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# On the Monetary Analysis of an Open Economy 1/

Prepared by Charles Collyns

Approved by Deena R. Khatkhate

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## Contents



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1/ This paper has arisen from the author's doctoral thesis (Collyns (1981)), and was completed while he worked in the Central Banking Department. The author benefited from the support of his thesis supervisor, Mr. Peter Oppenheimer, and from comments given by Messrs. Aghevli, Sinclair and Sundararajan.

## I. Introduction

The original contribution of the monetary approach to the balance of payments was to focus on conditions in the money market in explaining developments in the external sector of the economy. Payments' surpluses or deficits were seen as arising from imbalances between the supply and demand for money at a given exchange rate. Alternatively, under a free float, the exchange rate was viewed as varying to balance the demand for money to a fixed supply of money. Subsequent elaboration of this approach has broadened its perspective. The constant income velocity assumption has been relaxed as alternative assets, including bonds and foreign currencies, have been introduced into the analysis. Using this asset-market approach, together with more complex treatment of the formation of expectations and of differing rates of adjustment in asset and product markets, it has been possible to model the current and capital accounts separately, and to analyze such phenomena as exchange rate overshooting. 1/ But it should be noted that money itself is still usually treated as merely cash balances and demand deposits bearing no interest. This seems curious as the relevance of such narrow money to total liquidity has declined with the increasing attractions of quasi-money and the widening spectrum of near money.

Less attention has been paid to improving the analysis of the liability side of the balance sheet. The standard assumption has been that all domestic assets are issued directly by the monetary authorities. The supply of money or bonds only varies if the authorities intervene in bond or foreign exchange markets, or indulge in "helicopter" operations. This approach provides no role for the domestic private borrower in generating the basic demand for credit, or for the banking system in intermediating between borrower and lender.

This paper argues for a more sophisticated treatment of the supply of money. The simplifications that all money bears no interest and that all assets are claims on the government clearly limit the richness of the asset-market approach. The approach does not permit the analysis of the joint determination of money interest and exchange rates, or of how shifts in banking behavior or the demand for credit affect equilibrium. Such limitations may perhaps be forgiven at the early stages of development of a theory: some abstraction is always necessary to facilitate the analysis of a complex situation. However, if the simplifications lead to policy conclusions that are seriously misleading or incomplete, the incorporation of a more satisfactory treatment becomes more urgent.

The body of this paper consists of five main sections. It opens with a discussion of how recent institutional changes make the simplified treatment of money increasingly unrealistic, and argues in favor of an approach in which the demand for credit is given the same prominence as

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1/ Dornbusch (1980), and Frenkel and Mussa (forthcoming) provide useful sources for much of this material.

the demand for monetary assets. The next section develops a Keynesian model of monetary equilibrium in a competitive banking system which provides the basic framework for the subsequent analysis. The three following sections each study the behavior of this model from a different angle: the first looks at long-run equilibrium in which prices and wages have adjusted to relative values accepted by firms and unions, and all wealth and capital stocks are at their target levels; the second analyzes short-run equilibria in which prices and wages are sticky; and the third focuses on short-run equilibria in which consumers and firms gradually adjust their holdings of wealth and capital toward their targets. These sections are not supposed to add up to an exhaustive study of the situations considered but rather to indicate the dangers of the standard approach and to suggest a preferable way of proceeding.

## II. Interest Rates, Indeterminacy and the Demand for Credit

### 1. The relevance of quasi-money

A peculiarity of the asset-market approach is that it does not include any explicit interest payable on money holdings, as if the only types of money available were cash balances and demand deposits--i.e., narrow money--but not time and savings deposits--i.e., quasi-money. This neglect would be justified analytically if (a) the demand for all relevant assets were completely independent of the interest paid on quasi-money, or (b) the nominal rates of interest paid on quasi-money were fixed, or (c) an alternative asset were included in the model whose properties essentially mirrored the properties of quasi-money. In the first case, the rates of interest paid on quasi-money would be immaterial to the determination of equilibrium provided that the distribution effects of interest rate shifts were of second-order importance. In the second, the nominal rates of interest would become part of the given economic environment and could be treated as implicitly factored into the description of people's behavior. In the third, the omission of quasi-money would be an appropriate simplification without major analytical consequences unless the focus of interest was specifically quasi-money itself.

In many if not most open economies, the first two of these conditions no longer hold, if ever they did. The institutional changes that have occurred in financial markets in recent years have tended to increase both the interest elasticity of the demand for money and the flexibility of interest rates paid on quasi-money.

From first principles, one would conjecture that the demand for money would depend on the total demand for financial wealth, on the relative rates of return expected from the various forms of money and alternative assets, and on the variation of characteristics such as convenience, liquidity, security and the anticipated stochastic distribution of real returns between these assets. These non-pecuniary characteristics

of different assets give the wealth holder reason to differentiate between assets bearing the same expected returns, so that in particular the demand for money would not be perfectly interest elastic. Indeed, the traditional theories of money, such as the quantity theory, go to the other extreme and implicitly see money as having non-pecuniary characteristics so unique that the demand for money can be treated as essentially independent of its own rate of return. But, in most countries, the interest elasticity of the demand for money is probably increasing over time as institutional changes occur which make the characteristics of money less special. The precise story will be different in each country but the general trend seems clear.

First, new types of financial instrument have been introduced and familiar types revamped to increase the attractions and the range of alternative forms of money and near money. Interest-bearing stores of value with reasonable liquidity are offered by credit unions, savings and loans, building societies, money market mutual funds, and many others. Increasingly, these institutions extend check writing facilities to their accounts to provide means of payment. Credit cards and "easy access" overdraft facilities make available instant lines of credit which may also be used as means of payment.

Second, the progressive removal of domestic exchange controls and the increasing integration of world financial markets has substantially reduced the transactions cost of holding bank accounts and other assets abroad, and hence made available a range of close foreign substitutes for domestic monetary assets. A monetary asset held in a foreign banking system has similar but not identical liquidity and security characteristics to the equivalent maturity domestic deposit. If denominated in a foreign currency, its pattern of expected real returns might be strongly differentiated from the domestic alternatives by uncertainty over future exchange rate variations. But the existence of forward currency markets and offshore banking facilities provides the opportunity of holding assets abroad without incurring any concurrent exchange risk.

Third, the growth of multinational operations and the accumulation of financial wealth owned outside the traditional financial centers has provided a substantial pool of highly mobile and professionally managed funds seeking attractive short-term investments. As a result, it is no longer true, at least in the major developed countries, that domestic money is held only by domestic residents. By its very nature, this foreign demand is likely to be particularly interest elastic; the international placement of funds will be closely related to comparative returns in different markets.

All in all, there exist many domestic and foreign substitutes for both narrow and quasi-money except in countries at a rudimentary level of financial development and with effective controls on capital mobility. Outside these cases, the demands for the various types of money and near money will tend to be sensitive to the rates of interest payable on quasi-money.

If nominal rates of interest payable on all forms of money were fixed and not subject to policy manipulation, then clearly they would not need to be included as variables in one's economic model, whatever the demand elasticities. However, in most developed countries, while interest may not be paid on demand deposits, the interest rates paid on time and savings deposits and on other types of liquidity are increasingly flexible. This flexibility in part reflects a new propensity on the part of monetary authorities to relax restrictions and to allow interest rates to be set by the financial institutions concerned. This deregulation is usually accompanied by measures aimed at increasing the degree of competition for funds among banks and between banks and other financial institutions. In consequence, interest rates on at least the less liquid monetary instruments tend to be highly sensitive to market conditions.

The literature does contain, of course, many studies which include narrow money and some other domestic asset, usually bonds, that bears interest at a market-determined rather than fixed rate. Why is more work needed? One reason is that a narrow money/bond model is inadequate for the analysis of monetary policy using broad money as an explicit target. A second is that the domestic bond real interest rate is usually assumed to be fixed by a perfectly elastic international demand for bonds, as if domestic and foreign bonds were indistinguishable; this contrasts sharply with the companion assumption that narrow money is held only by domestic residents. 1/ Neither assumption captures the intermediate view of quasi-money as an interest-bearing differentiated asset held both for its liquidity and as a store of value. Models which do treat bonds as a differentiated asset 2/, on the other hand, let the supply of bonds and money be separately determined by the authorities. Such analysis would only be applicable to a narrow money/quasi-money framework if the authorities were to develop policy instruments capable of controlling these two monetary aggregates separately; and it also raises a serious theoretical problem to be considered in the following subsection.

## 2. The problem of indeterminacy, and possible solutions

If one crudely introduced an extra variable, the rate of interest on domestic liquidity, into one of the standard asset-market models of the balance of payments or exchange rate determination, the available degrees of freedom would be immediately increased by one. Consider the following very simple model of the monetary sector. Let the nominal demand for domestic broad money, denominated in sterling, DM2, be a decreasing function of domestic nominal income, Y, and the nominal rate of interest paid on broad money, R, only. Let Y itself be an increasing function of the exchange rate, e (the price of sterling in terms of SDRs).

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1/ See, for example, Mundell (1968) or Dornbusch (1976).

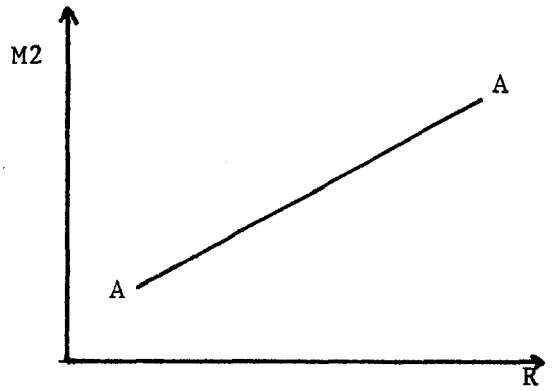
2/ See, for example, Branson (1979) or Dornbusch (1980), ch. 10 and 11.

Let the supply of broad money, M2, be controlled by the government. Then the money market equilibrium condition is written:

(1) $M2 = DM2(Y(e),R)$

Figure 1 illustrates this condition as the locus AA in M2/R space for a given exchange rate:

Figure 1




AA slopes up, as increasing the interest rate raises the demand for broad money; the more interest elastic is the demand for broad money, the steeper the slope of AA. An exchange rate appreciation reduces nominal income and shifts AA down and to the right, so altering the feasible combinations of M2 and R. In this situation, the government has two degrees of freedom in selecting its monetary policy: it may choose to set two out of M2, e and R. This result is contrary to the conventional wisdom that the government has only one degree of freedom, that for example if it chooses to aim for a money target it must allow the exchange rate and interest rates to be market determined. According to the present model, the government could well achieve both money supply and exchange rate targets, despite shifts in the demand for money, if it were willing to vary the interest rate as required.

The salient point is that, after considering the rate of interest on bank deposits, there are not one but two prices of domestic money: the interest rate and the exchange rate; this feature leads directly to the extra degree of freedom. The difficulty does not go away if one relaxes assumptions to broaden the picture of the asset market. Introducing bonds or foreign money both lead to an extra market equilibrium condition and two extra variables--one a rate of return and the other an aggregate supply variable--and so increase rather than reduce the available degrees

of freedom. Separating narrow from quasi-money has no analytical consequence in this context unless the supplies of narrow and quasi-money could be independently controlled--which would leave the degrees of freedom unaffected. Nor does it help to hypothesize that the demand for bank deposits is perfectly interest elastic on the basis of an infinite willingness by wealth holders to arbitrage between domestic and foreign money markets. Not only is this hypothesis implausible, requiring wealth holders to be utterly indifferent to the currency composition and security of their portfolios, but it leaves the total demand for domestic money indeterminate. In consequence, equation (1) could not be solved for the exchange rate even if the money supply were fixed.

There are two alternative directions in which to proceed. One is to accept that the authorities may indeed determine two out of the three variables--money supply, interest rate and exchange rate--and investigate the basis on which policy should then be decided. In developing countries, this approach has in fact received much attention. For example, there is the literature on the choice of interest rates 1/ which takes for granted that a stable exchange rate can be achieved simultaneously with controlled interest rates. Implicit in these discussions is the belief that interest and exchange rates are independent policy variables on a permanent basis. But, in developed countries, experience has been that the authorities have very limited power to control more than one of the key variables on a permanent basis. Attempts to sustain both money supply and exchange rate, or interest rate and exchange rate, targets have eventually foundered on external disequilibrium. Then it would seem that the asset-market approach is an insufficient theoretical framework for policy analysis in such countries as its practical implications are ill-founded once it is realized that money like other assets has a variable rate of return. Reacting to this conclusion, it would appear necessary to extend the asset-market approach to include additional factors which would effectively constrain the application of monetary policy.

The solution offered in this paper is to extend the analysis of the supply of money beyond the simplistic assumption that it is under the direct control of the monetary authorities. Instead, it is recognized that monetary assets are the counterparts of monetary liabilities, consisting of bank loans and advances to the private sector and other debt instruments. Monetary equilibrium in a competitive market then requires that the demands for monetary assets and liabilities be matched; using this extra condition reduces the degrees of freedom and gives the desired result that the authorities are able to determine only one of the three key variables. 2/

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1/ See Khatkhate and Coats (1980).

2/ An equivalent approach in a model featuring high-powered money and bonds only would be to introduce the government's own demand for credit as a dependent variable rather than a given.

Clearly this approach requires an analysis of the demand for monetary liabilities compatible with the treatment of the demand for monetary assets. Economists have generally paid far less attention to the study of the demand for credit and its components than they have to asset-portfolio selection; and this relative neglect of liability management has also, until recently, been a feature of practical business affairs. But, on first principles, it would seem plausible to approach the demand for monetary liabilities in an analagous way to the demand for monetary assets, i.e., as depending on the total demand for finance, on the relative rates of interest payable on the various forms of bank credit and alternative sources of funds, and on the variation of characteristics such as convenience, liquidity, and the anticipated stochastic distribution of interest costs between these sources. As with the demand for monetary assets, the existence of these other characteristics gives the borrower reason to differentiate between sources requiring the same expected rates of return, so that in particular the demand for monetary liabilities would not be perfectly interest elastic. In practice, however, this interest elasticity is probably increasing over time, as institutional changes occur which make the characteristics of bank credit less unique. These include a widening range of domestic financial institutions and increasing opportunities to raise funds overseas.

A model of monetary equilibrium matching the demands for monetary assets and liabilities must also inevitably contain a sub-model of the means of intermediation between these two, i.e., the banking system. This sub-model would ideally explain the ratio between bank reserves and lending, and the spread between deposit and lending rates of interest. Also, this sub-model should contain mechanisms by which the monetary authorities would be able to influence banking behavior in order to affect the position of monetary equilibrium. Of course, the appropriate modeling of the banking system would depend on the degrees of competitiveness within the system, on conventions of banking behavior, and on the instruments of monetary control, and hence would vary between countries.

One of the lessons of this section is that no single approach to the monetary analysis of an open economy can be appropriate for the study of all countries. In some countries, in particular developing ones where interest rates are fixed and credit is allocated by rationing, the conventional monetary approach may indeed be adequate for many purposes. But elsewhere a more elaborate analysis may be necessary to capture the behavior of the system and to delineate the policy options open to monetary policy.

## III. Analytical Framework

This section develops a model of an industrial economy, open to both trade and financial flows. This model is Keynesian in the sense that relative prices are not perfectly flexible and domestic output depends on

demand. To simplify, the real economy is reduced to one sector, and the fiscal branch of the government is omitted. Savings and investment are treated as the outcome of the adjustment of stocks of wealth and capital toward target levels. The financial sector consists of an aggregate banking system which intermediates between the demands for domestic assets and for domestic liabilities, both denominated in sterling. Features and assumptions of the model are explained more fully in Collyns (1981).

## 1. The real economy

The home economy produces a single good that is differentiated from the output of the rest of the world. The price of this good is set by mark-up over costs on home and world markets; firms set production to meet the resulting domestic and export demand; employment is determined by the labor required to achieve this production level. Wages are fixed by trade unions who seek to achieve an appropriate balance between the take-home pay and the employment of their members. The rest of the world is large relative to the domestic economy in the sense that activity levels and prices do not depend on the state of the domestic economy. Imports are in perfectly elastic supply, and priced by arbitrage with world markets.

Let real income be y and production f; by convention small letters indicate real values with the price of the domestic good being used as the numeraire. y and f are related by:

$$(2) \quad y = f + r^* \cdot (w - k)$$

where w is real domestic wealth, k is the real domestic capital stock and $r^*$ is the real rate of return on foreign investment.

Let $\alpha$ be the price of the domestic good relative to imports, i.e., a measure of the competitiveness of the domestic economy; its value depends on the interaction between the price and wage setting mechanisms. Arbitrage sets the domestic price of imports, PM, to the world price, PM*, adjusted by the exchange rate, e (again the price of sterling in terms of SDRs):

$$(3) \quad PM = PM^*/e$$

Then the home price of the domestic good, PD is given by:

$$(4) \quad PD = \alpha . PM$$

The proportion of home consumption allocated to the domestic good, $\lambda$, is a decreasing function of $\alpha$. So, demand for the domestic good on the home market is given by:

$$(5) \quad z = \lambda(\alpha,.).c$$

where c is home consumption. Sales of exports are also a decreasing function of $\alpha$:

$$(6) \quad z^* = z^*(\alpha,.)$$

i. The long run

In the long run, relative prices and wages reach equilibrium in the sense that firms and unions, knowing the state of the economy and taking the actions of others as given, are content with the prices and wages they set respectively. Movements of the exchange rate affect the overall level of prices and wages, via their effect on the nominal price of imports, but not relative prices. The level of the long-run real domestic lending rate, $\bar{r}$, does, however, affect competitiveness: a rise in the cost of funds will increase firms' mark-ups, and hence raise $\alpha$. $\alpha$ may also shift due to fundamental changes in technology, institutional attitudes or other structural facets of the economic environment. So:

$$(7) \quad \bar{\alpha} = \bar{\alpha}(\bar{r},.)$$

Another feature of the long run is that the economy is in static stock equilibrium: given activity levels and prices, firms and consumers hold just the stocks of physical capital and wealth that they desire. Firms achieve their target capital stock, $\bar{k}$ ($^-$ represents a target or long-run value) which is an increasing function of the long-run output level, $\bar{f}$:

$$(8) \quad \bar{k} = \bar{k}(\bar{f},.)$$

Consumers achieve their target level of wealth, $\bar{w}$, which is an increasing function of $\bar{y}$:

$$(9) \quad \bar{w} = \bar{w}(\bar{y},.)$$

Firms sell what they produce and consumers spend what they earn. So:

(10) $\bar{f} = \bar{z} + \bar{z}^*$

and

(11) $\bar{c} = \bar{y}$

Equations (2) and (5)-(11) combine to give a simple macroeconomic system which can be solved to give $\bar{f}$ and $\bar{y}$ as reduced-form functions of $\bar{r}$ and exogenous variables.

(12) $\bar{y} = \bar{y}(\bar{r},.)$

(13) $\bar{f} = \bar{f}(\bar{r},.)$

ii. The short run

In the short run, wage/price equilibrium is not necessarily maintained. In particular, unanticipated exchange rate movements may affect the value of $\alpha$, as the import price responds faster than wages or the price of the domestic good. At a single point in time, this stickiness may be expressed in the equation:

(14) $\alpha = \alpha(e,.)$

where $\alpha(.)$ is an increasing function of e. Short-run interest rates are supposed not to affect $\alpha$ on the grounds that firms do not vary the value of their mark-ups over the business cycle. In the absence of future shocks, $\alpha$ increases over time at rate $\beta$ toward its long-run equilibrium value, $\bar{\alpha}$. $\beta$ is a decreasing function of $\alpha-\bar{\alpha}$:

(15) $\beta = \beta(\alpha-\bar{\alpha},.)$

The domestic rate of inflation, $\rho$, which is defined as the rate of change of the domestic price over time, depends on $\beta$ and on the rate of depreciation of the exchange rate, $\gamma$, according to:

(16) $\rho = \beta + \gamma$

Another feature of the short run is that stocks may not be at their target levels at the beginning or end of any given period. The capital stock held by firms at the start of the period, $\hat{k}$ ($\hat{}$ denoting a start of period stock), may differ from target, $\bar{k}$. Demand for domestic goods, z, may also diverge from its long-run level, $\bar{z}$. Capital is accumulated by producing more than is sold, and depleted by selling more than is produced. Firms set output to balance the costs of deviating from the long-run level of output and from the target capital stock according to the rule: 1/

$$(17)\quad f = \mu.(\bar{k} - \hat{k} + z) + (1-\mu).\bar{f}$$

The parameter $\mu$ is higher, the greater the weight placed on achieving the target capital stock relative to the long-run production level. Equation (17) corresponds to the stock adjustment rule:

$$(18)\quad k = (1-\mu).(\hat{k} - z + \bar{f}) + \mu.\bar{k}$$

The wealth held by consumers at the start of the period, $\hat{w}$, may differ from target $\bar{w}$. Income, y, may also diverge from its long-run level, $\bar{y}$. Consumers respond by setting their consumption to balance the costs of deviating from the long-run consumption level, $\bar{c}$, and from the wealth target according to the rule:

$$(19)\quad c = \nu.(\hat{w} - \bar{w} + y) + (1-\nu).\bar{c}$$

where the parameter $\nu$ is higher, the greater the weight placed on achieving the wealth target rather than the long-run consumption level. Equation (19) corresponds to the stock adjustment rule:

$$(20)\quad w = (1-\nu).(\hat{w} + y - \bar{c}) + \nu.\bar{w}$$

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1/ This rule minimizes the objective function $\mu_1(k - \hat{k})^2 + \mu_2(f - \bar{f})^2$ subject to the constraint that $\hat{k} + f = k + z$, where $\mu \equiv \mu_1/(\mu_1 + \mu_2)$. See Collyns (1981) ch. 6 for details of this derivation and of the derivation of the succeeding adjustment rules. Such rules are preferred to the more usual treatment of stock adjustment in international economics (see, for example, Calvo and Rodrigues (1977) or Dornbusch and Fischer (1980)), in which the rate of stock adjustment is not influenced by short-run demand or income levels.

To simplify the exposition, let $\sim$ signify the deviation of an end of period stock from its target value (e.g., $\tilde{w} \equiv w - \bar{w}$) or the deviation of a short-run activity level from its long-run value (e.g., $\tilde{c} \equiv c - \bar{c}$. Let $\wedge$ signify the deviation of a start of period stock from its target value (e.g., $\hat{w} = \hat{w} - \bar{w}$). Using this notation, and recalling equations (10) and (11), equations (17)-(20) can be rewritten:

$$(21)\quad \tilde{f} = \mu.(\tilde{z} - \hat{k})$$

$$(22)\quad \tilde{k} = (1-\mu).(\hat{k} - \tilde{z})$$

$$(23)\quad \tilde{c} = \nu.(\hat{w} + \tilde{y})$$

$$(24)\quad \tilde{w} = (1-\nu).(\hat{w} + \tilde{y})$$

Foreign wealth holders and firms always hold their target stocks of wealth and capital. These targets are fixed in terms of imported rather than domestic goods, and so may be expressed as $\alpha \cdot \bar{w}^*$ and $\alpha \cdot \bar{k}^*$ respectively in terms of domestic goods.

## 2. The financial sector

The domestic financial sector consists of a banking system, regulated by a central bank. 1/ Domestic monetary assets and liabilities are denominated in the domestic currency, sterling. There are no controls on external financial flows to restrict domestic access to foreign financial markets or foreign access to domestic financial markets. Sterling is, however, differentiated from other currencies by its own particular non-pecuniary characteristics.

Domestic firms finance part of their capital, K, through sterling loans from domestic banks and through loans from foreign banks; the remainder is provided by the firms' owners. Firms pay an interest rate of R on loans from domestic banks; they expect sterling to depreciate at rate $\gamma$ and domestic prices to increase at rate $\rho$. The share of capital financed through sterling loans, l, is a decreasing function of the real interest rate, $R-\rho$, and of a measure of the cost of domestic loans relative to foreign loans, $R-\gamma$.

Foreign firms may also borrow from domestic banks. They raise the share $l^*$ of their capital, $K^*$, in sterling loans; this share also decreases with $R-\gamma$. So the total demand for sterling loans, DL, is given by:

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1/ There is no stock market; ownership titles to firms are not transferable.

(25) $DL = l(R-\rho, R-\gamma, .).K + l^*(R-\gamma, .).K^*$

Domestic wealth holders divide their wealth, W, between holdings of non-interest-bearing sterling currency, sterling bank deposits bearing interest at rate $R-\delta$ ($\delta$ being the interest rate spread), property rights and foreign assets. They also expect the domestic currency to depreciate at rate $\gamma$ and domestic prices to increase at rate $\rho$. The portfolio share of sterling currency, $k_{M1}$, is a decreasing function of the inflation rate and of the real interest paid on deposits, $R-\delta-\rho$; the portfolio share of bank deposits, $k_{MQ}$, is an increasing function of $\rho$, $R-\delta-\rho$, and $R-\delta-\gamma$. Foreign wealth holders place $k^*_{MQ}$ of their wealth, W* in sterling deposits. $k^*_{MQ}$ increases with $R-\delta-\gamma$. So the total demand for domestic broad money, DM2, is given by:

(26) $DM2 = [k_{M1}(\rho, R-\delta-\rho, .) + k_{MQ}(\rho, R-\delta-\rho, R-\delta-\gamma, .)].W$

$$+ k^*_{MQ}(R-\delta-\gamma, .).W^*$$

The initial capital stock is an accumulation of goods and so its real value is determined by history irrespective of current prices. The real value of wealth at the start of the period is also given to the extent that wealth consists of debt and equity claims on the country's capital stock. For example, an increase in the domestic price level would reduce the real value of sterling deposits but also increase the real value of equity. International financial claims complicate the situation. The precise relation between initial wealth and price level or exchange rate will depend on the compositions of the domestic portfolio of foreign assets and the foreign portfolio of domestic assets; but a priori sign restrictions cannot be established. As a convenient simplification, the real value of both capital and wealth stocks at the start of the period, $\hat{k}$ and $\hat{w}$, will be taken as given. 1/

The domestic banking system intermediates between the demand for sterling deposits and for sterling loans. Commercial banks offer facilities for interest-bearing accounts to depositors, and allocate their funds either to loans or to reserve deposits with the central bank. The central bank's liabilities, the monetary base, include these reserve deposits and also its issue of notes and coins; it deploys its assets either in lending to commercial banks or in foreign exchange reserves.

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1/ This assumption differs from the usual one that real domestic wealth is a decreasing function of domestic prices. Such an assumption might be appropriate in a model in which wealth consists of outside money only, but is less so when wealth is recognized to be direct and indirect claims on physical assets.

The central bank has various policy instruments at its direct disposal: it sets the required minimum ratio between commercial bank reserves and deposits, the rates of interest it pays on required and on excess reserves, and the rate of interest commercial banks pay to borrow from it. With these instruments, it may influence the behavior of commercial banks. A full account of the interactions taking place within the banking system is not attempted here; its details would depend on such factors as the degree of competition between commercial banks and the way in which commercial banks responded to risk. Briefly, the ratio of total sterling broad money to sterling bank credit, $\eta$, and the commercial bank interest rate spread, $\delta$, depend on the required reserve ratio and the spread between the interest rates the central bank pays on deposits and the rate it charges for loans: increasing either of these will tend to raise both commercial banks' desire for reserves and the cost of intermediation, hence to increase both $\eta$ and $\delta$. To simplify the analytical framework, the general presumption will be that the central bank operates to keep $\eta$ and $\delta$ fixed and invariant to changes in macroeconomic variables. The central bank's main policy instrument is the basic level of its interest rates, which is assumed to have a direct impact on R and hence on other potential macroeconomic variables.

Allocation within the banking system is competitive, in the sense that neither borrowers nor lenders face quantity constraints on their transactions at given prices. The sterling interest rate and/or exchange rate (depending on the government's monetary policy) adjust to ensure that the money market clears. The authorities are sufficiently knowledgeable to achieve monetary targets by setting appropriate values of the available instruments.

## IV. Long-Run Monetary Equilibrium

In the long run, domestic competitiveness is fixed at $\bar{\alpha}$; the expected rate of inflation, $\rho$, and the expected rate of exchange rate depreciation, $\gamma$, are then equal. Domestic consumers and firms achieve their stock targets, $\bar{w}$ and $\bar{k}$ respectively, which are functions of long-run output, $\bar{f}$, and income, $\bar{y}$. Using equations (2)-(13) and (25)-(26), the long-run conditions for money market equilibrium are:

$$(27)\quad M2 = [k_{M1}(\rho, R-\delta-\rho, .) + k_{MQ}(\rho, R-\delta-\rho, R-\delta-\gamma, .)].\bar{\alpha}.\frac{PM^*}{e}.\bar{w}(\bar{y}(\bar{\alpha}, .)$$
$$+ k^*_{MQ}(R-\delta-\gamma, .).\bar{\alpha}.\frac{PM^*}{e}.\bar{w}^*$$

$$(28)\quad M2 = \eta.[1(R-\rho, R-\gamma, .).\bar{\alpha}.\frac{PM^*}{e}.\bar{k}(\bar{f}(\bar{\alpha}, .), .) + 1^*(R-\gamma, .).\bar{\alpha}.\frac{PM^*}{e}.\bar{k}^*]$$

(29) $\bar{\alpha} = \bar{\alpha}(R-\rho,.)$

Equation (27) is the condition that the demand for sterling assets equal the stock of broad money; equation (28) requires that the demand for sterling loans be compatible with the stock of broad money; equation (29) sets the value of domestic competitiveness.

Provided the authorities follow a monetary policy compatible with stable prices--hence a stable exchange rate--$\rho$ (and $\gamma$) is set to zero. $\delta$ and $\eta$ are taken as behavioral parameters of the banking system, while PM*, $\bar{w}$* and $\bar{k}$* are exogenous variables. Equations (27), (28) and (29) can then be solved for the interest rate, relative prices, and the stock of real broad money, m2 ($\equiv$ M2/[$\alpha$.(PM*/e)]). Domestic prices and other nominal values depend on the authorities' choice of monetary target; they may set either the exchange rate or the broad money stock (or some other nominal value). 1/ Thus the government has no degree of freedom to affect real variables, but one degree of freedom to affect nominal values. Figure 2 illustrates this equilibrium in r/m2 space. AA represents equations (27) and (29) in r/m2 space; it slopes upwards provided the shift in portfolio composition toward broad money as r increases outweighs the negative impact of r on income and hence the wealth target. BB represents equations (28) and (29) in r/M2 space; it must slope down as both the substitution and the income effect reduce the demand for loans as r increases. r' is the equilibrium real lending rate, and m2', the equilibrium stock of real broad money. r' may well deviate from r* despite financial openness and monetary stability because of the imperfect substitutability of foreign currency for sterling; the stronger is the currency preference for sterling over other currencies, the less interest elastic the demand for sterling assets and liabilities, the shallower the AA and BB loci, and the more the scope for divergence between r' and r*.

What is the effect of an exogenous improvement in competitiveness? Assuming that the income effects on stock targets are stronger than the disinflationary price effects, the loci AA and BB both shift upward in m2/r space. The resulting equilibrium has a higher real money stock; but the impact on real interest rates is uncertain, depending on the relative income and interest elasticities of the demand for sterling deposits and loans. Other comparative static effects may be deduced in a similar manner.

If the authorities are willing to sacrifice price stability or to manipulate the behavior of the banking system, i.e., to alter the values of $\rho$, $\delta$ or $\eta$, then they may regain some influence over real variables:

---

1/ Price stability requires that the nominal interest rate be set equal to the equilibrium real interest rate.

(i) The value of the rate of inflation would matter if and only if it would affect the total domestic demand for broad money even though real interest rates were kept constant. For instance, if the shift away from non-interest-bearing money caused by inflation were to reduce the total monetary share of wealth portfolios, then it would shift AA down to the right in r/m2 space. In equilibrium, an increased rate of expansion of M2 or rate of depreciation of e, leading to a higher $\rho$, would result in an increase of real interest rate (hence a fall in real income) and a reduction of the real money stock. However, one would expect that persistent inflation would eventually lead to the evolution of interest-bearing means of payment, such as those mentioned in section II, to make it possible to hold liquid funds without incurring a negative return. This institutional development would limit the extent of the inflationary impact on the demand for broad money.

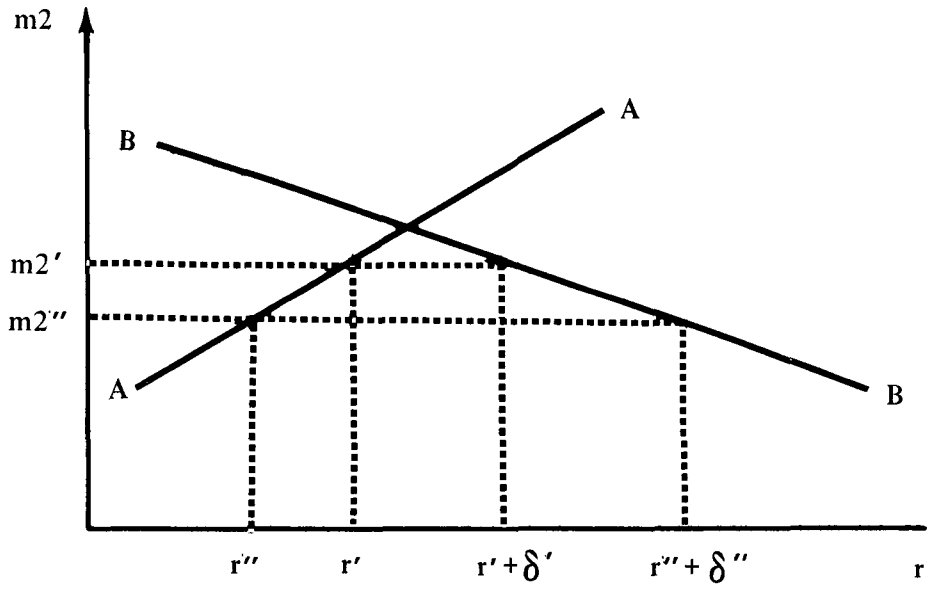
(ii) By increasing the cost of bank intermediation to engineer a rise of the interest rate spread, $\delta$, the authorities may achieve a reduction of real monetary balances. In Figure 2, raising the spread from $\delta'$ to $\delta''$ reduces equilibrium real monetary balances to m2". The deposit interest rate rises while the lending rate falls. The real effect of such a policy is limited by the extent that intermediation shifts away from the domestic banking system to alternative domestic financial institutions or offshore.

(iii) Reducing the proportion of foreign reserve assets held against the sterling liabilities of the banking system, in effect reducing $\eta$, increases the availability of sterling loans, and hence shifts BB down to the left. In equilibrium, this reduces domestic interest rates and increases real income. The extent of this effect is limited by the degree of interest elasticity of demand for sterling broad money balances: if interest elasticity is high, AA tends to be steep, and a shift in $\eta$ will mainly be reflected in a reduction of real money balances rather than a reduction in interest rates. Moreover, the scope for reducing $\eta$ is constrained by the country's need for foreign reserves to guard against short-run balance of payments difficulties caused by exogenous shocks.

## V. Monetary Equilibrium with Wage/Price Adjustment

This section investigates the short run in which relative prices and wages adjust slowly toward their long-run values. Movements of the exchange rate, which have an immediate impact on import and export prices, disturb the relative price of the domestic good on the home market from its long-run level, and consequently affect short-run production and income levels. To simplify the analysis, stock equilibrium is assumed to prevail throughout this section; stocks adjust instantaneously to targets, which are themselves set on the basis of short-run production and income levels.

Figure 2



In this framework, $\alpha$ is an increasing function of the exchange rate as in equation (14), while its rate of increase $\beta$ (which falls with $(\alpha-\underline{\alpha})$ as in equation (15)) becomes a declining function of the exchange rate. The rate of domestic price inflation, $\rho$, depends on the rate of depreciation of the exchange rate, $\gamma$, and on $\beta$ as in equation (16). Real capital and wealth stocks are increasing functions of short-run output and income, f and y, respectively:

$$(30)\quad k = k(f,.)$$

$$(31)\quad w = k(y,.)$$

where income is given by:

$$(32)\quad y = f + r^*.(w - k)$$

and output by:

$$(33)\quad f = \lambda(\alpha,.).y + z^*(\alpha,.)$$

Solving equations (30)-(33) gives f and y as decreasing functions of competitiveness and exogenous variables:

$$(34)\quad y = y(\alpha,.)$$

$$(35)\quad f = f(\alpha,.)$$

Under these assumptions, the short-run monetary equilibrium conditions include:

$$(36)\quad M2 = [k_{M1}(\rho,R-\delta-\rho,.)+k_{MQ}(\rho,R-\delta-\rho,R-\delta-\gamma,.)].$$
$$\alpha(e,.).\frac{PM^*}{e}.w(y(\alpha(e,.),.),.) + k^*_{MQ}(R-\delta-\gamma,.).\alpha(e,.).\frac{PM^*}{e}.w^*$$

$$(37)\quad M2 = \eta.[1(R-\rho,R-\gamma,.).\alpha(e,.).\frac{PM^*}{e}.k(f(\alpha(e,.),.),.) + 1^*(R-\gamma,.).\alpha(e,.).\frac{PM^*}{e}.k^*]$$

(38) $\rho = \beta(\alpha(e,.),.) + \gamma$

Taking $\delta$ and $\eta$ as behavioral parameters, these conditions are three equations in five endogenous variables: M2, R, e, $\rho$ and $\gamma$. Clearly missing is an equation governing the formation of future exchange rate expectations. But, in general, if expectations are to approach rationality, then it would be necessary to discover the complete adjustment path in order to model $\gamma$. To simplify, let the domestic portfolio share of broad money, $k_{M1} + k_{MQ}$, be independent of the inflation rate. Then the equation system (36)-(38) may be expressed in terms of only four endogenous variables: M2; e; the real interest rate, $R-\rho$; and the relative interest rate factor, $R-\gamma$. In this formulation, real values in the present are determined irrespective of anticipated future nominal values; only the nominal interest, inflation and depreciation rates cannot be discovered without a model of the complete adjustment path.

In either case, the authorities possess in the short run a degree of freedom to set a monetary target. Because prices are sticky, the value of this target will have repercussions on the real economy as well as on purely nominal values. In particular, monetary policy can be seen as an important element of any macroeconomic stabilization strategy. Alternative fixed target-type regimes will provide the economic system with characteristic insulation properties against exogenous shocks, while shifts in target can in theory be used to accelerate the process of wage/price adjustment.

To illustrate how the system would behave under different policy regimes, it is convenient to simplify the model further by assuming that the rate of wage/price adjustment is negligible; i.e, $\beta = 0$. Provided that exogenous variables and policy targets are expected to remain at their present values, the equilibrium in the next period is the same, in both real and nominal terms, as equilibrium in the present. So $\rho$ and $\gamma$ can also be set to zero. Lastly, let $\delta$ equal zero. Then the short-run monetary equilibrium conditions can be reduced to:

$$(39)\quad M2 = [k_{M1}(R,.) + k_{MQ}(R,.)].\alpha(e,.).\frac{PM^*}{e}.w(y(\alpha(e,.),.),.) + k^*_{MQ}(R,.).\alpha(e,.).\frac{PM^*}{e}.w^*$$

$$(40)\quad M2 = \eta.[1(R,.).\alpha(e,.).\frac{PM^*}{e}.k(f(\alpha(e,.),.),.) + 1^*(R,.).\alpha(e,.).\frac{PM^*}{e}.k^*]$$

Rather than attempt a systematic survey of the comparative static properties of this system 1/ this section concentrates on a few topics to bring out some of the possibilities inherent within this framework of analysis.

## 1. The fixed interest rate regime

If the authorities act so as to fix R to some target value, e and M2 then adjust to ensure monetary equilibrium in the short run. Figure 3 illustrates equations (39) and (40) in e/M2 space. The loci AA and BB, representing equations (39) and (40) respectively, both slope down as, with a fixed interest rate, an appreciation of the exchange rate leads to a fall in the demand for both sterling assets and liabilities. Equilibrium occurs at P, with an exchange rate of e' and a money stock of M2'.

An increase in the interest rate target shifts AA out to the left and BB down to the right. Provided that the slope of AA is steeper than the slope of BB, that is provided the wealth target is more responsive than the capital target to shifts in the exchange rate, the new equilibrium at Q has a higher exchange rate and a lower money stock than originally. This result is compatible with the conventional wisdom that raising domestic interest rates leads to an exchange rate appreciation and a contraction of monetary aggregates.

In the U.K., in the period 1980-81, the authorities had difficulty in controlling the growth of the money stock within the limits stated by their financial strategy. An explanation offered for this phenomenon was that raising interest rates in a recession might increase rather than reduce the demand for loans. Within the present analytical framework, this perverse response would indeed lead to the observed result: BB would shift not to the left but rather to the right; the new equilibrium at S then has a higher rather than lower money stock than before.

All floating exchange rate regimes, the fixed interest rate regime included, have the property of shielding the economy from external price shocks: the exchange rate moves to offset any movement in PM* to keep domestic prices at their original levels. The fixed interest rate regime has the distinctive property that it also insulates the real economy from internal price shocks. Consider an exogenous increase in the domestic markup, hence in PD. If the exchange rate depreciates so as to increase import prices by the same proportion, $\alpha$ is unaffected by the shock, while M2 grows to accommodate the proportionally higher demand for sterling assets and liabilities. By contrast, fixing M2 or some other monetary aggregate rather than R would mean that, in equilibrium, e would have depreciated less than PD had risen, so that $\alpha$ would increase and real income and output levels fall.

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1/ See Collyns (1981) ch. 7 and 8.

## 2. Alternative monetary aggregate regimes

Figure 4 illustrates equations (39) and (40) in e/R space for a given M2 target. The locus AA, representing equation (39), slopes up as an increase in interest rate is needed to counterbalance the deflationary effect of an exchange rate appreciation to keep the total demand for sterling assets fixed at the target. The locus BB, representing equation (40), slopes down as a reduction in interest rate is required to offset the impact of an increase in exchange rate to maintain the demand for sterling liabilities consistent with the target. Equilibrium is at P.

In this framework, it is clearly important to keep track of the direct effect of the exogenous shock on the demand for sterling liabilities as well as on the demand for sterling assets. For example, a rise in foreign interest rates will reduce the demand for sterling assets but raise the demand for sterling liabilities, shifting AA up to the left and BB up to the right. This leads to a corresponding rise in the sterling interest rate as equilibrium shifts to Q. By contrast, a general rise in foreign income levels, raising foreign wealth and capital stock targets will raise foreign demand for both sterling assets and liabilities, shifting both AA and BB to the right. This leads to an appreciation of the exchange rate with an indeterminate and small effect on the sterling interest rate as equilibrium shifts to S.

A variety of other monetary aggregates may also be used as the target for monetary policy, including the narrow money stock, M1; the domestic component of broad money, M2(-), which excludes foreign holdings of domestic deposits; and domestic credit, DC, the domestic component of sterling lending. The choice between alternative targets has consequences for the response of the economic system to different types of exogenous shock. Each of these may be analyzed after appropriate rearrangement of equations (39) and (40).

Consider a favorable income shock, such as for example the exploitation of a newly discoverd oil reserve, which shifts the functions $y(\alpha,.)$ and $f(\alpha,.)$ upward. Under all four regimes, the exchange rate appreciates to restore monetary equilibrium at the original monetary target; this appreciation reduces domestic competitiveness, hence partially neutralizes the original shock's positive effect on real income. However, the extent of this appreciation is less under the M2 target regime than under any of the other three. Under the former regime, the aggregates M1, M2(-) and DC may all increase as the exchange rate rises, as this appreciation reduces foreign demand for sterling assets and liabilities. Hence, the squeeze on the non-oil economy required to restore equilibrium is rather less.

The effects of various financial shocks may be qualitatively as well as quantitatively different under the alternative regimes:

(i) a shift in domestic portfolio preferences from narrow to quasi-money has no effect on equilibrium under M2(-), M2 or DC target regimes.

Figure 3

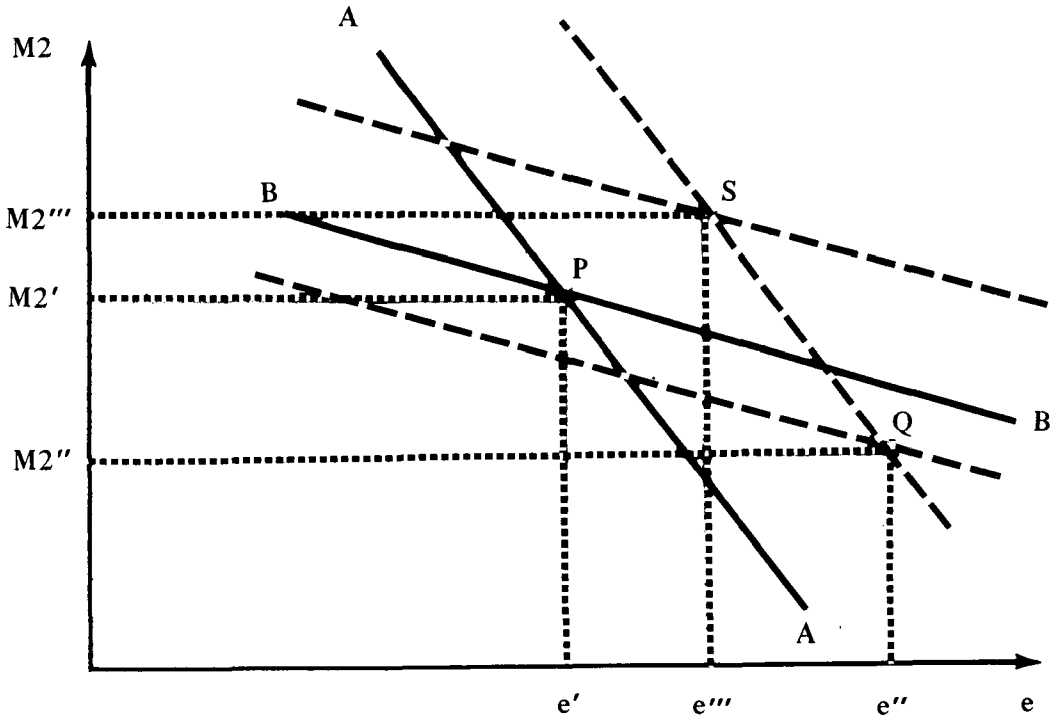
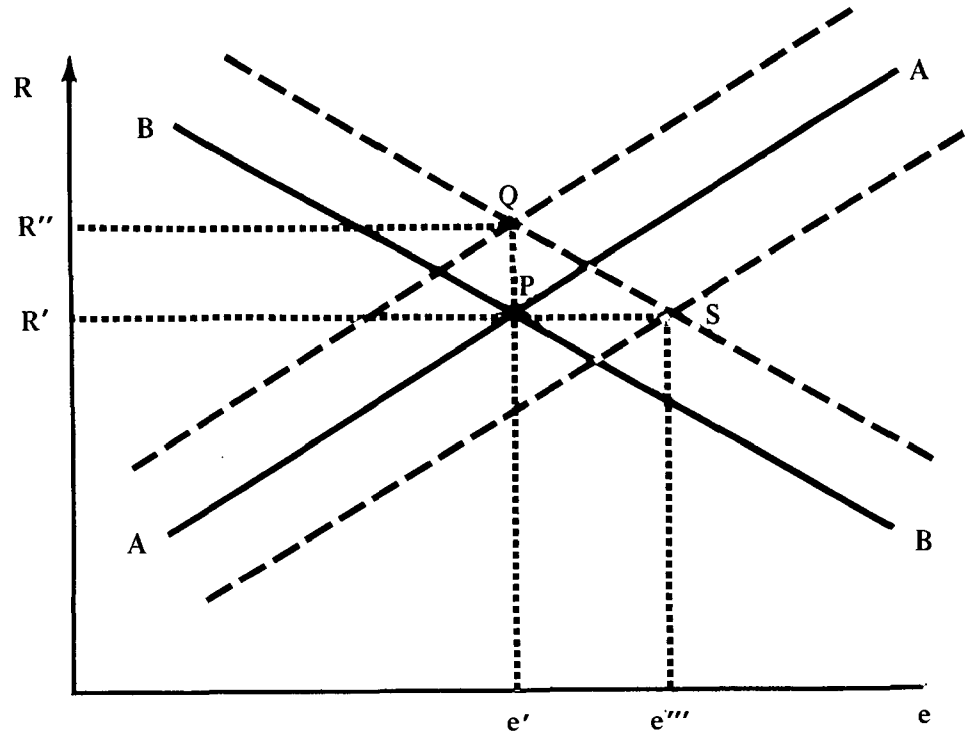



Figure 4



However, with an M1 target, an exchange rate depreciation and a fall in the interest rate is required to restore balance.

(ii) a shift in foreign portfolio preferences toward sterling assets under a fixed M2 or DC regime leads to a fall in the domestic interest rate and an exchange rate depreciation; under a fixed M1 or M2(-) regime, the same shift leads to a fall in the domestic interest rate with an exchange rate appreciation.

## VI. Monetary Equilibrium with Stock Adjustment

This section investigates the short run in which stocks adjust toward their long-run targets. It is assumed that the rate of stock adjustment is an order of magnitude slower than the rate of wage/price adjustment, so that the degree of competitiveness can be taken as fixed at its long-run level, $\bar{\alpha}$. Consumers and firms know the long-run equilibrium levels of real income and output, and set their targets accordingly. In the short run, start of period stocks are not at their target levels while real income and output may also deviate from their long-run levels as domestic agents attempt to adjust stocks to targets.

It is assumed that interest is paid on start of period stocks. Then the short-run deviation of income from its long-run level can be written:

$$(41)\quad \tilde{y} = \tilde{f} + r^*.\ (\tilde{w} - \tilde{k})$$

As $\alpha$, and hence $\lambda$, is fixed, short-run sales of the domestic good are given by

$$(42)\quad \tilde{z} = \lambda\ .\ \tilde{c}$$

Combining equations (21), (23), (41) and (42) gives:

$$(43)\quad \tilde{y} = \frac{(\mu.\lambda.\nu+r^*)}{1-\mu.\lambda.\nu}\ .\ \tilde{w} - \frac{(\mu+r^*)}{1-\mu.\lambda.\nu}\ .\ \tilde{k}$$

Equation (43) relates short-run income to initial wealth stocks and various parameters of the model only: short-run income tends to be higher relative to its long-run level, the greater are the excess holdings of wealth and the shortfall of capital. If both consumers and firms want to move their respective stocks in the same direction, the

two adjustment processes tend to counteract each other's impact on income, and vice versa. Also:

$$(44)\quad \tilde{z} = \frac{\lambda.\nu}{1-\mu.\lambda.\nu} \cdot [(1+r^*).\tilde{w} - (\mu+r^*).\tilde{k}]$$

The deviation of the end of period wealth stock from target can be obtained by combining equations (24) and (43):

$$(45)\quad \tilde{w} = (1+\phi).\tilde{w} + \Gamma.\tilde{k}$$

where:

$$(46)\quad \phi \equiv \frac{\mu.\lambda.\nu+r^*-\nu(1+r^*)}{1-\mu.\lambda.\nu}$$

and:

$$(47)\quad \Gamma \equiv \frac{-(1-\nu).(\mu+r^*)}{1-\mu.\lambda.\nu}$$

As $\mu$, $\lambda$, and $\nu$ are all between zero and one, and provided $r^*$ is small relative to these parameters, $\phi$ and $\Gamma$ are both negative.

Subtracting $\tilde{w}$ from each side of equation (45) gives the absolute adjustment of the wealth stock in the period, $\Delta w$ ($\equiv w - \hat{w}$), as:

$$(48)\quad \Delta w = \phi.\tilde{w} + \Gamma.\tilde{k}$$

So excesses of wealth and capital stocks both lead to the run down of wealth holdings.

Similarly, the deviation of the capital stock at the end of the period from its target can be obtained from equations (22) and (44):

$$(49)\quad \tilde{k} = (\Psi+1).\tilde{k} + \chi.\tilde{w}$$

where:

$$(50) \quad \Psi = \frac{\lambda.\nu.(\mu+r^*-\mu.r^*) - \mu}{1-\mu.\lambda.\nu}$$

and:

$$(51) \quad \chi = \frac{-\lambda.\nu.(1-\mu).(1+r^*)}{1-\mu.\lambda.\nu}$$

Provided $r^*$ is relatively small, both $\Psi$ and $\chi$ are negative. Subtracting $\hat{k}$ from each side of equation (49) gives the absolute adjustment of the capital stock in the period as:

$$(52) \quad \Delta k = \Psi.\hat{k} + \chi.\hat{w}$$

So an excess of capital and an excess of wealth both lead to the depletion of the capital stock.

The current account surplus, b, is equal to the increase in wealth less the increase in capital. So:

$$(53) \quad b = (\phi-\chi).\hat{w} - (\Psi-\Gamma).\hat{k}$$

The terms $(\phi-\chi)$ and $(\Psi-\Gamma)$ can both be shown to be negative, provided $r^*$ is relatively small; an excess of wealth and a deficiency of capital tend to produce current account deficits.

Figure 5 illustrates equations (43), (44), (48), (52) and (53) in $\hat{k}/\hat{w}$ space. These loci divide this space into ten sectors, in each of which the short-run characteristics of the real economy is distinct. Equations (48) and (52) can also be used to specify the paths of stock adjustment from any initial point toward long-run equilibrium. Note that the adjustment paths need not remain in one sector throughout their course; neither stock nor flow variables need adjust monotonically toward long-run values. Nevertheless, equilibrium is globally stable under the assumed adjustment rules, provided $r^*$ is relatively small, as the locus $\Delta k = 0$ is steeper than the locus $\Delta w = 0$.

Consider, for example, the aftermath of an exogenous shift in demand toward domestic goods, leading to an upward shift in long-run output and income, and hence in stock targets. The initial stocks of wealth and capital are given by history and are both below target--placing the economy at point C in Figure 5. From C, the economy adjusts toward stock equilibrium through a series of short-run equilibria with income above its new long-run value, consumption below, and a small current account surplus. In this case, the two separate stock adjustment processes serve to

countervail each other's short-run impact on the real economy. By way of contrast, consider the impact of a world-wide upward shift in interest rates that raises domestic wealth targets, but reduces domestic capital targets. Then the economy begins at D; the path of adjustment is characterized by a substantial slump of income and consumption and a large balance of payments surplus. In this case, the two stock adjustment processes reinforce each other's impact on the real economy. So, in gauging the short-run impact of a shock on the economy, it is important to assess its effect on the domestic demand for capital as well as on domestic demand for wealth.

Thus far, real stock and activities levels have been deduced without considering the position of monetary equilibrium itself. This property arises from the simplifying assumptions that neither relative prices nor initial stocks depend on interest and exchange rates or nominal prices in the short run. But having solved for $\tilde{k}$ and $\tilde{w}$, one can then solve for monetary equilibrium. Conditions for monetary equilibrium are: 1/

$$(54)\quad M2 = [k_{M1}(\rho, R-\delta-\rho, .) + k_{MQ}(\rho, R-\delta-\rho, .)].\bar{\alpha}.\frac{PM^*}{e}.(\bar{w} + \tilde{w}) + k^*_{MQ}(R-\delta-\rho, .).\bar{\alpha}.\frac{PM^*}{e}.\bar{w}^*$$

$$(55)\quad M2 = \eta.[1(R-\rho, .).\bar{\alpha}.\frac{PM^*}{e}(\bar{k} + \tilde{k}) + 1^*(R-\rho, .).\bar{\alpha}.\frac{PM^*}{e}.\bar{k}^*]$$

Provided that $(k_{M1} + k_{MQ})$ depends on the real interest rate but not the inflation rate alone, equations (54) and (55) may be solved for real values--m2 and r--without specifying monetary policy. This procedure leaves one degree of freedom for monetary policy: to determine nominal values by fixing M2, e or R. The path of real and nominal values during the period of stock adjustment may be plotted for a given monetary policy.

Matters would be much complicated if, for example, it were established that initial international wealth portfolios were such that real wealth at the start of the period was a declining function of the exchange rate as conventionally assumed. Then end-of-period stocks would not be independent of monetary variables; and equations (45) and (49) should be replaced by:

$$(56)\quad \tilde{w} = (1 + \phi).\tilde{w}(e, .) + \Gamma.\tilde{k}$$

$$(57)\quad \tilde{k} = (1 + \psi).\tilde{k} + \chi.\tilde{w}(e, .)$$

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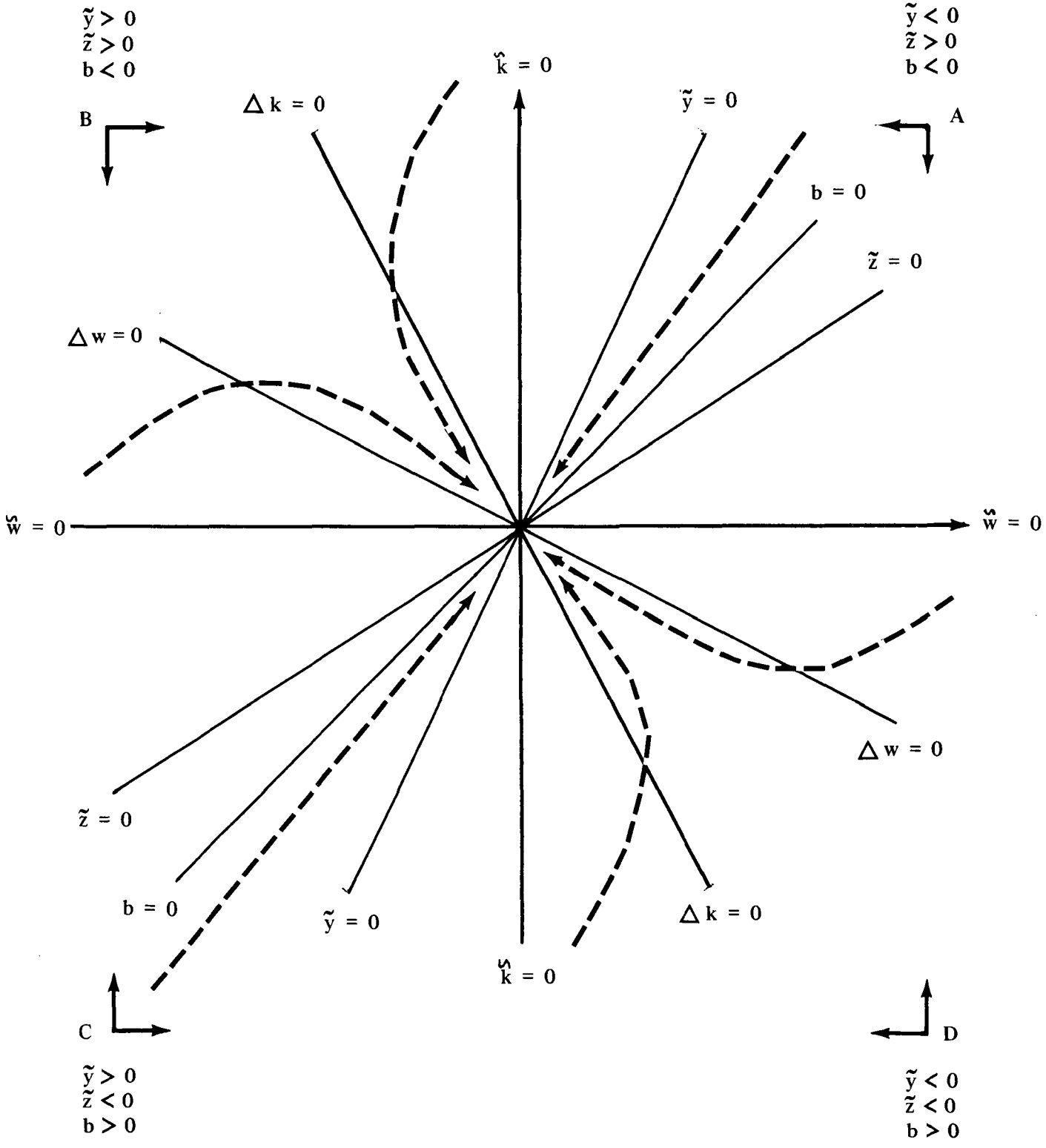
1/ Recall that, with $\alpha$ fixed, $\rho$ may be substituted for $\gamma$.

Figure 5


$\tilde{y} > 0$
$\tilde{z} > 0$
$b < 0$
$\tilde{y} < 0$
$\tilde{z} > 0$
$b < 0$
$\hat{k} = 0$
$\Delta k = 0$
$\tilde{y} = 0$
B
A
$b = 0$
$\tilde{z} = 0$
$\Delta w = 0$
$\hat{w} = 0$
$\hat{w} = 0$
$\Delta w = 0$
$\tilde{z} = 0$
$b = 0$
$\tilde{y} = 0$
$\Delta k = 0$
$\hat{k} = 0$
C
D
$\tilde{y} > 0$
$\tilde{z} < 0$
$b > 0$
$\tilde{y} < 0$
$\tilde{z} < 0$
$b > 0$

Then, money neutrality would no longer hold and the analysis could not be conveniently separated between real and monetary sectors; instead it would be necessary to solve equations (54)-(57) simultaneously to find monetary equilibrium in the immediate short run as a preliminary to discovering the path of adjustment. In this situation, the government could use its degree of freedom to influence real as well as nominal values.

For example, suppose the government chooses a money stock target, M2'. Figure 6 illustrates equations (54)-(57) in e/r space in this instance. The locus AA represents equations (54) and (56); it slopes up in e/r space as an increase in interest rate is needed to compensate for the depressing effect of a higher exchange rate on (i) domestic prices, and (ii) end of period real wealth, to maintain the demand for money at M2'. The locus BB represents equations (55) and (57); it slopes down in e/r space as a reduction in interest rate is needed to compensate for the depressing effect of a higher exchange rate on domestic prices, provided this effect outweighs the positive effect of a higher exchange rate on end of period real capital. 1/ The equilibrium exchange rate is then e', and the equilibrium real lending rate, r'. 2/ Increasing the money stock target shifts both loci to the left, and so leads to a fall of the short-run equilibrium exchange rate. If real wealth were initially too low, this movement would reduce the degree of stock disequilibrium and so contribute to the process of stock adjustment.

## VII. Conclusion

Recent institutional developments, particularly in developed economies, have led to increasingly competitive money markets dominated by price rather than quantity adjustment. The theme of this paper is that in such a situation monetary aggregates, interest rates and the exchange rate are jointly determined, and it is then essential to pay as much attention to modeling the supply of money as the demand. Otherwise, the analysis of monetary policy is sometimes misleading and at best incomplete.

If an interest rate on money balances is simply introduced into a standard model of asset market equilibrium, it appears that the authorities have two degrees of freedom, being able to set two from the set of monetary aggregates, interest rates and the exchange rate; this conclusion is at odds with the conventional wisdom on the limits to sustainable monetary policy. But the money market-clearing condition, that the demand for monetary assets be compatible with the demand for bank lending,

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1/ Note that low initial real wealth will tend to reduce sales in the short run, and hence cause firms to accumulate stocks.

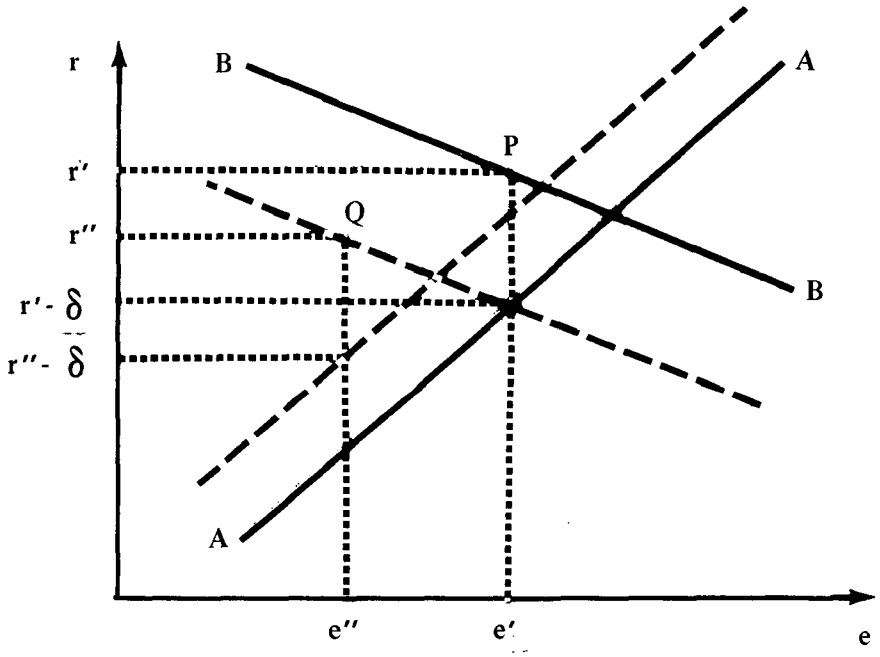
2/ The nominal interest rate can only be discovered by deriving next period's equilibrium exchange rate to find the expected rate of inflation.

provides an additional restraint on the power of monetary policy. In the long run, in which nominal prices are perfectly flexible and stocks at their target values, the authorities may control the price level but not real activity levels or relative prices or real interest rates in monetary equilibrium, unless they are prepared to manipulate the behavior of the banking system. In the short run, in which nominal prices are sticky and stocks may differ from their target values, the authorities may exert some influence over the real economy through their choice of monetary policy, but this policy cannot hope to achieve more than one independent monetary target without altering bank behavior.

The analysis contained in the body of this paper is also intended to bring out some of the comparative-static implications of models that treat the liability as well as the asset side of the money market. These include: (1) the conventional view that raising interest rates leads to an exchange rate appreciation and a contraction of the money stock rests on (i) the demand for money balances being more responsive to shifts of the exchange rate than the demand for bank lending, and (ii) the substitution effect of an increase in interest rates on bank lending outweighing the income effect; (2) the qualitative effect of a financial shock on monetary equilibrium depends on (i) the impact of the shock on the demand for bank lending as well as on the demand for money balances, and (ii) the precise choice of monetary target.

In addition, the inclusion of capital stocks as well as wealth in the model allows a more complete analysis of the process of stock adjustment. The impact of adjustment on the real economy depends on the direction and relative extent of the disparities between both capital and wealth stocks and targets. The role of monetary factors in stock adjustment depends on the relation between the real value of domestic wealth stocks and the exchange rate. The conventional assumption that real wealth increases with the exchange rate is less convincing when wealth is recognized to consist of direct and indirect claims on physical assets rather than merely outside money. The alternative assumption that real wealth is independent of the exchange rate implies that the activities levels during the period of stock adjustment are independent of monetary policy.

Figure 6



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