Monetary and Credit Targets in an Open Economy

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I. Introduction

Monetary theory has in general abstracted from an explicit examination of the role of credit in the monetary mechanism and the merits of credit aggregates as targets and guides of policy. The traditional focus of analysis has been the interaction of the money market with the "real" markets for goods and labor, with the credit market kept in the background as the "residual market" which automatically clears when all the other markets are in equilibrium. Theoretical studies of monetary policy have largely concentrated on policies which take the form of achieving target paths for interest rates or for the stock of money, narrowly defined by its main function as the medium of exchange. In these analyses, the nature and stability of the demand for money play a critical role in determining the effectiveness of policy while the nature and stability of the demand for and supply of credit do not appear as significant factors.

By contrast, credit market conditions and credit aggregates have played an important role in the practice of monetary policy — a role which is likely to become more prominent and widespread in the presence of ongoing fundamental changes in financial markets and institutions. During the 1970s, with the resurgence of monetarism and the shift in policy from targeting interest rates to controlling the stock of money, many countries chose, as their primary monetary target, domestic credit (Belgium, Italy, Sweden) or very broad monetary aggregates whose quantities correspond approximately to total domestic bank credit (France, Japan, Netherlands, United Kingdom).[1]

The usefulness of a broad credit aggregate as a target and guide for policy has also been advocated recently in the United States by a number of economists in the academic and business community as well as within the Federal Reserve. Although the Federal Reserve has been reporting targets for the rates of growth of various monetary aggregates to Congress since 1975, its primary objective until the summer of 1982 was the control of the

[1]See Black (1982a), Hodgman (1974), OECD (1979).

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narrow measure of the stock of money. But a succession of extensive financial innovations, which led to the creation of a plethora of very liquid assets, has seriously undermined the usefulness of money (M1) as a target and indicator of policy.[2] Simultaneously, a number of empirical studies in the United States established that broad credit and money aggregates can serve as efficient intermediate targets and guides on the basis of such criteria as the stability of their relationship to nominal income, their "causal" influence on output, and their contribution in providing advance information on output fluctuations.[3] Influential business economists also argued that broad credit aggregates provide effective measures of the thrust of monetary policy.[4] These views found increasing support within the Federal Reserve, which, in the presence of new instability in the financial markets, officially abandoned its M1 target in October 1982 and adopted in February 1983 a range for the rate of growth of "total domestic nonfinancial debt."[5]

The fact that many countries have been using credit aggregates as targets and that more may do so in the future does not, of course, imply that they are superior to other monetary targets. Indeed, the overall economic performance of the European countries employing credit targets is mixed [see Black (1982b)]. Moreover, the empirical evidence for the United States cited above in support of credit targets is based on data from periods when targets other than credit have been employed. The estimated statistical regularities may break down once the monetary authorities alter their targets and operating procedures as Goodhart and others have argued.[6] It is thus important to examine at a theoretical level the behavioral and institutional factors which determine the relative effectiveness of credit and monetary aggregates as targets and indicators. In a series of papers Modigliani and Papademos have studied the role of credit in the monetary mechanism and have shown how the relative effectiveness of monetary and credit aggregates in minimizing price and output fluctuations depends upon the source of economic instability, behavioral factors, and the financial and fiscal structure of the economy.[7] Their analyses, however, abstracted from the effects of international financial relations and thus from the question of whether credit targets are feasible and desirable in open economies, especially those highly integrated in international financial markets.

Macroeconomic analyses of open economies have paid little attention to the role of credit and to the potential usefulness of credit targets, having concentrated on the implications of alternative exchange rate regimes with

[2]For detailed descriptions of recent developments in the financial markets and discussions of their implications for monetary policy see Akhtar (1983), Cagan (1979), Davis (1981), Goodhart (1982), Hart (1981).

[3]See Cagan (1982), Davis (1979), B. M. Friedman (1980, 1983), Kopcke (1983). The robustness of this empirical evidence is questioned, however, by Berkman (1980), Fackler and Silver (1983), Islam (1981).

[4]See Kaufman (1980) and Wojnilower (1980).

[5]See Morris (1983) and Volcker (1983).

[6]See Goodhart, Letter to the Times of London, February 5th, 1980.

[7]See Modigliani and Papademos (1980, 1983) and Papademos and Modigliani (1983).

monetary policy taking the form of achieving target paths for the stock of money or exchange rates.[8] Two notable exceptions are the studies of Black (1982b) and Rozwadowski (1983). Black used an extended Modigliani-Papademos (1980) model to suggest the existence of a relationship between the choice of the monetary target and the type of exchange rate regime which is appropriate. He supported his hypothesis by evaluating the economic performance of 10 industrial countries, but he did not examine the issue formally on the basis of the model he developed. Rozwadowski (1983) studied the implications of narrow and broad monetary aggregates for the dynamic and stochastic stability of a small open economy under fixed and flexible exchange rates, but did not explore the effectiveness of credit targets or the implications of the imperfect substitutability between domestic and foreign instruments under flexible exchange rates.

This paper has two objectives. The first is to develop an open-economy model which focuses on the role of credit markets in the determination of macroeconomic equilibrium and which incorporates sufficient institutional detail to allow an examination of the relative effectiveness of various forms of monetary and credit control. The second objective is to examine the relative efficiency of a monetary and a credit target which have received a lot of attention in both the practice of policy and in recent discussions and empirical studies. These targets are the narrow measure of the stock of money (M1) and the total quantity of bank credit provided by the consolidated banking system (LB).

The paper is organized as follows. Section II develops the general theoretical framework. This model defines three monetary aggregates and two credit aggregates which may serve as policy targets. In section III we determine the general conditions for stochastic short-run equilibrium under the money and the total bank credit strategy. The analysis is carried out for a regime of freely floating exchange rates and under the assumption that expectations are formed "rationally." This section also presents the dynamic relations which describe how public anticipations about inflation, the terms of trade, and output depend upon the chosen path of the monetary or credit target as well as upon anticipated fluctuations of the world real interest rate. In section IV we analyze the implications of the money and credit targets for the dynamic and stochastic stability of the economy under the assumption that foreign and domestic loans are close substitutes. Although it has often been argued that a credit target is either infeasible or inefficient in such an environment, we find that in general total bank credit is a feasible target and we determine the conditions under which it is superior to the money target in the presence of four types of stochastic shocks. The concluding section summarizes our analysis and its policy implications.

[8]See, for example, Artis and Currie (1981), Henderson (1979, 1982), Melitz (1982), Turnovsky (1981), Weber (1981).

II. The Model of a Small Open Economy

An analysis of the effectiveness of credit aggregates as intermediate targets requires a model which incorporates financial intermediaries, makes explicit the role of credit in economic decisions and stresses the influence of credit markets on macroeconomic equilibrium. The framework developed here takes as its point of departure the model of Papademos and Modigliani (1983) which formalized the determinants of equilibrium in the credit markets in terms of the behavior of households (net lenders) and corporate firms (net borrowers).[9] That model is extended to allow for domestic and foreign financial instruments which, in general, are viewed as imperfect substitutes by both lenders and borrowers. Our model also incorporates a specification of aggregate price fluctuations in an economy in which domestic and foreign goods are imperfect substitutes, and it includes various types of stochastic disturbances. The model is presented in two parts. We first discuss the financial structure of the economy, describing the basic factors determining asset demands and supplies. We then examine the determinants of demand and supply of aggregate output, their relationship to credit markets, and the mechanism of price and wage adjustment.

A. The Financial Structure of a Small Open Economy

The financial structure of an economy is characterized in general by two elements: (1) the set of financial instruments available to households and firms for holding their wealth and financing the acquisition of tangible assets, and (2) the structure and characteristics of financial markets and intermediaries as defined by the degree of competition and the nature and extent of regulation.

The financial structure we examine is summarized in Table 1 which shows the set of financial instruments held by four domestic sectors [households (h), corporate firms (f), banks (b), and government including the central bank (c)] and a single foreign sector labelled "rest of the world" (w). Each row corresponds to a financial instrument and indicates the quantities of that instrument held as an asset (+) or as a liability (−) by each sector. Thus each row of Table 1 also corresponds to a market-clearing condition, indicating that the sum of sectoral demands equals the total supply. As usual, one of these conditions is redundant as a consequence of the sectoral budget constraints. Each column of Table 1 indicates the quantities of the various instruments held as assets or liabilities by that sector. The zero elements show that certain sectors are not involved with certain instruments.

[9] An alternative formulation is presented by Modigliani and Papademos (1980), where the equilibrium conditions in the credit markets are analyzed in terms of the behavior of "surplus" and "deficit" units.

Table 1

Financial Instruments and Markets	Sectors: Households	Firms	Banks	Government and Central Bank	Rest of the World
Currency and Bank Reserves (H)	H_h	H_f	H_b	$-H$	0
Foreign Currency and Reserves (H*)	0	0	0	EH_c^*	$-EH_w^*$
Demand Deposits (D)	D_h	D_f	$-D$	0	0
Time Deposits (T)	T_h	0	$-T$	0	0
Government Bonds (B)	0	0	B_b	$-(B_g - B_c)$	0
Bank Loans (L)	0	$-L_f$	L_b	0	0
Foreign Loans (L*)	EL_h^*	$-EL_f^*$	0	$-EL_c^*$	EL_w^*
Corporate Equity (V_e)	P_eS_e	$-P_eS_e$	0	0	0

Monetary and Credit Aggregates

Monetary Base	$M0 = H$
Money (narrow measure)	$M1 = (H - H_b) + D$
Money (broad measure)	$M2 = M1 + T$
Domestic Bank Credit	$LB = L_b + B_b + B_c + E(H_c^* - L_c^*)$
Total Domestic Credit	$LD = LB + EL_h^*$

Table 1 includes a total of eight financial instruments, six of which are created in the domestic economy and are denominated in domestic currency units. The domestic financial instruments are: currency and bank reserves (H), demand deposits (D), time and savings deposits (T), government bonds (B), bank loans (L), and corporate equity (V_e). There are two foreign-currency financial instruments held by domestic residents: foreign currency and reserves (H*), and foreign loans (L*). The term "foreign loan" is employed to denote all interest bearing foreign financial instruments (loans or bonds), issued by foreign governments and/or foreign private and central banks. The nominal quantities H* and L* are measured in terms of foreign currency and are therefore multiplied by the nominal exchange rate (E), the price of foreign currency in terms of domestic currency. All domestic assets, with the exception of corporate equity, have a fixed price per period in terms of the domestic currency. The value of corporate equity V_e is given by the stock of equity (number of shares) (S_e) multiplied by the market value of a share (P_e).

The nominal rates of return on all the financial instruments of Table 1, expressed in terms of domestic currency, are summarized by the vector

$$\underline{i} = [i_H, i_{H^*}, i_D, i_T, i_B, i_L, i_{L^*}, i_E]$$

Table 2 summarizes our assumptions on the expected values and interrelationships of all the elements of $\underline{i}$. The nominal rate of return on domestic base money, i_H, is zero, and the nominal rate of return on demand deposits, i_D, is fixed by a legal restriction or as a result of the banks' decision to charge implicitly for the transactions services they provide by offering demand deposits with a fixed or an infrequently changing low rate of return.

Table 2
Nominal Rates of Return on Assets in Terms of Domestic Currency

(1) Domestic Currency and Bank Reserves	$i_H = 0$
(2) Foreign Currency and Bank Reserves	$i_{H^*} = \hat{\epsilon}$
(3) Demand Deposits	$i_D = \bar{i}_D$
(4) Time Deposits	$i_T = (1-\kappa)i_L - \mu_T$
(5) Government Bonds	$i_B = i_L - \mu_B$
(6) Domestic Bank Loans	$i_L = i$
(7) Foreign Loans	$i_{L^*} = i^* + \hat{\epsilon}$
(8) Corporate Equity	$i_E = i_K + \lambda\zeta,\ \zeta = i_K - i_A$

Definitions of symbols
$\hat{\epsilon}$ = anticipated rate of depreciation of domestic currency
κ = required reserve ratio on time and savings deposits
μ_T = cost of intermediation per unit of bank deposits
μ_B = fixed spread between government bonds and private loans
i^* = interest rate on foreign loans measured in terms of foreign currency
λ = corporate firms' debt-equity ratio
ζ = risk premium
i_K = rate of return on the equity of "unlevered" firms
i_A = $\phi i + (1-\phi)(i^* + \hat{\epsilon})$, average interest rate on firms' debt
ϕ = share of domestic loans in firms' total debt

The rate of return on time deposits, i_T, is market determined by profit maximizing banks operating under competitive conditions. It can be expressed as a "mark-down" on the loan rate, i_L, as shown by (4) where κ is the required reserve ratio on time and savings deposits, and the spread μ_T reflects the costs of intermediation per unit of deposits due to the operating costs, reserve requirements on demand deposits, and the spread between the rates of return on bank loans and other bank assets.

In general, we may assume that all financial assets are gross substitutes. For analytical convenience, however, we assume that the rates of return on government bonds, bank loans, and corporate equity [i_B, i_L, i_E] differ by "constant" spreads, as shown by (5) and (8), which reflect differential transaction costs and risk characteristics. The rate of return on equity is expressed in terms of the rate of return on the equity of "unlevered firms" or rate of return on capital, i_K, and the risk premium ζ required by households for holding corporate equity. The risk premium is expressed relative to the average rate of return on firms' debt which is a weighted average of the domestic and foreign loan rates, weighted by the share of domestic bank loans in firms' total debt (ϕ). Households own corporate debt indirectly via their ownership of bank deposits but they may also hold firms' debt denominated in foreign currency.

The nominal rates of return on foreign assets expressed in terms of domestic currency reflect the anticipated rate of depreciation of the domestic currency. Assuming that the nominal rate on foreign currency and reserves, measured in terms of foreign currency, is zero, (2) states that i_{H^*} equals the anticipated rate of depreciation of the domestic currency $\hat{\epsilon}$,

$$\hat{\epsilon} = \hat{e}_{+1} - e$$

where e is the logarithm of the nominal exchange rate. The foreign loan rate is given by (7) as the sum of i^*, the interest rate on foreign loans, measured in terms of foreign currency, and $\hat{\epsilon}$. The assumption that the domestic economy is "small" implies that the world interest rate on foreign loans can be taken as given (in foreign currency units). Equations (1) – (8) (see Table 2) imply that the vector of nominal yields $\underline{i}$ can be expressed as a function of the two interest rates on domestic and foreign loans $[i, i^* + \hat{\epsilon}]$. Domestic and foreign loans are imperfect substitutes in part because of the exchange risk associated with the different currencies of denomination.

Households

Households hold domestic currency, demand and time deposits, foreign assets, and corporate equity. In this paper we assume that all real capital is held by corporate firms, and that households have claims on physical capital through their direct ownership of corporate equity and firms' foreign-currency debt and their indirect ownership of firms' domestic-currency debt via their holdings of domestic bank deposits. Since households do not own physical capital directly, they would borrow primarily for the purpose of acquiring corporate equity. But the extent of such household borrowing is very limited as the empirical evidence suggests and for reasons we have discussed elsewhere.[10] Accordingly, we will abstract from the households' demand for credit and will analyze the demand for bank loans (or supply of domestic private debt) in terms of the firms' decisions on how to finance their purchases of tangible assets.

The households' demand for every nominal asset is assumed to be proportional to the price level (P) and a real demand function denoted a[.] which depends upon the vector $\underline{i}$ of nominal rates of return on all assets, measured in terms of domestic currency, households' anticipated real disposable income ($\hat{Y}^D$), and initial real wealth (W_{-1}). Thus the demand for the representative asset A is expressed as:

$$A_h^d = Pa_h[\underline{i}, \hat{Y}^D, W_{-1}] \quad (9)$$

where

$$P = P_y^{\bar{\theta}} [EP_y^*]^{(1-\bar{\theta})} \quad (10)$$

The price level is measured by an index P defined as the geometric average of the price P_y of the domestically produced composite good Y and the price EP_y^* of the imported good in domestic currency units. P_y^*, the foreign-currency price of imports, is unaffected by domestic economic con-

[10]See Papademos and Modigliani (1983).

ditions and is taken as given. The domestically produced goods and the imported goods are imperfect substitutes. The weight in the price index represents the share of the domestic goods in total private expenditures by domestic residents at the long-run equilibrium. Real disposable income is defined in section II.B.

Firms

Corporate firms hold real capital and money (Ml) as assets which they finance by issuing equity and debt. Firms' debt is in the form of bank loans obtained from domestic banks or foreign currency loans from foreign banks and financial institutions and foreign currency bonds which are held by foreign and domestic residents.

The financing decisions of firms involve two fundamental choices: whether to finance new investment through debt or equity and whether to employ internal or external sources of financing new equity [retention of earnings vs. issuance of new shares]. In addition, firms must decide whether to borrow from domestic banks or in the international markets. The determinants of the capital structure of corporate firms have been discussed extensively in the financial literature, especially since the celebrated articles of Modigliani and Miller.[11] The issue has recently been reexamined within the context of a macroeconomic model by Papademos and Modigliani (1983). On the basis of that analysis, we postulate here that the total demand for bank loans (supply of debt) by corporate firms is proportional to the total value of the firms' assets:

$$L_{Tf}^{d} = \ell(\bar{\pi})[PK + Ml_f] \tag{11}$$

where the firms' capital is valued at its current replacement cost. The proportionality factor ℓ, the debt-asset ratio, is a function of the average anticipated inflation $\bar{\pi}$, but it is not sensitive to fluctuations in interest rates.[12] Its average value will reflect primarily parameters of the tax structure of the economy, which determine the contribution of leverage to the value of the firm, and parameters capturing the effects of bankruptcy and other costs that firms face as the debt-asset ratio increases. Given the tax structures of many western economies where nominal interest payments on debt are deductible from corporate taxes, the leverage ratio ℓ will tend to increase with the *average anticipated* inflation rate. Transitory fluctuations in the inflation rate are assumed to leave unaffected the anticipated long-run aver-

[11] Modigliani and Miller (1958), Miller and Modigliani (1961).

[12] It is possible to modify our present formulation of loan demand so as to allow for a negative interest rate effect on ℓ in order to capture the more conventional effects of interest costs on noncorporate borrowing which is not treated explicitly in the present analysis. Such an extension, however, does not alter the major conclusions of our analysis but it complicates the algebra.

age rate of inflation $\bar{\pi}$ and thus ℓ. The total (flow) demand for borrowing per period follows directly from (11):

$$\Delta L_{Tf} = \ell PI + \ell[\Delta P - \delta P]K_{-1} + \ell \Delta M1_f \quad (12)$$

where I is gross investment and δ is the rate of depreciation of the capital stock. An increase in the level of interest rates reduces total borrowing indirectly by reducing investment, (I), and by reducing the demand for money by firms. An increase in income increases credit demand through its effects on firms' money balances. The demand for money by firms is determined according to a conventional specification: $M1_f = Pm_f(\underset{-}{i}, \overset{+}{Y})$. It is assumed that the demands for money balances by households and firms are characterized by the same interest and real income elasticities.

Given the total demand for credit, the firms' demand for domestic and foreign loans depends on the interest rate differential, in domestic currency units. Employing (7) we have that,

$$L_f^d = \phi(i - (i^* + \hat{\epsilon}))L_{Tf} \quad (13)$$
$$[EL_f^*]^d = [1 - \phi(i - (i^* + \hat{\epsilon}))]L_{Tf}$$

where $0 < \phi(.) < 1$, and $\phi'(.) < 0$.

Given the firms' planned investment and borrowing policy, the remaining fraction of investment must be financed through equity, either by retaining earnings (S_f) or by issuing new shares (S_e) or a combination of both. The firms' dividend policy will determine the nature of equity financing. We assume that retention of earnings together with borrowing provide sufficient funds for financing investment. Any surplus funds are distributed as dividends to the equity owners. The real value of retained earnings (S_f) and dividends (Π) must equal the real value of corporate profits net of interest payments on firms' debt:

$$S_f + \Pi = F_K K_{-1} - [iL_f + (i^* + \hat{\epsilon})EL_f^*]_{-1}/P \quad (14)$$

where F_K is the marginal product of the existing capital stock, *net* of the per unit cost of acquiring and installing new capital, and the last term represents the real value of the interest payments on the corporate debt outstanding at the beginning of the period. The real value of dividends distributed to households per period can be derived from the firms' budget constraint

$$PI + \Delta M1_f = PS_f + P_e\Delta S_e + \Delta L_{Tf}$$

after replacing ΔL_{Tf} and S_f by the expressions given by (12) and (14), letting $\Delta S_e = 0$, and solving for Π to get

$$\Pi = F_K K_{-1} - \ell r_{A,-1}[K_{-1} + (M1_f/P)_{-1}] \quad (15)$$
$$- [\delta K_{-1} + \pi(1+\pi)^{-1}(M1_f/P)_{-1}] - (1-\ell)[I - \delta K_{-1} + \Delta(M1_f/P)]$$

where $r_A = [\phi i + (1 - \phi)(i^* + \hat{\epsilon}) - \hat{\pi}]$ is the average real interest rate on the firms' total debt (domestic and foreign).

Banks

The banking sector is defined to include all financial intermediaries whose liabilities take the form of deposits which can be grouped into two broad categories: demand deposits (D) and time and savings deposits (T). As noted above, the interest paid on demand deposits is constant, $i_D = \bar{i}_D$, but the interest paid on time deposits is market determined. Banks operate under competitive conditions and with constant returns to scale. Their assets consist of reserves, H_b, held in the form of domestic currency or as deposits with the central bank, domestic currency bank loans, L_b, and domestic currency government bonds, B_b.

Banks are required to hold reserves against their liabilities or assets, and for simplicity it is assumed that they only hold the required amount, satisfying their potential needs for liquid assets by holding short-term government bonds. The nature of reserve requirements imposed on private banks depends upon the central bank's choice of a monetary or a credit target. If the target is total domestic bank credit, a case we examine below, banks will be required to maintain reserves equal to a fraction κ of all their domestic assets or, equivalently, of all their domestic liabilities, so that

$$H_b = \kappa\,(H_b + L_b + B_b) = \kappa\,(1-\kappa)^{-1}(L_b + B_b) = \kappa\,(D + T) \tag{16}$$

The unrestricted funds are used by banks to extend credit either by making loans (L_b^s) or by purchasing government bonds (B_b^d). Hence,

$$B_b^d + L_b^s = (1-\kappa)\kappa^{-1}H_b = (1-\kappa)(D+T). \tag{17}$$

Banks' operations imply the equality of the risk-adjusted yields on bonds and loans so that (5) holds.

Government and the Central Bank

The fiscal authorities finance any deficits by issuing government bonds. The total quantity of these bonds B_g is held only by domestic financial institutions. The monetary authorities' assets consist of domestic credit, equal to a quantity B_c of government bonds and foreign currency and reserves EH_c^*. The central bank's liabilities are domestic currency and reserves H and foreign loans from official sources or private banks EL_c^*. If we denote by F_c the net foreign assets held by the central bank, measured in domestic currency units, that is $F_c = E(H_c^* - L_c^*)$, the balance sheet constraint of the central bank is $B_c + F_c = H$. The sum of all elements in the government and central bank column of Table 1 equals government debt: $-H - (B_g - B_c) - F_c = -B_g$.

The consolidated (flow) budget constraint of the fiscal and monetary authorities in units of domestic currency, and expressed in real terms by deflating with the price index P, is

$$P_y(G - T^G)/P + (r_B b)_{-1} + \Delta f_c = \Delta h + \Delta b + \pi h_{-1} + (r_c f_c)_{-1} \tag{18}$$

where $P_y(G - T^G)/P$ is the real value of government expenditures minus taxes (net of transfers), $h = H/P$, $b = (B_g - B_c)/P$, $f_c = F_c/P$ are the real values of high powered money, privately held government bonds, and net foreign assets of the central bank; $r_B = i_B - \hat{\pi}$, $r_c = i_c - \hat{\pi}$ where $\pi = P_{+1}/P - 1$ and i_c is the average rate of return on the net foreign assets of the central bank expressed in terms of domestic currency,

$$i_c = \hat{\epsilon}(EH_c^*/F_c) - (i^* + \hat{\epsilon})(EL_c^*/F_c) = \hat{\epsilon} - i^*(EL_c^*/F_c). \tag{19}$$

The real government budget constraint states that the government's real current deficit (the first two terms) plus its net real purchases of foreign assets must be financed by an increase in the real quantities of money and/or bonds, the "inflation tax" on real high-powered money, and the real income from its net foreign assets.

The Rest of the World and the Balance of Payments

The foreign sector's financial instruments relevant to the domestic economy are its net supply of foreign currency and reserves, EH_w^*, which appears as a net liability, and its net supply of debt instruments to the central bank and private sector, EL_w^*. The real value of the economy's balance of payments constraint, expressed in terms of domestic currency and deflated by P, is

$$P_y(X - ZX^*)/P + (r_c f_c)_{-1} + (i^* + \hat{\epsilon} - \hat{\pi})_{-1} f_{-1} - \Delta f = \Delta f_c \tag{20}$$

where $Z = EP_y{}^*/P_y$, $f = E(L_h^* - L_f^*)/P$, $f_c = E(H_c^* - L_c^*)/P$, $r_c = i_c - \hat{\pi}$, and i_c is given by (19). The first three terms measure the balance of trade and the net income (interest plus capital gains) on the real value of net foreign assets of the central bank, f_c, and of the private sector, f. The sum of these three terms constitutes the real value of the balance of payments on current account while the change in the real value of the net foreign assets of the private sector Δf determines the real balance of payments on capital account.[13] A deficit on the combined current and capital account implies an excess demand for foreign currency which must be financed by a change in the real value of the net foreign assets of the central bank, the official settlements balance, Δf_c.

B. The Markets for Domestic Goods and Labor

Aggregate Supply

Firms produce the domestic final goods (Y) according to an aggregate production function of capital (K) and labor (N) with constant returns to scale. In order to derive explicit solutions, we consider an explicit function-

[13]International transfer payments other than interest and capital gains on the stock of net foreign assets are not treated explicitly.

al form, and for simplicity we adopt the Cobb-Douglas technology

$$(21) \qquad y = an + (1-a)k, \ 0 < a < 1.$$

where y, n, and k are the logarithms of Y, N, and K. The analysis concentrates on a period short enough that the capital stock may be taken as fixed and equal to its long-run equilibrium level, $\bar{k}$. Profit maximization implies that firms' demand for labor must satisfy

$$(22) \qquad w - p_y = k_0 - (1-a)n$$

where p_y and w denote the logarithms of the price of domestic output and the nominal wage rate respectively, and $k_0 = \log(a) + (1-a)\bar{k}$. The supply of labor is assumed to be independent of the real wage rate in the long run, $n^s = \bar{n}$. It follows that the real wage and output supplied in steady state are equal to $\bar{w} - \bar{p}_y = k_0 - (1-a)\bar{n}$ and $\bar{y} = a\bar{n} + (1-a)\bar{k}$. The supply of output in the short run can be expressed in terms of its long-run equilibrium level and the deviations of the product real wage from its equilibrium value,

$$(23) \qquad y = \bar{y} - (a/(1-a))[(w - p_y) - (\bar{w} - \bar{p}_y)]$$

The real wage received by labor, which is deflated by the overall price index, P, given by (10), is related to the real product wage by

$$(24) \qquad (w - p) = (w - p_y) - (1 - \bar{\theta})z \ \text{where} \ z = e + p_y^* - p_y.$$

z is the logarithm of the terms of trade, the price of foreign goods relative to the price of domestic goods; and p, e, and p_y^* are the logarithms of the corresponding upper case variables. Although in long-run equilibrium, the real wage defined by (24) is determined by the equilibrium product real wage and the equilibrium terms of trade, the real wage demanded by labor in a given period can be expected to depend upon the actual level of employment, relative to the long-run full-employment level, and the anticipated price level, P. Accordingly, we postulate the following specification describing the adjustment of the real wage in the short run

$$(25) \qquad (w - \hat{p}) - (\bar{w} - \bar{p}) = \psi(n - \bar{n}), \ \psi > 0.$$

were $\hat{p}$ is (the logarithm) of the price level anticipated by workers at the beginning of the period in which they provide a quantity of labor services equal to n. Short-run equilibrium requires that the nominal wage satisfies (22) and (25). It follows that the (domestic) price level will depend upon the anticipated price level, the deviations of output from equilibrium, and the deviations of the terms of trade from equilibrium:

$$(26) \qquad p = \alpha(y - \bar{y}) + \hat{p} + (1 - \bar{\theta})(z - \bar{z}) + u^p$$

where $\alpha = (1 - a + \psi)/a$, and u^p represents an aggregate price disturbance which reflects the cumulative effect of random disturbances affecting the production technology, labor demand, and the real wage adjustment equation. This specification of the inflation-output tradeoff differs from the conventional closed-economy anticipations-adjusted Phillips specification by the last term whose relative significance depends on the share $(1-\bar{\theta})$ of imports in the steady-state level of private expenditures.

The Phillips-type relation (26) can be inverted and expressed as a Lucas-type specification of the determinants of short-run fluctuations of aggregate supply from its long-run equilibrium:

$$y^s = \bar{y} + \alpha_1(p - \hat{p}) + \alpha_2(z - \bar{z}) + u^s \tag{27}$$

where $\alpha_1 = \alpha^{-1}$, $\alpha_2 = -(1-\bar{\theta})\alpha_1$ and the supply shock $u^s = -u^p/\alpha$. This relationship can be directly determined by substituting the short-run market clearing real wage, satisfying (22) and (25), into the supply function (23).

Aggregate Demand

The market for domestic goods is in equilibrium when total domestic output (Y) equals the sum of domestic demands by households, firms and government plus the foreign demand for domestic goods:

$$Y = \theta(Z)P[C(\hat{Y}^D) + I(q, K_{-1})]/P_y + G + X(Z) \tag{28}$$

The first two terms are the real value of domestic private expenditures on domestic goods expressed as a fraction θ of the value of total domestic private expenditures deflated by the domestic price level P_y. The fraction θ is assumed to depend only on the terms of trade, Z.

Total real consumption is taken to depend on anticipated real disposable income. Real disposable income, Y^D, is the sum of real income out of current production, P_yY/P, minus real taxes net of domestic transfers, P_yT^G/P, plus real capital gains on the initial stock of capital and investment less depreciation, Y^K, plus the real (asset) income, Y^A, on the net claims of domestic private residents on the government and the rest of the world

$$Y^D = P_y(Y - T^G)/P_c + Y^K + Y^A \tag{29}$$

This definition of real disposable income corresponds to a measure of real saving which equals the change in real household net worth.

The demand for gross investment by corporate firms is expressed as an increasing function of Tobin's q, the ratio of the market value of the firms' assets to their reproduction cost, and of the initial stock of capital. We further assume that $I(q, K_{-1}) = I_K(q)K_{-1}$, $I'_K>0$, so that the rate of growth of capital is independent of the initial capital stock. Since firms hold money assets, q is defined by

$$q \equiv V/[PK + M1_f] = q_e(S_e/K) + \ell \tag{30}$$

where V is the market value of firms' assets. The second expression of (30) follows from the firms' balance sheet, equation (11), and the approximation $(1+m_K{}^{-1} \simeq 1$ where $m_K = M1_f/PK$. The value of q in a given period depends upon the real market value of corporate equity, q_e, which depends in turn upon the anticipated dividends and capital gains capitalized at the real rate "required" by households for holding corporate equity r_E. The value of q is thus determined according to

(31) $$q=[\hat{\Pi}_{+1}+(\hat{q}_{+1}-\ell)\hat{K}_{+1}]/K(1+r_E)+\ell$$

where

(32) $$K_{+1}=I_K(q_{+1})K+(1-\delta)K$$

and $\hat{\Pi}_{+1}$ and $\hat{q}_{+1}$ are the anticipated real dividends and the real value of the firm per unit of assets in the following period. The actual flow of real dividends is given by (15). In steady state, $K_{+1} = K$, $\hat{q}_{+1} = q_{+1} = q$, $\hat{\Pi}_{+1} = \Pi_{+1} = \Pi$, the equilibrium values of q, Π, and r_E are related by

(33) $$\bar{q}=\bar{\Pi}/\bar{r}_E\bar{K}+\ell \text{ and } \bar{q}=I_K^{-1}(\delta).$$

The last two terms of (28) denote the government expenditures on domestic goods, G, and real gross exports, X. Exports depend on the terms of trade which are determined endogenously in this model; they also depend on the real income of the rest of the world, which is exogenously determined and is not exhibited explicitly as an argument of X.

III. Equilibrium and Dynamics under a Money and a Credit Target

In this section we study how the choice of a money or a credit aggregate as a target by the central bank affects the economy's stochastic equilibrium in the short run and the dynamic response of aggregate output, prices, and the terms of trade to monetary policy. The model presented in the previous section allows the definition of three monetary aggregates and two credit aggregates which may serve as targets of monetary policy (see the lower part of Table 1). In this paper we examine the implications for the effectiveness of monetary policy of targeting the conventional narrow measure of the stock of money (M1) vs. targeting the total quantity of credit extended by domestic private banks and the central bank (LB). The behavior of the economy under these two targets is studied by employing a log-linear approximation of our model around the long-run equilibrium (steady-state) of the economy. The steady-state values of all real variables, which are denoted with a bar (–), are assumed constant and invariant to a change in the permanent rate of inflation. The steady-state inflation is assumed to be zero. In addition, it is necessary to specify (1) the nature of the exchange rate regime and the policies of the monetary authorities in response to external imbalance; (2) the policies of the fiscal authorities; and (3) the nature of expectations.

The analysis is carried out under the hypothesis that the exchange rate is allowed to fluctuate freely. The central bank adjusts the quantity of high powered money (H) so as to control the financial aggregate chosen as the intermediate target. This is achieved by open market purchases or sales of B_c while keeping the real value of the central bank's net foreign assets (f_c)

equal to the long-run desired level.[14] In order to isolate the implications of monetary policies from fiscal policy, we assume that the government keeps its budget balanced in real terms through appropriate changes in taxes, so that the real value of the government debt, $b_g = B_g/P$, remains constant.

Anticipations of all variables, except of transitory real capital gains, are formed "rationally"; that is, anticipations are model consistent and take into account the actions of the monetary and fiscal authorities. *Real* capital gains on all assets are expected to equal their long-run values. These assumptions on expectations, together with (the anticipated) balanced budget policy of the government, imply that the anticipated disposable income determining aggregate consumption is given by

$$\hat{Y}^D = P_y(Y - G)/P + (r_c f_c + r_f f)_{-1} - \delta K_{-1} \tag{34}$$

where $r_f = i^* + \hat{\epsilon} - \hat{\pi}$. All real income from transitory real capital gains is saved. The anticipated stream of future dividends is based on the (rationally) known steady-state values of the stock of capital and the firms' holdings of real money balances. It follows from (31) and (15) that

$$q = [\hat{\Pi}_K + (\bar{q} - \ell)]/(1 + r_E) + \ell$$

where $\hat{\Pi}_K = \bar{F}_K - (\ell r_A + \delta) - (\ell r_A + \hat{\pi})\bar{m}_K$ and $\bar{m}_K = (\overline{M1_f}/\overline{PK})$. Employing (8), so as to express the real rate of return of equity r_E in terms of the average interest rate on the firms debt r_A and the risk premium ζ, and rewriting the resulting expression in deviations from equilibrium we obtain

$$(q - \bar{q})/\bar{q} = q_1(r - \bar{r}) + q_1^*(i^* + \hat{\epsilon} - \hat{\pi} - \bar{r}^*) + u_q \tag{35}$$

where

$$q_1 = -\bar{\phi}(1 + \bar{\rho})^{-1};\ q_1^* = -(1 - \bar{\phi})(1 + \bar{\rho})^{-1} \tag{35a}$$

and

$$u_q = -[(\zeta - \bar{\zeta}) + (\hat{\pi} - \bar{\pi})\bar{m}_K\bar{q}](1 + \bar{\rho})^{-1} + u_q' \tag{35b}$$

An increase in either the domestic real loan rate or the foreign real loan rate reduces the real market value of firms to an extent that depends on the proportion $\bar{\phi}$ of domestic loans in firms' total debt at equilibrium.[15] The parameter $\bar{\rho}$ is the equilibrium value of the real rate of return on the assets of "unlevered" firms, $\bar{\rho} = \bar{i}_K - \bar{\pi}$. The stock market disturbance, u_q, captures the cumulative effect on market valuation of random variations in the risk premium ζ, the loss in the real value of firms' money balances due to anticipated inflation,[16] and other stock market shocks, u_q'.

[14]See Claassen (1976) and Grubel (1971) for discussions of the optimal size of foreign reserves.

[15]Note that the constancy of the terms of trade in steady-state implies that $\bar{\epsilon} = \bar{\pi} - \bar{\pi}_y^*$, so that $\bar{r}_f^* = \bar{i}^* + \bar{\epsilon} - \bar{\pi} = \bar{i}^* - \bar{\pi}_y^* = \bar{r}^*$ where $\pi_y^* = p_y^* - p_{y,-1}^*$.

[16]The second term of (35b) implies that inflation has a nonneutral effect on market value and thus real investment. This effect is not treated explicitly and it is considered part of the random term on the assumption that it is relatively small since it depends on the ratio of firms' money balances to the replacement cost of their capital stock (m_K).

Aggregate real consumption, gross investment, exports, and the share of domestic goods in total private spending are approximated by linear functions of their arguments around the steady-state and they are subject to random disturbances which are proportional to the steady-state values of the variables they affect. Thus we have

(36) $C = \overline{C} + c'(\hat{Y}^D - \overline{Y}^D) + u_c\overline{C}, \qquad c' > 0$

(37) $I = \delta\overline{K} + \nu(q - \overline{q})K_{-1} + u_i\delta\overline{K}, \qquad \nu > 0, \overline{q} = \delta/\nu$

(38) $X = \overline{X} + x'(Z - \overline{Z}) + u_x\overline{X}, \qquad x' > 0$

(39) $\theta = \overline{\theta} + \theta'(Z - \overline{Z}) + u_\theta\overline{\theta}, \qquad \theta' > 0$

Substituting (35) into (37) and assuming $K_{-1} = \overline{K}$, we obtain net investment per unit of capital as a function of the domestic and foreign loan rates:

(40) $I_K - \delta = g(r - \overline{r}) + g^*(i^* + \hat{\epsilon} - \hat{\pi} - \overline{r}^*) + (u_i + u_q)\delta$

where $g = \delta q_1$, $g^* = \delta q_1^*$, $g + g^* = -\delta(1 + \overline{\rho})^{-1}$.

Substituting (36)–(39) into (28), linearizing the resulting expression around the steady-state, replacing $\hat{Y}^D$ and $(q - \overline{q})/\overline{q}$ by (34) and (35), and employing the approximation $x - \overline{x} \equiv \log X - \log\overline{X} = X/\overline{X} - 1$, we arrive at the following specification for the economy's effective aggregate demand (IS)

(41) $y^d = \overline{y} + a_1[r - \overline{r}] + a_1^*[i^* + \hat{\epsilon} - \hat{\pi} - \overline{r}^*] + a_2[z - \overline{z}] + u^d$

where

(41a) $a_1 = -m_x s_i \overline{\phi}(1+\overline{\rho})^{-1} < 0$, $a_1^* = a_1(1-\overline{\phi})/\overline{\phi} < 0$,

$m_x = (1-c'\overline{\theta}),^{-1}$

(41b) $a_2 = m_x\eta_z =$
$m_x[(s_c+s_i)(\overline{\theta}+\overline{\theta}'\overline{Z}/\overline{\theta}) + s_x(\overline{X}'\overline{Z}/\overline{X}) - (1-s_g)\,\overline{\theta}^2c'] > 0,$

and

(41c) $u^d = m_x[s_c(u_c+u_\theta) + s_i(u_i+u_q+u_\theta) + s_x u_x]$,

(41d) $s_c = \overline{\theta PC/P_yY}$, $s_i = \overline{\theta\delta PK/P_yY}$, $s_x = \overline{X/Y}$, $s_g = \overline{G/Y}$.

Note that the variables y and z are now expressed in logarithms while the interest rates are expressed in percentages. The coefficient a_2 has been written as the product of the Keynesian impact multiplier (m_x) for an open economy and the elasticity of total aggregate demand with respect to the terms of trade (η_z). It is taken to be positive. The overall random component of effective aggregate demand (u^d) is given by a multiple of an average of the disturbances affecting consumption of domestic goods, investment, and exports, weighted by their respective shares in total output. The investment disturbance reflects two types of shocks: those associated with the real investment decisions of firms (u_i) and those originating in the stock market (u_q). Equilibrium in the market for domestically produced goods requires that effective aggregate demand equal the short-run supply of output, as given by (27).

We consider next the conditions for equilibrium in the financial markets. Since foreign loans (foreign assets) are, in general, imperfect substitutes for domestic loans, it is necessary to examine equilibrium in two financial markets simultaneously so as to determine the equilibrium values of the domestic loan rate and the foreign loan rate in terms of domestic currency [or, equivalently, the domestic loan rate and the exchange rate]. We choose to focus on the conditions for equilibrium in the money market (M1) and in the market for domestic bank credit (LB). The nature of equilibrium in the financial markets depends upon the central bank's choice of an intermediate target. When it controls M1, the supply of domestic bank loans is endogenously determined as a function of the money stock. Conversely, when the central bank attempts to fix the total quantity of bank credit, the supply of money is endogenously determined as a function of the target quantity of credit.

A. Equilibrium and Dynamics under a Money Target

When the central bank aims at achieving a target path for the stock of money M1, the private banks are required to maintain a fraction κ_1 of their demand deposits as reserves in the form of currency or deposits with the central bank. The central bank controls its liabilities (H) so as to achieve the desired monetary target. Employing a conventional log-linear specification for the demand for money, money market equilibrium requires that

$$(42)\quad m1 - p = n_1 i + n_1^*(i^* + \hat{\epsilon}) + k_1 y + v_1;\ n_1, n_1^* < 0,\ k_1 > 0,$$

where m1, p and y are the logarithms of the target quantity of money, the price level and real income, and v_1 represents the random component of the demand for real money balances. The coefficient n_1 is the total semi-elasticity of money demand with respect to the domestic rates of return on time deposits, government bonds, and corporate equity, which are expressed in terms of the domestic loan rate employing (4), (5) and (8).

The market for domestic bank credit is in equilibrium when the supply of domestic credit by private banks and the central bank, $L_b + B_b + B_c$, equals the demand for domestic credit by firms and the government, $L_f + B_g$. The *total* quantity of bank credit, denoted LB, provided by the consolidated banking system is $LB = L_b + B_b + B_c + F_c$. The balance sheet constraint of the central bank, $F_c + B_c = H = H_p + H_b$, and that of private banks, $H_b + B_b + L_b = D + T$, imply that total bank credit is identically equal to the broad measure of the money stock, $LB = M2 = H_p + D + T$. It follows that equilibrium in the market for domestic bank credit requires that

$$(43)\quad M1 + T = \phi(i - i^* - \hat{\epsilon})\ell\,[PK + M1_f] + P[\bar{b}_g + \bar{f}_c] + u_L(M1)\overline{LB},$$

where $b_g = B_g/P$ and $f_c = F_c/P$ are, respectively, the real values of the government debt and net foreign assets of the central bank, and $u_L(M1) = \ell u_\ell + \phi u_\phi$ represents random shifts in firms' borrowing behavior.

Log linearization of (43) around the long-run equilibrium of the economy yields

$$(44)\quad (1-s_T)\Delta m1 + s_T\Delta t = s_L[\phi'(\Delta i-\Delta i^*-\Delta\hat{\epsilon}) + s_K(I_K-\delta) + s_K\Delta p + (1-s_K)\Delta m1] + (1-s_L)\Delta p + u_L(M1)$$

where

$$(44a)\quad s_L = \overline{L}_f/\overline{LB} = \overline{\phi}\ell[\overline{PK} + \overline{M1}_f]/[\overline{M1} + \overline{T}],$$

$$(44b)\quad s_T = \overline{T}/[\overline{M1} + \overline{T}],$$

$$(44c)\quad s_K = \overline{\phi}\ell\overline{PK}/\overline{L}_f = \overline{PK}/[\overline{PK} + \overline{M1}_f],$$

and ϕ' is the elasticity of ϕ with respect to its argument, valued at equilibrium. The parameter s_L is the share of bank loans (or firms' debt) in total bank credit, s_T is the share of time deposits in the total supply of loanable funds by banks, and s_K is the share of capital in the total of firms' assets, valued at reproduction cost. All shares are valued at equilibrium. In deriving (44) we have used our earlier assumption that a policy objective is to maintain b_g and f_c constant. In (44) and in other expressions below we denote by Δx the deviation of a variable x from its steady-state value, i.e., $\Delta x \equiv x - \overline{x}$. As usual m1, t and p denote the logarithms of the corresponding upper case variables.

The demand for time deposits is given by

$$(45)\quad t = p + n_T i + n_T^*(i^*+\hat{\epsilon}) + k_T y + v_T;\ n_T > 0,\ n_T^* < 0,\ k_T > 0.$$

Substituting (45), in deviations from equilibrium, and (40) into (44) and rearranging terms, we obtain an implicit relation between the rates of return, income and inflation which must hold for equilibrium in the bank credit market, given the exogenously determined stock of money:

$$(46)\quad \Delta m1 - \Delta p = \nu_1\Delta i + \nu_1^*\Delta(i^*+\hat{\epsilon}) - s_1 s_T k_T\Delta y - s_1 s_L s_K(g+g^*)\Delta\hat{\pi} + v_L(M1)$$

where

$$(46a)\quad \nu_1 = s_1[s_L(s_K g+\phi') - s_T n_T] < 0,$$

$$(46b)\quad \nu_1^* = s_1[s_L(s_K g^*-\phi') - s_T n_T^*] > 0,$$

$$(46c)\quad s_1 = [1-s_T - s_L(1-s_K)]^{-1} = [\frac{M1}{M2}(1-\phi\ell(\frac{M1}{M1}f))]^{-1} > 1,$$

$$(46d)\quad v_L(M1) = s_1[s_L s_K(u_i+u_q)\delta - s_T v_T + u_L(M1)].$$

The parameters ν_1 and ν_1^* in (46) depend upon the negative interest elasticities of investment and loan demand by firms (g, g*, ϕ') and the interest semi-elasticities of time deposits by households ($n_T > 0$, $n_T^* < 0$). Since s_1, s_L, s_K, s_T, are positive, ν_1 is unambiguously negative. Although the sign of ν_1^* is ambiguous in general, we may assume that $\nu_1^* > 0$ since we expect that the elasticity of firms' demand for domestic loans with respect to changes in the spread between domestic and foreign loans ($\phi' < 0$) and n_T^* are sufficiently large relative to g* and will dominate. Note that if firms hold a small fraction of the stock of money (M1), or if firms' demand for credit depends only on the reproduction cost of their capital stock rather than the total value of their assets, then the parameters of (46) simplify considerably, since in this case $s_K = 1$ and $s_1 = 1/(1-s_T)$.

Equations (27), (41), (42) and (46) form a complete system from which we can determine all variables of interest under a money target. Employing the definitional relationships

$$(47)\quad \hat{\epsilon} = \hat{e}_{+1} - e, \hat{\pi} = \hat{p}_{+1} - p, p = p_y + (1-\bar{\theta})z, z = e + p_y^* - p_y,$$

these equations can be expressed in terms of the four variables [y, p, z, r], the anticipated values of the price level and the terms of trade $[\hat{p}_{+1}, \hat{z}_{+1}]$, the exogenously determined stock of money, the real rate on foreign loans adjusted for foreign inflation, $r^* = i^* - (p^*_{y,+1} - p^*_y)$, and four disturbance terms

$$(48)\quad \Delta y^d = a_1\Delta r + a_1^*\bar{\theta}[\Delta\hat{z}_{+1} - \Delta z] + a_2\Delta z + a_1^*\Delta r^* + u^d$$

$$(49)\quad \Delta y^s = \alpha_1[p - \hat{p}] + \alpha_2\Delta z + u^s$$

$$(50)\quad \Delta ml - \Delta p = n_1\Delta r + n_1^*\bar{\theta}[\Delta\hat{z}_{+1} - \Delta z] + k_1\Delta y + (n_1 + n_1^*)[\hat{p}_{+1} - p] + n_1^*\Delta r^* + v_1$$

$$(51)\quad \Delta ml - \Delta p = \nu_1\Delta r + \nu_1^*\bar{\theta}[\Delta\hat{z}_{+1} - \Delta z] - s_1 s_T k_T\Delta y - s_1 s_T(n_T + n_T^*)[\hat{p}_{+1} - p] + \nu_1^*\Delta r^* + v_L(M1)$$

Anticipations are formed "rationally", so that $\hat{x}_{t+i} = E[x_{t+i} | I_{t-1}]$, $(i=0,1)$, where I_{t-1} is the public's information set which includes knowledge of the economy's structure. It immediately follows from (49) that output is anticipated to deviate from equilibrium only if the public anticipates a deviation of the terms of trade from the long-run equilibrium:

$$(52)\quad \Delta\hat{y} = \alpha_2\Delta\hat{z}\ ,\ \alpha_2 = -(1-\bar{\theta})/\alpha.$$

The anticipated terms of trade and price level depend on the anticipated path of the money target and the anticipated current and future values of the world real rate, as specified by the following system of difference equations, which ensures the consistency of expectations with the model's economic structure:

$$(53)\quad \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} \Delta\hat{z} - \Delta\hat{z}_{+1} \\ \Delta\hat{p} - \Delta\hat{p}_{+1} \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} \begin{bmatrix} \Delta\hat{z} \\ \Delta\hat{p} \end{bmatrix} + \begin{bmatrix} \hat{f}_1 \\ \hat{f}_2 \end{bmatrix}$$

where

$$a_{11} = \bar{\theta}(a_1^* \nu_1 - a_1\nu_1^*), \qquad a_{12} = a_1 s_1 s_T(n_T + n_T^*),$$
$$a_{21} = \bar{\theta}(a_1^* n_1 - a_1 n_1^*), \qquad a_{22} = -a_1(n_1 + n_1^*),$$
$$b_{11} = \nu_1(a_2 - \alpha_2) + a_1\alpha_2 s_1 s_T k_T, \quad b_{12} = -a_1,$$
$$b_{21} = n_1(a_2 - \alpha_2) - a_1\alpha_2 k_1, \qquad b_{22} = -a_1,$$
$$\hat{f}_1 = a_1\Delta\hat{m}1 + a_{11}\Delta\hat{r}^*/\bar{\theta}, \qquad \hat{f}_2 = a_1\Delta\hat{m}1 + a_{21}\Delta\hat{r}^*/\bar{\theta}.$$

This system is obtained by determining the "rationally" anticipated relations between all variables in (48)–(51), eliminating the anticipated domestic real rate, and replacing $\Delta\hat{y}$ by (52). The set of equations (48)–(53) provides a complete characterization of the stochastic and dynamic properties of the economy under an M1 target.

B. Equilibrium and Dynamics under a Credit Target

We consider next the implications for the short-run equilibrium of the economy of a monetary policy which aims at controlling the total quantity of bank credit, LB, provided by the consolidated banking system. Since LB = M2, the supply of the narrow measure of the stock of money under the credit target is given by $M1^s = LB - T$; and equilibrium in the money market, expressed in deviations from the steady-state, requires that

$$(54)\quad \Delta\ell b = s_M\Delta m1 + (1-s_M)\Delta t, \quad s_M = \overline{M1}/\overline{M2} = (1-s_T).$$

where ℓb is (the logarithm of) the target quantity of bank credit. Employing (42) and (45), we express the condition for equilibrium in the money market as

$$(55)\quad \Delta\ell b - \Delta p = n_L\Delta i + n_L^*\Delta(i^* + \hat{\epsilon}) + k_L\Delta y + v_2$$

where

$$n_L = s_M n_1 + (1-s_M)n_T, \; n_L^* = s_M n_1^* + (1-s_M)n_T^*,$$
$$k_L = s_M k_1 + (1-s_M)k_T, \; v_2 = s_M v_1 + (1-s_M)v_T.$$

Under a total bank credit target, equilibrium in the market for bank credit requires that

$$(56)\quad LB = \phi(i - i^* - \hat{\epsilon})\ell[PK + M1_f] + P[\bar{b}_g + \bar{f}_c] + u_L(LB)\overline{LB}.$$

Substitution of (42) and (40) into (56) and log-linearization of the resulting expression around the steady-state yields

(57) $\Delta\ell b - \Delta p = \nu_L \Delta i + \nu_L^* \Delta(i^* + \hat{e}) + s_L(1-s_K)k_1\Delta y - s_L s_K(g+g^*)\Delta\hat{\pi} + v_L(LB)$

where

(57a) $\nu_L = s_L[s_K g + \phi' + (1-s_K)n_1] < 0,$

(57b) $\nu_L^* = s_L[s_K g^* - \phi' + (1-s_K)n_1^*] > 0,$

(57c) $v_L(LB) = s_L s_K(u_i + u_q)\delta + s_L(1-s_K)v_1 + u_L(L).$

Equations (55) and (57) determine the conditions for equilibrium in the financial markets under the bank credit target. They can be expressed in terms of the four variables [y, p, z, r] and their anticipated values, employing (47):

(58) $\Delta\ell b - \Delta p = n_L \Delta r + n_L^* \bar{\theta}[\Delta\hat{z}_{+1} - \Delta z] + k_L \Delta y + (n_L + n_L^*)[\hat{p}_{+1} - p] + n_L^* \Delta r^* + v_2$

(59) $\Delta\ell b - \Delta p = \nu_L \Delta r + \nu_L^* \bar{\theta}[\Delta\hat{z}_{+1} - \Delta z] + s_L(1-s_K)k_1\Delta y + s_L(1-s_K)(n_1 + n_1^*)[\hat{p}_{+1} - p] + \nu_L^* \Delta r^* + v_L(LB)$

The "rationally" anticipated price level and terms of trade are determined according to

(60) $$\begin{bmatrix} a'_{11} & a'_{12} \\ a'_{21} & a'_{22} \end{bmatrix} \begin{bmatrix} \Delta\hat{z} - \Delta\hat{z}_{+1} \\ \Delta\hat{p} - \Delta\hat{p}_{+1} \end{bmatrix} = \begin{bmatrix} b'_{11} & b'_{12} \\ b'_{21} & b'_{22} \end{bmatrix} \begin{bmatrix} \Delta\hat{z} \\ \Delta\hat{p} \end{bmatrix} + \begin{bmatrix} \hat{f}'_1 \\ \hat{f}'_2 \end{bmatrix}$$

where

$a'_{11} = \bar{\theta}(a_1^* \nu_L - a_1 \nu_L^*),$ $a'_{12} = -a_1 s_L(1 - s_K)(n_1 + n_1^*),$

$a'_{21} = \bar{\theta}(a_1^* n_L - a_1 n_L^*),$ $a'_{22} = - a_1(n_L + n_L^*),$

$b'_{11} = \nu_L(a_2 - \alpha_2) - a_1\alpha_2 s_L(1-s_K)k_1,$ $b'_{12} = - a_1,$

$b'_{21} = n_L(a_2 - \alpha_2) - a_1\alpha_2 k_L,$ $b'_{22} = - a_1,$

$\hat{f}'_1 = a_1\Delta\hat{\ell b} + a_{11}\Delta\hat{r}^*/\bar{\theta},$ $\hat{f}'_2 = a_1\Delta\hat{\ell b} + a_{21}\Delta\hat{r}^*/\bar{\theta}.$

Equations (58)–(59), together with (48)–(49) and (60), provide a complete description of the stochastic and dynamic properties of the four basic variables [y, p, r, z] under the credit target.

IV. The Stability of Prices and Output When Domestic and Foreign Loans Are Close Substitutes

In this section we compare the relative efficiency of the money and credit targets on the basis of two criteria: (1) their implications for the dynamic stability of aggregate output and the price level, and (2) their effectiveness in minimizing unanticipated output and price fluctuations induced by stochastic shocks. Due to space limitations, our analysis will focus on the case of close substitutability between domestic and foreign loans. This case is considered by many as the most relevant empirically in a world of high capital mobility; and it has been suggested that close substitutability between domestic and foreign debt undermines the feasibility of a credit-oriented policy in an open economy.[17] We shall show, by contrast, that credit policies are feasible even if borrowers view domestic and foreign loans as perfect substitutes so long as net lenders view domestic and foreign assets as imperfectly substitutable. The asymmetry between lenders' and borrowers' behavior may be traceable to their different attitudes towards risk or to differential access to capital markets and to hedging foreign exchange risk.

When domestic and foreign loans are highly substitutable, the proportion of borrowing in domestic currency $\phi(i - i^* - \hat{\epsilon})$ is very sensitive to the interest rate differential. So, formally, this case can be examined by studying the properties of our model as $\phi' \to -\infty$. As may be verified by inspecting (46) under the M1 target and (57) under the credit target, this implies that (in both cases) the credit market equilibrium condition reduces to the requirement

$$(61) \qquad i = i^* + \hat{\epsilon} \quad \text{or} \quad r = i^* + \hat{\epsilon} - \hat{\pi} = r^* + \bar{\theta}(\hat{z}_{+1} - z)$$

where $r^* = i^* - (\hat{p}^*_{y,+1} - p^*_y)$. The first of these equations shows that the domestic nominal loan rate (i) must equal the foreign nominal loan rate expressed in domestic currency units $(i^* + \hat{\epsilon})$. The second relationship between domestic and foreign real rates is obtained by using (47).

A. Anticipated Fluctuations under the Money and the Credit Targets

We first examine the implications of the two targets for the dynamic stability of the anticipated output and price level. When $\phi' \to -\infty$, the system (53) describing the anticipated path of the terms of trade, and thus output, and of the price level under the M1 target becomes recursive with the interesting property that the terms of trade (z) and thus output (y) are independent of nominal variables. The characteristic roots of (53) are:

$$(62) \qquad \lambda_z = \left[\frac{(a_1 + a_1^*)\bar{\theta}}{(a_1 + a_1^*)\bar{\theta} - a_2 + \alpha_2}\right]^{-1}, \quad \lambda_p(M1) = \left[\frac{-(n_1 + n_1^*)}{1 - (n_1 + n_1^*)}\right]^{-1}$$

Both roots are greater than one, since all parameters, except for $\bar{\theta}$ and a_2, are negative. This ensures that expectations of p and z are well behaved (bounded) functions of the expected future paths of the exogenous variables $\hat{m}1$ and $\hat{r}^*$. The "forward solution" of (53) is stable.

[17]Of course, perfect capital mobility does not imply perfect substitutability between domestic and foreign assets (as it is often assumed). In general, the empirical evidence supports the proposition that domestic and foreign assets are imperfect substitutes. See Obstfeld (1980) and Hansen and Hodrick (1980).

The system (60) describing the behavior of $\hat{z}$ and $\hat{p}$ under the credit target is also recursive when $\phi' \to -\infty$. The characteristic root, λ_z, of the first equation of (60) is exactly the same as under the money target, confirming that nominal factors do not affect the anticipated path of the terms of trade and output. But the other characteristic root, which relates to the dynamic behavior of $\hat{p}$, is different,

$$(63) \qquad \lambda_p(LB) = \left[\frac{-(n_L + n_L^*)}{1 - (n_L + n_L^*)}\right]^{-1} \gtrless 0,$$
$$n_L + n_L^* = s_M(n_1 + n_1^*) + (1 - s_M)(n_T + n_T^*) \gtrless 0$$

Since the dynamic behavior of output is independent of the chosen financial target, we concentrate on a comparison of the behavior of the anticipated price level under the two targets. Equations (53) and (60) imply that, when $\phi' \to -\infty$, the anticipated price level in period t can be expressed in terms of the anticipated path of the target variable $\hat{a}$, over the interval (t, τ), and the anticipated price level at $\tau + 1$, according to

$$(64) \qquad \hat{p}_t = (1-\tilde{n})^{-1} \sum_{j=0}^{\tau-t} [(-\tilde{n}/(1-\tilde{n}))^j \hat{a}_{t+j} + (\bar{p} - \bar{a})] + (-\tilde{n}/(1-\tilde{n}))^{\tau+1} \hat{p}_{\tau+1}$$

where $\tilde{n}$ is a parameter characteristic of the financial target.

When $\hat{a} = \hat{m}1$, $\tilde{n} = n_1 + n_1^* \leq 0$ and $0 \leq -\tilde{n}/(1-\tilde{n}) < 1$. Letting $\tau \to \infty$, we obtain the familiar result that if the sequence of the anticipated stock of money $\{\hat{m}1\}_t^\infty$ is bounded, then the sum in (64) converges and the anticipated price level is finite provided that[18]

$$(65) \qquad \lim_{\tau \to \infty} (-\tilde{n}/(1-\tilde{n}))^{\tau+1} \hat{p}_{\tau+1} = 0.$$

The imposition of this terminal condition excludes the occurence of "bubbles," fluctuations in the anticipated price level which are not related to anticipated changes in the stock of money but which are induced by anticipations of price changes in the distant future. Equation (65) assures the uniqueness of $\hat{p}$.

When $\hat{a} = \hat{\ell b}$, $\tilde{n} = n_L + n_L^* = s_M(n_1 + n_1^*) + (1-s_M)(n_T + n_T^*) > (n_1 + n_1^*)$ since $(n_T + n_T^*) \geq 0$. Note that although $n_T > 0$ and $n_T^* < 0$, the households' budget constraint implies that the net effect is nonnegative. It follows that under a credit (M2) target $\tilde{n}$ may be negative or positive. As long as $\tilde{n} < 0$, the weights $(-\tilde{n}/(1-\tilde{n}))^j$ in (64) are positive and less than one, so that a bounded path of bank credit $\{\hat{\ell b}\}_t^\infty$ will result in a finite $\hat{p}$ provided that (65) holds. Since the weights in (64) under the credit or M2

[18]See Sargent and Wallace (1973) for the continuous time analog.

target are smaller and are decreasing at a faster rate than under the money target, the "announcement effects" on the current $\hat{p}$ of future changes in the credit target will be less pronounced than the effect of changes in the money target. Indeed, if the total interest elasticities of the demands for money ($n_1 + n_1^*$) and for time deposits ($n_T + n_T^*$) and the share of M1 in M2 are such that $\tilde{n} = 0$, then $\hat{p}_t = \ell \hat{b}_t + (\bar{p} - \ell\bar{b})$, which eliminates all announcement effects and the possibility of bubbles, since (65) is identically equal to zero. If $\tilde{n} > 1/2$, λ_p is less than one in absolute value, in which case the price level is unbounded for anticipated bounded paths of the credit aggregate. Thus, under "rational," forward-looking expectations the credit target is potentially unstable. This potential may be serious as we move to a world in which interest bearing money instruments are becoming prevalent.[19]

In comparing the relative effectiveness of the two targets in mitigating unanticipated price and output fluctuations, we will assume that the economy is dynamically stable under both targets in the sense that public anticipations are well-defined, bounded functions of the anticipated paths of the targets. Under the credit target, this amounts to imposing the restriction that $n_L + n_L^* < 1/2$.

B. Unanticipated Fluctuations under the Money and the Credit Targets

Turning to the characteristics of unanticipated fluctuations of price and output, we use (61) to eliminate r wherever it appears in (48) and (50) and rewrite the IS curve as

$$\Delta y^d = (a_1 + a_1^*)(\Delta r^* + \bar{\theta}\Delta\hat{z}_{+1}) - a_z \Delta z + u^d, \tag{66}$$
$$a_z = (a_1 + a_1^*)\bar{\theta} - a_2 < 0.$$

The coefficient a_z represents the total effect on aggregate demand of the terms of trade, z, being the sum of the direct effect a_2 and the indirect effect via the expected real interest rate $\bar{\theta}(a_1 + a_1^*)$. Employing (66) we eliminate z from the money market equilibrium condition (50) and obtain the relationship between aggregate demand and the price level, necessary for simultaneous equilibrium in the money and goods markets under the M1 target. The "aggregate demand schedule," expressed in deviations from the anticipated levels of output and the price level, is given by:

$$\text{D(M1)}: (y - \hat{y}) = d_1(m1 - \hat{m}1) - \gamma_1(p - \hat{p}) + \epsilon_1^d \tag{67}$$

where

$$d_1 = a_z\beta_1 > 0,\ \beta_1 = (a_z k_1 + (n_1 + n_1^*)\bar{\theta})^{-1} < 0, \tag{67a}$$
$$\gamma_1 = [1 - (n_1 + n_1^*)]d_1 > 0,$$

$$\epsilon_1^d = \beta_1[(n_1 + n_1^*)a_2(r^* - \hat{r}^*) - a_z v_1 + (n_1 + n_1^*)\bar{\theta}u^d]. \tag{67b}$$

[19]This result parallels closely the findings of Rozwadowski (1983) with reference to an M2 target.

The stochastic term ϵ_1^d includes the unanticipated deviations of the world real interest rate and it also depends on the random components of money demand (v_1) and of the "effective" demand for output (u^d).

Short-run equilibrium in the goods market implies another relationship between unanticipated fluctuations of output and the price level. Equality of "effective" demand (48) and aggregate supply (49) requires an (unanticipated) adjustment of the terms of trade in response to unanticipated movements of p and r^* and the disturbances u^d and u^s. The resulting short-run equilibrium level of output is then given by:

(68) $$\text{YY:} \quad (y - \hat{y}) = (1/\alpha')(p - \hat{p}) + \epsilon_1$$

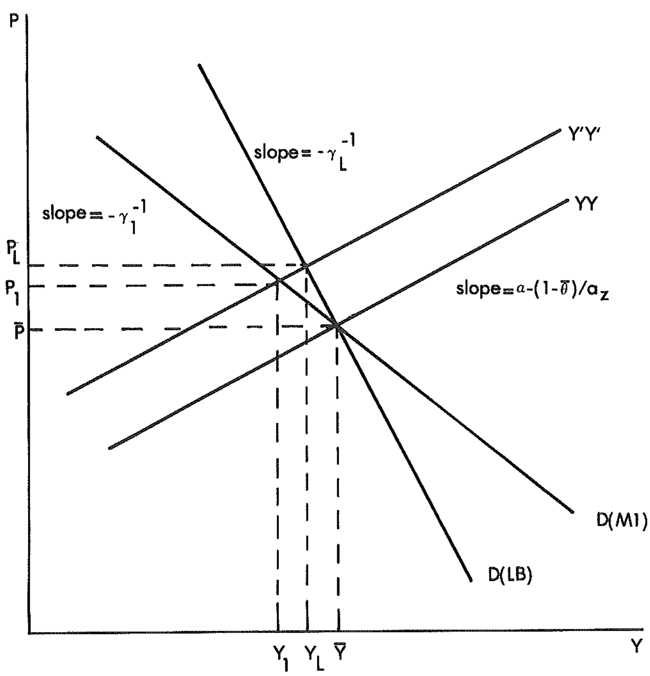
where

(68a) $$\alpha' = \frac{a_z + \alpha_2}{a_z \alpha_1} = \alpha - \frac{(1 - \bar{\theta})}{a_z} > 0,$$

(68b) $$\epsilon_1 = (a_z + \alpha_2)^{-1}[\alpha_2(a_1 + a_1^*)(r^* - \hat{r}^*) + \alpha_2 u^d + a_z u^s].$$

Figure 1 shows the aggregate demand schedule (67) under the money target, denoted D(M1), and the goods market equilibrium condition (68),

Figure 1



denoted YY. The slope of the YY schedule, α', depends upon the slope α of the short-run Phillips-type tradeoff, the elasticity of aggregate demand with respect to the terms of trade, and the share of imports in total private spending $\bar{\theta}$. The position of YY is determined by unanticipated fluctuations in the world real rate and real demand and supply shocks.

Simultaneous solution of (67) and (68) yields the following "reduced forms" describing the way random disturbances and unanticipated deviations of the stock of money induce unanticipated fluctuations of output and the price level when the central bank employs a money target:

(69) $$(y-\hat{y}) = (1+\alpha'\gamma_1)^{-1}[d_1(m1-\hat{m}1)+\epsilon_1^d+\alpha'\gamma_1\epsilon_1],$$

$$(p-\hat{p}) = \alpha'(1+\alpha'\gamma_1)^{-1}[d_1(m1-\hat{m}1)+\epsilon_1^d-\epsilon_1].$$

The derivations of the unanticipated components of y and p under the credit target run parallel, so we need only point out that since the IS and supply schedules (48) and (49) are common to both systems and since in both cases credit market equilibrium reduces to (61), all differences arise from the fact that the money market equilibrium condition is now (58) instead of (50).

The aggregate demand schedule under the credit target, expressed in deviations from the anticipated levels of all variables, is

(70) $$D(LB):\ (y-\hat{y}) = d_L(\ell b-\hat{\ell b})-\gamma_L(p-\hat{p})+\epsilon_L^d$$

where

(70a) $$d_L = a_z\beta_L,\ \beta_L = (a_zk_L+(n_L+n_L^*)\bar{\theta})^{-1},\ \gamma_L = [1-(n_L+n_L^*)]d_L,$$

(70b) $$\epsilon_L^d = \beta_L[(n_L+n_L^*)a_2(r^*-\hat{r}^*)-a_zv_L+(n_L+n_L^*)\bar{\theta}u^d].$$

The sign of d_L need not be positive, in general, since β_L may be of either sign depending upon the sign of $(n_L+n_L^*)$. Stability of the equilibrium in the goods and the money markets requires that $\beta_L<0$ which we assume in what follows. This ensures that an unanticipated increase in bank credit will increase aggregate demand ($d_L>0$). The D(LB) schedule is also illustrated in Figure 1 with a slope which is smaller in absolute value than the slope of D(M1). This need not be always the case since the relative steepness of the two schedules depends upon a measure of the "degree of openness" of the economy as we discuss below. The YY schedule is not affected by the choice of the intermediate target.

The unanticipated fluctuations in output and the price level under a credit strategy are given by

(71) $$(y-\hat{y}) = (1+\alpha'\gamma_L)^{-1}[d_L(\ell b-\hat{\ell b})+\epsilon_L^d+\alpha'\gamma_L\epsilon_L]$$

$$(p-\hat{p}) = \alpha'(1+\alpha'\gamma_L)^{-1}[d_L(\ell b-\hat{\ell b})+\epsilon_L^d-\epsilon_L]$$

The coefficients d_L, γ_L and the shock ϵ_L^d are defined in (70), α' and $\epsilon_L \equiv \epsilon_1$, in (68). By comparing (69) and (71) we can find conditions under which a target promotes greater stochastic stability. In making these comparisons, we assume that the central bank fully announces and successfully enforces the path of the chosen target, so that the terms $(m1 - \hat{m}1)$ and $(\ell b - \hat{\ell} b)$ in (69) and (71) do not contribute to aggregate fluctuations, and we concentrate on the price and output effects of the four disturbances (u^s, u^d, v_1, v_L) under the two targets.

When the supply shock is predominant, then the credit target will result in smaller output fluctuations than the money target if the economy is "sufficiently open" in the sense that

$$\text{(72)} \qquad \bar{\theta}/a_z > \omega(k_1 - k_L) - k_1$$

where $a_z = (a_1 + a_1^*)\bar{\theta} - a_2(\theta', \bar{\theta}) < 0$, $\omega = [1 - (n_1 + n_1^*)]/[(n_L + n_L^*) - (n_1 + n_1^*)]$. If the income elasticities of the demand for M1 and M2 are equal, (72) reduces to

$$\text{(72')} \qquad a_2(\theta', \bar{\theta})/\bar{\theta} > 1/k_1 + (a_1 + a_1^*).$$

The ratio of $a_2/\bar{\theta}$, the elasticity of aggregate demand with respect to the terms of trade divided by the share of domestic goods in total private spending, is a measure of the degree of openness of the economy. The role of this measure in determining the output effects of supply shocks under the two targets can be explained as follows. Although the main difference in the functioning of the economy under the two targets relates to the nature of equilibrium in the money markets, the extent to which an unanticipated change in the price level (supply shock) affects aggregate demand under M1 or LB is the outcome of an interaction between the financial and goods markets which depends on the responsiveness of aggregate demand to the adjustment in the terms of trade necessary to accommodate the shock. This is illustrated in Figure 1 which shows that the effects of a supply shock depends only on the slopes of the demand schedules under the two targets. Condition (72) ensures that $\gamma_1 > \gamma_L$ so that D(M1) is less steep than D(LB). The figure also makes clear that supply shocks will induce larger price fluctuations under the credit strategy than under the money strategy if (72) holds. It follows that the choice of a target imposes an unavoidable tradeoff between price and output variability. If one target is superior in minimizing output fluctuations, it is inferior in reducing price fluctuations.

The role of the degree of openness can be further clarified by noting that if condition (72′) holds for a closed economy ($a_2 = 0$, $\bar{\theta} = 1$, $a_1^* = 0$), it will also hold for an open economy ($a_2 > 0$, $1 > \bar{\theta} > 0$, $a_1^* < 0$). In this case openness strengthens the condition. On the other hand, if (72′) does not hold for a closed economy, it may hold for an economy which is sufficiently open. It is thus interesting to observe that (72′) is not likely to be valid in a closed economy for representative values of the parameters k_1 and a_1. Therefore, the degree of openness plays a critical role in determining the relative effectiveness of the credit target in the presence of supply shocks.

The degree of openness is also important in the case of a shock to aggregate effective demand, u^d. The credit target delivers an unambiguously more stable level of output than the M1 target, if the following inequalities are jointly satisfied

(73) $$(n_L+n_L^*)<1-\bar{\theta}$$

(74) $$[(n_L+n_L^*)-(n_1+n_1^*)]\bar{\theta}+\alpha^{-1}[k_1(n_L+n_L^*)-k_L(n_1+n_1^*)] -(1-\bar{\theta})\alpha^{-1}(k_1-k_L)>0$$

These additional conditions are not very restrictive. Equation (73) is obviously satisfied for the likely case of $(n_L+n_L^*) \leq 0$. More generally, in view of the dynamic stability condition imposed above, that $(n_L+n_L^*) <1/2$, (73) is always true if $\bar{\theta}<1/2$, that is if domestic goods are as important in private spending as imports. Condition (74) indicates that the extent of output fluctuations under the two targets depends, ceteris paribus, on the degree of price flexibility, measured by the slope α of the Phillips tradeoff. This is intuitively sensible since in an open economy the demand shock induces a shift in both the D and YY schedules of Figure 1. Notice, however, that (74) is always satisfied when the income elasticities k_1, k_L are equal. In this case the main restriction conditioning the relative outcome of u^d on Y under the two targets is (73). Neither target, however, dominates on the basis of a simple criterion with respect to its implications for price volatility when effective demand is the main source of instability.

We next turn to shocks that originate in asset markets, the velocity shock v_1 associated with money demand under an M1 target and the velocity shock $v_1(L)$ under a credit target which corresponds to the stochastic component of the total demand for all bank liabilities and may be labelled v_2. Three possible outcomes are of interest of which the first two are easily analyzed. First, if the random shock reflects a shift in demand between M1 and time deposits, that is $s_M v_1 = -(1-s_M)v_T$ then, $v_2 = 0$ and the credit target is superior since it provides full insulation by allowing banks to accommodate the shift. Second, if the shock is a shift in demand from time deposits to a third asset (say foreign time deposits), then $v_1 = 0$ and M1 provides full insulation from the effects of the shock while credit does not. The third possibility is that $v_1 \neq 0$ and $v_2 = s_M v_1 \neq 0$: there are unanticipated shifts in the demand for M1 at the expense of a third asset (perhaps foreign money). In this case neither target provides full insulation but it can be shown that as long as (72) holds—so long as the economy is sufficiently open—the credit target dampens output fluctuations more effectively and is therefore the better alternative.

The above analysis has shown that the total bank credit or M2 target *can* insulate the economy better than the conventional money target from various stochastic shocks. It is equally evident, however, that it is not possible to reach a general verdict concerning the relative superiority of the two targets. Their effectiveness depends not only upon the origin of disturbances, but also on the degree of openness of the economy and the degree of price flexibility. Moreover, a single target need not provide the most effective means of minimizing price and output variability simultaneously. Finally, our analysis has abstracted from an examination of the implementation problems and uncertainty associated with the control of the two targets by the central bank.[20] This is an important topic for future research. It should be pointed out, however, that although a broad credit aggregate may not be as precisely controllable as the stock of money, the empirical evidence suggests that its control is possible and fairly accurate [Kopcke (1983)]; consequently, the relative effectiveness of the credit aggregate in stabilizing the price level and output remains a basic criterion for judging its usefulness as a target and guide of policy.

VI. Concluding Remarks

This paper has developed a macroeconomic model which stresses the role of credit markets in the monetary mechanism and incorporates sufficient institutional detail to allow an analysis of the relative effectiveness of alternative forms of monetary and credit control. The model formalizes the determinants of equilibrium in the credit markets in terms of the behavior of households (net lenders) and corporate firms (net borrowers) who consider domestic and foreign financial instruments as imperfect substitutes. The model defines three monetary aggregates and two credit aggregates which may serve as policy targets. We have employed this model to compare the relative efficiency of two widely used and discussed targets: the narrow measure of the stock of money and the total quantity of credit provided by the consolidated banking system. Our analysis has focused on the case when firms regard domestic and foreign instruments as perfect substitutes but households consider them as imperfect substitutes.

The efficiency of the two targets is evaluated on the basis of two criteria: (1) their implications for the dynamic stability of the economy, and (2) their effectiveness in minimizing unanticipated fluctuations of aggregate output and the price level in the presence of various shocks. The analysis is carried out under freely floating exchange rates and under the assumption that anticipations are formed "rationally." Although rational expectations and the absence of intertemporal price and wage rigidities imply that anticipated changes in the quantities of money and credit cannot affect real output, the central bank's decision to formulate a policy in terms of a money or a credit target affects the unanticipated fluctuations of output and the price level as well as the dynamic stability of the anticipated price level.

The results of this analysis are summarized in sections IV.A and IV.B and need not be repeated here. Three general observations, however, are worth reemphasizing. First, a measure of the degree of openness of the economy has emerged as an important factor which conditions the relative effectiveness of the two targets given the origin and relative significance of stochastic shocks and the relative magnitudes of certain key behavioral parameters. Second, in the presence of certain disturbances a single target

[20]Angeloni and Galli (1983) analyze how the effectiveness of monetary policy is affected by disequilibrium and quantitative ceilings.

can not deliver the best performance with respect to both output and price variability. Third, when borrowers regard domestic and foreign loans as perfect substitutes, the effectiveness of the credit target depends, ceteris paribus, upon the stability of the demand for bank liabilities (supply of domestic bank credit) but it is independent of the presumably fairly unstable demand for domestic credit. However, when domestic and foreign loans are also viewed as imperfect substitutes, a case examined in a forthcoming paper, the stability of the demand for domestic credit and the firms' financial structure and investment decisions become important factors in determining the efficiency of the credit target. In general, the answer to the question of whether credit or money serves as the best intermediate target must be an eclectic one. No single target can be expected to dominate for all stochastic environments and independent of the structure and degree of openness of an economy. In principle, as B. M. Friedman (1983) has also advocated, the best policy is a combination policy which monitors both money and credit targets simultaneously. Although such a policy may be difficult to implement, it provides the central bank with more information on the origin of disturbances and a more effective means of attaining the dual goal of price and output stability.

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Discussion

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The useful task that Papademos and Razwadoski (P-R) have set themselves is to evaluate the relative merits of narrow and broad monetary aggregates as intermediate targets for monetary policy in an open economy. Specifically they focus on the comparison between M1, defined as currency plus fixed interest demand deposits, and M2, which, in addition, includes time deposits that are assumed to yield a market determined rate of interest.

Although this distinction is specific to the United States (since in several countries rates on both types of deposits are regulated, while in others, such as Italy, both are free), the analysis is of general interest since it really involves the issue of whether it is desirable for large portions of the money stock to yield a variable rate of interest.

Credit enters the analysis through accounting indentities: since M2 comprises all banks' liabilities in the model, it is also equal to a perfectly legitimate, although rather unconventional, definition of total bank credit, in which the central bank's balance sheet is consolidated with that of private financial institutions.

It is worth noting that the authors are not concerned with the issue of why intermediate targets should be set at all. B. Friedman (1975) and more recently W. Buiter (1980) have convincingly argued that the mere existence of stochastic disturbances is not a sufficient justification for following a constant x policy (whether aggregates or interest rates). Except under particular conditions, a discretionary policy that involves looking at more than one factor always dominates constant x policies.

Other reasons must be invoked for having targets and especially (if the issue is not to be trivial) for keeping them unchanged for a prolonged period of time, such as several months or quarters. These reasons can range from the recognition of the linkage between credible targets and market expectations to the need for making sure that policies have the necessary political consensus (see A. Lamfalussy (1981)).

Neither are the authors concerned with the issue originally raised by W. Poole (1970) as to whether it is preferable to pursue a target in terms of interest rates or aggregates.

On both these grounds, this research can be classified as a second- or third-best analysis. Taking it for granted that in most countries targets are set and that they are often set in terms of aggregates for reasons which are extraneous to the analysis and in part probably not strictly economic, the authors ask what difference it makes whether an M1 or an M2 target is set and whether the choice between the two should be influenced by the finan-

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cial structures of individual countries.

It is perhaps of some interest that the answer to the second question is negative in the sense that the ranking of targets does not depend—within the P-R model—on such structural features as the composition of firms' financing, the weight of intermediaries in total assets, the size of markets etc.

This fact considerably simplifies the analysis since it can focus on a streamlined IS-LM-aggregate supply model of an open economy with perfect substitutability between domestic and foreign securities.

The basic difference, stressed by P-R, between the two aggregates is the greater interest elasticity of M1. On the basis of this difference they put forward two arguments relating to the stochastic stability of a final target (real output) and to the dynamic stability of the price level under the assumption of rational expectations. I will consider the three issues separately (interest elasticity, stochastic stability, dynamic stability).

1. Interest elasticities of M1 and M2

The authors contend that the total (semi) elasticity of the demand for M2 is smaller than that for M1, because the rate on time deposits (which accounts for the difference between the two aggregates) varies with the general level of interest rates, while that on demand deposits is fixed.

This may be true empirically in some countries, but can be questioned on theoretical grounds since M1 can be very interest *inelastic* (if it is held primarily for transaction purposes), while increases in the general level of interest rates may induce agents to shift from time deposits into alternative securities if, due to reserve requirements, such increases are accompanied by a widening of the interest differential.

Assuming that the P-R presumption is correct, there is still the question, which plays an important role in their discussion of dynamic stability, as to whether the interest semielasticity of M2 can be positive. It seems to me that this should be considered even more unlikely than the authors suggest: the implication is that when the rate on alternative assets is raised exogenously (say, because of foreign countries' policies) and banks start to lose deposits, they will react by raising the deposit rate by such large amounts as to end up, in the final equilibrium, with a larger stock of deposits than in the initial situation. Reserve requirements combined with banks' optimizing behavior should rule out this possibility.

2. Stochastic stability under M1 and M2 policies

Proceeding under the above stated presumption (that M2 is less interest elastic than M1), P-R provide a ranking of the two targets based on a comparison of the variance of real output in the face of shocks originating in the goods market (demand and supply) and in the financial system. They thus extend the Poole (1970) analysis to an open system with a supply side.

The basic result is that, in the face of supply shocks, an M2 target is superior if the following condition (72′ in the paper) is satisfied

$$(1) \qquad -(a_1 + a_1^*) + \frac{a_2}{\overline{\theta}} > \frac{1}{k_1}$$

where
a_2 = terms of trade elasticity of aggregate demand
$\overline{\theta}$ = share of domestic goods in total private demand
k_1 = income elasticity of money demand
a_1 = domestic interest elasticity of aggregate demand
a_1^* = foreign interest elasticity of aggregate demand

In order to clarify the meaning and relevance of this condition, we can ask the following questions:
a) how does this condition differ from its closed economy analogue?
b) what is the role of the degree of openness of the economy?
c) how general is the result?

a) As to the first question, it can be shown that condition (1) closely parallels the condition which ensures the superiority of an M2 target in a closed economy.

Intuitively, the issue is whether is it desirable to have a steep LM (M2 target) in the face of supply shocks. The general presumption is that this is not the case. A supply shock can in fact be viewed as a shock to the (real) supply of money: its effects are thus the same as those of a financial shock in the traditional Poole fixed price framework. As shown by S. Fisher (1977), monetary accomodation is generally preferable.

The ranking may differ if changes in the price level enter the IS schedule, as they do in the P-R model, since they affect the expected rate of change of prices and thus the real rate of interest. This point can be clarified by considering the following standard model which is the closed economy analogue of the P-R model (P-R symbols are used):

$$(2) \qquad m - p = n_1 i + k_1 y + v_1 \qquad n_1 < 0 \quad k_1 > 0 \quad \text{LM}$$

$$(3) \qquad y = a_1\left[i - (\hat{p}_{+1} - p)\right] + u^d \qquad a_1 < 0 \quad \text{IS}$$

$$(4) \qquad y = \alpha_1\left[p - \hat{p}\right] + u^s \qquad \alpha_1 > 0 \quad \text{aggregate supply}$$

where $\hat{p}_{+1}$ is the expectation held today for tomorrow's price level, while $\hat{p}$ is the expectation held yesterday for today.

If we assume, following P – R, that expectations are rational, all variables perfectly flexible and disturbances serially uncorrelated, we can impose the condition that expected prices are always equal to their time invariant equilibrium level ($\bar{p}$).

From (2) and (3) we can then find an expression for the aggregate demand schedule:

(5) $$p = \frac{m}{1 - n_1} - y(\frac{n_1 + a_1 k_1}{(1-n_1)a_1}) + c$$

where $$c = -\frac{1}{1 - n_1}\left[v_1 - \frac{n_1}{a_1} u^d + n_1\bar{p}\right]$$

It is easily verified that (5) is steeper in the p,y space under an M2 target (n_1 algebraically larger) and therefore that supply shocks have smaller effects on output if

(6) $$-a_1 > \frac{1}{k_1}$$

which is the same as (1) except that the parameters corresponding to foreign variables (a_1^*, a_2) make it more likely to hold.

The general point is that, when prices are expected to return to their preshock level, the ranking of targets in both an open and a closed economy may be reversed and steep LMs may become preferable in the face of supply shocks.

As to aggregate demand and financial shocks, it is easily seen that, in a closed economy, supply considerations do not alter the traditional fixed price ranking.

b) The degree of openness of the economy is measured in (1) by $a_2/\bar{\theta}$, where, to recall, a_2 is the terms of trade elasticity of aggregate demand and $\bar{\theta}$ the share of domestic goods in private spending. a_2 enters because aggregate demand is a function of both the real rate and the terms of trade: a large a_2 thus has the same role as a large a_1 (interest elasticity of aggregate demand) in formula 6.

The parameter $\bar{\theta}$ enters instead through the effects of import prices on the general price level, which is correctly used to deflate both nominal money balances and the nominal rate of interest. Analytically, the P-R model is model 2–4 with the addition of a terms of trade (z) effect in both the IS ($+a_2z, a_2<0$) and in the aggregate supply schedules ($+\alpha_2 z, \alpha_2<0$) and of the familiar open interest parity condition

(7) $$i = i^* + \hat{e}_{+1} - e$$

where i^* is the foreign nominal rate of interest and e and $\hat{e}_{+1}$ are the nominal exchange rate and its expected level one period ahead (a_1 and n_1 are also redefined as $a_1 + a_1^*$ and $n_1^* + n_1$ to account for the potentially different effects of foreign interest rates on the demands for goods and for money).

The crucial point is the definition of p: if p is defined as a weighted average of domestic and foreign prices (p_y and p_y^*),

$$(8) \quad p = \bar{\theta} p_y + (1 - \bar{\theta})(p_y^* + e)$$

under the usual assumption that z is expected to return to its constant equilibrium level (stability in the sense of rational expectations), the ranking of targets depends on (1). It can easily be shown on the other hand that if p were defined as the price of domestic goods (p_y), the formula would be

$$(9) \quad -(a_1 + a_1^*) + a_2 > \frac{1}{k_1}$$

in which $\bar{\theta}$ does not appear.

c) One of the paper's central suggestions is that in very open economies, an M2 (or total bank credit) target can insulate real output against various stochastic shocks better than the conventional money target.

In my view, this suggestion is subject to caveats that are somewhat more substantial than those already noted in the paper.

A first caveat concerns the crucial role of expectations. If exchange rate expectations were static, the interest elasticity of money demand ($n_1 + n_1^*$) would play no role; if present movements of the exchange rate were taken as a signal of further movements in the same direction the ranking of targets could be reversed.

A second consideration concerns banks' liability management. As explained in the Caranza-Fazio paper presented at this conference, a major reason why priority has not been given to money in Italy (where it yields a free rate of interest) is the possible instability of the interest differential. In the P-R model, a large disturbance in equation (4) (banks' mark-up) would make the LM schedule considerably less stable under an M2 target.

3. Dynamic stability

My understanding of the P-R discussion of dynamic stability is that they encounter the problem of the multiplicity of solutions of flexible price models with rational expectations (see Buiter 1981).

The standard solution to this problem is to assume that agents choose initial conditions for the price level (and other nonpredetermined variables) which bring the system on to the unique asymptotically bounded path. This method of solution is possible if this path is indeed unique, which requires, among other conditions, that the root of the price dynamics equation (say, in a Cagan type of money demand equation) should be unstable (more generally that the number of unstable roots be equal to the number of nonpredetermined variables). Since the authors do not exclude the possibility that the interest elasticity of the demand for M2 be positive and greater than .5, they find one stable root too many. This means that if the price equation is solved in the backward direction, any initial condition will be asymptotically stable (multiple solutions), while if solved in the forward direction the present price level will appear to be infinite (since the integral of the solution does not converge). They thus conjecture that the price level may be less stable under an M2 target.

My impression is that this is not a problem, so to speak, in the real world. Rather it is a problem of models (not just the P-R model) which assume rational expectations and fully flexible prices. It should be sufficient to put some inertia in the dynamics of prices and/or expectations to have finite initial conditions and (in the case $(n_1 + n_1^* > .5)$ asymptotic boundedness of the price level.

Finally, I feel that I should say that the paper contains considerably more than my remarks would make it appear: the model that is used for the final analysis, although relatively standard, is carefully derived from an analysis of the financial structure as well as of the behavior of households, firms, and financial institutions. This analysis is interesting and provides a useful framework within which we can work and enhance our understanding of the monetary mechanism in different countries and institutional settings.

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