend to abstract from the short-run dynamics of adjustment by banks and the public and thus leave the role of interest rates implicit rather than explicit. Among

[17] Burger's fully specified multiplier model (1971) is virtually indistinguishable from the financial sector of the popular macro econometric models. Within the general equilibrium models developed by Kaminow (1977), Santomero and Siegel (1979), and Kopecky (1978), the formal expressions for the money stock include the simple multiplier model in the text as a special case.

[18] This latter point is one of the themes developed by Gramley and Chase (1965, p. 1390).

[19] The discussion focuses more on the multiplier models because they have come to dominate the literature and underlie much of the policy advice concerning monetary control. Virtually all of the points raised apply with equal force to larger scale "structural" models.

[20] In contrast, Roberts and Margolis (1976), utilizing a multi-equation monthly model of the financial sector, find that exercising close short-run control over money growth with reserves is extremely difficult.

other things, this implies that "instrument instability"[21] and changes in the multiplier induced by changes in interest rates resulting from variations in reserves are not very important (Rasche, 1972). Furthermore, disaggregation and the introduction of more allocative detail are not viewed as crucial for the overall outcome.[22]

While proponents of the multiplier approach point to the high degree of explanatory power of the relevant equations and the "small" forecasting errors over intervals of several months, skeptics point to the "large" monthly forecasting errors and a host of analytical and empirical problems resulting in part from the parsimonious specification of the process determining the money stock.[23] It is argued that such problems make the whole approach misleading, unreliable, and therefore unusable. As Benjamin Friedman has noted, such reactions by policymakers or their advisers "at times give the impression that the Federal Reserve can precisely control no variable familiar in the discussions of monetary economists" (Friedman, 1977, p. 92).

The control mechanism contained in multiplier-type models implies that deposit expansion in the banking system is *quantity-constrained* through the Fed's control over the *sources* of bank reserves.[24] The Fed, in contrast, adheres to the view that the system is equilibrated through the movement of interest rates which, through their effect on bank revenues and costs, determine banks' desired asset and liability positions.[25] In this view money and reserves are "controlled" by using open market operations to affect interest rates which in turn affect the *uses* of bank reserves. As pointed out above, both views are compatible at an analytical level under fairly general assumptions. At the empirical or operational level, however, the Fed believes that the

[21] Holbrook has stated: "In addition to offsetting the undesired effects of changes in exogenous variables, current policy decisions must offset the current impact of past policy decisions as well" (1972, p. 57). As a result, "under quite reasonable assumptions attempts to offset the cumulative impact of past changes in the policy instrument may require ever greater changes in the future value of the instrument, a situation we will characterize as one of instrument instability" (Holbrook, 1972, p. 57). The variance in interest rates, reserves, and the monetary aggregates over the past year suggests instrument instability may exist at least to some degree.

[22] The relative unimportance of allocative detail has become an important monetarist tenet (Brunner, 1970; Mayer, 1978). Coghlan, defending the use of multiplier models, notes that "often the ratios [multiplier] approach is rejected on the grounds of its lack of realism only to be replaced by . . . the even more unrealistic assumption of a structural model containing only linear behavioral equations" (1977, p. 421). He points out that if m and R are independent, and thus the ratios composing m are not very sensitive to induced changes in interest rates, then the multiplier approach and the more detailed behavioral models will yield virtually identical results.

[23] For example, many would call the forecast errors for the multiplier reported by Johannes and Rasche (1979, pp. 320-323), *expressed at an annual rate*, unacceptably large. The authors, on the other hand, characterize the errors as very small.

[24] Open market operations determine the size of the Fed's portfolio of securities (the major individual source of reserves) and these operations can be used to offset movements in all other sources.

[25] It should be noted that when I speak of "the Fed's view" I have in mind the position which appears, implicitly or explicitly, most frequently in public statements by policymakers and in papers prepared by staff members. Of course, some individual staff members and policymakers do not embrace "the Fed's view."

structure of regulations and the specific operating procedure being employed at the time play a decisive role in determining causal relationships and system dynamics. Since most multiplier models abstract from such details, the usefulness of multiplier models is questioned.[26] The Fed's critics, on the other hand, argue that empirical applications of the multiplier model predict money growth as well or better than available alternatives and that procedures and regulations can be altered to effect a tighter monetary control mechanism which is approximated by various analytical versions of the multiplier model. In general, both sides are correct: given the current structure of regulations and the Fed's operating procedure, the linkages implied by some of the analytical and empirical work surrounding the multiplier approach are misleading, *especially* within the context of short-run monetary control; regulations and procedures can probably be changed to bring the linkages in the system into closer alignment with those implied by the multiplier approach; there is no evidence that the predictive power of the Fed's model(s) of money stock determination exceeds the predictive power of multiplier models.

Proceeding on the basis of the lagged reserve accounting (LRA) scheme in effect as of this writing,[27] and taking account of the Fed's description of the reserves-based approach to monetary control implemented in October 1979 (Board of Governors of the Federal Reserve System, 1980), Figure III summarizes the key linkages in the Fed's conception of the process determining the money stock. Peter Keir, a senior staffer at the Fed, described this process this way:

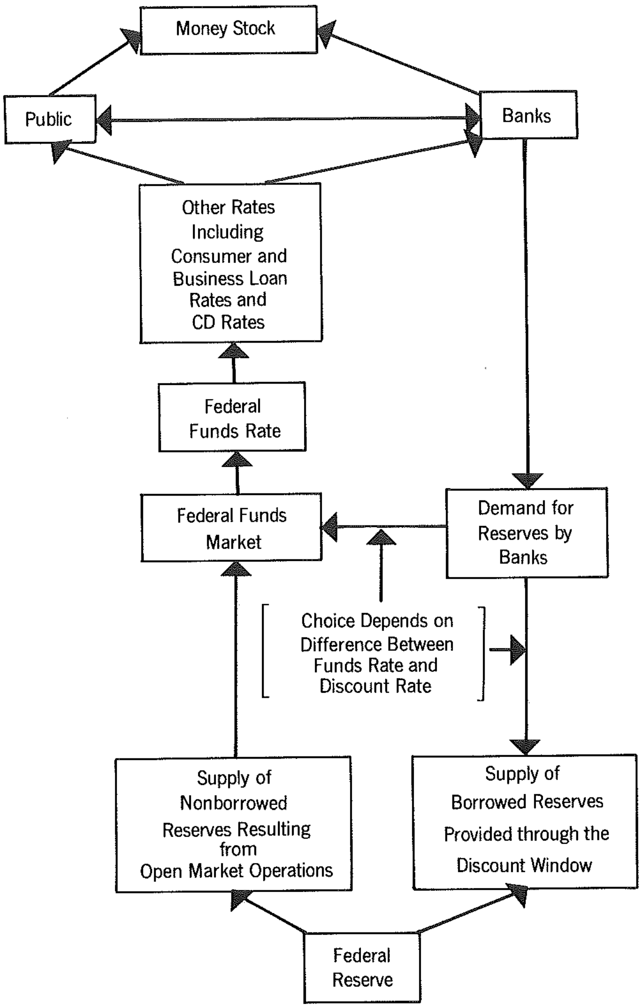
> At any given point, bank demands for reserves depend on the volume of deposits outstanding and the consequent need for required reserves. Under present operating procedures, if the growth in private deposits and associated [reserve demands] appears to be more rapid than desired, the Desk holds back on the provision of nonborrowed reserves. This forces banks to seek out sources of reserves and, on the margin, to turn to the System discount window. In the first instance, except for a slight reduction in bank's

[26] This difference in perspective probably accounts in part for the frequent failure of academicians and policymakers (and their advisers) to communicate. Several years ago at a briefing for academic consultants, a senior adviser at the Federal Reserve Board indicated that the Fed was projecting a particular rate of monetary growth over the coming quarter. In response, Milton Friedman asked why the Fed was not controlling money — that is, picking a money stock target and gearing its operations toward that objective. As discussed above, and elaborated on below, the emphasis on *projecting*, as opposed to *controlling*, money reflects deeper differences concerning the analytical significance of money and the feasibility and desirability of more precise control over money growth.

[27] The LRA system took effect in September 1968. The reserves a member bank is required to hold on average in a given week are determined by multiplying the appropriate reserve requirement by the average level of deposits held by the bank two weeks previously. Thus required reserves are a *lagged* function of deposits. In a June 4, 1980 press release, the Federal Reserve Board indicated that it was considering a return to the pre-September 1968 contemporaneous reserve accounting scheme wherein required reserves are a function of deposits in the current week. This possibility is discussed further below.

Figure 3

The Linkages Between Open Market Operations, Nonborrowed Reserves, and the Money Stock: The Fed's View



The Fed supplies reserves through open market operations (nonborrowed reserves) or the discount window (borrowed reserves); banks demand reserves mainly to satisfy their reserve requirements; banks will acquire needed reserves in either the federal funds market or directly from the Fed through the discount facility depending on the difference between the funds rate and the discount rate; changes in the funds rate will induce changes in other interest rates; changes in these other interest rates will affect the public's willingness to borrow and banks' willingness to lend, and thus the rate of growth of the money stock (and other monetary aggregates).

> excess reserves, the Desk's action does not reduce the flow of [total reserves] it only changes the mix between nonborrowed and borrowed reserves. However, if the constraint [on nonborrowed reserves] persists, increased member bank borrowing is partly offset by smaller increases — or reductions — in nonborrowed reserves, and as banks seek alternative sources of funds, they bid up money market rates. In time, higher interest rates encourage the public to economize on deposits; and growth in the monetary aggregates slows down.
>
> The sequence of relationships in this process is clear. The Desk holds back on the provision of nonborrowed reserves, forcing banks into debt at the discount window. This raises money market rates. Higher interest rates lead the public to economize on deposits, and demands [for reserves] are then lowered. In the last analysis, while the reserve tightening process starts with the Desk holding back on the provision of nonborrowed reserves, the actual attainment of slower growth in total [reserves] and the aggregates reflects a lagged response [of money demand] to higher interest rates. (Federal Open Market Committee, August 1972, p. 31).[28]

Formally, the linkages between reserves, interest rates, and the money stock, within a weekly time frame, can be captured in the following equations:[29]

$$(6)\quad R_t^d = \alpha_0 + \alpha_1 i_t + \alpha_2 M_{t-2} + u_t$$
$$\alpha_1 < 0, \alpha_2 > 0$$

$$(7)\quad NBR_t^d = R_t^d - BR_t^d$$

$$(8)\quad BR_t^d = \gamma_0 + \gamma_1 (i_t - i_{FR}) + w_t$$
$$\gamma_1 > 0$$

$$(9)\quad NBR_t^s = \overline{NBR}$$

$$(10)\quad M_t^d = \beta_0 + \beta_1 i_t + \beta_2 Z_t + v_t$$
$$\beta_1 < 0, \ \beta_2 > 0$$

[28] There is no evidence that the Fed's view, as articulated by Keir, has changed in any fundamental way since 1972. In his review of Fed actions during 1979, Lang (a staff economist at the Federal Reserve Bank of St. Louis) puts the October 1979 change in operating procedure into clear perspective: "Thus the overall framework for analyzing the effects of open market operations on reserve and money growth — that open market operations change interest rates, which affect the demand for money, thereby influencing the demand for bank reserves used to support money — has not changed. What has changed under the new operating procedures is the FOMC's emphasis on restricting interest rate fluctuations and consequently, the Desk's ability to respond to deviations of money growth from its desired path" (1980, p. 15).

[29] This type of model appeared implicitly or explicitly in nearly all internal memoranda dealing with various aspects of monetary control during my tenure at the Federal Reserve Board (1971-77). It also is the conceptual framework contained in an important paper by LeRoy (1979), a former member of the Board's staff.

where R_t^d = banks' demand for total reserves (during week t)
i_t = "the" interest rate
M_{t-2} = the money stock 2 weeks ago
NBR_t^d = banks' demand for nonborrowed reserves
BR_t^d = banks' demand for borrowed reserves (from the Fed's discount facility)
i_{FR} = the Federal Reserve discount rate
NBR_t^s = the supply of nonborrowed reserves (provided through open market operations)
Z_t = an exogenous shift variable
$\alpha_0, \beta_0, \gamma_0$ = constant terms
u_t, v_t, w_t = independent, normal error terms with zero means

Equation (6) is a demand function for reserves. It reflects banks' demand for required reserves, which is a function of the money stock lagged two weeks, and banks' demand for excess reserves which is a function of the interest rate (and perhaps other variables impounded in the constant term). Equation (7) is an identity; banks' demand for nonborrowed reserves, which reveals itself in the federal funds market, is equal to the demand for total reserves minus banks' demand for borrowed reserves. As shown in equation (8), the latter is determined by the difference between the market interest rate and the discount rate set by the Federal Reserve. In any particular week the discount rate and the supply of nonborrowed reserves (equation [9]) are assumed to be fixed exogenously by the Fed. Equation (10) is a money demand function.

Given the discount rate and the supply of nonborrowed reserves, equations (6)–(10) will yield an equilibrium interest rate and quantity of money. Within the model it is clear that there is no simple, direct link between the supply of nonborrowed reserves and the money stock — the dynamics work through borrowed reserves and interest rates.[30] Porter, Lindsey and Laufenberg of the Fed staff put it this way:

> Lagged required reserve accounting destroys the direct link between contemporaneous injections of reserves and the monetary aggregates. Under lagged accounting the weekly stock of demand deposits is not determined by the simultaneous interaction of a supply of deposits function and the demand for deposits function. Rather the short term rate, say, the commercial paper rate, is determined by the interaction of nonborrowed reserve injections and the banks' demand for nonborrowed reserves — which depends not on current deposits, but on deposits two weeks previously. The current stock of demand deposits, in turn, is determined by this rate interacting with the demand function for demand deposits. . . . Another way of putting this result is to say that under lagged reserve accounting the textbook supply of demand deposits [money] function does not exist: there is no

[30] The model can also be used to show that borrowed reserves and interest rates are essential for the equilibrium solution regardless of the system of reserve accounting in effect. This can be seen by replacing M_{t-2} with M_t in equation (6) — reflecting a CRA world — and resolving the model for M and i.

> independent avenue for reserve injections to affect the equilibrium level of deposits in the same week other than by operating through interest rates and deposit demand. Marshall's scissors has lost one of its blades (1975, p. 4).

The clear implication according to the authors is that "no relation . . . exists . . . to relate the current week's demand deposits, nonborrowed reserves, and interest rates that is not dependent on the demand deposit demand function" (1975, p. 40).

Given these analytical foundations (and even if we ignore the Fed's operating procedure for the moment), it is clear that empirical work proceeding in the tradition of equations (4) or (5) suffers from a serious misspecification or the relevant linkages.[31] All this *does not* imply that multiplier models are worthless or that it is impossible to control monetary growth with reserves in a LRA world. However, it *does* imply that empirical work which abstracts from the role of interest rates and various regulations (and the apparent instability of money demand examined by Porter and Simpson, this volume) is likely to be less reliable than work which does not.

Unfortunately, moving from a weekly time frame to the monthly or quarterly time frame used in most empirical work compounds rather than solves the basic problem. In this context, aggregation over time obscures the underlying process and thus confounds cause and effect.[32] Furthermore, once the weekly time frame is abandoned, treating the Fed's instrument — in the present case, nonborrowed reserves — as exogenous is most inappropriate.

As is clear in the Fed's description of its procedures (1980), the week-to-week setting of nonborrowed reserves is a function of the current and lagged disturbance terms in equations (6), (8), and (10), interest rates, member bank borrowing, and the desired rate of monetary growth, which itself varies month to month and quarter to quarter. Thus in the post-October 1979 period, a reserve-setting equation — the Fed's reaction function — is needed to close the model contained in equations (6)–(10) if the system is to be estimated properly over a monthly or quarterly time frame. Similarly, if one were dealing with the period when the Fed first began to give weight to monetary growth in the formulation and implementation of policy and used a federal funds rate-based (demand) approach to monetary control (early 1970 through September 1979), a funds rate-setting equation would be needed to close the model. As Geweke has argued:

> If the specification is incorrect the otherwise identifying restrictions imposed on structural equations may not be sufficient to identify those equations, estimation procedures will be inconsistent and the model cannot adequately portray the dynamics of the system it seeks to describe. It is

[31] David Pierce (1976) develops this theme in some detail.

[32] Black (1973) examines the effect of aggregation over time on money demand functions.

therefore desirable to test the exogeneity specification rather than let it remain a mere assertion (1978, p.1).[33]

The tendency to ignore the endogeneity of the Fed's instrument compounds the estimation problem generated by ignoring LRA. In fact, since there is persuasive evidence that over the postwar period the Fed has leaned with rather than against the wind, reserves are more properly viewed as a result of rather than cause of changes in the money stock.[34]

When all the above estimation problems are combined with the effect that changes in Fed procedures and regulations have probably had on the optimal decision rules of banks, other financial intermediaries, and the public at large, and thus on the "structural" parameters of financial models,[35] the limitations of received empirical work would seem considerable. Feige and McGee summarize the problem this way:

> Our results show that there is no exogenous variable in the trivariate [money stock, reserves, interest rate] money market model. Second, the behavior of the central bank and in particular its operating procedures are likely to have an impact, not only on the variables it controls but also on the structure of the economy as a whole. Finally, the demonstrated dynamic nature of the money market and the observed lags in adjustment suggest that policy recommendations based on simple comparative static models are likely to be misguided (1979, p. 397).

Proposals Designed to Improve Monetary Control[36]

Despite the limitations of much of the empirical work, economists have devoted considerable attention over the past decade to various possible reforms which could strengthen central bank control over one or more of the popular monetary aggregates.[37] It would appear that much of this work had little initial effect on policymakers or their advisers because it ignored the so-

[33] Fair (1978), has recently shown (as have others before him, including this author) that endogenizing policymaker behavior in a macro econometric model has a dramatic effect on the resulting estimates.

[34] See Feige and McGee (1977) and Mason (1977) and the references cited therein. At least one researcher at the Federal Reserve Bank of St. Louis has recently come around to this view: "In essence the Federal Reserve has tended to supply reserves to accommodate the growth of bank credit, instead of pursuing an independent monetary policy" (Gilbert, 1980, p. 17). One can only wonder if the implications of this observation for the "St. Louis Model" will be fully appreciated. See also the recent paper by Stein (1980).

[35] In this context Lombra and Kaufman (1980) examine the implications of Lucas's argument (1976) for money supply and money demand functions. Among other things, they find that conventional "money supply" functions flunk tests for structural stability. See also Brown (1972) and Coats (1972; 1976), for discussions of how the 1968 changes in Regulation D affected bank behavior and the money supply process.

[36] At the outset it should be noted that much of the literature on this topic was motivated by the important paper by Poole and Lieberman (1972).

[37] Some proposals tighten control over one aggregate and loosen control over other aggregates.

called "membership problem" and was predicated on a reserves-based approach to monetary control and contemporaneous reserve accounting (CRA) — an environment which did not exist during the 1970s, but may well come into being during the 1980s.[38] Noting these and other limitations, policymakers showed little enthusiasm for various proposals they thought would have minimal effects on monetary control. Although the papers by Pierce and Brunner cover some of these issues in more detail, some aspects of the literature and various reform proposals should be highlighted.

Following the very useful paper by Pierce and Thomson (1972) delivered at the last Federal Reserve Bank of Boston conference on controlling monetary aggregates, much was written on the choice of the optimal instrument — the federal funds rate or some reserve aggregate such as the monetary base or nonborrowed reserves — for controlling money (or the monetary aggregates). When the dust had settled at the end of the decade the Fed had apparently junked the funds rate and adopted a reserves instrument.[39]

Contemporaneous Reserve Accounting

Not surprisingly, the Fed's shift in operating procedure has been accompanied by widespread support for a return to CRA. As Poole had argued earlier: "The current system of lagged reserve requirements quite literally minimizes the accuracy of short-run control of the money stock" (1976, p. 138).[40] Careful work by Laufenberg (1976) and LeRoy (1979) has shown that the variation of the money stock (and interest rates) introduced by supply or demand disturbances is unambiguously greater under LRA than under CRA.[41]

The Fed's reaction to this work, which is contained in a series of letters and memos Chairmen Burns, Miller, and Volcker have exchanged with Henry Reuss, Chairman of the House Banking Committee, has passed through several phases. Initially, the Fed argued that as long as a funds rate operating procedure was employed, a change to CRA was of little help in improving monetary control. This along with the fact that banks overwhelmingly favored LRA — the argument being that it lowers the costs of reserve

[38] Long and variable lags are not uncommon in monetary economics.

[39] I say apparently because the extent and significance of the change is not yet entirely clear. See Lombra and Torto (1975) for a description of the formulation and implementation of policy under the old approach and a discussion of the supply and demand approaches to monetary control.

[40] See also Coats's careful analysis (1972; 1976). Most researchers recognized that under the funds rate-based, demand approach to monetary control, previously employed by the Fed, CRA vs. LRA was not a critical issue, since the money demand function is independent of the system of reserve accounting.

[41] Since current disturbances have no effect on current required reserves, movements in both interest rates and the money stock are not moderated by the absorption or release of reserves which would accompany disturbances under CRA. Among other things, it might be noted that this implies a given open market operation has a larger initial effect on interest rates and deposits under LRA than CRA.

management — was the rationale for maintaining the often attractive status quo.[42]

Immediately after the October 1979 shift in operating procedure the Fed was forced to alter its position somewhat. In an October 18, 1979 letter to Congressman Reuss, Chairman Volcker said a change to CRA would be resisted by small and medium-sized banks and thus would probably exacerbate the membership problem. At the same time he stated: "I am not convinced that the existing two-week lag between deposits and required reserves is an important complication in achieving reserve and monetary targets over a period of three to six months or so."

With the membership problem taken care of by the Monetary Control Act of 1980, the major outstanding issue is still the significance of a change to a CRA scheme.[43] I do not believe economists have much more to say on this issue. It seems clear from a large body of research (summarized most recently by Gilbert, 1980) that a switch to CRA, given current operating procedures, would improve monetary control somewhat. (The existing bands limiting the fluctuations in the federal funds rate also limit the improvement associated with the switch to CRA.) My own judgment, however, is that the possible degree of improvement is understated by comparing the variance of the money stock (and interest rates) before and after LRA was introduced in 1968. This, along with "reduced-form" regressions of money on reserves, has been the empirical evidence presented by the Fed to support its position that over three to six month periods CRA would have negligible effects on the Fed's ability to control the money stock and other aggregates (Board of Governors of the Federal Reserve System, 1977). The Fed's approach to policy (i.e., its decision rule) and the financial system have changed considerably since 1968. Among other things, the money stock was not viewed as an important variable to be monitored or controlled; the structure of reserve requirements was less complicated; the role of nonmember banks, foreign institutions, and other financial intermediaries in the money and credit creation process was much less important; liability management was not yet a central feature of bank behavior; and the System managed reserve requirements and the discount rate somewhat differently than in the 1970s. Taken together, these considerations would seem to vitiate the type of evidence used to support the Fed's position; everything else besides the reserve accounting system is not equal in the CRA and LRA periods.[44] I should add, however,

[42] See the discussion in Board of Governors of the Federal Reserve System, (1977).

[43] There is also a question concerning the advisability of changing to CRA at the same time that the new system of reserve requirements called for under the Monetary Control Act of 1980 is being phased in. A certain amount of confusion and resulting reporting errors are probably unavoidable. One can argue it is best to get the changes and transition period over with as soon as possible or one can argue it is best to spread the changes out to ease the transition. The problem with the latter approach is that it may lengthen the time it takes to pin down reliable empirical relationships (such as estimates of the multiplier) which are important in the control process.

[44] In its latest consideration of the issue (August 1980), the Board decided to study the problem further! In an August 15, 1980 press release the following appears: "The Board is disposed

that it is extremely unlikely that the *major* control problems of the past or the future lie in the particular system of reserve accounting in effect.[45]

The Setting of Reserve Requirements

The literature on the "optimal" structure of reserve requirements grew against the background of an existing set of differential reserve requirements (and other regulations) which became ever more complicated during the 1970s. George Kaufman summarized the problem this way:

> By increasing the complexity of the money multiplier, proliferating rate ceilings on various types of deposits and encouraging banks, albeit unintentionally, to search out nondeposit sources of funds, the Federal Reserve has increased its own difficulty in controlling the stock of money. . . . To the extent the increased difficulty supports the long voiced contention of some Federal Reserve officials that they are unable to control the stock of money even if they so wished, the actions truly represented a self-fulfilling prophecy (1972, p. 57).

For the most part the literature has concerned itself with how to set reserve requirements so as to minimize the variance of deposits in response to various disturbances.[46] As one would expect, the literature has gradually matured as the assumptions and restrictions present in earlier work have been relaxed. Kopecky (1978, 1979), and Froyen and Kopecky (1979) have recently shown that the optimal structure of reserve requirements is not invariant with respect to the Fed's operating procedure.[47] These general equilibrium approaches, including the insightful papers by Kaminow (1977)) and Santomero and Siegal (1979), which build on earlier partial equilibrium studies, have demonstrated the importance of preserving the adding-up constraints and cross-equation restrictions emphasized by Brainard and Tobin (1968).

Froyen and Kopecky (1979), and Benavie and Froyen (1979), have also shown that it is essential to take account of the own rate on deposits in

toward returning to contemporaneous reserve accounting, possibly by September 1, 1981 if further investigation indicates that such a system is operationally practical." CRA was obviously operationally practical before September 1968; why it may not be now is a puzzle.

[45] Recent empirical work by Cacy, Higgins and Sellon (1980) led them to conclude that "the differences in the degree of monetary control are so small that it is unlikely that a change in reserve accounting procedures would substantially affect monetary control *under almost any reasonable assumptions about how open market operations are conducted*" (p. 12, emphasis added). See Poole (1976), Judd (1977), and Laurent (1979) for alternatives to the current LRA system and the old CRA system. Judd and Scadding (1980) analyze these various reserve accounting proposals in some detail.

[46] See, for example, Laufenberg (1979), and Sherman, Sprenkle and Stanhouse (1979).

[47] Kopecky (1978; 1979) argues that reserve requirements on demand deposits should be set at their upper limit under a reserves-based operating procedure. Interestingly enough, the Fed is in the process of *lowering* reserve requirements for many institutions in connection with the Monetary Control Act of 1980.

designing reserve requirement schemes.[48] Fixed, perfectly flexible (competitive), and slowly adjusting deposit rate regimes affect the short- and long-run properties of any reserve requirement structure. The tendency to *assume* the own rate is either fixed or equal to the competitive rate finesses rather than solves the problem and ignores empirical evidence to the contrary. Startz has carefully examined the yield on demand deposits and summarizes his important results this way: "The rate of implicit interest appears to be well below the competitive rate on deposits. It is also well above zero and is responsive to changes in market interest rates. I estimate that the implicit deposit rate has been historically approximately one-third to one-half of the competitive rate" (1979, p. 515).

The tendency to, in effect, ignore the own rate on deposits and its implications for the process of money stock determination, is symptomatic of a more general tendency to ignore the factors determining the rates set on all types of deposits by banks and other financial intermediaries and the associated effects on short- and long-term aspects of monetary control. Thus, a major remaining void in the literature, in my judgment, is the absence of adequate dynamic microfoundations for monetary control. For example, it is common practice to assume that reserve requirements are binding, regardless of the level and structure of interest rates, the services provided by the Fed, and the composition and variances of deposit flows. Micro analysis would suggest that banks' desired level and composition of reserve balances are a function of the above factors. As Kane argues, "Reserve requirements in excess of the ratios that a bank would prudentially establish for itself may be interpreted as a confiscatory 100-percent tax on the income the bank would otherwise earn on the funds it earmarks to meet the 'excess requirements' " (1980, p. 2). Kane, and Kanatas and Greenbaum (1979), develop the implications of this proposition for monetary control. They argue that although reserve requirements can serve as a tax device and monetary control device in the short run, over the longer run they serve as neither because of the financial innovation they induce. More specifically, the incentive to shift or avoid the tax encourages the development of substitutes for "high" reserve requirement liabilities by banks, nonbank financial intermediaries, and foreign institutions. *This innovation in turn makes the monetary aggregates relevant for policymaking harder to measure and control.* As Kanatas and Greenbaum point out, "under plausible behavioral assumptions reserve requirements will increase the variance of monetary aggregates and thereby complicate the implementation of monetary policy" (1979, p. 2). The result is that the call for universal or uniform reserve requirements and the various proposals discussed above designed to tighten monetary control are "premised on ignoring the fact that reserve requirements induce the creation of deposit substitutes. When this innovation effect of reserve requirements is

[48] See also Klein (1978) and Saving (1979); Saving notes that "neglecting the market determination of deposit rates does significantly affect the results of a market determined supply process" (p. 22).

taken into account, the presumption that the predictability of monetary aggregates increases with reserve requirements vanishes" (Greenbaum, 1979, p. 2).

The above illustration is just one example of the process of regulation-induced financial innovation, discussed in detail by Kane (1977), which affects both money demand and money supply. Unfortunately, this merging of micro and macro, and static and dynamic analysis is almost totally absent from the literature.[49] Simply put, the longer run, often unintended effects of various regulations on the competitive relationships among various types of financial institutions and thus on demanders and suppliers of money and near-monies cannot be ignored.[50]

The Monetary Control Act of 1980 sets the broad parameters within which policymakers will probably have to operate in the 1980s. Macro models which treat the evolving structure of reserve requirements (and other regulations) as instruments which directly constrain the aggregate volume of deposits and bank credit are likely to be less helpful than those which build on micro models (Baltensperger, 1980) and focus on the costs of deposits, the net return on assets, and the competitive relationships among various types of financial institutions (domestic and foreign).

Reforming the Discount Mechanism

As is clear from the discussion of the process determining the money stock, presented above, the setting of the discount rate, the administration of the discount facility, and the resulting volume of member-bank borrowing, play an important role in linking Fed actions to bank behavior and variations in money and credit. The desire to tighten these linkages has given rise to a variety of proposals designed to alter the Fed's management of the discount rate and other aspects of the discount mechanism. For example, some economists have argued that the discount mechanism provides an escape hatch for banks, at least in the short run, from the effects of a restrictive monetary policy. If the Fed uses open market operations to reduce the volume of reserves in the banking system, banks can borrow additional reserves at the discount window and thus, at least temporarily, offset the Fed's actions. The notion that the Fed can or should quantity-constrain the banking system leads these economists to recommend reforms which would minimize the potential offsets. Although the Fed has considered some of these reforms from time to time, it has traditionally emphasized the desirability of preserving the "flexibility" provided by current practices while downplaying the slippages.

[49] A notable exception is the conference paper by Porter and Simpson which develops the linkages between financial innovation and money demand.

[50] For a fuller development of some of the micro aspects of the problem, see Boyd and Kwast (1979). Some have suggested that the Fed pay interest on reserve balances as an alternative to reserve requirements. See Kanatas and Greenbaum (1979), Santomero and Siegel (1979), and Lindsey (1977) for discussions and analyses of this proposal.

Currently, the Federal Reserve Board sets the discount rate administratively and promulgates regulations regarding the size, frequency, and permissible reasons for borrowing.[51] By far the most often suggested reform is to make the discount rate a penalty rate by tying it to and setting it above the federal funds rate or some other short-term rate. The major problem with a proposal to make the discount rate a penalty rate over the *current* funds rate, which eliminates the incentive to borrow from the Fed, is easily illustrated. Under LRA, banks' demand for reserves, which is dominated by the need for banks to meet their reserve requirements, is essentially interest inelastic.[52] If the Fed's supply of nonborrowed reserves is exogenous and thus perfectly interest inelastic, and less than banks' demand for reserves, then these conditions and the penalty-rate proposal make the federal funds rate indeterminate; LRA prevents banks from adjusting required reserves by adjusting liabilities, there is no incentive to borrow from the Fed, and excess reserves are negative in the aggregate. A central bank concerned (often excessively) with the variance of interest rates, is understandably not attracted to such a proposal.[53] Of course, one could tie the discount rate to last week's funds rate or Treasury bill rate. This would eliminate the indeterminacy and reduce, but not eliminate, the slippages associated with current arrangements.

With the Monetary Control Act of 1980 providing access to the discount window for *all* financial institutions required to hold reserves, the potential volume of borrowing and attendant problems for monetary control are greatly enlarged. Giving some weight to the Fed's attachment to several characteristics of the present regime, desirable attributes of any reforms are to make the volume of borrowing more predictable, thus facilitating the selection of appropriate target paths for nonborrowed reserves, and to speed up rather than slow down the public's portfolio adjustments to policy-induced alterations in financial conditions. Toward these ends, serious consideration should be given to the penalty rate proposal discussed above, as well as a program that would in effect control the elasticity of the supply of borrowed reserves to banks. A (rapidly) rising marginal cost of borrowing from the Fed, with the elasticity tied to size, frequency, or current policy objectives,

[51] See Lombra and Torto (1977) for a critical examination of the Fed's setting of the discount rate and the notion that changes in the rate generate "announcement effects."

[52] I say essentially rather than completely because it is possible banks' demand for excess reserves is somewhat interest elastic or that banks' willingness to carry over reserve surpluses or deficiencies is sensitive to the current or expected federal funds rate. Current regulations enable banks to carry over surpluses or deficiencies of up to 2 percent of their required reserves. I am not aware of any empirical evidence which suggests the resulting interest elasticity is other than negligible.

[53] If CRA were adopted, the direct link between an interest-elastic demand for money and a contemporaneous derived demand for reserves would remove the indeterminacy. However, since the short-run elasticity would in all likelihood remain small, the short-run variation in the federal funds rate induced by supply or demand disturbances could still be quite large. Nonetheless, the alteration of the basic result does illustrate the interdependence among the various proposals. See Sellon (1980) for a useful analysis of the role of the discount rate under alternative operating procedures.

could well serve to complement rather than offset other policy actions.[54] Much would depend on the technical details of the program and the effect it would have on other key behavioral parameters.

It seems likely that a variety of possible reforms, some of which have been discussed above, could tighten control over the monetary aggregates if policymakers embraced the intermediate target approach. It is also possible these same reforms could make it easier to interpret movements in the monetary aggregates if policymakers used the aggregates as information variables rather than intermediate targets. Furthermore, although the effect of any one reform might be rather small, the cumulative effect of a package of reforms of existing techniques and regulations could ultimately be significant.[55] Nonetheless, any resulting improvements in monetary control and policymaker performance would in the final analysis depend on the reliability of various empirical relationships linking policy instruments to financial and real variables, interdependencies among the various reforms, and the willingness of policymakers to modify several aspects of the policymaking process.

IV. The Reliability of Empirical Relationships and the Execution of Policy

Over the past 20 years an ever growing and somewhat bewildering empirical literature has examined the relationship between various variables under the potential or actual control of policymakers and various measures of economic activity. It is fair to say that the results and forecasts generated by both "reduced-form" and "structural" models indicate that the short-run relationships are not as tight and reliable as much of the policy advice purportedly based on some of this research would have one believe. At the same time, however, the evidence suggests that these relationships are not as loose and unreliable over the intermediate run as policymakers seem to believe. Furthermore, despite the myriad of estimation problems generated by the issues discussed in the previous sections, and addressed in the papers by Porter and Simpson, and Berkman,[56] which leave the power of many tests conducted in this context in serious doubt, one still has to grant the basic validity of the important point made by Poole (and other monetarists): the problem with monetary policy over the 1970–79 period "was not that money growth fluctuated quarter to quarter, but that its average rate was too high

[54] I understand Perry Quick of the Federal Reserve Board staff has developed a proposal along these lines.

[55] I hasten to add, however, that ongoing empirical work is unlikely to provide decisive evidence regarding the payoffs associated with such reforms. Any change in current regulatory arrangements will alter structural relationships and therefore estimated parameters in econometric models (Lucas, 1976). In addition, interdependencies between the reforms and other elements of the money supply process must not be ignored. For example, changing to CRA or reforming the discount window, could affect banks' demand for excess reserves. Unfortunately, economists often tend to take the *ceteris paribus* assumption too seriously.

[56] The list of problems should also include the inadequate treatment of expectations (Poole, 1976; Willes, 1980) and international financial relationships.

and the fluctuations around that average were procyclical" (1979, p. 475).

It is axiomatic that control of, or interpretation of, movements in monetary and real variables depends on the reliability and thus stability of various empirical relationships, the ability of policymakers and their advisers to identify these relationships, and the willingness of policymakers to guide policy in light of forecasts and analyses based on these relationships. No one believes that U.S. monetary policymakers gathered each month over the past 10–15 years and consciously tried to: (1) raise the trend rates of monetary growth and inflation; and (2) pursue procyclical policies. Since both happened it is important to distinguish between "failures" of economics and "failures" of policymaking as sources of such undesirable outcomes.

In a recent study of the analytical foundations and forecasts guiding the formulation and implementation of policy, Lombra and Moran (1980) found that the nonfinancial forecasts produced by the Fed's staff were about as good as others produced in the private sector. However, the errors were large over a two to four quarter horizon, deteriorated over the 1970–74 period, and were biased in the sense that real GNP tended to be overestimated, while inflation was underestimated. It was argued that the latter problems resulted in part from the staff's short forecasting horizon, which in turn was a function of policymakers' planning horizon, and the failure to adequately assess the longer run cumulative effects of past policy actions.

On the financial side, short-run money stock projection errors were also found to be quite large. The interpretation of the errors and their significance for future policy, as rendered by both the staff and policymakers, revealed a "flexible" analytical foundation for policymaking which appeared to frustrate communication among the parties involved and led to inconsistencies and circularities in the policy process. Unfortunately, the resulting disorientation, along with the large financial and nonfinancial projection errors, imparted a short-run bias to policy discussions and thus a focus on current, rather than projected, economic and financial conditions in selecting among policy alternatives. It also contributed to an emphasis on the real output effects of various policy actions which dominate over the short run, rather than the price effects which dominate over the longer run. Taken together these several aspects of the policymaking process contributed to procyclical movements in the money stock and economic instability.

Most students of monetary theory and policy agree that there are a variety of slippages in the linkages comprising the monetary control mechanism and that these slippages can be significant over the short-run horizon which has traditionally characterized policy deliberations and decisions. However, there is a large body of evidence which suggests that many of these apparent slippages dissipate over longer time horizons and may be avoidable if various regulations and procedures are altered. Nonetheless, one can easily overemphasize the importance of various existing and proposed regulations and procedures in contributing to past policy errors and future policy successes. *The secular rise in inflation and accompanying secular decline in* *monetary discipline cannot reasonably be attributed to technical aspects of policymaking.* Such proximate causes of monetary control problems are not independent of the constraints (actual or perceived) generated by the political and economic environment within which policymakers operate.[57]

IV Summary and Conclusions

The literature on monetary control has moved in several productive directions since the Federal Reserve Bank of Boston convened the 1972 conference on this topic. To help facilitate the continued development of the literature, this paper has addressed a variety of issues which are central to an analysis of the monetary aggregates and monetary control.

1. The definition and measurement of money (and near-monies) are logically distinct processes which have become conceptually confused in the ongoing debate over the appropriate targets, instruments, and indicators for policy. Defining money, measuring its quantity, estimating supply and demand functions and identifying the appropriate or optimal monetary policy target(s) are related but separable steps as one proceeds from the formulation of hypotheses, to empirical testing, to the development of policy prescriptions. Unfortunately, a considerable portion of the analytical and empirical work on the monetary aggregates fails to make these distinctions. The inevitable result, as Tobin noted some years ago, is that advocates of a monetary aggregates strategy often appear to be saying "we don't know what money is, but whatever it is, its stock should grow steadily at 3–4 percent per year" (Tobin, 1965, p. 465). Policymakers, on the other hand, often appear to be saying that conceptual, analytical, and technical problems surrounding the monetary aggregates make better control over any of the aggregates difficult, if not impossible, and perhaps inadvisable. The first view contributes to an intellectual paralysis, while the second leads to policy paralysis. At a minimum all parties should be able to agree that central bank pursuit of monetary targets or use of the money stock as an information variable depends on our ability to distinguish between supply and demand disturbances which are either transitory or permanent. The need for such analysis cannot be aggregated away.

2. The Fed's ability to interpret short-run variations in the monetary aggregates and guide policy accordingly is severely limited by the large transitory component of short-run variations (reflecting the instability of supply and demand), and a variety of problems resulting from seasonal adjustment, data revisions, changes in operating procedure, and changes in regulations, such as those being implemented under the Monetary Control Act of 1980.

3. Empirical work and policy prescriptions regarding monetary control are often based on models of the process determining the money stock (and

[57] A detailed consideration of this theme would take us too far afield. See the relevant papers in Lombra and Witte (1981), for elaboration.

other monetary aggregates) which fail to take adequate account of existing regulations and Fed operating procedures in determining causal relationships and system dynamics. Multiplier-type models, for example, imply that deposit expansion in the banking system is quantity constrained through the Fed's control over the sources of bank reserves. A seemingly alternative view, embraced by the Fed, is that the system is equilibrated through the movement of interest rates which affect bank revenues and costs and therefore desired asset and liability positions. The problem is not for the most part at the analytical level, since each view shares a common analytical foundation, but rather at the empirical level. Given the structure of regulations and the Fed's operating procedure, I would argue that the linkages implied by most of the empirical work surrounding the multiplier models and "structural" models are misleading. While it is clear that regulations and procedures can be altered to tighten the linkages in the system and bring them into closer conformity with those implied by this work, empirical work which abstracts from existing arrangements must be viewed with some skepticism.

4. A variety of reforms regarding the system of reserve accounting, the structure of reserve requirements, and the operation of the discount window, have been proposed. Several, such as a return to contemporaneous reserve accounting and instituting a penalty discount rate or a positively sloped supply of borrowed reserves, could enhance monetary control. However, the assessment of many reform proposals suffers from the absence of an adequate dynamic microfoundation which is needed to guide the analysis of the effects of such reforms over time on the cost of deposits, the net return on assets, and the competitive relationships among various types of financial institutions (domestic and foreign). Insufficient attention to such considerations in the past contributed to the failure to recognize the implications of the innovation induced by various regulations for the definition, measurement, interpretation, and control of the monetary aggregates.

5. Available evidence suggests that sizable forecasting errors, shifting views on the analytical significance of the money stock and the other monetary aggregates, and political and economic constraints (actual or perceived), have in the past imparted a short-run bias to the formulation and implementation of policy. The resulting focus of policymakers on current, rather than projected, economic and financial conditions has contributed to procyclical policy and economic instability.

The voluminous research on improving monetary control, undertaken both inside and outside the Federal Reserve, appears to have had observable effects on the conduct of monetary policy. However, the aura of consensus on how to formulate and execute policy obscures a number of unresolved analytical and empirical issues addressed above. As a result, lasting improvements in monetary control will depend on continuing research in these areas *and* the willingness of policymakers to modify regulations and procedures accordingly. Conferences such as this one suggest that the outlook may not be as bleak as an extrapolation of the last decade would indicate.

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Discussion

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After reading Ray's skillful and wide-ranging paper I really found myself with very little to comment on negatively, and have only praise to offer. In listening to his oral statement, however, a couple of things hit me that I may have overlooked in reading his paper, and would like to comment briefly on them before offering some more general observations.

First, I think Ray was distinguishing between money as an indicator and money as a target. I had the impression he was saying that money still has many indicator properties in the Fed's view. In my view, while money can be considered as an indicator, money is and has been a target to the Fed. The System has announced one-year money targets that it takes as objectives. That is not to say that short-run money movements may not have some indicator properties if you mean indicators of GNP and all that, though I have never been clear in my mind why money should have a special role in that respect when more direct evidence on GNP is available on a current basis. It should be clear that money is a target and that the System intends to hit the target that it sets, although shorter run variability around the target can certainly be expected in response to endogenous forces in the economy.

My second point, and this too is relatively minor, relates to Ray's characterization of the Fed staff view about the money supply process. I have been very hard pressed to find a single Fed staff view. There are enough differences in emphasis and interpretation about the role of money and about how it can be controlled — given different interpretations about interrelationships among money, reserves, interest rates, and GNP and related lags and slippages — to provide considerable variety in staff views.

I would like to raise some other points, generally related to Ray's paper, but also to issues discussed in other panels. On the demand function for money, I have been in the situation over the years, because my principals are interested in these things, of assessing money-interest rate relationships and of attempting to use money demand functions to that end. I may be exaggerating a little, but every three months or so one finds that a function has been reestimated and that the lags have changed and the interest elasticity has changed. The changes are often sizable, depending on the sample time period. Moreover, there are almost as many differently specified functions as there are flavors of ice cream. And they don't predict too well out of sample periods. This makes one very uneasy about whether the function is inherently stable or predictable. I tend to think something is there that can be grasped, but it is very elusive and leaves scope for, not to say the need for, good judgment on the part of the policymaker.

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That and other experiences over a long period of practicing monetary economics lead me to strong feelings of eclecticism, recognizing the danger some may conclude I thereby became like the old St. Louis Browns shortstop who couldn't hit but he couldn't field either.

Still there are several issues about which I would like to vent my eclecticism. I am convinced, and have been convinced for a long time, that money matters. That was true at either Harvard, where I was an undergraduate, as at Chicago, where I was a graduate — all 30 to 35 years ago. But the analysis differed at the two institutions. There was a question on the AB Honors exam at Harvard to which the answer was: you put in money causing interest rates to go down therefore investment goes up and as a result, income is influenced. But the Ph.D. exams at Chicago at the time had a question that required an answer indicating that the preceding analysis was wrong or at best incomplete, because it ignored the direct substitution that could occur between money and goods, and thus that the whole effect on the economy of changes in money supply did not have to go through interest rates. Passing both exams brought me one step toward eclecticism.

We also have the problem of defining money. We've had some very intensive staff debates at the Federal Reserve, for example, about whether RPs are transactions money or merely a store of liquidity. And that debate has made me somewhat more eclectic. I became convinced as a result of our research that there is a very important transactions component to RPs, but that there was also a large investment component. This view was buttressed by conversations with people in the market; some of them say RPs are part of their money, while some say they are part of their investment portfolio. It is clearly part of both. More generally a money component is evident in a variety of financial assets, with modern financial technology making it easier to develop assets that directly substitute for old-fashioned demand deposits. Thus, there would seem to be doubt that there is a unique concept of money.

Another issue about which one is tempted to feel quite eclectic involves the degree of flexibility needed in procedures employed to achieve monetary targets. There is something to be said for procedures that have enough flexibility to permit assessment of underlying factors affecting money demand — whether, for example, any tendency for money to grow strongly or weakly reflects a shift in demand for money given GNP and interest rates, or reflects a strengthening or weakening of GNP itself. Let me hasten to say that I do not in any way mean to say that we shouldn't be targeting on money at this time and this place. I think we should.

But I think there is a substantive issue about whether you want control to be on a month-by-month basis or to be over a longer horizon of three months or so, which provides room for assessing the possibility of changing relationships, if any, between money and the economy.

There are also very practical reasons for flexibility in procedures that may permit sometimes fairly sizable short-run movements away from target. There is a lot of noise to weekly and monthly, sometimes even quarterly, money supply figures. Noise is for the most part unexplainable. But there are occasional large variations that are explainable. For instance, the sharp drop of money in the second quarter of this year appears in part to represent a response to the credit control programs as cash holders paid off debt. The subsequent rebound in money growth may have to a degree represented an effort to restore cash positions. Whether pure noise or explainable noise, it is reasonably clear to me that smoothing such erratic short-run movements in money would not necessarily serve a substantial economic purpose. I am not even sure that they could be controlled if one wanted. Perhaps you could close the discount window or have 100 percent reserve requirements, but then I believe banks might begin holding high excess reserves as a precautionary measure, or the market might invent alternative forms of money outside the banking system to accommodate the erratic nature of money flows in the economy.

Controlling money over, say, a three- to six-month horizon, rather than on a precise month-to-month basis, still involves the need for continuous assessment of the appropriateness of a predetermined money target. As I noted above, a shift in money demand relative to GNP would indicate that, for a given GNP, the targets should be raised or lowered, depending on the direction of shift. But it is never very clear if deviations in money growth as they are occurring should be interpreted as such a shift or not. An aggregate reserve operating procedure is not accommodative to such demand shifts, but a nonborrowed reserve target probably provides a bit of accommodation in the short run and in that sense adds a degree of flexibility to monetary policy operations. Still over any reasonable run, even a nonborrowed procedure, which does involve changing the nonborrowed path in response to changes in demand for borrowing from the discount window by banks, would not be even partially accommodative to a tendency for money to run strong or weak. That is the virtue of a reserve target, of course. But it also places a high premium on choosing the basic money supply target wisely. And it also suggests the need for adjustment of the money target if anticipated shifts in demand are occurring relative to the ultimate goals for economic activity and prices.

Finally, I would like to say a few words about the money supply target which reserve procedures are designed to control. We are rather clearly living through a period of considerable change in the structure of the financial system and of proliferation in the types of instruments in which "money" can be held — RPs, checking deposits at thrifts, Eurodollars, zero balance accounts, electronic transfers out of savings accounts, etc. As changes have been phased in, we have been able to adjust targets to them, with a varying degree of uncertainty involved, and we have adjusted money supply definitions.

But looking far down the road — and foreseeing ever wider use of electronic transfers among other things — the problem of finding an adequate measure of money, either on an institutional basis or as bearing some systematic or predictable relation to GNP, may well become much more difficult. We have some research going on at the Fed by Bill Barnett who is trying to develop weighted averages for various money series which take account of the degree of moneyness in a variety of assets, and maybe that will lead us somewhere. But if you ever get to the point where you have little or no confidence in what the definition of money is, then control of interest rates of course tends to become a more attractive policy option. Problems with controlling interest rates have been evident. You don't need me to review the difficulty of distinguishing between nominal and real interest rates and of estimating how borrowers might respond to nominal rates, which requires somehow estimating borrowers' attitudes toward inflation.

I am tempted to think, and this is looking years ahead, not this year, not next year, not the year after, that we may be driven back to an eclectic system of money and interest rate control. However, the definition of money would need to be quite different from what we now have. Money would be pure outside money. I believe Jim Tobin in a paper prepared for a conference we had on the monetary aggregates rightly said that the nonborrowed monetary base was the economy's outside money, and termed it M zero. If you take the view that the nation's central bank should be sure to provide enough "substance" of some sort from outside — "substance" the economy does not generate on its own — to sustain the nation's long-run growth, one might consider for starters putting in a reasonable amount of nonborrowed base, which the Fed can control. That would provide a quantity fulcrum, so to speak, for the economy with the amount initially chosen on the low side of the range of possibilities so as to encourage price stability. If that amount is not sufficient to support noninflationary growth, banks will then borrow more base.

But, of course, in practice the ups and downs of borrowing may be supporting inflation or contributing to deflation. Therefore, it becomes essential under such a procedure for the discount rate to be actively employed as a control instrument that affects the level of market interest rates. In essence, the money provided through the nonborrowed base would be the quantitative element of policy and the discount rate would be the other policy tool that is used to influence credit conditions as a year progresses.

Such an approach differs from what we are now doing in that our present nonborrowed reserve path (in principle a nonborrowed base could also now be an operating target) is determined from a money supply target, and the discount rate is rather more passively adjusted to market conditions, which are essentially determined by the intersection of money demand and money supply. But I was using the possible alternative approach to raise issues in your mind about how one might conceive of operating in a world — if it should ever develop — where money cannot be well delineated from the myriad of other assets held by consumers and businesses.

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