The Structure of Financial Markets and the Monetary Mechanism

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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 $\bar{Y}$ 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)	$M1^d = \underline{P}L(r, r_d, r_s)$
(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
$\underline{P}$	=	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:

$$\rho \Delta L \leq \Delta \bar{R} \tag{5.1}$$

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:

$$\Delta L = \frac{\overline{\Delta R}}{\rho} = \overline{B} \qquad (5.2)$$

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:

$$I(r) = S(Y) \qquad (5.3)$$

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

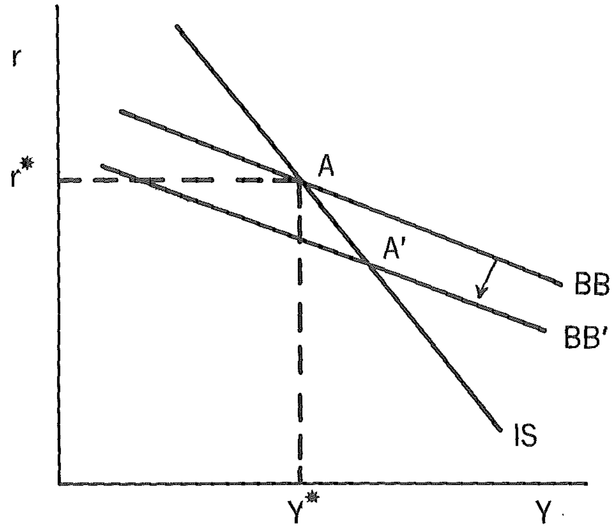
$$B(r, Y) = I_d(r) - S_d(Y) + \Delta M1_d(r, Y) = \overline{B} \qquad (5.4)$$

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:

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

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

$$\Delta E = E(r_s, Y) = I_s(r_s) + S_d(Y) \qquad (5.9)$$

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

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

where $\overline{B}$ 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

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

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

$$I = \Phi(\overline{B}, r, r_s) \qquad (5.12)$$

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

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

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

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

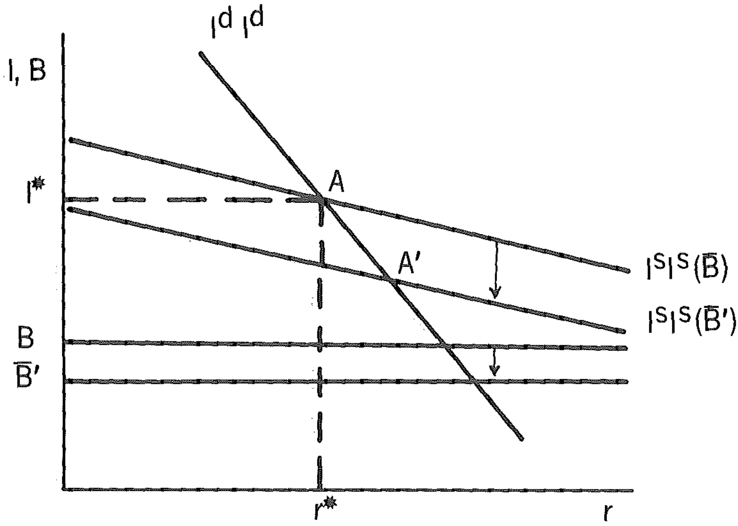
$$\partial E/\partial r_s = dI_s(r_s)/dr_s < 0$$

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



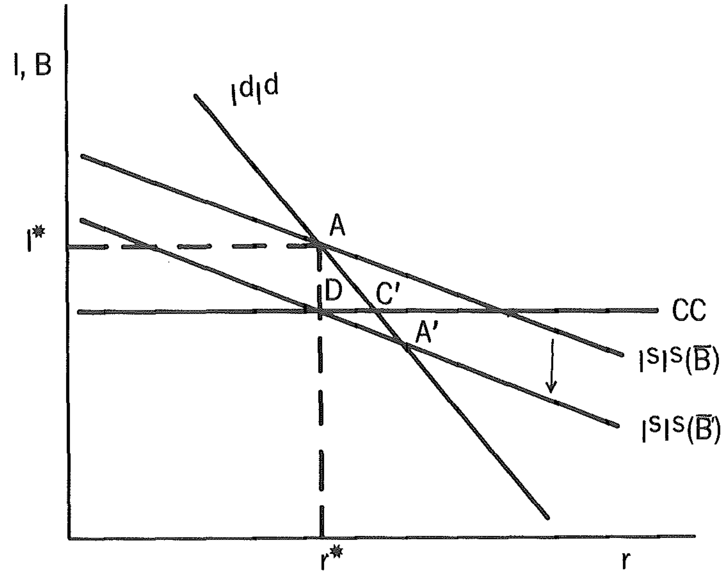
It is apparent from Figure 2 how control of nominal income can be achieved through the management of bank credit, which affects directly the debt financed investment, and indirectly, the equity financed component. An expansion (reduction) of bank credit shifts the I^sI^s curve up (down) leading to an 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

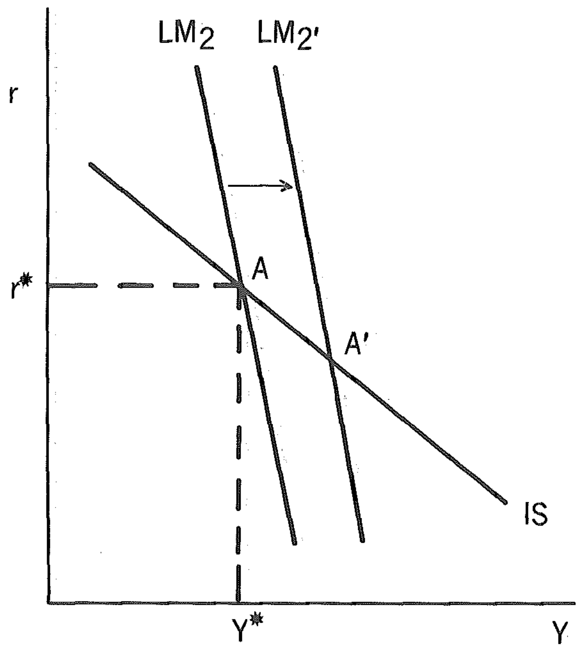
$$L2(r, Y) = \overline{\Delta M2} \tag{5.16}$$

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.

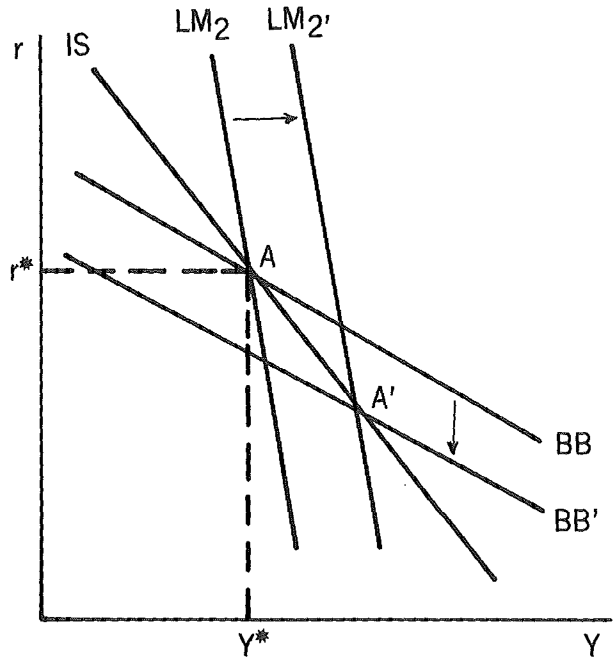
This paradigm focuses on the conditions for equilibirum in the two financial markets: the equilibrium condition (5.4) in the bank credit market and the equilibrium condition (5.16) in the bank liabilities market. Recalling that, for a given credit target, $\bar{B}$, controlled by the monetary authority,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

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

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

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:

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

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

$$M1^d = k_0 + k_1Y + k_2r + v_1 \qquad k_0>0,\ k_1>0,\ k_2<0 \qquad (6.3)$$

$$M2^d = h_0 + h_1Y + h_2r + v_2 \qquad h_0>0,\ h_1>0,\ h_2>0 \qquad (6.4)$$

$$L^d = b_0 + b_1Y + b_2r + \eta \qquad b_0>0,\ b_1\gtrless 0,\ b_2<0 \qquad (6.5)$$

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:

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

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

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

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

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]

$$s_d = w_s s \quad \text{and} \quad s_s = (1-w_s)s \quad \text{where} \quad w_s = \frac{S_d}{S}$$

$$i_d = w_i i \quad \text{and} \quad i_s = (1-w_i)i \quad \text{where} \quad w_i = \frac{I_d}{I} \tag{6.10}$$

$$k_{1d} = w_m k_1 \quad \text{and} \quad k_{2d} = w_m k_2 \quad \text{where} \quad w_m = \frac{M1_d}{M1}$$

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

$$v_2 = u^+_s - u^+_i + v_1^-$$
$$\eta = u^-_i - u^-_s + v_1^- \tag{6.11}$$

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

$$v_2 = (1-w_s)u_s - (1-w_i)u_i + w_m v_1$$
$$\eta = w_i u_i - w_s u_s + w_m v_1 \tag{6.12}$$

The above equations imply the relationship

$$u_s + \eta = u_i + v_2 \tag{6.13}$$

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

$$Y|_{\bar{r}} = a_0 + a\,\bar{r} + u \qquad (6.16)$$

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

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

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

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

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

and

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

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

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

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 $\beta = \beta_2$.

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

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

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

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

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

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

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

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):

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

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

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

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

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

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

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

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

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

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:

$$\frac{\sigma_s^2}{\sigma_i^2} < \alpha\, \mu^2 \tag{6.34}$$

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:

$$\frac{\sigma_s^2}{s^2} < \alpha'[\mu^2 \frac{\sigma_i^2}{s^2} + (1-\mu)^2 \frac{\sigma_{v1}^2}{k_1^2}] \tag{6.37}$$

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 $\beta_1^2[k_2^2(\sigma_s^2 + \sigma_i^2) + i^2\sigma_{v1}^2] > \sigma_s^2$.

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.