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The Monetary Approach to the Balance of Payments – A Simple Test of Jamaican Data

INTRODUCTION

A central proposition of the Monetary Approach to the Balance of Payments (monetary approach) is that the balance of payments is a monetary phenomenon requiring analysis with the tools of monetary theory. Although real factors are not excluded, the demand for and supply of money are the central theoretical relationships used in the analysis of the balance of payments.

Empirical tests of the fixed exchange rate model of the monetary approach have focused on the accuracy of its predictions, and the validity of its assumptions. Surveys of the empirical literature can be found in Dornbrecht [11] and Krenin and Officer [22]. (See also, Bhatia [2] and Uddin [33]). In general, mixed results have been obtained, and researchers have utilized different specifications and data sets.

This paper employs annual Jamaican data to estimate the relationship between domestic credit and international reserve flows using both reserve-flow and sterilization formulations. Given a theoretical structure, the focus is on the use of extensive testing procedures to avoid the possibility of spurious inference from misspecified models. Diagnostic tests are thus used as a means of evaluating model adequacy prior to the examination of the theoretical predictions. The results for broad money indicate that for the period analysed, the proposition of the monetary approach that an increase in the domestic component of the monetary base leads to an equivalent outflow of reserves could not be rejected. However, changes in reserves were sterilized by the authorities.

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The conceptual framework for testing the monetary approach is outlined below, and following this, the results are presented. The final section summarizes the conclusions.

RESERVE FLOW EQUATION

Under fixed exchange rates, changes in international reserves are a result of the excess demand for or supply of money as a stock. The dependent variable can be levels, changes, or rates of growth of international reserves. The determinants of the demand for or supply of money constitute the right-hand-side explanatory variables.

Tests of the predictive power of the monetary approach tend to consider the predictions of the effects of the money supply and the demand for money, or their determinants, on the balance of payments. These translate into sign and/or magnitudinal predictions in the estimating equation.

Consider the demand for money function

$$\frac{M^d}{P} = f(y, r, \pi) \qquad (1)$$

where M^d is the demand for nominal money balances,
P is the domestic price level,
y is the domestic real income,
r is the domestic rate of interest, and
π is the rate of inflation.

Differentiating (1) yields

$$\frac{dm}{dt} = \frac{\partial m}{\partial y}\frac{dy}{dt} + \frac{\partial m}{\partial r}\frac{dr}{dt} + \frac{\partial m}{\partial \pi}\frac{d\pi}{dt} \qquad (2)$$

where $m = M^d/P$ is the demand for real money balances.

Thus,

$$\frac{dm}{dt}\cdot\frac{1}{m} = \frac{\partial m}{\partial y}\cdot\frac{y}{m}\frac{dy}{dt}\cdot\frac{1}{y} + \frac{\partial m}{\partial r}\cdot\frac{r}{m}\frac{dr}{dt}\cdot\frac{1}{r} + \frac{\partial m}{\partial \pi}\cdot\frac{\pi}{m}\frac{d\pi}{dt}\cdot\frac{1}{\pi} \qquad (3)$$

or

$$\frac{\dot{m}}{m} = \eta_{my}\frac{\dot{y}}{y} + \eta_{mr}\frac{\dot{r}}{r} + \eta_{m\pi}\frac{\dot{\pi}}{\pi} \qquad (4)$$

where z = dz/dt

with $\eta_{my} > 0$, $\eta_{mr} < 0$, and $\eta_{m\pi} < 0$ being the elasticities of the demand for real money balances with respect to real income, the interest rate, and inflation respectively.

(4) can be rewritten as

$$\frac{\dot{M}}{M} = \frac{\dot{P}}{P} + \eta_{my}\frac{\dot{y}}{y} + \eta_{mr}\frac{\dot{r}}{r} + \eta_{m\pi}\frac{\dot{\pi}}{\pi} \qquad (5)$$

Let the money supply be defined as the product of the money multiplier (a) and the stock of high-powered money (H) with H being decomposable into international (R) and domestic (D) components (usually international reserves, and net domestic liabilities of the monetary authorities respectively).

Then

$$M = aH = a(R + D) \qquad (6)$$

and

$$\frac{\dot{M}}{M} = \frac{\dot{a}}{a} + \frac{R}{H}\cdot\frac{\dot{R}}{R} + \frac{D}{H}\cdot\frac{\dot{D}}{D} \qquad (7)$$

OR

$$\frac{\dot{R}}{R} = \frac{H}{R}\left[\frac{\dot{M}}{M} - \frac{\dot{a}}{a}\right] - \frac{D}{R}\cdot\frac{\dot{D}}{D} \qquad (8)$$

If we assume that the demand for nominal money balances equals the supply ($M^d = M$), then (5) and (8) imply

$$\frac{\dot{R}}{R} = \frac{H}{R}\left[\frac{\dot{P}}{P} + \eta_{my}\frac{\dot{y}}{y} + \eta_{mr}\frac{\dot{r}}{r} + \eta_{m\pi}\frac{\dot{\pi}}{\pi} - \frac{\dot{a}}{a}\right] - \frac{D}{R}\cdot\frac{\dot{D}}{D} \qquad (9)$$

or

$$\frac{\dot{R}}{H} = \left[\frac{\dot{P}}{P} + \eta_{my}\frac{\dot{y}}{y} + \eta_{mr}\frac{\dot{r}}{r} + \eta_{m\pi}\frac{\ddot{\pi}}{\pi} - \frac{\dot{a}}{a}\right] - \frac{\dot{D}}{H} \qquad (10)$$

(10) assumes that the demand for money function is homogeneous of degree one in prices. The analysis also assumes the existence of a stable long-run demand for money function. Both of these assumptions are testable.

Assuming the existence assumption to be valid, we can test the homogeneity assumption as a coefficient restriction of an unrestricted specification of (10), namely:

$$\frac{\dot{R}}{H} = \alpha_1\frac{\dot{P}}{P} + \alpha_2\frac{\dot{y}}{y} + \alpha_3\frac{\dot{r}}{r} + \alpha_4\frac{\dot{\pi}}{\pi} + \alpha_5\frac{\dot{a}}{a} + \alpha_6\frac{\dot{D}}{H} \qquad (11)$$

where the expected signs and magnitudes are

$$\alpha_1 = 1, \quad \alpha_2 > 0, \quad \alpha_3 < 0, \quad \alpha_4 < 0, \quad \alpha_5 = \alpha_6 = -1.$$

Thus, an increase in the growth rates of real income and prices will lead to improvements in the balance of payments, whereas reserve losses will occur as a result of increases in the growth rates of the rate of interest, inflation, the money multiplier, and the domestic credit variable.

The coefficient on the domestic credit variable, called 'offset coefficient', is expected to have a value of minus unity. It measures the degree to which changes in the domestic component of the monetary base are offset by changes in international reserves.

If we alter the role of the money supply variables so that the domestic component of the monetary base is now the dependent variable of a regression equation with reserves and other variables on the right-hand-side, then the coefficient of the international reserves variable – expected to be zero – is known as the 'sterilization coefficient'. It measures the authorities' use of monetary policy to counteract the impact of reserve flows on the monetary base. To the extent that neither the offset nor the sterilization coefficients have a true value of zero, then the use of ordinary least squares will cause simultaneous equation bias in the estimated coefficients (see Kouri and Porter [21], Magee [26]). In fact, the bias is upward towards minus unity (or even beyond). Further simultaneous equation bias will arise in the reserve-flow equation because it ignores the identity $\Delta R = \Delta H - \Delta D$. Consequently, the overall effect of simultaneity is to bias the offset coefficient test in favour of the monetarist prediction. At a minimum therefore, a systems estimation method (e.g. Two-stage Least Squares (2SLS)) should be utilized.

Another source of potential bias in the offset coefficient – in this case downward towards zero – can be due to the omission of the CD variables of foreign trading partners [De Grauwe 9, 10], the expectation being a positive marginal effect on the domestic country's balance of payments. Useful proxies include a world interest rate, and a suitably weighted average of foreign CD's. Of course, a foreign interest rate may enter the demand for money function in an open economy on its own merit (see Hamburger [17]). Figure 1 shows the close relationship that existed for most of the estimation period between the Jamaican (domestic) and UK (foreign) treasury bill rates. Interest rate policy, particularly during the early part of the estimation period, followed a defensive role whereby foreign interest rate changes were matched by domestic interest rate changes in order to mitigate capital flows.

The above refinements are incorporated into the analysis, and the following equation is estimated.

$$\frac{\dot{R}}{H} = \alpha_0 + \alpha_1\frac{\dot{P}}{P} + \alpha_2\frac{\dot{y}}{y} + \alpha_3\frac{\dot{r}}{r} + \alpha_4\frac{\dot{\pi}}{\pi} + \alpha_5\frac{\dot{a}}{a} + \alpha_6\frac{\dot{D}}{H} + \alpha_7\frac{\dot{r}_f}{r_f} + \sum_{j=1}^{P}\alpha_{7+j}\frac{\dot{DC}_{fj}}{DC_{fj}} + \epsilon \qquad (12)$$

where r_f is a foreign rate of interest,

DC_{fj} is a foreign credit variable, and

ϵ is the conventional error term with standard properties.

Equation (12) allows us to test directly for the omission of variables.

The inclusion of both real income and a domestic-foreign interest rate differential provides a discriminating test of the opposite predictions of the monetary and non-monetary approaches, in that the interest rate differential should capture the effects of interest-induced capital flows The above domestic-foreign interest rate relationship suggests that an interest rate differential may not be discernible given that the two rates are approximate transformations of each other. However, opposite signs on α_3 and α_7 could favour an interest-rate-differential interpretation; $\alpha_3 = -\alpha_7$ is not a strictly valid test since the growth rate of the difference is not equal to the difference of the growth rates.

RESULTS

OLS Estimates

Ordinary Least Squares estimates of equation (12) are reported in Table 1. The results indicate that the coefficients have the expected signs; the assumption of price homogeneity is not supported by the data. Further, the income elasticity seems low and is poorly determined; however, it is approximately equal to the price elasticity in all the regressions reported. This could be interpreted as indicating that the relevant demand for money function could be specified in terms of nominal income; also, some degree of money illusion exists as the demand for nominal money balances does not increase equiproportionately with prices.

The hypothesis that the offset coefficient is minus unity ($\alpha_6 = -1$) is easily accepted at the 5 per cent level. Krenin and Officer [22] argue that the criteria to be used in validating the monetarist claim should be:

"(a) statistically significant,
(b) not significantly different from the theoretically expected value.
[and] (c) considered as a point estimate, the coefficient is close to the predicted value".

So acceptance may require "significantly different from, say −0.80 or −0.90, while not being significantly different from −1" [Krenin and Officer 22]. The coefficient on the money multiplier is also insignificantly different from unity (t-statistics range from 1.05 to 1.17); however, with a point estimate of 0.89/0.90, criterion (c) above would not be satisfied.

The foreign credit variables (domestic credit of the U.K. and U.S. respectively) are insignificantly different from zero at the 5 per cent level, and, in general, have negative signs. A composite foreign credit variable, defined as the sum of the two foreign credit variables, also proved to be statistically insignificant. The composite foreign credit variable is the one used in the results reported below.

Both the domestic interest rate and the domestic-foreign-interest-rate-differential variables are statistically insignificant. The coefficient on the foreign interest rate variable is negative and attains a t-value of unity when the domestic interest rate is omitted ($\alpha_3 = 0$). If the foreign rate of interest is a significant determinant in the reserve-flow equation, it would seem to be more as a determinant of the demand for money balances, with an opportunity cost interpretation. Further, the rates of growth of the foreign interest rate and inflation seem to be collinear in that the coefficient on the latter "approximates significance" only when the former variable is excluded from the regression equation.

Table 2 presents the full set of OLS estimates for the reserve-flow equation. The equation estimated is:

$$\frac{\dot{R}}{H} = \alpha_0 + \alpha_1 \frac{\dot{P}}{P} + \alpha_2 \frac{\dot{y}}{y} + \alpha_3 \frac{\dot{r}}{r} + \alpha_4 \frac{\dot{\pi}}{\pi} + \alpha_5 \frac{\dot{a}}{a} + \alpha_6 \frac{\dot{D}}{H} + \alpha_7 \frac{\dot{r}_f}{r_f} + \alpha_8 \frac{F\dot{D}C}{FDC} + \epsilon_t \qquad (13)$$

where FDC is the composite foreign credit variable referred to above. The notion that the predictions of the monetary approach may be invariant to the definition of money used is investigated by estimating the above regression equation for both broad (M2) and narrow (M1) definitions of money; M2 includes currency, demand deposits, plus time and savings deposits.

Linear regression analysis assumes that the unobservable disturbance term satisfies the classical assumptions of homoscedasticity, and serial correlation. Tables 2(b) and 2(c) list a set of diagnostic tests based on the estimated residuals of the five pairs of equations in Table 2(a). The normality test is based on Bera and Jarque [1]. Of the two misspecification tests, MS1 is Ramsey's RESET [28] and includes predictions up to the fourth power; MS2 tests for the omission of the lagged regressor set (excluding any redundant variables). Three tests of heteroscedasticity are reported: Engle's ARCH Test (see Engle [12] and Engle *et al.* [15]); an evolving coefficient variation test based on the square of the regressors (HT1); and a variant of White's misspecification test [34] that uses the vector of estimated coefficients as weights on the cross-product matrix (HT2). The test, described in Pagan and Hall [27], gains power in certain directions in being a chi-square with one degree of freedom. The variant reported includes predictions up to the second power and is consequently chi-square with two degrees of freedom. AC1 (u_{t-1}) and AC2 (u_{t-1}, u_{t-2}) are Lagrange Multiplier tests for Serial Correlation up to first and second order respectively. AC3 (u_t) in contrast to AC1 and AC2, tests for first order *non-linear* serial correlation (see Pagan and Hall [27]). Finally, three parameter constancy tests are included: PC1 is a chi-square test based on squared prediction errors, whilst PC3 is the Chow [3] test for structural change when the number of observations is less than the number of regressors. PC2 is the mean average forecast error which is arguably a more informative diagnostic than one based on the equation standard error (see Harvey [18] for description and comment on the parameter constancy test). In addition, the regressors should be weakly exogenous [Engle *et al.* 14] for the parameters of interest. Whilst the validity of the instrument set in the instrumental variables regression [Sargan 29, 30] – (see ϕ_1 statistic in latter paper) can be suggestive, a direct test of weak exogeneity can be performed along lines explored in Engle [13]. (For other definitions and tests of exogeneity, see Jacobs *et al.* [20], Sargent [31], Sims [32] and Wu [35, 37]). The test for weak exogeneity was not performed; however, instrumental variables estimates are reported below.

The approach adopted is that inference is at best hazardous if the model is not adequately specified. It is clear from Table 2(b) that equation 4 (row 4 of Table 2(a) satisfies all the tests, except that for first-order non-linear serial correlation. In Table 2(c), the same equation satisfies the serial correlation tests, but fails the parameter constancy tests. Thus, equation 4 of Table 2(a) is tentatively adequate in the class of models that exhibit *linear serial independence* when a broad definition of money is used. The data clearly support the prediction of the monetary approach to the balance of payments that an increase in the domestic component of the monetary base will lead to an equivalent outflow of international reserves. Further, the positive price and income elasticities indicate acceptance of the predictions that an increase in the rate of growth of either prices or output will improve the balance of payments. Like the previous result, the coefficient on the money multiplier is insignificantly different from unity, but as a point estimate, it is insignificantly different from 0.90.

On a more general note, the results in Table 2(a) lend support to the notion that the rates of growth of inflation and the foreign rate of interest are potentially collinear. For money broadly defined, inflation is significant at the 5 per cent level when the foreign rate of interest is omitted and the foreign rate of interest is most significant – albeit not at the

5 per cent level – when the inflation variable is omitted. An additional observation is that the regression equation for the misspecification test MS2 indicated t-values in excess of unity (1.5) for one of the variables, lagged MR. Including lagged MR in the preferred equation produces row six for M2 in Table 2(a). Not surprisingly, it satisfies all the diagnostics. More significantly, the mean forecast error is reduced by approximately 38 per cent. Further, the coefficients on domestic credit and the money multiplier are now both insignificantly different from unity, and satisfy the point estimate criterion. This may be an indication that the money supply process is not as simple as posited.

Whilst the coefficient on the money multiplier is approximately equal for both M1 and M2 equations and insignificantly different from unity, they are insignificant, as point estimates, from 0.90. The offset-coefficient is significantly reduced in the M1 equations and in some equations significantly different from unity. Further, only the coefficients on the money multiplier and domestic credit are statistically significant.

The OLS results can be summarized as favouring the offset-coefficient prediction of the monetary approach when a broad definition of money is used, and lending some support to the money-multiplier-supply process when the narrower definition of money is used.

SYSTEMS ESTIMATION

The OLS results assumed that the right-hand-side explanatory variables were exogenous and determined independently of the rate of growth of international reserves. In particular, the domestic credit variable is exogenously determined independently of international reserves. In fact, the monetary approach assumes unidirectional causation running from domestic credit to international reserves. If the domestic credit variable is in part determined by the international reserves variable, then the OLS estimates of the reserve-flow equation will be biased. In this section, the assumption that the domestic credit variable is exogenously determined independently of international reserves is relaxed. Table 3 and 4 report the results for the reserve flow and sterilization equations using instrumental variables, whilst Table 5 is a set of Three-Stage Least Squares (3SLS) estimates which take account of non-zero covariance terms across the equations.

A similar set of diagnostics for evaluating model adequacy are also presented (see Pagan and Hall [27] for details). A few observations are pertinent. The Bera-Jarque Normality Test, computed with GIVE residuals, requires "the joint distribution of the disturbances of the reduced form equations of the dependent variable and the current endogenous variables being used as explanators" to be jointly normal [27]. Thus, we need to maintain normality for all the included endogenous variables. The normality assumption is assumed in Tables 3 and 4. Table 5 tests the residuals of the three-stage least squares estimates for bivariate normality [Cox and Small 4]. The OLS regressions for residual serial correlation are based on the predictions of the regressor set on the matrix of instruments. With regard to the heteroscedasticity tests Pagan and Hall [27] show that for heteroscedasticity of the form

$$\sigma_t^2 = \sigma^2 + \psi z_t = \delta d_t$$

$$\sqrt{T}(\delta - \delta) \xrightarrow{N} (0, \text{ plim } T(2\sigma^4 (D'D)^{-1} + 4\sigma^2 \Psi(\hat{X}'\hat{X})^{-1} \Psi'))$$

where $\hat{X} = W(W'W)^{-1} W'W$, W is the Instrument set, X is the the regressor set, and Ψ is the matrix of regression coefficients of X_tU_t on $D = d_{ij}$. The above assumes normality. As estimator robust to non-normality (i.e. does not assume normality) is also provided, the asymptotic covariance matrix being

$$\text{plim } T\{(\mu_4 - \sigma^4)(D'D)^{-1} - 2\mu_3 (D'D)^{-1} D'\hat{X}(\hat{X}'\hat{X})^{-1} \Psi'\} + 4\sigma^2 \Psi(\hat{X}'\hat{X})^{-1}\Psi' \quad T\to\infty$$

with μ_j being the jth moment of u_t.

The test utilized for $\psi = 0$ is based on the quadratic form $yV^{-1}y' - X^2$ (q) where q is the dimension ality of z_t, and V^{-1} is a lower-submatrix of the inverse of the variance-covariance matrix of δ. (See, for example, Hausman [19] and Wu [36]).

A comparison of the OLS estimates with those of Table 3 indicate that, for the offset and multiplier coefficients, the OLS estimates exhibit a uniform upward bias for the M2 formulation, and a downward bias for the M1 formulation. The diagnostic results are similar to those of Table 2. The offset coefficient prediction for M2 in equation 4 is again not rejected by the data. However, of the remaining equations – with the exception of the moeny multiplier coefficient in equation 5 – the offset and money multiplier coefficients are not supported by the data. If we recall the OLS results, the offset coefficient prediction was not rejected for M2 and not supported for the M1 definition.

The above results seem to suggest that the validation of the predictions of the monetary approach to the balance of payments (specifically the offset coefficient being equal to minus unity) will depend on whether we use a narrow or broad definition of money. In particular, our results indicate that a narrow definition seems more sympathetic to a non-monetary approach. Table 6 reports the results of a non-nested test of an M1 versus an M2 definition (for non-nested tests, see for example McAleer [23], MacKinnon [24], Davidson and MacKinnon [5, 6, 7, 8], and MacKinnon, White and Davidson [25]). Whilst our non-nested test is based on instrumental variables estimates, an examination of Table 2 clearly indicates that the M2 definition is preferred to its M1 counterpart on the Akaike Information Criterion (AIC). The AIC reduces to choosing the model with the highest $\bar{R}^2$ in the case of two models with the same number of parameters.)

Columns 1 and 2 of Table 6 present the results of an instrumental variables version of the JA test (see McAleer [23]). Here we follow the recommendation of MacKinnon, *et al.* [25]: "a procedure which is computationally identical to the J-test, except that 2SLS replaces OLS throughout, may validly be used when the competing hypotheses are linear models with endogenous variables on the right-hand side".

Paired comparison $-H_0$ against H_1 and H_1 against H_0 – are utilized within the framework of a JA test. In both cases the null hypothesis is that the coefficient on the auxilliary variables (AINV and YINV) is zero. The M2 formulation is not rejected against the M1 formulation whereas, in the reverse case, the M1 formulation is rejected against M2, thus favouring the latter. Columns 3 and 4 represent the MacKinnon/Davidson C-test. The coefficient of the "prediction variable" based on the "false" hypothesis should be zero, whilst that based on the "acceptable" hypothesis unity. It is clear that the M2 formulation is again favoured irrespective of whether or not a constant is included in the auxilliary regression.

For the sterilization equation, a general "reaction-type" function was formulated; the right-hand-side dependent variables included the growth of prices and the acceleration of inflation, plus current and lagged growth rates of output, international reserves, the money multiplier, and the fiscal deficit. The parameter of interest is the coefficient on the growth rate of international reserves. The other independent variables were chosen to reflect plausible factors that may influence the determination of domestic credit. The results reported in Table 4 show that equation 3 is a tentatively adequate parsimonious parameterization that satisfies all of the diagnostic tests above. The sterilization coefficient is statistically insignificantly different from unity. The Jamaican data thus support the conclusion that monetary policy was used to offset changes in the stock of international reserves.

In the 3SLS results (Table 5), combinations of the least and most restricted versions of the instrumental variables regressions are reported. Using the covariance matrix of the least restricted model as metric, a quasi-likelihood ratio test was performed [Gallant and Jorgenson 16]. The relative efficiency of the Two-and Three-Stage Least Squares estimators were examined by testing the diagonality of the cross-equation covariance matrix. Thus,

$$H_0:\ \Sigma = \begin{bmatrix} \sigma_{11} & 0 \\ 0 & \sigma_{22} \end{bmatrix}$$

and

$$H_1:\ \Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \sigma_{22} \end{bmatrix}$$

The test utilized is a variant of the above quasi-likelihood ratio test. Given that the objective function minimized is of the form

$$f(\theta)'\Sigma^{-1}w(w'w)^{-1}w'f(\theta)$$

where w is the matrix of instruments, the test for diagonality is simply

$$H_0:\ \Sigma^{-1} = \begin{bmatrix} \sigma^{11} & 0 \\ 0 & \sigma^{22} \end{bmatrix}$$

vs.

$$H_1:\ \Sigma^{-1} = \begin{bmatrix} \sigma^{11} & \sigma^{12} \\ \sigma^{21} & \sigma^{22} \end{bmatrix}$$

where a superscript indicates the value of the partitioned inverse. Thus, the covariance matrix in diagonal form is tested versus an unrestricted covariance matrix using the three-stage least squares (3SLS) covariance matrix as the relevant testing metric. Additionally, a test for bivariate normality using both 3SLS and 2SLS(IV) residuals are reported [Cox and Small 4].

The overall results indicate that the coefficient on the money multiplier (V) is significantly different from unity; further, whilst both the offset (W) and sterilization (G) coefficients are insignificantly different from unity, two of the model configurations (EQ1/EQ4 and EQ2/EQ4) will not satisfy the point estimate criterion. The model configuration (EQ1/EQ4) is rejected against the least restricted model (Note (3) :T2). The restrictions characterizing the more parsimonious models (column 4, 5 and 6) are not rejected by the data. Starting from column 4, the imposition of the additional restrictions D = 0 and B = K = 0 increase the value of the objective function by 1.73 and 8.15, respectively. Thus, although the restrictions in column 6 are not rejected against the least restricted model, the imposition of the three additional restrictions to column 4 increases the value of the objective function significantly on a chi-square criterion. [Note that this is not a test of the model of column 5 versus that of column 4 as the comparing metric would have to be altered, and the level of significance changed to reflect the fact that the test is column 5 versus column 4 conditional on column 4 being accepted against column 1.] In view of the above, EQ2/EQ5 is accepted as the preferred specification.

For that specification, the offset coefficient prediction of minus unity is upheld. Both the price and inflation elasticities are reasonably well-determined; the approximate equivalence of the price and output elasticities observed in the single equation results no longer hold. The diagonality test is rejected in all cases. Of note, the correlation coefficient (p) for the IV equation residuals is approximately 0.65; 3SLS estimation reduces it, in the preferred model, to 0.12.

Thus for the period analysed, the 3SLS estimate indicate that for the Jamaican economy an increase in the domestic component of the monetary base will lead to an equivalent outflow of reserves. Also, changes in reserves were sterilized by the authorities. The positive price elasticity supports the prediction of an improvement in the balance of payments due to an increase in the growth rate of prices; however, acceleration of the rate of inflation will result in a deterioration of the balance of payments. This latter result seems to be consistent with the experience of the Jamaican economy during the decade of the seventies.

SUMMARY

This paper examined testable predictions of the monetary approach using reserve-flow and sterilization equations in both single equation and simultaneous equation contexts. Diagnostic tests were used as criteria to evaluate model adequacy prior to using statistical inference to evaluate the predictions of the monetary approach. The results indicate that, in general, the *a priori* predictions of the monetary approach to the balance of payments were not rejected by the data — the notable exceptions being the rejection of the sterilization coefficient prediction and the failure of the money multiplier coefficient to satisfy a strict criterion of being a point estimate.

In conclusion, a cautionary note. The analysis ignored the question of lags in the adjustment of actual to desired quantities, and assumed the existence of a long run demand for money function that is stable and independent of the money supply process. The methodological dilemma of specifying the length of the long run was also assumed away. Further, the price, output, and interest rate variables were assumed exogenously determined. However, at the expense of complexity, these assumptions can be tested and the relevant modifications, if any, incorporated into the analysis.

FIGURE 1: JAMAICAN (RTBL) AND UK (RTBLE) TREASURE BILL RATES

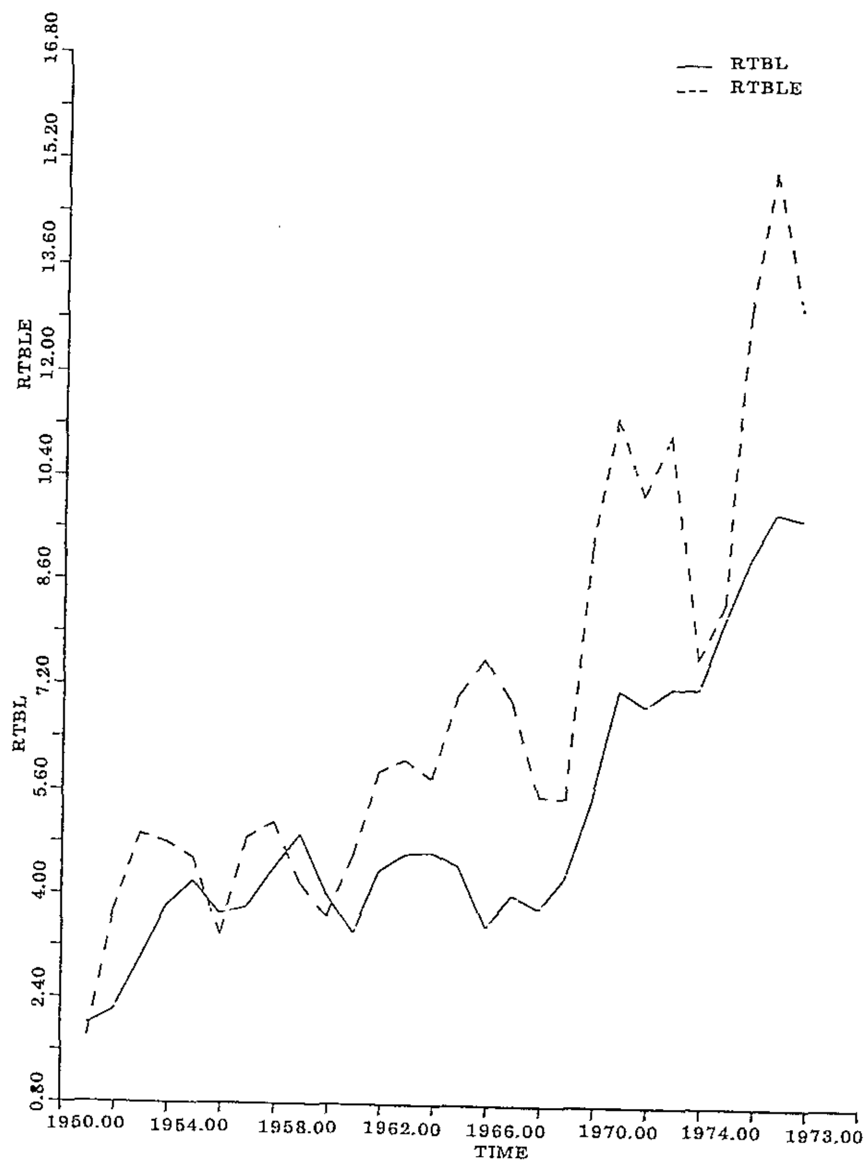

TABLE 1. OLS ESTIMATES OF RESERVE-FLOW EQUATION (12)

	Unrestricted	$\alpha_7 = 0$	$\alpha_3 = 0$	Interest Rate Differential
C	0.10 (3.84)	0.10 (4.16)	0.10 (4.01)	0.10 (3.99)
P	0.40 (1.81)	0.35 (1.65)	0.39 (1.91)	0.33 (1.50)
RY	0.41 (1.58)	0.39 (1.53)	0.40 (1.67)	0.37 (1.51)
RT	−0.01 (0.13)	−0.03 (0.29)		
RK	−0.06 (0.89)		−0.06 (0.95)	
RD				−0.002 (0.05)
PP	−0.04 (1.35)	−0.05 (1.96)	−0.04 (1.43)	−0.05 (2.11)
MR	−0.89 (9.17)	−0.90 (9.43)	−0.89 (9.48)	−0.90 (9.41)
DC1	−1.01 (14.09)	−1.03 (15.36)	−1.01 (14.51)	−1.03 (15.29)
DC2	−0.006 (0.34)	−0.009 (0.49)	−0.007 (0.36)	−0.01 (0.49)
DC3	−0.01 (0.08)	0.002 (0.01)	−0.009 (0.07)	0.003 (0.03)
$\bar{R}^2$	0.935	0.936	0.939	0.936
D.W.	2.04	2.01	2.01	1.96
s.e.	0.059	0.058	0.057	0.059
F(p−1,T−p)	41.27	46.93	49.28	46.70

Notes: 't' statistics are in parentheses; T = 26

TABLE 2 (A). OLS ESTIMATES RESERVE-FLOW EQUATION

Dependent Variable: R

EQN	C	P	RY	RT	RK	PP	MR	DC	FDC	MR(−1)	$\bar{R}^2$	s.e	F(p−1,T−p)	DW	RSS	F(s,T−k)
M2	0.09 (3.92)	0.42 (1.96)	0.41 (1.63)	−0.02 (0.18)	−0.06 (1.05)	−0.03 (1.35)	−0.89 (9.38)	−1.01 (14.76)	0.01 (0.19)		0.939	0.057	48.82	2.16	0.05580	
M1	0.04 (0.92)	0.56 (1.42)	0.49 (1.04)	−0.03 (0.16)	−0.17 (1.59)	0.05 (1.20)	−0.85 (3.91)	−0.75 (7.20)	−0.10 (0.80)		0.800	0.103	13.54	2.33	0.18151	
M2	0.09 (4.13)	0.44 (2.32)	0.41 (1.70)	−0.02 (0.21)	−0.07 (1.18)	−0.03 (1.35)	−0.88 (10.27)	−1.00 (15.85)			0.942	0.056	58.94	2.17	0.05592	F(1,15)= 0.03
M1	0.05 (1.10)	0.43 (1.21)	0.47 (1.00)	−0.01 (0.08)	−0.15 (1.46)	0.03 (0.92)	−0.90 (4.32)	−0.77 (7.58)			0.804	0.102	15.69	2.43	0.18831	0.56
M2	0.09 (4.28)	0.43 (2.41)	0.40 (1.76)		−0.07 (1.30)	−0.03 (1.63)	−0.88 (10.62)	−1.00 (16.31)			0.945	0.054	72.40	2.14	0.05606	F(2,15)= 0.03
M1	0.05 (1.16)	0.43 (1.27)	0.46 (1.06)		−0.16 (1.36)	0.03 (0.94)	−0.90 (4.49)	−0.77 (7.79)			0.815	0.100	19.32	2.42	0.18838	0.28
M2	0.10 (4.44)	0.38 (2.16)	0.36 (1.57)			−0.04 (2.25)	−0.88 (10.44)	−1.03 (17.18)			0.943	0.055	83.60	2.15	0.06108	F(3,15)= 0.47
M1	0.06 (1.45)	0.29 (0.86)	0.32 (0.72)			0.01 (0.41)	−0.84 (4.13)	−0.81 (8.29)			0.802	0.103	21.19	2.23	0.21238	0.85
M2	0.09 (4.13)	0.33 (1.90)	0.31 (1.35)		−0.10 (2.00)		−0.81 (11.02)	−0.94 (19.05)			0.940	0.057	79.80	2.23	0.06385	F(3,15)= 0.72
M1	0.05 (1.10)	0.52 (1.65)	0.55 (1.29)		−0.12 (1.31)		−0.96 (5.08)	−0.82 (9.57)			0.816	0.099	23.13	2.20	0.19723	0.43
M2	0.10 (4.64)	0.39 (2.38)	0.37 (1.74)			−0.05 (2.59)	−0.97 (10.64)	−1.05 (18.31)		−0.21 (1.98)	0.950	0.052	80.43	1.94	0.05067	n.a.

Notes: 't' statistics are in parentheses. T = 26
The last column indicates an F-test of zero restrictions on the least restricted equation (i.e. row 1).

TABLE 2 (B). DIAGNOSTIC TESTS USING OLS RESIDUALS (MR)

Dependent Variable: R

	EQN 1	EQN 2	EQN 3	EQN 4	EQN 5	EQN 6
Description	C, P, RY, RT, RK, PP, MR, DC, FDC	C, P, RY, RT, RK, PP, MR, DC	C, P, RY, RK, PP, MR, DC	C, P, RY, PP, MR, DC	C, P, RY, RK, MR, DC	C, P, RY, PP, MR, DC, MR(-1)
Misspecification						
MS1 [F(3,22)]	0.24	0.24	0.26	0.31	0.28	0.43
MS2 [X^2(7)]	8.60	8.34	8.03	6.96	8.40	n.a.
Normality						
LMN [X^2(2)]	6.24	6.82	6.97	4.19	3.69	0.38
Parameter Constancy						
PC1 [X^2(2)]	4.04	4.53	4.91	4.95	7.11	3.89
PC2	0.007	0.007	0.007	0.008	0.011	0.005
PC3 [F(2, T-K-2)]	0.88	0.94	1.02	0.98	1.66	0.89
Heteroscedasticity						
Arch (HT3) [X^2(1)]	0.07	0.11	0.08	0.02	0.29	0.83
Pagan (HT2) [X^2(2)]	0.13	0.15	0.07	0.20	0.02	1.08
Random Cofficients (HT1) [X^2(K−1)]	0.88	0.48	0.38	0.31	0.34	0.57
Serial Correlation						
$\tilde{u}_{t-1}$ [X^2(1)]	0.92	0.95	0.27	0.24	0.48	0.03
$\hat{u}_t$ [X^2(1)]	17.05	16.35	13.87	9.84	13.03	3.25
$\tilde{u}_{-1}, \tilde{u}_{t-2}$ [X^2(2)]	2.67	2.48	1.46	3.18	0.91	0.93

Notes: (1) u are OLS residuals; $u_t = u_t \times u_{t-1}$. T = 26

TABLE (2)C. DIAGNOSTIC TESTS USING OLS RESIDUALS (MRI)

Dependent Variable: R

	EQN 1	EQN 2	EQN 3	EQN 4	EQN 5
Description	C, P, RY, RT, RK, PP, MR1, DC, FDC	C, P, RY, RT, RK, PP, MR1, DC	C, P, RY, RK, PP, MR1 DC	C, P, RY, PP, MR1, DC	C, P, RY, RK, MR1, DC
Misspecification					
MS1 [F(3,22)]	0.85	0.87	0.90	0.21	0.59
MS2 [X^2(7)]	7.22	6.96	6.40	5.20	6.52
Normality					
LMN [X^2(2)]	2.68	1.33	1.47	0.71	2.87
Parameter Constancy					
PC1 [X^2(2)]	32.48	31.66	33.24	33.47	35.92
PC2	0.086	0.086	0.085	0.093	0.088
PC3 [F(2, T-K-2)]	9.61	9.29	9.82	10.03	11.20
Heteroscedasticity					
Arch (HT3) [X^2(1)]	0.12	0.03	0.02	0.001	0.06
Pagan (HT2) [X^2(2)]	0.33	0.25	0.28	0.08	0.07
Random Coefficients (HT1) [X^2(K-1)]	2.17	2.76	3.39	2.53	2.66
Serial Correlation					
$\tilde{u}_{t-1}$ [X^2(1)]	6.85	8.24	6.08	3.18	3.89
$\hat{u}_t$ [X^2(1)]	0.17	0.11	0.07	1.49	1.02
$\tilde{u}_{t-1}, \tilde{u}_{t-2}$ [X^2(2)]	8.47	10.12	7.47	4.53	5.46

Notes: (1) u are OLS residuals; $\hat{u}_t = \tilde{u}_t \times \tilde{u}_{t-1}$. T= 26

TABLE 3. INSTRUMENTAL VARIABLES ESTIMATES OF RESERVE-FLOW EQUATION

Dependent Variable: R

Eqn		C	P	RY	RT	RK	PP	MR	DC	FDC	R	s.e	D.W	RSS	φ
1	M2	0.09	0.39	0.37	-0.01	-0.10	-0.008	-0.80	-0.90	-0.02	0.93	0.061	2.02	0.06373	
		(3.50)	(1.71)	(1.39)	(0.15)	(1.42)	(0.24)	(6.84)	(8.71)	(0.26)					
		0.04	0.56	0.49	-0.03	-0.17	0.05	-0.85	-0.75	- 0.10					
	M1	(0.92)	(1.41)	(1.04)	(0.16)	(1.52)	(1.05)	(3.73)	(4.97)	(0.79)	0.80	0.103	2.33	0.18151	
2	M2	0.09	0.37	0.37	-0.01	-0.09	-0.01	-0.82	-0.91		0.94	0.059	2.02	0.06236	$\chi^2(1)$= 0.07
		(3.88)	(1.81)	(1.43)	(0.13)	(1.47)	(0.53)	(8.09)	(10.10)						
		0.05	0.44	0.47	-0.01	-0.15	0.03	-0.91	-0.78						
	M1	(1.10)	(1.21)	(1.01)	(0.08)	(1.37)	(0.75)	(4.22)	(5.46)		0.80	0.102	2.42	0.18852	0.62
3	M2	0.09	0.36	0.36		-0.09	-0.01	-0.81	-0.91		0.94	0.057	2.00	0.06253	$\chi^2(2)$ =0.08
		(4.01)	(1.89)	(1.50)		(1.59)	(0.56)	(8.37)	(10.38)						
		0.05	0.43	0.46		-0.15	0.03	-0.90	-0.78						
	M1	(1.16)	(1.28)	(1.06)		(1.46)	(0.76)	(4.39)	(5.60)		0.82	0.100	2.42	0.18858	0.63
4	M2	0.10	0.32	0.32			-0.03	-0.83	-0.97		0.94	0.057	2.06	0.06423	$\chi^2(1)$ 2.31
		(4.35)	(1.73)	(1.36)			(1.44)	(8.72)	(12.07)						
		0.06	0.34	0.34			0.005	-0.87	-0.86						
	M1	(1.40)	(0.97)	(0.77)			(0.15)	(4.08)	(6.42)		0.80	0.104	2.23	0.21505	2.60
5	M2	0.09	0.32	0.33		-0.11		-0.78	-0.88		0.94	0.059	2.01	0.06922	$\chi^2(3)$ 0.36
		(3.91)	(1.78)	(1.36)		(2.01)		(10.04)	(14.57)						
		0.05	0.53	0.53		-0.12		-0.97	-0.86						
	M1	(1.11)	(1.65)	(1.24)		(1.25)		(5.08)	(8.22)		0.81	0.100	2.23	0.19903	1.17

Notes: (1) 't' statistics are in parentheses. T = 26

(2) Instruments: Constant, P. lagged R. lagged DC, and current and lagged values of RY, RT, RK, MR (or MR1), FDC, PP, and DF.

(3) ϕ is quasi-likelihood ratio test of zero restrictions defined as $\phi = Q^\circ - Q_1)/\sigma^2$; where Q° is objective function for null, Q_1 that for the maintained hypothesis, and σ is standard error of maintained hypothesis.

TABLE 3(B). DIAGNOSTIC TESTS USING INSTRUMENTAL VARIABLES RESIDUALS (MR)

Dependent Variable: R

Description	EQN 1		EQN 3		EQN 4		EQN 5	
	C, P, PP, MR, DC, RY, RK, RT, FDC		C, P, PP, MR, RY, RK, DC		C, P, PP, MR, RY, DC		C, P, MR, RY, RK, DC	
Validity of Instruments	7.54		8.69		11.50		8.56	
Zeta $[X^2(W-K)]$								
Misspecification								
MS1 [F(3,22)]	0.13		0.12		0.26		0.12	
MS2 $[X^2(2)]$	2.14		2.29		1.98		2.14	
MS2A $[X^2(7)]$	7.29		6.58		5.48		6.33	
Normality								
LMN $[X^2(2)]$	2.06		2.66		2.26		1.31	
Parameter Constancy								
PC1 $[X^2_{(2)}]$	4.27		4.93		5.00		6.16	
PC2	0.0072		0.0074		0.0077		0.0094	
PC3 [F(2, T-K-2)]	1.90		1.94		1.44		2.34	
Heteroscedasticity		N		N		N		N
Arch (HT3) $[X^2(1)]$	0.12	0.09	0.03	0.02	0.007	0.006	0.008	0.007
Pagan (HT2) $[X^2(2)]$	0.30	0.26	0.30	0.25	1.42	1.13	0.22	0.21
	(0.27)	(0.22)	(0.20)	(0.15)	(0.56)	(0.44)	(0.14)	(0.12)
Random Coefficients (HT1) $[X^2(K-1)]$	22.82	16.44	6.37	4.97	5.11	4.03	5.16	4.41
Serial Correlation								
$\tilde{u}_{t-1}$	0.26		0.13		0.06		0.10	
$\bar{u}_{t-1}$	0.32		0.13		0.07		0.10	
$\hat{u}_t$ $[X^2(1)]$	12.41		10.97		9.74		9.67	

Notes: (1) Brackets indicate predictions are fitted values of IV regression.

(2) W = number of instruments; K = number of regressors; T = 26

(3) $\tilde{u}$ are IV residuals; $\bar{u}$ are the predictions of $\tilde{u}$ based on the regression of $\tilde{u}_{t-1}$ on the instrument set; $\hat{u}_t = \tilde{u}_t \times \tilde{u}_{t-1}$.

(4) N in the heteroscedasticity row-block indicates normality assumptions was not used in generating variance – covariance matrix.

TABLE 3(C). DIAGNOSTIC TESTS USING INSTRUMENTAL VARIABLES RESIDUALS (MR1)

Dependent Variable: R

Description	EQN 1		EQN 3		EQN 4		EQN 5	
	C, P, PP, MR1, DC, RY, RK, RT, FDC		C, P, PP, MR1, RY, RK DC		C, P, PP, MR1, RY, DC		C, P, MR1, RY, RK, DC	
Validity of Instruments								
Zeta $[X^2(W-K)]$	14.19		15.94		16.67		16.48	
Misspecification								
MS1 [F(3,22)]	4.03		4.04		3.89		4.45	
MS2 $[X^2(2)]$	2.78		2.06		2.61		2.38	
MS2A $[X^2(7)]$	7.76		6.69		4.78		6.04	
Normality								
LMN $[X^2(2)]$	2.62		1.79		1.99		4.39	
Parameter Constancy								
PC1 $[X^2(2)]$	30.55		31.85		33.35		35.31	
PC2	0.082		0.082		0.093		0.086	
PC3 [F(2, T-K-2)]	9.49		9.78		10.27		11.37	
Heteroscedasticity		N		N		N		N
Arch (HT3) $[X^2(1)]$	0.15	0.10	0.04	0.03	0.004	0.0002	0.03	0.02
Pagan (HT2)	1.74	1.60	1.60	1.48	2.51	2.02	3.02	2.38
$[X^2(2)]$	(0.52)	(0.38)	(0.44)	(0.33)	(0.29)	(0.18)	(0.31)	(0.19)
Random Coefficients (HT1) $[X^2(K-1)]$	10.92	8.68	11.01	8.84	8.48	6.21	13.24	9.94
Serial Correlation								
$\tilde{u}_{t-1}$	8.30		6.92		4.40		5.54	
$\bar{u}_{t-1}$	9.84		7.71		4.83		6.51	
$\hat{u}_t$ $[X^2(1)]$	0.18		0.05		0.64		0.36	

Notes: (1) Brackets indicate predictions are fitted values of IV regression.
(2) W = number of instruments; K = number of regressors; T= 26
(3) $\tilde{u}$ are IV residuals; $\bar{u}$ are the predictions of $\tilde{u}$ based on the regression of $\tilde{u}_{t-1}$ on the instrument set; $\hat{u}_t = \tilde{u}_t \times \tilde{u}_{t-1}$
(4) N in the heteroscedasticity row-block indicates normality assumptions was not used in generating variance – covariance metrix.

TABLE 4(A). INSTRUMENTAL VARIABLES ESTIMATES OF STERILISATION EQUATION

Dependent variable: DC

EQN	C	P	PP	MR	MR(-1)	DF	DF(1)	DRY	R	$\bar{R}^2$	s.e	DW	RSS	φ
1	0.12	0.12	-0.02	-0.98	-0.13	0.02	0.02	0.43	-0.92	0.974	0.040	2.06	0.02676	
	(8.67)	(1.25)	(1.57)	(15.23)	(1.51)	(2.41)	(2.85)	(2.00)	(13.14)					
2	0.12	0.13	-0.02	-0.95		0.02	0.02	0.51	-0.93	0.972	0.041	2.15	0.03049	$X^2(1)$= 2.27
	(8.47)	(1.26)	(1.38)	(14.81)		(2.48)	(2.94)	(2.40)	(12.70)					
3	0.13			-0.95		0.02	0.03	0.46	-0.99	0.967	0.045	1.96	0.0410	$X^2(3)$= 4.97
	(12.55)			(13.45)		(2.46)	(3.41)	(2.03)	(15.32)					
4	0.13			-0.97	-0.12	0.02	0.03	0.38	-1.00	0.968	0.045	1.87	0.03786	$X^2(2)$= 2.94
	(12.37)			(13.50)	(1.27)	(2.37)	(3.32)	(1.67)	(15.54)					
5	0.13		-0.01	-0.95		0.02	0.03	0.44	-0.97	0.969	0.044	2.01	0.03632	$X^2(2)$= 3.97
	(12.90)		(0.91)	(13.92)		(2.59)	(3.16)	(2.01)	(13.83)					

Notes: (1) 't' statistics are in parentheses. T = 26
(2) Instruments: Constant, P, lagged R, lagged DC, and current and lagged values of RY, RT, RK, WR (or MR1). FDC, PP, and DF
(3) ϕ is quasi-likelihood ratio test of zero restrictions defined as $\phi = (Q^{\circ} - Q_1)/\sigma^2$; where Q° is objective function for null, Q_1 that for the maintained hypothesis, and σ is standard error of maintained hypothesis.

TABLE 4(B). DIAGNOSTIC TESTS USING INSTRUMENTAL VARIABLES[1] RESIDUALS

Dependent Variable: DC

Description	EQN 1		EQN 2		EQN 3		EQN 4		EQN 5	
	C, P, PP, MR, MR(-1), DF, DF(-1), R, DRY		C, P, PP, MR DF, DF(-1), R, DRY		C, MR, DF, DF(-1), R, DRY		C, MR, MR(-1) DF, DF(-1), R, DRY		C, PP, MR, DF, DF(-1), R, DRY	
Validity of Instruments										
Zeta $[X^2(W - K)]$	6.14		7.82		8.54		7.17		8.33	
Misspecification										
MS1 $[F(3,22)]$	0.44		0.29		0.34		0.30		0.45	
MS2 $[X^2(2)]$	1.91		0.49		0.63		1.36		0.56	
Normality										
DMN $[X^2(2)]$	1.11		4.48		0.74		0.31		1.03	
Parameter Constancy										
PC1 $[X^2(2)]$	4.22		1.23		1.05		2.97		0.95	
PC2	0.0034		0.001		0.001		0.0028		0.0009	
PC3 $[F(2, T-K-2)]$	0.86		0.62		1.58		1.67		1.20	
Heteroscedasticity		N		N		N		N		N
Arch (HT3 $[X^2(1)]$	0.58	0.74	1.25	0.76	1.33	1.22	0.76	1.02	1.37	1.27
Pagan (HT2)	0.09	0.10	0.86	0.50	1.10	0.99	0.22	0.27	0.78	0.71
$[X^2(2)]$	(1.05)	(1.06)	(1.47)	(0.88)	(0.83)	(0.75)	(0.28)	(0.35)	(0.56)	(0.50)
Random Coefficients (HT1) $[X^2(K-1)]$	3.60	4.50	4.68	2.94	2.79	2.73	2.54	3.23	2.30	2.30

TABLE 4(B). (Cont'd) DIAGNOSTIC TESTS USING INSTRUMENTAL VARIABLES RESIDUALS

Dependent Variable: DC

Description	EQN 1	EQN 2	EQN 3	EQN 4	EQN 5
	C, P, PP, MR, MR(-1), DF, DF(-1), R, DRY	C, P, PP, MR DF, DF(-1), R, DRY	C, MR, DF, DF(-1), R, DRY	C, MR, MR(-1) DF, DF(-1), R, DRY	C, PP, MR, DF, DF(-1), R, DRY
Serial Correlation					
$\tilde{u}_{t-1}$	0.06	0.24	0.01	0.12	0.007
$\bar{u}_{t-1}$	0.29	1.13	0.22	0.05	0.44
$\hat{u}_t$ $[X^2(1)]$	1.08	1.82	3.53	1.78	5.30

Notes:
(1) Brackets indicate predictions are fitted values of IV regression.
(2) W = number of instruments; K = number of regressors; T = 26.
(3) u are IV residuals; u are the predictions of u based on the regression of u_{t-1} on the instrument set; $u_t = u_t \times u_{t-1}$.
(4) N in the heteroscedasticity row-block indicates normality assumptions was not used in generating variance – covariance matrix.

TABLE 5. MABP ESTIMATES USING THREE STAGE LEAST SQUARES

	EQ1/EQ3	EQ1/EQ4	EQ1/EQ5	EQ2/EQ3	EQ2/EQ4	EQ2/EQ5
L	0.11 (6.28)	0.12 (7.85)	0.11 (6.19)	0.12 (7.13)	0.12 (8.93)	0.12 (7.05)
M	0.24 (1.54)	0.05 (0.50)	0.20 (1.82)	0.18 (1.33)	0.004 (0.04)	0.21 (1.54)
N	-0.01 (0.69)	0.01 (0.71)	-0.02 (0.96)	-0.03 (1.56)	0.002 (0.15)	-0.03 (1.75)
Q	0.06 (0.40)	0.08 (0.57)	0.12 (0.84)	0.03 (0.27)	0.04 (0.33)	0.07 (0.53)
S	0.005 (0.12)	-0.01 (0.27)	-0.02 (0.38)	-	-	-
T	-0.02 (0.71)	-0.01 (0.37)	-0.02 (0.59)	-	-	-
V	-0.78 (9.08)	-0.73 (9.67)	-0.81 (9.59)	-0.82 (10.07)	-0.75 (10.57)	-0.83 (10.32)
W	-0.95 (12.67)	-0.89 (13.83)	-0.97 (13.30)	-0.98 (14.23)	-0.91 (15.76)	-1.00 (14.64)
X	-0.05 (1.21)	-0.03 (0.92)	-0.04 (1.00)	-	-	-
A	0.12 (10.74)	0.13 (17.08)	0.12 (10.69)	0.12 (10.93)	0.13 (17.24)	0.12 (10.90)
B	-0.03 (2.17)	-	-0.03 (2.23)	-0.03 (2.17)	-	-0.03 (2.21)
C	-0.90 (18.72)	-0.89 (18.71)	-0.89 (18.72)	-0.89 (18.77)	-0.88 (18.83)	-0.88 (18.81)
D	-0.06 (1.47)	-	-	-0.05 (1.31)	-	-
E	0.008 (2.34)	0.01 (2.69)	0.009 (2.39)	0.007 (2.22)	0.009 (2.80)	0.007 (2.34)
F	0.009 (2.51)	0.01 (3.69)	0.01 (2.68)	0.009 (2.59)	0.01 (3.70)	0.01 (2.72)
G	-0.97 (18.13)	-1.03 (24.38)	-0.96 (18.13)	-0.98 (19.25)	-1.04 (25.81)	-0.97 (19.25)
H	0.24 (1.88)	0.28 (2.31)	0.30 (2.43)	0.19 (1.75)	0.23 (2.22)	0.24 (2.24)
K	0.15 (1.89)		0.16 (2.04)	0.15 (1.87)	-	0.16 (1.97)

Notes: (Table 5):

EQ1 : R = L + M * P + N * PP + Q * RY + S *RT + T * RK + V * MR + W * DC + X * FDC;
EQ2 : R = L + M * P + N * PP + Q + RY + V * MR + W * DC;
EQ3 : DC = A + B * PP + C * MR + D * MR (–1) + E * DF + F * DF (–1) + G * R + H * DRY + K*P;
EQ4 : DC = A + C * MR + E * DF + F * DF (–1) + G * R + H * DRY;
EQ5 : DC = A + B * PP + C * MR + E * DF + F * DF (–1) + G * R + H * DRY + K*P;

Instruments: Constant, P, lagged R, lagged DC, and current and lagged values of RY, RT, RK, MR (or MR1), FDC, PP and DF.

t – statistics are in parentheses

TABLE 5. (Cont'd) MABP ESTIMATES USING THREE STAGE LEAST SQUARES

	EQ1/EQ3	EQ1/EQ4	EQ1/EQ5	EQ2/EQ3	EQ2/EQ4	EQ2/EQ5
S.E (1/4)	.0517	.0573	.0509	.0512	.0510	.0505
S.E.(9/10/11)	.0400	.0470	.0434	.0405	.0442	.0411
D.W. (1/4)	1.96	2.11	2.00	1.94	1.97	1.98
D.W. (9/10/11)	2.05	2.16	2.08	2.02	2.06	2.11
P	0.12	0.14	0.12	0.22	0.14	0.12
$X^2(2)$	0.42	1.46	0.32	1.78	1.55	0.29
P^*_{IV}	0.58	0.66	0.65	0.64	0.69	0.70
$X^2_{IV}(2)$	2.32	4.02	5.22	2.92	4.85	6.48
	20.90	29.74	23.07	22.44	30.59	24.17

Notes:

(1) 't' statistics are parentheses. T = 26.

(2) Instruments: constant, P, lagged R, lagged DC, and current and lagged values of RY, RT, RK, MR (or MR1), FDC, PP and DF.

(3) $T1(X^2(3)) = 1.54$; $T2(X^2(3)) = 8.83$; $T3(X^2(4)) = 3.26$; $T4(X^2(1)) = 2.17$; $T5(X^2(6)) = 9.69$.
The covariance matrix used as metric for testing restrictions is that of least restricted model.

(4) P is the correlation coefficient; ϕ is the value of the objective function.

TABLE 6(A). NON-NESTED TESTS

Dependent Variable: R

	1	2	3	4
C	0.12 (3.41)	-0.09 (2.54)		-0.005 (0.47)
P	0.51 (2.13)	-0.23 (0.87)		
RY	0.45 (1.70)	0.13 (0.48)		
RT	-0.01 (0.13)	-0.05 (0.51)		
RK	-0.09 (1.28)	0.17 (2.00)		
MR	-1.05 (6.11)			
MR1		0.17 (0.77)		
DC	-1.26 (5.35)	0.68 (2.58)		
FDC	-0.09 (0.11)	0.23 (2.51)		
PP	-0.03(1.03)	-0.11 (3.12)		
YINV	-0.29 (1.07)			
AINV		2.09 (5.68)		
YY			1.12 (6.98)	1.12 (6.88)
AA			-0.07 (0.45)	-0.07 (0.41)
SE	0.0583	0.0569	0.0599	0.0593
DW	1.84	1.86	2.03	2.08

Notes: 't' statistics are in parentheses; T = 26

TABLE 6(B). NON-NESTED TESTS

Dependent Variable: R

	1	2	3	4
C	0.13 (4.05)	-0.12 (3.27)		-0.004 (0.33)
P	0.45 (2.40)	0.09 (0.50)		
RY	0.39 (1.64)	0.27 (1.10)		
RT				
RK				
MR	-1.07 (7.13)			
MR1		0.23 (1.17)		
DC	-1.34 (6.27)	0.84 (3.26)		
FDC				
PP	-0.05 (2.35)	(-0.06) (2.84)		
YINV	-0.33 (1.48)			
AINV		2.13 (6.61)		
YY			1.13 (7.72)	1.13 (7.58)
AA			-0.10 (0.67)	-0.09 (0.64)
SE	0.0621	0.0608	0.0613	0.0610
DW	1.89	1.88	1.99	2.02

Notes: 't' statistics are in parentheses; T = 26

Notes (Table 6):

EQ1 : $R = \alpha + \beta_0 P + \beta_1 RY + \beta_2 RT + \beta_3 RK + \beta_4 MR + \beta_5 DC + \beta_6 FDC + \beta_7 PP;$

EQ2 : $R = \delta + \gamma_0 P + \gamma_1 RY + \gamma_2 RT + \gamma_3 RK + \gamma_4 MR1 + \gamma_5 DC + \gamma_6 FDC + \gamma_7 PP;$

EQ3 : $YY = \eta + \Theta_0 P + \Theta_1 RY + \Theta_2 RT + \Theta_3 RK + \Theta_4 MR1 + \Theta_5 DC + \Theta_6 FDC + \Theta_7 PP;$

EQ4 : $AA = \Psi + \omega_0 P + \omega_1 RY + \omega_2 RT + \omega_3 RK + \omega_4 MR + \omega_5 DC + \omega_6 FDC + \omega_7 PP;$

YY is predicted value, R, based on EQ1 as null.
YINV is predicted value, YY, of EQ3 based on EQ2 as alternative.
AA is predicted value, R, based on EQ2 as null.
AINV is predicted value, AA, of EQ4 based on EQ1 as alternative.
t statistics are in parentheses.

N.B.: Although the above definitions are for Table 6(a), the same are applicable (*mutatis mutandis*) for Table 6(b); the relevant changes are zero restrictions.

REFERENCES

[1] BERA, A.K. and C.M. JARQUE, "Efficient tests for normality, homoscedasticity and serial independence of regression residuals", *Economics Letters,* Vol. 6, 1980, pp. 255-59.

[2] BHATIA, S.L., "The monetary theory of balance of payments under fixed exchange rates: an example of India 1951-1973", *Indian Economic Journal,* Vol. 29, 1982, pp. 30-40.

[3] CHOW, G.C., "Tests of equality between sets of coefficients in two linear regressions", *Econometrica,* Vol. 28, 1960, pp. 591-605.

[4] COX, D.R. and N.J.M. SMALL, "Testing multivariate normality", *Biometrika,* Vol. 65, 1978, pp. 263-72.

[5] DAVIDSON, R. and J.G. MacKINNON, "On a simple procedure for testing non-nested regression models", *Economics Letters,* Vol. 5, 1980, pp. 45-48.

[6] ———, "Several tests for model specification in the presence of alternative hypotheses", *Econometrica,* Vol. 49, 1981, pp. 781-93.

[7] ———, Some non-nested hypothesis tests and the relations among them, *Review of Economic Studies,* Vol. 49, 1982, pp. 551-65.

[8] ———, "Model specification tests based on artificial linear regressions", *International Economic Review,* 1984, pp. 484-502.

[9] DE GRAUWE, P., "International capital flows and portfolio equilibrium: comment, *Journal of Political Economy,* Vol. 83, 1975, pp. 1077-80.

[10] ———, *Monetary interdependence and international monetary reform,* Lexington, Mass.; Health, 1976.

[11] DOMBRECHT, M., "The monetary approach to the balance of payments under fixed exchange rates; a survey", *Tijdschrif voor Economie en Management,* Vol. 23, 1978, pp. 471-91.

[12] ENGLE, R.F., "Autoregressive conditional heteroscedasticity with estimates of the variance of United Kingdom inflation", *Econometrica,* Vol. 50, 1982, pp. 987-1007.

[13] ———, "Likelihood ratio, lagrange multiplier, and wald tests in econometrics", in Zvi GRILICHES and M.D. INTRILIGATOR (eds.), *Handbook of Econometrics,* Amsterdam: North-Holland, 1984.

[14] ———, D.F. HENDRY, and J.F. RICHARD, "Exogeneity", *Econometrica,* Vol. 51, 1983, pp. 277-304.

[15] ———, and D. TRUMBLE, "Small sample properties of arch estimators and tests", *Canadian Journal of Economics,* Vol. 18, 1985, pp. 66-93.

[16] GALLANT, A.R. and D.W. JORGENSON, "Statistical inference for a system of simultaneous, non-linear, implicit equations in the context of instrumental variable estimation", *Journal of Econometrics,* Vol. 11, 1979, pp. 275-302.

[17] HAMBURGER, M.J., "The demand for money in an open economy: Germany and the United Kingdom", *Journal of Monetary Economics,* Vol. 3, 1977, pp. 25-40.

[18] HARVEY, A.C., *The Econometric analysis of time series,* Oxford: Philip Alan, 1981.

[19] HAUSMAN, J.A., "Specification tests in econometrics", *Econometrica,* Vol. 46, 1978, pp. 1251-72.

[19] HAUSMAN, J.A., "Specification tests in econometrics", *Econometrica,* Vol. 46, 1978, pp. 1251-72.

[20] JACOBS, R.E., E.E. LEAMER, and M.P. WARD, "Difficulties with testing for causality", *Economic Inquiry,* Vol. 17, 1979, pp. 401-13.

[21] KOURI, P.J.K. and M.G. PORTER, "International capital flows and portfolio equilibrium", *Journal of Political Economy,* Vol. 82, 1974, pp. 443-67.

[22] KRENIN, M.E. and L.H. OFFICER, "The monetary approach to the balance of payments: a survey", *Princeton studies in international finance,* No. 43, Princeton University, 1978.

[23] McALEER, M., "Specification tests for separate models: a survey", Australian National University *Working Papers in Economics and Econometrics,* No. 110, 1984.

[24] MacKINNON, J.G., "Model specification tests against non-nested alternatives", *Econometric Reviews,* Vol. 2, 1983, pp. 85-110.

[25] ———, H. WHITE, and R. DAVIDSON, "Tests for model specification in the presence of alternative hypotheses: some further results", *Journal of Econometrics,* Vol. 21, 1983, pp. 53-70.

[26] MAGEE, S.P., "The empirical evidence on the monetary approach to the balance of payments and exchange rates", *American Economic Review,* Vol. 66, 1976, pp. 163-170.

[27] PAGAN, A.R. and A.D. HALL, 1983", Diagnostic tests as residual analysis", *Econometric Reviews,* Vol. 2, 1983, pp. 159-218.

[28] RAMSEY, J.B., "Tests for specification errors in classical linear least-squares regression analysis", *Journal of the Royal Statistical Society,* Vol. B 31, 1969, pp. 350-71.

[29] SARGAN, J.D., "Wages and prices in the United Kingdom: a study in econometric methodology", in P.E. HART, G. MILLS, and J.K. WHITAKER (eds.), *Econometric analysis for national economic planning,* London: Butterworths, 1964.

[30] ———, J.D., "Testing for misspecification after estimating using instrumental variables", London School of Economics, unpublished, 1976.

[31] SARGENT, T.J., "Causality, exogeneity, and natural rate models: reply to C.R. NELSON and B.T. McCALLUM", *Journal of Political Economy,* Vol. 87, 1979, pp. 403-409.

[32] SIMS, C.A., "Exogeneity and causal orderings in macroeconomic models", in C.A. SIMS (eds.), *New methods in business cycle research: proceedings from a conference,* Minneapolis: Federal Reserve Bank of Minneapolis, 1977.

[33] UDDIN, M.S., "The monetary approach to the balance of payments: evidence from less developed countries", *Indian Economic Journal,* Vol. 44, 1985, pp. 92-104.

[34] WHITE, H, 1980, "A heteroscedastic-consistent covariance matrix estimator and a direct test for heteroscedasticity", *Econometrica,* Vol. 48, 1980, pp. 817-38.

[35] WU, D-M., "Alternative tests of independence between stochastic regressors and disturbances", *Econometrica,* Vol. 41, 1973, pp. 733-750.

[36] ———, "Tests of causality, predeterminedness and exogeneity", *International Economic Review,* Vol. 24, 1983, pp. 547-58.

[37] ——— A remark on a generalised specification test *Economics Letters,* Vol. 1983b, pp. 365-70.

APPENDIX

NOTATION USED IN REPORTING RESULTS

The following notation is adopted in reporting the results, purely for simplicity. The estimation period used throughout is 1956-1981. Data was obtained from the IMF *IFS Yearbook,* 1982.

R	=	ΔTR/H;
DC	=	ΔDCJ/H;
P	=	ΔCPI/CPI (−1);
PP	=	ΔP/P (−1);
RY	=	ΔRGDP/RGDP (−1);
RT	=	ΔRTBL/RTBL (−1);
Rk	=	ΔRTBLE/RTBLE (−1);
RD	=	ΔRDIFF/RDIFF (−1);
MR	=	ΔM2M/M2M (−1);
MR1	=	ΔM1M/M1M (−1);
DCK	=	ΔDCUK/DCUK (−1);
DCS	=	ΔDCUS/DBUS (−1);
FDC	=	ΔTDC/TDC (−1);
DF	=	ΔDEF/DEF (−1);
TDC	=	DCK + DCS;
DC(Z)	=	H(Z) − TR(Z), for (Z) = J, UK, US (representing Jamaica, U.K., and U.S., respectively;

TR	is total reserves in domestic currency;
H	is reserve money;
CPI	is consumer price index;
GDP	is gross domestic product;
RGDP	is real output, defined as GDP/CPI;
RTBL	is treasury bill rate;
RTBLE	is UK treasury bill rate;
RDIFF	is the domestic-foreign interest rate differential (TRBL-RTBLE);
M	is money stock (both narrow (M1) and broad (M2) definitions are used)

DEF	is fiscal deficit;

M2M and M1M are money multipliers defined with M2 and M1 respectively (i.e. M/H)

The foreign credit variables (DCK and DCS) were both denominated in domestic currency terms (namely, J$).