

THE MONEY SUPPLY PROCESS AND MONETARY EQUILIBRIUM IN THE
OPEN, PETROLEUM ECONOMY

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The search for a relevant and realistic macro-model of Caribbean-type economy has been subjected to fits and starts over the last two decades. It is now almost twenty (20) years since Dudley Seers (13) rejected the Keynesian model as an adequate vehicle for analysing the open, 'petroleum' economies of the Caribbean, arguing in part that the explicandum should not be national income, but rather the level of employment. Kennedy (11) sought to make appropriate extensions and modifications to the basic Keynesian framework, and Bruce (4) and Brewster (3) advanced the technical aspects of the debate, but took rather eclectic positions which did not help to address the fundamental methodological issues initially raised by Seers. Best and Levitt (1) also took their own insightful approach to the problem, but, in our view, failed to provide an adequate alternative theoretical framework.

Since the early 1970s, the debate on the appropriate macro-model for Caribbean economy has subsided as researchers withdrew to re-evaluate their positions and to do the empirical work that must necessarily provide the foundation for any theoretical approach. In addition, in the industrialised countries, the Monetarist critique of orthodox Keynesianism was beginning to make important inroads, not only in academe, but also increasingly in policy-making circles as well. This critique has also given Caribbean theorists pause, not necessarily because of any intellectual dependence, but because the monetarist critique seemed familiar and relevant, given the

work of C. Y. Thomas (14) and other monetary economists, who had long suggested that the Classical view of the demand for money might be more relevant to our circumstances. The adoption of this view would call into question the validity of the interest rate nexus emphasised in the Keynesian model and destroy that particular link between the monetary and the real sectors.

In fact one of the major weaknesses of macro-economic theorising in the Caribbean was the failure to deal adequately with the monetary sector and the nature of, and conditions for monetary equilibrium. These considerations do not appear at all in the work of Seers (13) and Kennedy (11), and were less than adequately treated by the later writers. Specifically, the problem of modelling the monetary sector does not relate solely to the question of the interest sensitivity of the demand for money. In fact the much larger problem is the issue of how the modelling of the money supply process should be handled for these types of economies, since it has become quite clear that the Keynesian and Monetarist assumption of an exogenous money stock is not appropriate (Farrell (9); Bruce (5).)

This paper addresses the problem of constructing a model of the monetary sector in the open, petroleum economy, a subset of the wider class of open, dependent economies. The real sector is not treated explicitly, partly because of a need and a desire to treat the monetary sector in some detail, given its relative neglect in the previous Caribbean literature, and partly because of our view that both Keynesian and Monetarist approaches to the modelling of the real sector are not entirely appropriate to these circumstances, and therefore to juxtapose a more elaborate model of the monetary sector with these real sector models would be equally inappropriate.

1. The Monetary Sector

(i) The Supply Side

The money supply is defined here as currency in circulation C, plus commercial bank deposits, D. Defining the monetary base, H, as currency in circulation plus commercial banks reserves, R, and given the relationship between reserves holdings and total deposits, the money supply may be expressed in terms of the product of the monetary base, H, and the money multiplier, m.

$$M = m H \quad (1)$$

In orthodox Keynesian and mainstream Monetarist analyses, the monetary base, H is taken as controllable by the government and hence exogenous, and given the stability and predictability of the money multiplier, the money supply itself becomes an exogenous variable.

This is not the case in open, petroleum economies where the stock of base money is backed less by government securities than by foreign assets. Assuming for convenience that government does no borrowing from the Central Bank, the monetary base may be expressed as:

$$H = C + R = NFA - GD \quad (2)$$

- where NFA is net foreign assets, GD is government deposits at the Central Bank and all other assets and liabilities are assumed to be zero and are ignored⁽¹⁾. The change in the monetary base may then be written:

$$\Delta H = \Delta NFA_g - \Delta NFA_p - \Delta GD \quad (3)$$

- where ΔNFA_p is the change in net foreign assets arising from private sector transactions and will be negative and large, and ΔNFA_g is the change

in net foreign assets arising from government transactions (oil tax receipts) which will be positive and large. (Government foreign borrowing is assumed to be zero).

The government budget balance may be written:

$$G_d + G_f - T_d - T_f = \Delta GD < 0 \quad (4)$$

$$\text{or } (G_d - T_d) + (G_f - T_f) = \Delta GD < 0 \quad (5)$$

-where $(G_d - T_d)$ is the domestic budget deficit, i.e. we assume $G_d > T_d$, and $(T_f - G_f)$ is the net inflow of foreign exchange on government account, $(T_f > G_f)$. We assume an overall budget surplus, hence there is an increase in government deposits. Rewriting (5), we have

$$G_d - T_d = (T_f - G_f) - \Delta GD \quad (6)$$

but $\Delta NFA_g = T_f - G_f \quad (7)$

whence $\Delta NFA_g = (G_d - T_d) + \Delta GD \quad (8)$

and $\Delta H = (G_d - T_d) - \Delta NFA_p \quad (9)$

The change in the stock of base or high-powered money is thus equal to net foreign exchange outflows of the private sector, which reduce the stock, and the domestic budget deficit, which increases the stock of base money.

The following system of equations then explains the flow supply of money, ΔM :

$$T_d = T_d(Y) \quad T_{dy} > 0 \quad (10)$$

$$\Delta NFA_p = \mu(Y) \quad \mu_y > 0 \quad (11)$$

$$\Delta H = (G_d - T_d) - \Delta NFA_p \quad (9)$$

$$\Delta M = m \Delta H \quad (12)$$

$$m = \bar{m} \quad (13a)$$

or $m = m(r) \quad m_r < 0 \quad (13b)$

The system explaining the flow supply of money has five (5) equations in five (5) endogenous variables -- T_d , ΔNFA_p , ΔH , ΔM and m . (If we assume the multiplier is constant, then equation (13a) is relevant and we can reduce the system to four (4) equations in four (4) variables). The exogenous variables are -- Y , G_d , r , where r is the banks' desired reserve ratio. The foreign exchange outflows function requires some explanation. We assume that these outflows are related mainly to imports, IM , which are a function of aggregate expenditure, AE , which in turn is related to income, $Y^{(2)}$.

We can therefore write after appropriate substitution:

$$\Delta M = m(r) \cdot (G_d - T_d(Y) - \mu(Y)) \quad (14)$$

and
$$d\Delta M = m(r) (dG_d - T_{dy} dY - \mu_y dY) + \Delta H m_r dr \quad (15)$$

$$d\Delta M = m(r) dG_d - m(r) (T_{dy} + \mu_y) dY + \Delta H m_r dr \quad (16)$$

where ΔH is $(G_d - T_d(Y) - \mu(Y))$

Equation (16) illustrates clearly that the flow supply of money is determined by the behaviour of the non-bank public, the commercial banks and the central government. The direction of change in the flow supply of money due to changes in the exogenous variables is also evident.

$$\frac{d\Delta M}{dY} = -m(r) (T_{dy} + \mu_y) < 0 \quad (17)$$

$$\frac{d\Delta M}{dG_d} = m(r) > 0 \quad (18)$$

$$\frac{d\Delta M}{dr} = \Delta H m_r < 0 \quad (19)$$

An increase in income will reduce the flow supply of money because it increases tax revenue and imports which constitute leakages from the stream of money flows. An increase in government domestic expenditure will increase the flow supply of money, and an increase in the commercial banks' desired reserve ratio will decrease the flow supply of money.

(ii) The Demand Side

The demand side of the money market is fairly easily handled. We postulate that the incremental (flow) demand for money will be related, through a partial adjustment mechanism, to income, Y , and the (stock) demand for money in the previous period. (3)

$$\Delta M^d = L(Y, M_{-1}^d) \quad L_y > 0; \quad L_m < 0 \quad (20)$$

We can therefore have:

$$d\Delta M^d = L_y dY + L_m dM_{-1}^d \quad (21)$$

The demand for money is here viewed as mainly arising for transactions and precautionary purposes. There is no interest rate effect postulated and the empirical evidence available suggests that the interest elasticity of the demand for money is either zero or quite small in the types of economies under consideration. (4) One of the possible reasons for the failure of the interest rate variable to show up in the empirical work may be because this effect is swamped by the inflationary expectations effect which affects the yield on physical goods and causes a change in the demand for money. Equation (20) may therefore be extended to include the (expected) inflation rate.

$$\Delta M^d = L(Y, M_{-1}^d, \dot{p}) \quad L_p < 0 \quad (22)$$

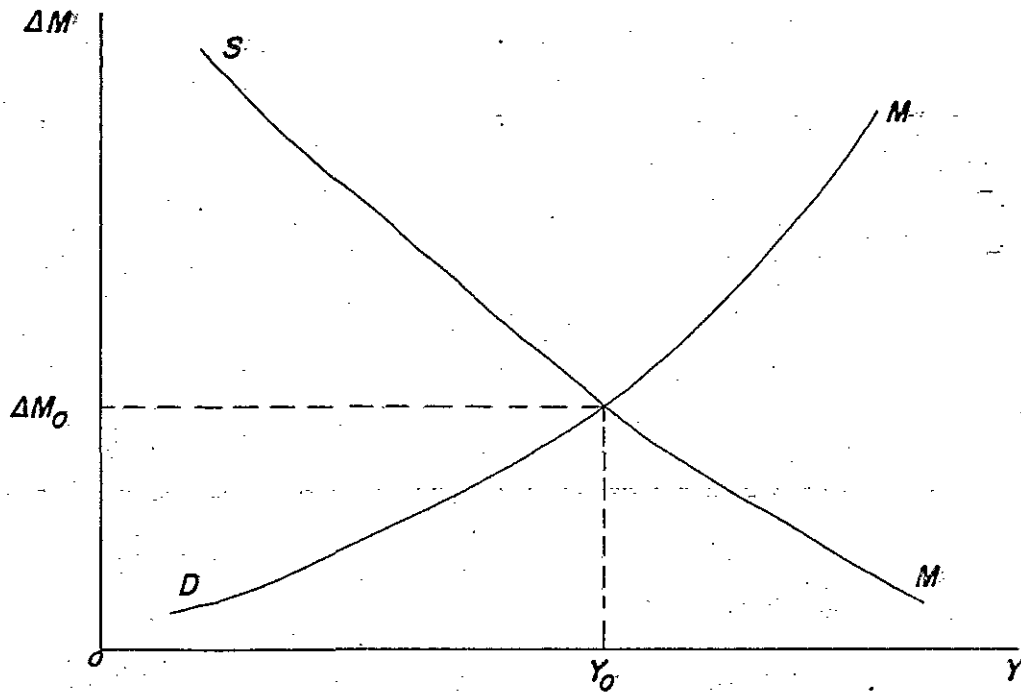
$$d\Delta M^d = L_y dY + L_m dM_{-1}^d + L_p d\dot{p} \quad (23)$$

(iii) Equilibrium

Equilibrium in the money market may be depicted in terms of the relationship between the flow supply and demand for money, and income. This is illustrated in Figure 1 below. The relationship between the flow supply of money and income is given by the downward-sloping curve, SM , which shows that, ceteris paribus, an increase in income will reduce the flow supply of

Fig.1

MONETARY EQUILIBRIUM



money through the tax and foreign exchange outflows leakages (Equation (17)). The relationship between the flow demand for money and income is expressed by the upward-sloping curve, DM, indicating that an increase in income will, ceteris paribus, increase the flow demand for money. The equilibrium flows of money and income will occur where the SM and DM curves intersect at ΔM_0 and Y_0 .

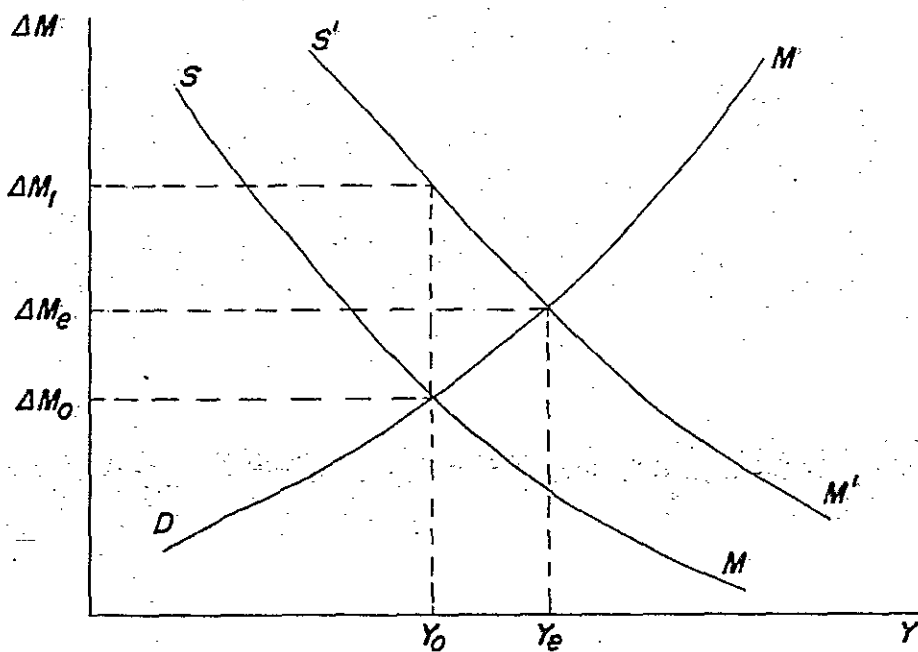
An important consideration is the behaviour of the system when there has been a disturbance to equilibrium. The adjustment mechanism is viewed as operating through two main channels:

- (i) variations in aggregate expenditure which will affect income and hence imports and tax revenues, which then feed back to the money supply;
- and (ii) changes in the level and rate of change of domestic prices as a result of the change in the level of expenditure.

Through its effect on aggregate expenditure, variations in the flow supply of money will cause variations in nominal income. The division between the effect on real output and on prices is not determined by the model. We can surmise however that in a highly open economy, the real output response to a change in expenditure will be small in the short and medium runs because of structural rigidities which affect the supply side. Most of the effect of expenditure variations will be felt on imports and on domestic prices.

Consider for example a change in some exogenous variable which causes an excess supply of money to appear at the equilibrium level of income (Figure 2). The supply curve has shifted to $S^{\wedge}M^{\wedge}$ and an excess supply of money ($\Delta M_1 - \Delta M_0$) will cause expenditure to rise. Part of the increase in expenditure will cause imports and foreign exchange outflows to rise and this will exert downward pressure on the flow supply of money. Additionally, the increased expenditure will cause domestic prices and hence nominal income to rise. This will lead to an increase in the demand for money and further decreases in the supply of money through the taxation leakage. The new equilibrium will be at a higher level of income and a higher flow of money depending on the relative elasticities of the two functions.

Fig. 2



Adjustment to disequilibrating forces will therefore normally involve both supply and demand side responses. An important question, which however can only be answered empirically, is how long the adjustment process will take before a new equilibrium is established and what path the system will take to the new equilibrium. It seems plausible however that the adjustment lags will be longer than in more developed financial systems where an interest rate nexus is involved. In the case of the open, petroleum economy, a number of lags are involved once we have a change in one of the exogenous variables. The first is the multiplier lag between the change in base money and the change in the money supply which essentially depends on the speed of the portfolio adjustments of the commercial banks. If the experience of Trinidad and Tobago is any guide, this lag can be quite long (more than two (2) quarters). Secondly there is the expenditure lag between the change in the money supply and the change in aggregate expenditure, including imports. Thirdly there is the inflation lag between the change in domestic expenditure and the change in domestic prices. Finally, there is the revenue lag between changes in nominal income and the effects on tax revenues, which may itself be quite long.

Whilst these lags can be identified without much difficulty, their variable lengths clearly pose problems for tracking the disequilibrium behaviour of the monetary system and more especially, pose unique problems for policy formulation in respect of the monetary sector. This latter problem is discussed at greater length in Section 3 below.

2. Some Comparative Statics

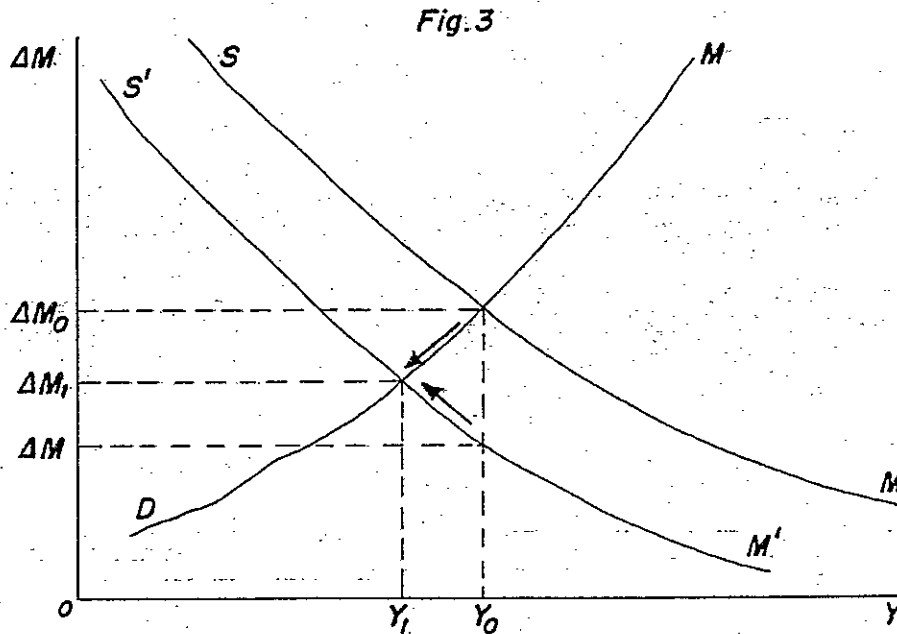
With the model described in the previous section, we are able to answer a variety of questions which could be legitimately be addressed in the context of an open, petroleum economy. Before proceeding to this

however, it is important to note that certain relationships identified in the orthodox approach to money supply determination in open economies do not necessarily obtain in the open, petroleum economy. For example, in the orthodox presentation, an increase in foreign exchange reserves will increase the money supply unless there is deliberate sterilization by the monetary authorities who can reduce domestic credit expansion. In the open, petroleum economy an increase in reserves is automatically sterilized since the inflows of reserves accrue largely on government account and lead to an increase in government deposits. It is only when government begins to spend that these reserves are injected into the stream of money flows. It is because of these institutional realities, that the model outlined above shifts attention away from the balance of payments/money supply nexus to the government budget/money supply relationship, when the expansion of the money supply is considered. The balance of payments continues to be significant as a contractionary factor affecting the money supply via the import function and foreign exchange outflows.

Consider then an increase in government domestic expenditure. This will lead to an increase in the domestic budget deficit and an equivalent increase in base money. The extent of the increase in the money supply will depend on the size of the multiplier. This will constitute the initial or first round effect which will cause an excess supply of money at the prevailing level of income. The final equilibrium will depend on the adjustment mechanisms described in the previous section, (Figure 2).

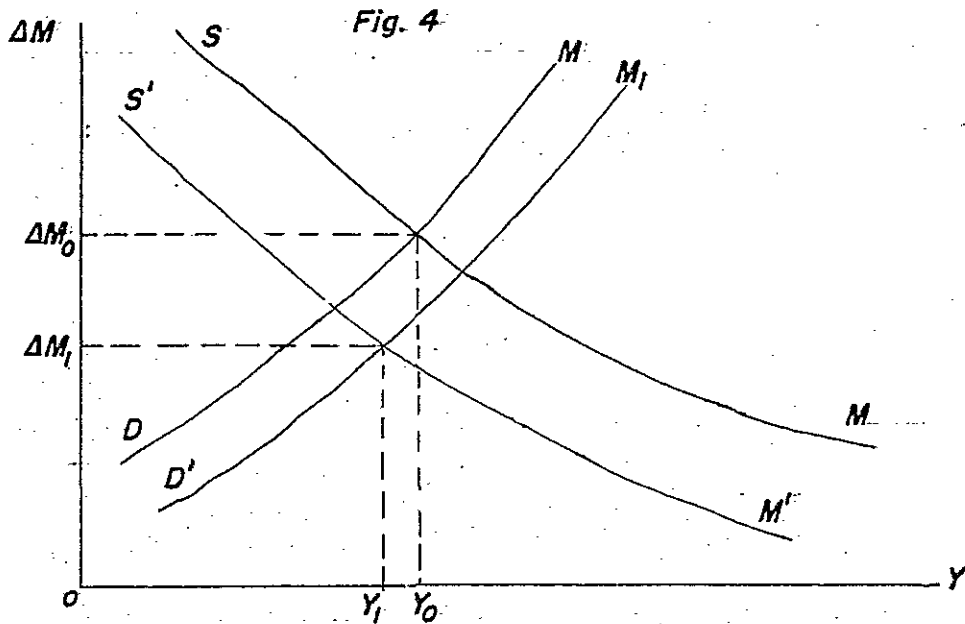
An increase in tax rates will have the opposite effect. The supply of money will decline. The extent of the decline will depend on the magnitude of the change in tax rates, and the size of the multiplier. There

will be an excess flow demand for money and, assuming no change in velocity, real output growth will decline, causing the demand for money to decline and at the same time, falling aggregate expenditure will cause imports and thus foreign exchange outflows to decline and the money supply as well. The new equilibrium levels of the money supply and income will be lower than before. Figure 3 illustrates. The supply curve shifts to S'M' and there is excess flow money demand of $(\Delta M_0 - \Delta M)$. Adjustment involves both reduction in the demand for money and subsequent increases in the flow supply of money which will eliminate the excess demand.



An increase in the marginal propensity to import and/or an increase in import prices will have an initial effect similar to that of an increase in tax rates. The adjustment to a new equilibrium may however be different because the balance of payments and the stock of foreign exchange reserves, which are usually independent objectives of economic policy, will be affected and policy responses in this area may make adjustment faster or slower. If an increase in import prices affect domestic prices and the

inflation rate, there may also be a shift in the demand for money function as velocity increases. This would serve to moderate the decline in income needed to achieve equilibrium (Figure 4).



Finally we may consider the effect of an increase in the commercial banks' desired reserve ratio. An increase in this ratio will reduce the money multiplier and hence the flow supply of money. The extent of the change in the flow supply of money will depend on the change in the multiplier arising from the change in the reserve ratio and the flow supply of base money.

The next section considers some of the implications for policy which flow from the analysis above.

3. Policy Implications

The model outlined in the previous pages postulates a relationship between the money supply and real output and prices. The money supply is itself determined by government budgetary operations, the balance of payments of the private sector and commercial bank behaviour. Given that variations in the money supply may have significant effects on output

and prices, then the question of the control of the money supply comes to the fore.

The previous analysis suggests that base money and the money supply are both endogenous variables, which are not solely or directly determined by the monetary authorities. The issue then arises as to how the monetary authorities can effect the requisite control over the money supply. Four (4) potential instruments of control can be identified.

Firstly, the monetary authorities (i.e. Central Bank cum Ministry of Finance) can seek to control government domestic expenditure. There are two main reasons why this instrument would be difficult to use ordinarily. Firstly, it is unlikely that the government will subordinate its other policy objectives to that of money supply control. When it does so, the problem of what categories of spending should be cut becomes critical, and certain interests will be adversely affected, other objectives of policy may be compromised (e.g. reduction of unemployment), and political unrest may result.⁽⁵⁾ Secondly, the mechanics of controlling government spending are not very clear. The monetary authorities would need to know with a fair degree of precision what the level of expenditure must be to achieve a given rate of change of the money supply and make such cuts or increases in expenditure as are necessary to attain the desired level. But government programmes are difficult to subject to that kind of 'stop-go' action, and the efficacy of expenditure control is accordingly diminished.

The second potential policy instrument is the control of tax revenues either through changes in tax rates or in the tax base. Like government expenditure, short run variations in tax revenues would be

difficult to effect, because the nature of the system of taxation is such that tax rates and tax bases cannot be varied frequently simply to accommodate a money supply target.

The third potential instrument is import and exchange controls. This instrument would work by causing parametric shifts in the foreign exchange outflows function and hence in the money supply. The problems with this instrument are two. Firstly, the use of this instrument, as with the others previously mentioned, involves a policy conflict. If it is desired to restrict monetary growth, then import and exchange controls have to be relaxed. This would have adverse effects on the level of foreign exchange reserves and on the import substitution process in the real sector. On the other hand, if these controls are tightened, there will be expansion of the money supply as foreign exchange outflows are choked off. Secondly, this instrument also suffers from the problem of viscosity of operation i.e. it is not usually appropriate to vary these controls in order to achieve short or medium-term money supply targets.

The fourth potential instrument of money supply control is the use of reserve requirement variations. This instrument has the important advantage over the others that it does not normally involve policy conflict, and is a much more efficacious short-term instrument than the others, even though frequent variations in the reserve ratio are strictly not kosher. Reserve requirement variations are however not without problems. There is the question of what level of required reserves will be needed to achieve a given level of the flow money supply. The determination of this is complicated by the action of the commercial banks who may vary their levels of desired excess reserves and so frustrate monetary policy, at least for a time. Additionally, it is recognised that though the monetary authorities

can effectively 'pull on the string', it is difficult to 'push the string', and there remains a fundamental asymmetry in the efficacy of this instrument of policy. Perhaps more important is the fact that reserve requirement variations work through the multiplier. But the effect on the money stock will depend on the size of the flows of base money. In other words, the impact of reserve requirement variations on the money supply may be nullified, wholly or partially, by offsetting endogenous variations in base money. It may be the case for example that the Central Bank is trying to control the money supply by raising the required reserve ratio, whilst government domestic spending is accelerating.

The discussion of the potentially available policy instruments suggests that:

- (i) it is not the case that, because the money supply is endogenous, the monetary authorities have no means of controlling the money supply;
- (ii) three of the available instruments are however subject to policy conflicts and are difficult to use in the close control of the money supply, particularly in the short and medium runs;
- (iii) reserve requirement variations is the best short-run control instrument available, but its efficacy too is fraught with problems;
- (iv) close control of the money supply in open, petroleum economies is extremely difficult and requires coordination of monetary and fiscal policies, as well as monetary and balance of payments policies.

How the monetary authorities in such systems can increase their leverage over the monetary sector is properly the subject of another study. It may be noted here however that

- (i) effective monetary policy will be made even more difficult by the inside lags in policy formulation and policy implementation;
- (ii) even in those happy instances where monetary management is active and the inside lags are relatively short, there remains the problem that if the monetary system is subject to frequent random shocks and the disequilibrium behaviour of the system is not well known, the nature and timing of policy interventions becomes even more difficult to determine.

4. Conclusion

This paper has sought to outline a model of the monetary sector in open, petroleum economies. The model can be easily modified to suit the wider class of open, dependent economies where the staple sector is not petroleum. The model also enables us to identify the problems of monetary management in such an economy.

We would be remiss however if we did not also point out some of the problems and limitations of the model. Firstly, there is need to ground the model more firmly in the real sector, since the adjustment process involves both real output responses, as well as price and balance of payments responses. This is not a particularly easy task because the real sector is quite complex in these economies, and the simple production function characterisation of output and income generation is simply not appropriate.

Secondly, the disequilibrium dynamics of the model need to be explored at length because, as we have suggested, the process of adjustment to equilibrium is likely to be fairly long, thus allowing random shocks and perhaps policy actions with respect to government budgetary operations and the balance of payments to intervene and complicate the process. How the system behaves out of equilibrium constitutes one of the grey areas which needs clarification. The empirical evidence indicates that the money supply is in fact subject to considerable fluctuation in the short run and that factors other than those described in the model do impact substantially on the money supply from time to time (Farrell (8)).

The third problem, which is less serious, is that the model as outlined above does not allow for any interaction between the money multiplier and changes in the stock of base money. It is in fact possible that the banks' desired reserve ratio is sensitive to the size of the flows of base money via its effect on deposit variability. This possibility can however be incorporated into the existing structure of the model.

Finally the empirical work to verify and support the relationships postulated needs to be carried out, more especially because of the potential usefulness of the framework to monetary policy.

NOTES

(1) These other assets and liabilities may be easily incorporated into the analysis and in fact variations in these components can and do cause fluctuations in the money supply. (See Farrell (8)). Our intention here however in constructing the model is to focus on the essentials, leaving the less significant variables for a more elaborate exercise.

(2) See Farrell (9).

(3) The optimal demand for money is assumed to be a function of income:

$$M^{d*} = f(Y)$$

Adjustment to the optimal money demand is given by:

$$M^d - M_{-1}^d = \gamma (M^{d*} - M_{-1}^d) \quad 0 < \gamma < 1$$

or
$$\Delta M^d = \gamma (f(Y) - M_{-1}^d)$$

$$\Delta M^d = L(Y, M_{-1}^d)$$

(4) See Bourne (2), Bynoe (6), Howard (10) and London (12).

(5) This has apparently been the case in the United Kingdom under the Thatcher administration, and a similar situation may be emerging in the United States.

GLOSSARY OF SYMBOLS

(in order of appearance; time subscripts are omitted)

C	-	Currency in Circulation
D	-	Commercial Bank Deposits
H	-	Stock of Base Money
R	-	Commercial Bank Reserves
M	-	Money Stock
m	-	Money Multiplier
NFA	-	Stock of Foreign Assets (net)
GD	-	Government Deposits at Central Bank
ΔNFA_p	-	Change in Net Foreign Assets arising from private sector transactions
ΔNFA_g	-	Change in Net Foreign Assets arising from official transactions
G_d	-	Government Domestic Expenditure
G_f	-	Government Foreign Expenditure
T_d	-	Government Domestic Revenue
T_f	-	Government Foreign Revenue (Oil Receipts mainly)
Y	-	Gross Domestic (Non-Oil) Income
r	-	Commercial Banks' Desired Reserve Ratio

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