Monetary Mechanisms in Open Economies: A Model for the Caribbean

by

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Abstract

If we are to explain adequately the process by which very small open economies adjust to monetary changes, we must describe commercial bank behaviour carefully. Many popular models embody assumptions about the relationship of money and expenditures which are invalid because they misrepresent bank behaviour and its effects. We present a model to represent bank decisions, estimate it for three Caribbean countries and discuss what it reveals about the impact of some exogenous changes.

The widespread use of monetary instruments for economic stabilisation in recent years has spawned numerous models to explore the relationships between money and output. Much of the work on less developed countries has been done with small models where the interaction of the supply of and demand for money is the pivotal link in the chain of causation from money to prices and production. Unfortunately, these models are often not explicit about the behavioural relationships which they embody. This paper addresses that deficiency; it offers a model structured around equations describing banking behaviour. It is designed to represent a small open economy with no non-monetised sector to speak of, where the banking system services all significant economic activity: a description which fits the Caribbean island states for which the model will be tested.

A typical model of monetary relationships in LDCs features a demand for money which is a function of an income and/or a wealth variable, interest rates and/or prices (usually expected prices) and, occasionally, novelties such as variables to represent the degree of credit restraint (Wong [1977]). The supply of money, in a fixed exchange

rate regime, is determined by the balance of payments and net advances by the central bank to banks, government and the public. When demand does not equal supply this sets up reactions which alter expenditures and relative prices, thereby affecting output and the balance of payments (For a sampling of offerings in this vein see Grossman, Hanson and Lucas [1982], Blejer and Fernandez [1978], Aghevli and Rodriguez [1979] and several contributions to Coats and Khatkhate [1980]).

There are several stories about the motives for the price and expenditure reactions. They vary with the definition of money. If one is concerned with narrow money it can be argued that a certain level of liquidity is needed to service transactions; firms will accept low yield or no yield so as to have this ready cash. However, unemployed funds in excess of this minimum will be placed at more attractive interest. The portfolio adjustment to an increase in the money supply lowers interest rates on alternative financial assets as firms try to rid themselves of unwanted liquidity. It becomes cheaper to borrow and spending rises. Although originally cast in terms of a dichotomy between money and interest-bearing assets the argument has been modified to accept a whole range of financial assets. A rising money stock lowers relative yields at the money end of the spectrum, shifting finance towards the investment end (Harrington [1983]).

Alternatively, one may argue that money is a factor of production. More of it, relative to demand, drives down its price (or opportunity cost, if money bears no interest) and lowers supply schedules, offering the possibility of higher levels of output.

If we switch to the broad definition, monetary liabilities may be seen as competing with real assets, particularly consumer durables and real estate. If the supply of monetary liabilities rises, depressing returns, the purchase of real assets becomes more attractive and spending rises. In countries with a large unorganised money market contraction in the supply and the associated interest rate increase is expected to draw funds out of hoards and raise the degree of monetisation of the economy.

In every one of these cases the increase in expenditure that results from the additional money changes relative prices as well as absolute prices, because of the small country assumption. World market conditions determine tradable goods prices; domestic developments affect only the prices of non-tradables. Because of the differences in the supply and demand curves of tradables and non-tradables the change in relative prices will alter the level of output.

None of the foregoing explanations is really quite satisfactory, however. For one thing, they imply that the motives for spending and financial accumulation are similar. The similarities may be less important that the differences. Conceptually, the motives for financial accumulation may be segregated in several ways, including distinction between 'income', 'precautionary' and 'liquidity' reasons. If the motive for financial accumulation is to secure a future stream of income, the acquisition of a real asset which carries an actual or implicit steam of returns is a meaningful alternative. It is reasonable to expect an expenditure reaction to an increase in the money supply. If the motive for financial accumulation is precautionary, we can expect the same expenditure reaction only if there are durables or investment goods which offer security to compare with the asset holder's confidence in bank liabilities. If the banks are used mainly as a source of liquidity, monetary movements may stimulate little expenditure. We will observe little substitution between different categories of assets in this case; shifts will take place, for the most part, among financial assets and among real assets, not from financial to real assets. An increase in money supply is likely to result in holdings of foreign financial assets or a wider spread on local interest rates for different deposit maturities, rather than any change in expenditure.

By focussing on comparative returns on real and financial assets we risk neglecting crucial variables in the investment and consumer-durables demand functions. The expected rate of return on investment depends on factors such as the economic sector involved, the nature of the production function, the maturity of the technology and its relationship to available skills and factor endowments. Investment in the Caribbean countries from which data are drawn in the third section depends largely on export prospects and the government capital programme. Factors such as export market conditions, US tariffs, levels of domestic protection, assimilation of new technology and available natural resources have played the dominant role. Purchases of consumer durables are primarily influenced by income growth and current and expected inflation.

This analysis fails to distinguish between money and finance. In the aggregate, finance is a factor of production; the cost of finance for working capital, trade credits and other funding to cover transactions in progress will enter into the supply function. However, this aggregate finance will never be equal to money, whether narrowly or broadly defined. It is made up of cash flow and borrowing, the relative proportions being the result of decisions by firms' managers. This aggregate is different from total credit, although credit seems a better proxy than money. All firms in the economy use some credit, so the loan rate represents their marginal cost of finance. Moreover, if cash management expertise does not change quickly, the relationship of finance to credit may not change much over the short run.

We may ground our analysis more firmly in the real world, and provide explanations which correspond to observable behaviour, by focussing on credit-expenditure relationships, rather than money-expenditure relationships. Commercial banks' loan interest rates directly affect production and expenditure. The cost of bank finance is an important element in the supply schedule of producers, commercial banks being the main source of working capital (See Keller [1980]). Consumer expenditure should also be sensitive to the cost of bank credit, which is used to help finance the purchase of durable goods.

Some recent analyses have suggested an index of credit rationing by banks as a more appropriate measure of the effect of monetary changes on expenditure. These studies correctly perceive that banks range their potential customers along a scale of credit-worthiness and that the least credit-worthy are denied funds. However, if we use a credit-worthiness index to measure effects on spending we imply that banks move back and forth along the credit-

worthiness spectrum as their liquidity changes: when they have unwanted liquid funds they offer credit to customers who previously would not have qualified. However, in the Caribbean customers are rationed by institutional norms, not by availability of funds. Those who do not meet conventional credit standards never qualify for loans, no matter how liquid the banks are. Those who qualify are accommodated; if banks do not have resources themselves, they borrow to meet the needs of these clients. It is the cost of finance that varies, depending on the cost to the bank of the resources provided.

The Model

The model differs from the majority of those to be found in recent literature on less developed countries in two respects. It is designed to measure effects on loan interest rates rather than on monetary liabilities and it neglects the money multiplier in favour of an explicit structure to represent commercial bank behaviour.

The supply and demand for credit determine the loan interest rate. That rate triggers price, output and expenditure reactions, in ways which we explore elsewhere (Holder and Worrell [1983]). The supply of credit is explained via commercial bank behaviour. Coats and

Khatkhate [1978] describe how changes in commercial bank excess reserves may determine the reaction to a monetary disturbance. They are concerned with the impact of government borrowing, but the argument holds for any disturbance to the financial sector. If banks accommodate government by use of excess reserves the money supply increases even though base money is unchanged; the money multiplier has increased. Like Coats and Khatkhate we provide an explicit model for the determination of excess reserves, though ours is structural where they use a single equation. There is no money multiplier in our model since money is not our focus, but an implicit interest rate multiplier may be calculated from the structural etimates we compute, along lines discussed in the final section of the paper.

The credit market has a central place in the model. In the first section we noted that firms need bank credit for working capital, households demand credit for the purchase of durables and government seeks credit for deficit financing. The way in which these requirements vary in response to changes in the cost of credit is given by:

$$(1) \quad Cr = f_1 (Y, r_1)$$

where credit (Cr) depends on the level of economic activity - represented by the value of output (Y) - and on the cost of credit (r_1).

We do not include the foreign interest rate as an argument in the credit demand function, even though we are dealing with an open financial system. As we shall soon see foreign rates do have an impact on domestic loan rates, thereby affecting credit indirectly. However, it is not common to find firms on the local market borrowing from banks abroad as an alternative to credit from the domestic banking system. The working capital finance for which firms seek bank loans is provided on the basis of knowledge of the firm and its operations, and local bank managers are the repositories of this information. If firms do need to tap foreign sources for working capital the usual procedure is to channel the funding through a local bank or branch, which would then maintain the liability to its foreign correspondent. Such loans as are contracted directly by firms from foreign financial institutions are for capital formation, for which funds are not normally available from local commercial banks.

The supply price of credit depends on banks' response to deposit growth relative to the demand for credit, and to the cost of funds to them. The funds

available to banks for new lending at any time may be represented by the total of excess reserves (XR), the surplus after they have satisfied current requests for credit and the monetary authority's reserve requirements. If demand for credit exceeds available excess funds (minus allowance for a liquidity float), the bank has the option of borrowing from the monetary authority or from abroad. The loan offer rate is based on the cost of funds available from the bank's own resources, represented by the deposit rate (r_d), modified by the cost of borrowing from the monetary authority (r_b) or from abroad (r_f).

$$(2) \quad r_l = f_2 (r_b Ad, r_d XR, r_f \Delta NFL),$$

where Ad is the net of central bank advances to commercial banks during the year and ΔNFL is the difference between the bank's net foreign liability position at the beginning of the year and at the end.

If the calls on bank reserves (BR) are so large as to require the banks to borrow, the choice between the monetary authority and foreign sources is based on relative interest rates:

$$(3) \quad Ad = f_3 (\Delta BR, r_f - r_b),$$

where ΔBR is the difference between the bank's year end reserve balances and their value at the beginning of the year. If foreign finance is less expensive, banks tend to borrow abroad. In addition foreign balances are needed to cover stochastic variation in external receipts and payments.

$$(4) \quad \Delta NFL = f_4 \, [\Delta BR, \; r_f - r_b, \; Var(CA)],$$

where CA is the current account balance.

Each year's stream of income (Y) will generate a demand for additional financial asset holdings. The choice between local bank deposits and the financial liabilities of foreign institutions depends on comparative interest rates, with an allowance made for the cost and risk of foreign exchange transactions. Bank deposits (D) increase in proportion to income, provided the differential between domestic deposit rates (r_d) and rates abroad (r_f) is too small to compensate for the cost of foreign exchange transactions. Deposits will vary with differentials above that threshold, which is modelled by means of a dummy variable (DM) used to filter out differentials which empirical tests suggest are too small to matter.

$$(5) \quad \Delta D = f_5 \, [Y, \; DM \, (r_d - r_f)]$$

There are no price or real interest variables because neither theory nor evidence gives us reason to expect substitutability between real and financial assets. Interest rates affect only the form in which financial assets are held, and the available options are local bank deposits or the liabilities of foreign institutions, which we have taken care of. Changes in the expected rate of inflation, the other argument often introduced in deposit equations, will affect consumption and savings decisions, but since we argue there is no necessary correspondence between real and financial saving, that gives no reason to expect any systematic impact on deposits.

Domestic deposit rates will stay in line with rates abroad, with adjustments dictated by inflows and outflows of funds. However, the banks' liquidity situation allows for variation in the speed of adjustment, within narrow limits on either side of the foreign rate:

$$(6) \quad r_d = f_6 \, (r_f, \; XR)$$

Identities for reserves and excess reserves complete the system:

$$(7) \quad BR \equiv D - Cr + NFL - OA$$

where OA are all other assets, net.

(8) XR BR - qD

where q is the monetary authority's reserve requirement. The equations are listed in Exhibit A for convenient reference.

The supply of money depends on commercial banks' response to the demand for credit and the demand for deposits. In order to preserve target profitability[1] banks may respond to demand shifts on either side of their balance sheet by borrowing abroad or from the central bank, repaying advances, or changing interest rates and the relationships between different rates. For example, the model allows for a widening spread between deposit and loan rates, together with higher levels of excess liquidity, in response to a deficiency in credit demand. Responses to a given pattern of deposits and credit will vary with variations in foreign interest rates and with the interest elasticities of credit and deposits. These reactions may be measured with the help of the coefficients of equation (2).

The workings of the model may best be exposed by considering the impact of central bank policies, the balance of payments and deficit financing. Central bank's discount

1. In the appendix we provide a simple model to illustrate aspects of commercial bank behaviour.

rate by itself has no effect on the supply of credit; banks will borrow from abroad if the costs are lower than central bank charges. Only where limits are placed on foreign borrowing in a situation of declining bank reserves will the cost of credit be influenced by the discount rate. An increase in reserve requirements may be used to secure the desired contraction in free bank reserves. By itself, manipulation of the required reserve ratio is ineffectual. The central bank may resort to credit ceilings; if they are sufficiently low they will drive up the loan rate by creating an excess demand.

Next we consider an expansionary balance of payments shock, say an export windfall. The export earnings will boost nominal income by a proportion which depends on the relative use of imported and domestic inputs in the export sector and the size of the sector relative to national output. Rising income implies increased demand for deposits and credit, and an effect on excess reserves which depends on the relative income elasticities of deposits and credit. Banks may adjust the spread between deposit and loan rates in response to changing reserves, leading to possible feedback effects on supply prices (via the cost of bank finance) and to further adjustment in deposits and bank reserves. There will be second round effects deriving from expenditure stimulated by the higher national income.

Import leakages will reduce secondary income effects, but prices and output of non-tradables will probably rise somewhat, generating further monetary adjustment. The initial addition to foreign exchange reserves at the time of the windfall is innocuous. It will remain on the central bank's account, matched by excess reserves of commercial banks, until the processes of income and interest rate adjustment bring the banks back to their target profitability range. The outturn is indeterminate in general, but it may include higher bank reserves and a wider spread between deposit and loan rates.

Government has only one weapon for sterilising the impact of the windfall - a tax on the proceeds which may take the form of an export levy, a stabilisation fund, or a marketing institution which accumulates the excess over a contract price to farmers, and which is used to replace central bank financing for an unchanged budget deficit. This policy replaces fiscal expansion by export expansion, a situation which will improve the balance of payments outturn.

Government deficit financing raises both deposit and loan interest rates. The impact depends on whether government spends the borrowed funds on wages, domestic purchases or foreign purchases. Spending on wages will raise national income by an equal amount in the first

instance and may have multiplier effects in the non-tradable sector; purchases from abroad will have little effect on income, providing the banking system can muster the foreign exchange to finance them. The size of the income effect determines the impact on credit, deposits, bank liquidity and hence, on interest rates. The interest rate changes will provoke further adjustment of deposits and credit, and another round of interest rate adjustment.

The Results

The model was tested on three Caribbean island states - Barbados, Jamaica and Trinidad and Tobago - using annual data 1964 - 1982 for the first two countries and to 1981 for Trinidad and Tobago. The equations were specified in log-linear form and the two stage least squares technique was employed. Where there was suspicion of serial correlation we applied the Cochrane - Orcutt technique. If we obtained an acceptable serial correlation coefficient (rho) that result is reported; in other cases we reverted to the original results.

For Barbados and Jamaica we show reasonable results on the equations determining credit, loan interest rates and deposit changes (See Table 1). These equations showed high coefficients of determination, Durbin-Watson statistics for

which we can accept that there is no serial correlation at a five percent level, and no coefficients which violate our maintained hypothesis. For Trinidad and Tobago, the credit and deposit results were credible, but those for the loan interest rate were not. Our equations for central bank advances provide a large part of the explanation for their movements in the two countries where such advances were made (there were none recorded for the Trinidad central bank), but in the case of Barbados bank reserves have a perverse effect and for Jamaica neither explanatory variable has a significant effect; that equation cannot be considered satisfactory. The results clearly indicate that we have failed to specify the appropriate determinants of net foreign liabilities, but we have so far failed to devise a plausible alternative.

Taking all three countries together we have reasonable results for credit demand. Its elasticity with respect to income is about unity in all three countries. Interest rates have no discernible influence in any of the equations.

The loan interest rate in Barbados and Jamaica is significantly influenced by banks' reliance on central bank accommodation. For Barbados, the only other consideration seems to be the level of loan rates in the previous period;

its influence is indicated by the significant serial correlation coefficient. For Jamaica, the banks' excess reserves seem to have an unexpected effect, inducing banks to raise loan rates with increases in excess reserves. We expected that banks would wish to lower deposit rates in these circumstances so as to stimulate credit demand. However, they may have perceived the inelasticity of credit with respect to interest rates and adopted the alternative strategy of raising loan rates relative to deposit rates when their liquidity rises. Because they do not expect any greater volume of loans they seek to increase margins on funds currently employed so as to compensate for the excess of non-interest earning (or low-interest earning) funds. Banks' foreign borrowing has some effect on the loan rate in Trinidad and Tobago, but the elasticity measuring that response is tiny. However, we have failed to capture most of the influences on loan rates in Trinidad. Banks' overseas borrowings have no measurable effect on lending rates in the other two countries.

Banks' demand for central bank advances seem to depend on the level of bank reserves in Barbados, but surprisingly the banks seek more accommodation the higher the level of reserves. This paradoxical finding is to be further investigated. In Jamaica the advances seem to depend mainly on their level in the previous period, as suggested by the high serial correlation coefficient.

Banks in Barbados seem to fix deposit rates in the manner our hypothesis would suggest. Foreign rates provide a guide, with local deposit rates adjusting half as fast. The movement in local rates also depends on the level of excess liquidity. However, the equation leaves most of the deposit rate variation unexplained. Although the Jamaica equation explains most of the rate variation in that country, banks appear to have increased deposit rates when excess liquidity rose. We can find no explanation for this behaviour; in any case, we have been unable to eliminate serial correlation from the equation by use of the Cochrane-Orcut technique, so the result must be considered unsatisfactory. Deposit rates in Trinidad depend mainly on foreign rates; the equation is significant and there is no serial correlation. Excess reserves have a perverse effect, as in Jamaica, but it is so small it may be neglected.

For Barbados and Jamaica, the rate of deposit accumulation is roughly proportional to national income while in Trinidad-Tobago deposits grow much more rapidly. The differential between local and foreign rates has no noticeable impact on deposit growth.

The results can be used to trace the effects of shocks and monetary policy on the cost of finance in each island state. We use only those elasticities which are

estimated to have significantly non-zero values at the 10% level, using the t-statistic. These elasticities are presented for convenience in the accompanying exhibit B.

Suppose that in any one of these three countries had recorded a 10% rise in national income from an exogenous source -an export windfall, for example. In Barbados that would have been sufficient to lift the demand for credit by 10% while the increment to deposits would have been 11% greater than in 1982. Taking account of the level of bank deposits at the end of 1982 (Central Bank of Barbados, Annual Statistical Digest 1982, table B2) we calculate the rise in deposits at seven percent. The increases in credit and deposits together would have reduced bank reserves by one percent of end-1982 levels (Annual Statistical Digest, table B24). We might then have expected banks to increase discounts with the Central Bank, but the estimates suggest that Central Bank advances will fall by 0.6% of amounts outstanding at the end of 1982. The lower level of advances would serve to depress the loan interest rate (the principal object of interest to us in this study) by 0.17%. The credit and deposit changes would also alter the level of excess reserves and hence the deposit interest rate, but these variables have no measurable effect on the cost of funds.

In Jamaica a similar income injection also leads to a 10% increase in credit demand and an 11% acceleration in deposit growth. From a base of December 1982 (Bank of Jamaica, Statistical Digest, February 1983, table 9) credit rises J$0.2 billion and deposits increase J$0.4 billion. With a reserve requirement (cash and liquid items) of 29% the increase in excess reserves is calculated at 50%. Excess reserve changes have a perverse effect on deposit interest rates; instead of lowering interest rates in an attempt to discourage the accumulation of unwanted funds, banks would seem to raise the rate by eight percent. This combination of excess reserve changes and deposit rate changes boosts loan interest rates by six percent. In contrast to the adjustment process in Barbados, changes in bank reserves have no effect on borrowing from the Central Bank. In Barbados the income 'shock' has weak effects on the costs of finance, arising via induced Central Bank discounts. In Jamaica the effects arise via the banks' interest rate reaction to excess liquidity, and are much stronger.

For Trinidad and Tobago the additional income will have no effects whatever on the cost of finance, which is directly linked to foreign interest rates. The injection to income will boost credit demand by TT$0.5 billion (ten percent), starting from December 1982, while deposits

increase by TT$2.6 billion. The reserve requirement was 38%, and the increase in excess reserves is large - TT$0.6 billion, over 500% of the end-December level. As for Jamaica, the gain in reserves pushes up deposit interest rates, in this case by 25%. In the Trinidad case there is no further adjustment; the banking system appears to tolerate large excess liquidity.

Next consider a disturbance which adds to income and simultaneously creates additional credit demand over and above that induced by the rising income. We call this a 'fiscal' shock, because it captures a typical fiscal imbalance, caused by rising expenditure - adding to national income - financed by borrowing. Let us analyse the impact of a five percent increment to income, with a government borrowing requirement which adds five percent to existing credit demand.

In Barbados bank reserves will fall 13%: credit goes up five percent on account of the growth in income, plus another five percent for government, for a total of BDS$68 million, but deposits rise only BDS$32 million. Central bank advances fall, contrary to expectations, and the cost of borrowing from banks falls by two percent. For Jamaica, the decline in excess reserves is 30%, depressing deposit interest rates by five percent. The combination of

lower reserves and falling deposit rates brings down the loan rate by 3.4%. In Trinidad and Tobago excess reserves would have risen 250% and deposit rates 13%, without affecting loan rates.

The central bank is the source of the third disturbance to be analysed. A change in the reserve requirement - apart from direct credit controls the most powerful weapon in the bank's armoury - will be influential only in Jamaica. If the authorities had increased December's 29% reserve ratio to 34%, for example, excess reserves would have fallen by 65%. The effect on interest rates would have been the opposite of what the central bank might have intended: a 10% fall in the deposit rate and a seven percent decline in the loan rate. In Barbados, there is no effect because bank reserves remain unchanged and excess reserve movements do not influence the loan rate. Trinidad's loan rate is impervious to all domestic influences.

Summary

The effects of similar disturbances appear to be quite different in the three countries tested, depending on the behaviour of banks with respect to changes in their liquidity position. At one extreme (Trinidad and Tobago)

the cost of finance shows no response to domestic credit and financial conditions. In contrast, reactions may be quite violent and perverse, as in the case of Jamaica. These conclusions are tentative. Our description of the banking system is incomplete; we do not have reasonable explanations of some variables, notably foreign liabilities. Moreover, some specifications must be re-evaluated in the light of results which we consider perverse. Nevertheless, the study demonstrates that, as a practical matter, we must specifically model banking behaviour if we are to say useful things about the impact of bank finance on the real economy.

Table 1

Estimates of the Model

Barbados

(1) $\ln Cr = \underset{(-0.93)}{-0.82} + \underset{(0.60)}{0.22} \ln r_l + \underset{(5.80)}{0.96} \ln Y$

$R^2 = 0.99$ DW = 1.63 SEE = 0.12 F(2, 18) = 641.4 Rho = 0.81

(2) $\ln r_l = \underset{(12.54)}{2.30} + \underset{(2.23)}{0.28} \ln r_b \; Ad - \underset{(-1.12)}{0.04} r_d \; XR - \underset{(-0.95)}{0.03} \ln r_f NFL$

$R^2 = 0.70$ DW = 1.97 SEE = 0.10 F(3, 17) = 13.38 Rho = 0.80

(3) $\ln Ad = \underset{(1.85)}{1.01} + \underset{(4.34)}{0.65} \ln BR - \underset{(-1.69)}{0.50} \ln (r_f - r_b)$

$R^2 = 0.60$ DW = 1.72 SEE = 0.99 F(2, 19) = 14.29

(4) $\ln NFL = \underset{(-0.90)}{-3.05} - \underset{(-1.26)}{0.42} \ln BR - \underset{(-0.27)}{0.11} \ln (r_f - r_b) + \underset{(1.28)}{0.80} \ln (Var\ CA)$

$R^2 = 0.07$ DW = 1.90 SEE = 1.34 F(3, 18) = 0.46

(5) $\ln \Delta D = \underset{(-1.97)}{-3.33} + \underset{(3.93)}{1.08} \ln Y - \underset{(-0.90)}{0.24} \ln DM(r_d - r_f)$

$R^2 = 0.75$ DW = 2.16 SEE = 0.62 F(2, 18) = 27.09 Rho = 0.41

(6) $\ln r_d = \underset{(5.50)}{1.00} - \underset{(-2.97)}{0.16} \ln XR + \underset{(4.40)}{0.55} \ln r_f$

$R^2 = 0.46$ DW = 1.30 SEE = 0.19 F(2, 19) = 8.00

Jamaica

(1) $\ln CR = \underset{(-2.67)}{-2.65} + \underset{(1.56)}{1.69} \ln r_l + \underset{(3.49)}{0.99} \ln Y$

$R^2 = 0.99$ DW = 2.02 n = 21 SEE = 0.11 Rho = 1.15

(2) $\ln r_l = \underset{(7.51)}{1.83} + \underset{(1.93)}{0.12} \ln r_b \; Ad + \underset{(5.52)}{0.10} \ln r_d XR - \underset{(-0.30)}{0.03} \ln r_f \; NFL$

$R^2 = 0.7102$ DW = 1.70 n = 22 SEE = 0.14

(3) $\ln Ad = \underset{(1.19)}{1.11} + \underset{(0.75)}{0.18} \ln BR + \underset{(1.26)}{0.53} \ln(r_f - r_b)$

$R^2 = 0.76$ DW = 1.98 n = 21 SEE = 0.71 Rho = 0.72

(4) $\ln NFL = \underset{(-0.72)}{-5.82} - \underset{(1.14)}{0.89} \ln BR - \underset{(-0.17)}{0.12} \ln(r_f - r_b) + \underset{(-0.92)}{1.37} \ln(Var\ CA)$

$R^2 = 0.492$ DW = 2.07 n = 22 SEE = 1.50

(5) $\ln \Delta D = \underset{(-0.63)}{-1.58} + \underset{(2.47)}{1.09} \ln Y - \underset{(-0.20)}{0.09} \ln DM(r_d - r_f)$

$R^2 = 0.6155$ DW = 2.04 n = 21 SEE = 0.89 Rho = 0.04

(6) $\ln r_d = \underset{(5.12)}{1.20} + \underset{(3.89)}{0.16} \ln XR + \underset{(0.32)}{0.05} \ln r_f$

$R^2 = 0.6511$ Dw = 0.75 n = 22 SEE = 0.21

Trinidad and Tobago

(1) $\ln Cr = \underset{(-5.79)}{-6.29} + \underset{(2.26)}{2.31} \ln r_l + \underset{(2.98)}{0.96} \ln Y$

$R^2 = 0.97$ DW = 1.63 SEE = 0.21 F(2, 17) = 282.46 Rho = 0.12

(2) $\ln r_l = \underset{(42.22)}{1.96} + \underset{(1.64)}{0.02} \ln r_d \; XR + \underset{(2.98)}{0.04} \ln r_f \; NFL$

$R^2 = 0.45$ DW = 2.03 SEE = 0.11 F(2, 17) = 7.00 Rho = -0.11

(4) $\ln NFL = \underset{(-0.16)}{-0.48} - \underset{(-0.53)}{0.11} \ln BR + \underset{(1.00)}{0.34} \ln(r_f - r_b) + \underset{(0.70)}{0.29} \ln(Var\ CA)$

$R^2 = 0.10$ DW = 1.94 SEE = 1.62 F(3, 16) = 0.59 Rho = -0.43

(5) $\ln \Delta D = \underset{(-4.84)}{-9.30} + \underset{(7.15)}{1.73} \ln Y - \underset{(-1.17)}{0.29} \ln DM(r_d - r_f)$

$R^2 = 0.76$ DW = 2.04 SEE = 0.93 F(2, 18) = 28.65

(6) $\ln r_d = \underset{(9.66)}{1.54} + \underset{(2.93)}{0.05} \ln XR + \underset{(2.82)}{0.23} \ln r_f$

$R^2 = 0.26$ DW = 2.25 SEE = 0.14 F(2, 18) = 3.19

Notes

The t-statistic associated with each estimate is shown in brackets.

DW: the Durbin-Watson statistic

SEE: the standard error of the estimate

Rho: the coefficient of serial correlation, estimated by the Cochrane-Orcut process.

The definition of variables appears in Exhibit A.

EXHIBIT A

A Model of the Monetary Sector

(1)	Cr	$= f_1(Y, r_l)$	$f_1'(Y) > 0,\ f_1'(r_l) < 0$
(2)	r_l	$= f_2(r_b Ad, r_d XR, r_f NFL)$	$f_2'(r_b Ad) > 0,\ f_2'(r_d XR) < 0,\ f_2'(r_f NFL) > 0$
(3)	Ad	$= f_3(BR, r_f - r_b)$	$f_3'(BR) < 0,\ f_3'(r_f - r_b) > 0$
(4)	NFL	$= f_4[BR, r_f - r_b, Var(CA)]$	$f_4'(BR) < 0,\ f_4'(r_f - r_b) < 0,\ f_4'[Var(CA)] > 0$
(5)	ΔD	$= f_5(Y, DM(r_d - r_f), r_d - P)$	$f_5'(Y) > 0,\ f_5'(r_d - r_f) > 0,\ f_5'(r_d - P) \lesseqgtr 0$
(6)	r_d	$= f_6(r_f, XR)$	$f_6'(r_f) > 0,\ f_6'(XR) < 0$
(7)	BR	$\equiv D - Cr + NFL - OA$	
(8)	XR	$\equiv BR - qD$	

Variables

Ad	-	Central Bank advances to commercial banks
BR	-	Commercial bank reserves
CA	-	Current account of the balance of payments
Cr	-	Credit outstanding with banks
D	-	Deposits at banks
DM	-	A dummy variable to filter out small absolute values of $(r_d - r_f)$
NFL	-	Net foreign liabilities of banks
OA	-	Other assets of banks (net)
P	-	GDP deflator
q	-	Ratio of required bank reserves at deposits
r_b	-	The bank rate
r_d	-	Rate on 12-month time deposits
r_f	-	Rate on Eurodollar deposits in London
r_l	-	Prime lending rate
XR	-	Excess bank reserves
Y	-	GDP

Endogenous: Ad, BR, Cr, D, NFL, r_d, r_l, XR

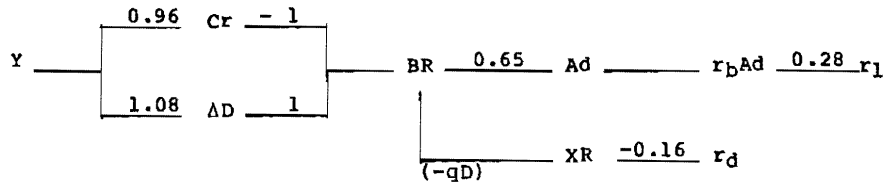
Exogenous (policy): q, r_b

Exogenous (other) : CA, OA, P, r_f, Y

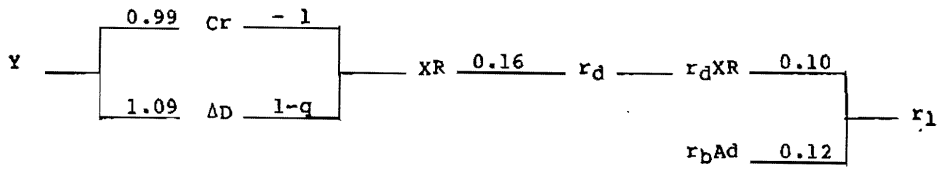
Exhibit B

Significant Monetary Influences*

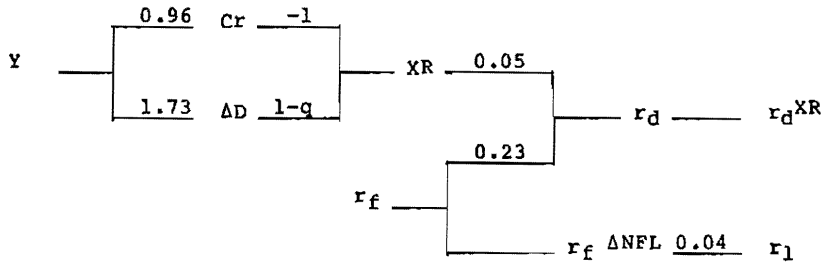
Barbados



Jamaica



Trinidad and Tobago



* Read from left to right

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Appendix

Aspects of the Theory of the Banking Firm

Several approaches to modelling the banking firm are to be found in the literature (For a survey, see Van Loo [1980]). Each provides a different insight, though all are deficient in some way. We may use a simple model to be found in Tobin [1982] to illustrate some aspects of the underlying commercial bank adjustment process which produces the results our macroeconomic model leads us to expect.

One important factor is the existence of a banking oligopoly. The accompanying diagrams (A1, A2, A3) enable us to compare bank adjustment under competitive market conditions with monopoly. There is a market demand for loans (DM) from which we derive the marginal revenue curve (MR); both are expressed net of the cost of deposits, for convenience of presentation. The marginal opportunity cost of loans (MOC) is the cost of holding excess reserves (which may be negative). It is a stochastic variable because the supply of deposits to banks is uncertain and therefore so is the expectation that any level of loans will allow a margin of liquidity. Loans and reserve assets are the only choices available to banks for employing their resources.

Banks maximise their profits by equating MR and MOC. Diagrams A1 and A2 compare two firms with equal resources, one operating in a competitive market and the other a monopolist in its market. From identical initial positions the banks are

jolted by, for example, an increase in the cost of borrowed reserves engineered by the Central Bank. This raises MOC. The competitive firm cuts its loans sufficiently to provide additional reserves to reduce MOC to its original level; it compensates for the increased cost of borrowing by reducing the likelihood that it will need to borrow. The monopolist is able to secure higher marginal revenues by reducing loan volume; since this helps to offset the increased cost of borrowed reserves, the monopolist need not increase his precautionary reserves quite so much as the competitive firm must.

This comparison most closely resembles the situation in the Caribbean, where individual banking enterprises are tiny by international standards and would be subject to atomistic competition in larger markets. In the small economies of the Caribbean, however, they are sufficiently large and few enough to constitute enduring cartels and reap the benefits of monopoly.

Diagram A3 presents the comparison between a single bank and a competitive system, operating in markets of identical size. The competitive market supply curve is assumed identical to the MOC of the monopolist. The increase in central bank lending rates to banks is assumed to shift MOC and the supply curve in exactly the same way, so that we do not complicate the story. The monopolist made fewer loans at higher cost than competitive banking firms would have done in the first place; his reaction to increased MOC is to cut back further, with corresponding increase in lending rates. Competitive market adjustment also leads to reduced volume of loans at higher interest rates. The comparative

adjustment of competitive and monopolistic firms depends on the interest elasticity of the demand for loans in the relevant ranges. This comparison is less meaningful for Caribbean conditions, where financial markets are too small to support a competitive banking system.

The diagrams only tell a small part of the story. Bankers' perceptions of the workings of the system and the parameters of its structure will determine the way in which adjustment takes place. Consider a simple model where banks maximise profits subject to their balance sheet constraint and the need to hold percautionary excess reserves. The balance sheet identity (much simplified) is

(A1) $D = L + qD + XR + OA$ where D : deposits; L : loans; q : reserve requirement; XR : excess reserves; OA : all other assets net

Deposits are given by

(A2) $D = a_o + a_1 Y + a_2 (r_d - r_f) + \varepsilon \qquad \varepsilon \sim (O, \sigma_\varepsilon)$

a simplified version of the equation actually estimated. Profits vary with banks' need to borrow reserves. Excess reserves are zero when

(A3) $\varepsilon = (L + OA)/(1-q) - a_o - a_1 Y - a_2 (r_d - r_f)$

which may be derived from A1 and A2. This value of ε is designated Z, where $XR > o$ when $\varepsilon > Z$. If the yield on excess

reserves is by r_g and the cost of borrowed reserves is r_b, then profits are given by

$$(A4)\quad \begin{cases} \pi_1 = r_1 L + r_g \{\bar{D}(1-q) + (1-q)\int_Z^{\alpha} \varepsilon\, d\varepsilon - L - OA)\} - r_d D \\ \pi_2 = r_1 L + r_b \{\bar{D}(1-q) + (1-q)\int_{-\bar{D}}^{Z} \varepsilon\, d\varepsilon - L - OA)\} - r_d D \end{cases}$$

where r_1 = loan interest rate

$\bar{D} = a_o + a_1 Y + a_2(r_d - r_f)$

r_d = deposit interest rate

The banker will choose targets for loan volume, loan interest rates and deposit interest rates which will maximise his profits. The targets he will pick depend on his evaluation of the interest elasticities of loans and deposits, the variance and probability distribution of deposit inflow, and his expectations about the growth of income. Judgements such as these are implicitly incoporated in the schedules in diagram A1 to A3.

This analysis illustrates the kind of adjustment processes which might produce the interaction modelled in the paper. It is by no means a complete description; we doubt the present state of theory allows that. We have not dealt with adjustment lags, costs of information, effects of incomplete information and how we are to represent the perceptions of the bankers (what many economists prefer to call 'the formation of expectations').

References for appendix

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