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MONETARY POLICY AND DEFICITS FINANCING IN JAMAICA

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A vector error-correction model (VECM) is estimated to examine the relationship among interest rates, monetary base, credit claims to the private sector, real income, prices, government spending, budget deficits and exchange rate in Jamaica. Cointegration is used to identify the VECM. The empirical results show that fiscal deficits are monetized in the long-run; the roles of financial services are weak, and inverse price-real output relationship exists in both the short-run and the long-run. Monetary disciplines, reduction in fiscal spending and sound regulatory actions are crucial to reduce the national debt, the inflation and interest rates, crowd in private investments, avert financial crisis and promote economic growth.

Keywords: Vector Error-correction Model, Fiscal Spending, Financial Services, Deficit Finance, and Jamaica.
JEL classification: E6

1. INTRODUCTION

Privatization, divestment, deregulation and liberalization are policies that have been followed in the post Bretton Woods era in Jamaica. In the 1989 election, the People National Party came to power following almost a decade of Jamaica Labour Party reign and was mandated to pursue more comprehensive, coordinated and 'decentralized' divestment programmes. However, the sequencing of the privatization and liberalization policies was not well ordered.[1] The National Commercial Bank (NCB) was privatized in 1989 whereas the foreign exchange rates, prices and the nominal interest rates were liberalized in 1991. These developments led to massive depreciation of the Jamaican dollar relative to the US dollar by more than 68% in 1991, while nominal interest rates

[1] Shaw (1973) and McKinnon (1973) had argued earlier that financial liberalization promotes economic growth, however, Dornbusch and Reynoso (1993) have cautioned that financial liberalization in the absence of a fiscal discipline environment will lead to higher inflation and interest rates, capital flight under a fixed exchange rate regime, bankruptcies and hamper economic growth. Similar sentiments are also shared by Sargent (1993) and McKinnon (1993).

and inflation rates rose by more than 76% and 51%, respectively, although the M2/GNP ratios which measure financial 'deepening', a financial process which Shaw (1973) describes as "accumulation of financial assets at a pace faster than non-financial wealth"[2] fell from 51.4% in 1985 to 44.5% in 1991. The government expenditure per gross domestic product (GDP) dropped in 1991 to about 21%, and a budget surplus was recorded for the first time in about two decades, because of the sale of State-own enterprises. The relative importance of privatization as a share of GDP was 5.8% in Jamaica, second only to the 12% recorded in Chile where privatization and liberalization policies started in the 1970's. See Table 1, McKinnon (1993), Edwards (1985) and Corbo (1985).

Table 1. Monetary and Budgetary Indicators in Percentages, 1970-1994[1)]

	1970	1977	1980	1985	1990	1991	1992	1993	1994
Δ p	14.6	10.8	27.1	25.9	21.8	51.1	77.2	22.1	35.7
Δ er	0	0	0.7	40.8	25.7	68.7	89.7	8.7	32.6
Δ mb	19.7	16.7	47.9	34.8	15.8	28.2	88.6	44.8	31.3
Δ ge	23.7	9.0	25.8	29.8	9.4	–1.3	46.2	53.2	61.1
rr^{ep}	–10.6	–3.6	–17.2	–6.9	4.4	–25.5	–42.8	6.8	7.3
ERR	8.8	10.6	17.2	29.7	32.7	24.8	29.8	32.3	30.7
CU/MB	61.1	66.7	50.8	28.7	37.8	38.8	29.8	28.1	28.5
CU/GDP	3.9	6.1	5.4	4.8	7.4	5.8	4.9	5.0	5.8
M2/GNP	33.8	36.5	38.4	51.4	44.4	44.5	45.0	41.8	44.2
GE/GDP	20.2	35.8	41.7	40.1	31.3	20.8	22.7	25.8	30.8
BD/GDP	–2.8	–16.8	–15.2	–8.6	–4.1	1.1	–3.8	–5.6	–6.4
CUCMB	0.9	1.5	0.9	1.0	1.0	2.5	1.6	1.5	1.4
RRCMB	0.3	–0.2	2.4	3.9	1.7	1.3	7.7	4.2	3.4
TRMB	1.1	1.4	3.3	4.9	2.6	3.7	8.7	5.7	4.9
GGDP	7.8	–2.3	–5.7	–4.6	5.4	0.7	1.6	1.4	0.9
RY(J$b)	1.30	1.41	1.01	1.14	1.70	1.72	1.64	1.88	1.87

Notes: [1)] The sources of the computed figures are various years' issues of IMF's *International Financial Statistics*, and PIOJ's *Economic and Social Survey of Jamaica*. CU/MB is a currency-monetary base ratio, CU/GDP is currency-GDP ratio, M2/GNP is M2-GNP ratio, GE/GDP is GE-GDP ratio, BD/GDP is Budget deficits-GDP ratio, TRMB is seigniorage, RRCMB is seigniorage due to the reserve component of monetary base, CUCMB is seigniorage due to currency component of monetary base, and rr^{ep} is ex-post real interest rates. GGDP is the average annual growth rate, RY is the real income (GDP/CPI) where CPI is the period average consumer price index (1995 = 100).

[2] McKinnon (1993) used M3/GNP ratios to define financial deepening, but because Bank of Jamaica does not report data on M3, we have defined the financial process by M2/GNP ratios.

From 1990 to 1994, the money supply as a share of GDP averaged more than 42%, the ex-post real interest rates averaged about negative 10%, the effective reserve ratio (ERR) defined as legal reserves as proportion of total deposits (both time and sight deposits) and the currency-monetary base (CUMB) ratios, respectively, averaged more than 30% confirming that the Jamaican economy remained financially repressed[3] with currency and coins constituting only a small fraction of the base money in the country. During these periods the average seigniorage as a share of gross national products (GNP) was more than 5% as compared with about 1% in most developed countries and 4.5% in Latin America. Additionally, about an average of 73% of the seigniorage accrued from the required reserve component of the monetary base over those periods as shown in Table 1. The relatively low interest rates which the government pays on public debt including the zero interest rate on reserve requirements on bank deposits imply that the seigniorage derived by the government to finance fiscal deficits in the country, as high as it is, is still under-estimated. The high spread between savings and loans averaged more than 14% from 1991-1996 which meant that private individuals, and not commercial banks, generally ended up paying most of the seigniorage in the country.

Fiscal deficits as a share of GDP increased successively to an average of more than 5% from 1992 to 1994. Bank reserve requirement ratios were increased to 25% in the budget of 1994 causing the Treasury bill rates and the lending rates to rise to 42.98% and 49.46%, respectively. As a result, both the public and government resorted to overseas borrowing, thus aggravating the external and internal debts. Although the banking and financial institutions recorded massive profits in the early years of the stabilization programmes due to drastic increases in inflation rates, interest rates, and devaluation, by 1995, the associated adverse selection and moral hazard problems had reversed most of their profits to losses, and most of the institutions had become insolvent due to non-performing and bad loans. This necessitated the closing down of some banks[4] and the establishment of the Financial Sector Adjustment Company (FINSAC) in February 1997 by the government to serve as a bridge bank to channel funds to

[3] It is the financial process whereby the flow of money to profitable investments in the system is restricted by non-market forces such as government and oligopolistic institutions, and allocation of loanable funds are carried on by administrative means rather than by market forces. See John Black (1997) and McKinnon (1993).

[4] Among the financial institutions that failed and were either closed down or taken over by FINSAC in the mid 1990s are: Blaise Trust and Merchant Bank, Century National Bank, Tetrarch Investments, Universal Investments, Island Life Merchant Bank, Voche Capital Investments, Caldon Finance Group, Fidelity Finance and Merchant Bank, Island Victoria Bank, Workers Bank, and Eagle Group which consisted of Commercial Bank, Merchant Bank and Building Society. In 1998, non-performing loans in both Citizens Bank and NCB amounting to about $15 billion were acquired by FINSAC with the government owning close to 85 percent of the shares of Citizens Bank, and most of the financial institutions in the country were distressed.

distressed banks and restructure their operations. In 1998, the assessments of the financial losses were estimated to cost the country about 30% of the GDP, making the government the principal share holder of most of the financial and banking institutions in the country. At the close of 2001, the dust of the FINSAC's debt settled at the cost of J$120b to tax payers, while the national debt rose to J$495b which formed 134% of the GDP in 2002. Inflation rose from about 15% in 1970 to the height of about 77% in 1992, during that period the economy recorded negative average real growth.

In view of the above overview of the economy, the motivation for this paper is to estimate a vector error correction model (VECM) to examine the effect of fiscal and monetary policies on the national debt, the abysmal economic growth, and the dynamics of inflation financing in the country following the adoption of the stabilization programme in 1989. We have tested for the effect of these policies on the price-real output relationship, and examined the characteristic of 'financial deepening or repression', and other macroeconomic issues for (a) the long run by using the t-ratios and zero restriction tests on the distributed lags of the relevant coefficients of the cointegration estimates of the VECM; (b) a medium term and short run by using the stylized ratios in Table 1, and the results of impulse response functions and innovation accounts, and finally (c) by conducting sensitivity analysis to test the robustness of the findings. Hopefully, the findings will provide us with a better understanding of the dynamic characteristics of the economy to assist in prescribing appropriate policy recommendations to deepen the financial markets, reduce the growing debt and promote economic growth.

The model is developed and the sources of data are discussed in Section 2. The empirical results and sensitivity analysis are reported and evaluated in Section 3, and the study is concluded with a summary and policy recommendations in Section 4.

2. THE MODEL

A vector auto-regressive (VAR) model is referred to as 'atheoretical' because current variables are regressed on their lags without relying on any detail theoretical basis. This study, however, used macroeconomic theory to develop the included variables in the VAR model. Based on the objectives of the study, we have included interest rate in the model because it was found to be significant in Jamaica by Ghartey (1998). Additionally, it is often used by the bank of Jamaica to offset undesirable speculation in the exchange rate.

The pure vector auto-regressive model is expressed as

$$A^{*}(L)X_t = u_t \tag{1}$$

where $A^*(L) = I - A_1L - A_2L^2 - A_3L^3 - \ldots$, $E(u_t) = 0$, $E(u_t u_s') = \Omega \ \forall t = s$, $E(u_t u_s') = 0 \ \forall t \neq s$, $E(y_t u_s') = 0 \ \forall t < s$, and $X = [r \ mb \ p \ y \ pcr \ g \ bd \ er]'$ is an 8×1 vector of observable endogenous variables. The lower case letters in X denote the logarithmic form of the variables and subscript t denotes time period. Thus the logarithmic form of monetary base is mb, credit claim to the private sector is pcr, real output is y, price is p, government spending is g, a budget deficit is bd, an interest rate is r, and the exchange rate is er. The reduced form of Equation (1) is

$$X_t = A(L)X_{t-1} + u_t \tag{2}$$

where $A(L) = (I - A^*(L))L^{-1} = A_1 + A_2L + A_3L^2 + \ldots$. The VAR representation of the stochastic vector of variables exists only if the process is invertible, meaning that the elements of the coefficient matrices $A_i \to 0$ as $i \to \infty$. The reduced form Equation (2) can be consistently estimated by using the ordinary least squares (OLS) method without experiencing a simultaneous equation bias problem. The Cholesky decomposition of the contemporaneous covariance positive definite matrix Ω is

$$\Omega = P^{-1}P^{-1'} \quad \text{or} \quad P\,\Omega\,P' = I$$

where P and P^{-1} are lower triangular matrix, and $E(Pu_t u_t'P') = P\Omega P' = I$. The corresponding dynamic vector moving average (VMA) representation of the reduced form of X_t is written in the form of Wold decomposition as follows:

$$PX_t = PA(L)X_{t-1} + Pu_t, \tag{3}$$

$$\Rightarrow \quad P(I - A(L)L)X_t = Pu_t.$$

Thus $X_t = (I - A(L)L)^{-1}P^{-1}v_t$, where $v_t = Pu_t$, and the Wold VMA becomes as follows:

$$X_t = B(L)v_t \tag{4}$$

where $B(L) = (I - A(L)L)^{-1}P^{-1}$; $B(L) = P^{-1} + B_1L + B_2L^2 + \ldots$; $L^j v_t = v_{t-j}$, $E(v_t) = E(v_t v_s') = 0$, $\forall t \neq s$, and $E(v_t v_s') = I$, $\forall t = s$; v is a column vector of unobservable exogenous orthogonal innovations which are serially and mutually uncorrelated at leads and lags with a dimension of 8×1, and $B(L)$ is an 8×8 matrix of polynomials in the lag operator L.

The coefficient matrix of $B(L)$ represents the response of the system to a one

standard error innovation in v_t. A representative element of $B(L)$ is $b_{ij}(L)$, and it shows the response of all future values of x_i to a one standard error's one-time current innovations in x_j. Thus, $b_{ij}(L)$ is the impulse response function of x_i with respect to a shock in x_j. From Equation (4), the *i*th element of X at time $t+h$ is $x_{it+h} = \sum_{j=1}\sum_{s=0} b_{ij,s} v_{j,t+h-s}$. Thus, the percentage of the expected *h*-period-ahead squared prediction error of x_{it} produced by an innovation in x_j is zero if x_i is exogenous. This is the necessary and sufficient condition for x_i to be exogenous with respect to the remaining variables in the system.

The structural vector auto-regression (VAR) of the reduced form model of Equation (4) is recovered in the form of VECM in the tradition of Johansen and Beveridge-Nelson decomposition as follows:

$$C(L)X_t = \Delta C^*(L)X_t + C(1)LX_t = C^*(L)\Delta X_t + C(1)X_{t-1} = v_t, \tag{5}$$

where $C(L) = B^{-1}(L)$ and $\Delta C^*(L) = C(L) - C(1)$ which means $C(1) = B^{-1}(1)$.

Thus, Equation (5) is the simultaneous-equations system which captures the VMA representation of the structural Equation (4), and its corresponding reduced-form system is

$$D\alpha' x_{t-1} + \varphi(L)\Delta x_t = v_t^*. \tag{6}$$

The reduced rank ($0 < q < 8$) implies that $C(1)$ can be factorized as $C(1) = D\alpha'$. Thus, $C(1)$ is a singular matrix and is expressed as a product of two rectangular matrices with full column rank, where D measures the adjustment speed to close deviations of the errors from equilibrium and α captures the matrix of cointegrating vectors. The common trend's representation of Equation (5) was transformed by Johansen's VECM into Equation (6), and its long-run cointegration of the variables were used to restrict and identify the non fundamental representations of the VAR model in the study to give a reasonable or economically acceptable impulse-response functions and vector decomposition. See Blanchard and Quah (1987, 1993), Lippi and Reichlin (1993), Crowder (1995), and Ghartey (2001) for an application to a developing country. Additionally, the model was also triangularized into orthogonal form by ordering the included variables in accordance with the pair-wise correlations between their innovations, and the bi-variate causal relationship between them using the Granger (1969) causality technique. The resulting level form of the ordered variables included in the VECM were estimated, and the long-run estimates from the VECM were then used to identify and obtain a more robust impulse response functions and innovation accounts that withstood sensitivity analysis.

2.1. Data

Data were collected primarily from various issues of the IMF ***International Financial Statistics.*** However, the missing fiscal accounts and GDP annual data were updated from various issues of ***Economic and Social Survey*** published by the Planning Institute of Jamaica (PIOJ), and their respective quarterly series were generated by using the method outlined in Goldstein and Khan (1976), and employed for Jamaica by Ghartey (1998).

P is the price level and is measured by the consumer price index (CPI); Y is real GDP (GDP; GNP); G is government spending; BD is a budget deficit; R is a treasury bill rate; ER is period average of an exchange rate; MB is monetary base; M1 is the money supply and PCR is the credit claim to private sectors. The data covered the period 1961.1 - 1998.4, but because of lack of adequate data for GDP, G and BD, and some lost end-point data due to lag adjustments, the estimated period is 1962.2 - 1993.4, a sample of size 122.

3. THE EMPIRICAL RESULTS

Tests of augmented Dickey and Fuller (1979) and Phillips and Perron (1988) showed that the variables employed in the study were integrated of order one.[5] The optimum lag length of the variables included in the VECM was chosen based on minimum information results obtained from Akaike information criterion (AIC), Schwartz Bayesian information criterion (SBIC), and Sims (1980) asymptotic χ^2 statistics to be one, after starting from eight lags to preserve the degrees of freedom. Note that the VECM approach did not require the use of economic theory to impose zero restrictions. See Ghartey (2001, p. 421). We have therefore ordered the variables in the model according to the results of the pair-wise correlation, Granger causality tests and cointegration. It was found that monetary base and money multiplier, real income and prices, and government spending and budget deficits have residual correlations with absolute values that exceeded 80 percent, and their causal relationships were statistically significant. See Table 2.

The Johansen's cointegration tests were estimated using an augmentation lag interval of one, over the 1962.2 - 1993.4 sample periods, under the assumption of a constant term without a deterministic trend in data. At the 0.05 significant levels, the more robust maximal eigenvalues' test showed that there were at least two cointegration vectors while the trace test showed at least three cointegrated vectors.[6] See Table 3.

[5] These are routine results which are not reported for brevity. They can be requested from the author.

[6] Extended critical values tabulated in Osterwald-Lenum (1992) were used for both trace and maximal eigenvalues' tests. Johansen and Juselius (1990) recommended the maximal eigenvalues' test for having

Table 2. Bi-variate Granger Causality Test Results, 1962.2 - 1993.4

Δ y⇒Δ m1	7.2	Δ y⇒Δ mb	4.6	Δ y⇔Δ p	19.0;4.1
Δ g⇒Δ m1	5.5	Δ g⇔Δ p	8.4;5.2	Δ g⇔Δ bd	6.8;5.5
Δ g⇔Δ mb	4.7;5.9	Δ g⇒Δ y	4.4	Δ g⇒Δ er	4.2
Δ mm⇒Δ g	3.0***	Δ cudd⇒Δ r	2.8***	Δ er⇒Δ y	12.4
Δ er⇔Δ p	12.0;3.10***	Δ er⇒Δ r	4.0	Δ er⇒Δ cudd	5.0
Δ m1⇒Δ er	5.5	Δ bd⇒Δ p	5.9	Δ bd⇒Δ y	3.4
Δ p⇒Δ m1	20.5	Δ p⇒Δ mb	9.8	Δ p⇒Δ cudd	4.8
Δ mb⇒Δ pcr	4.1	Δ g⇒Δ pcr	4.5	Δ mb⇒Δ cudd	3.1
Δ mb⇒Δ bd	3.0***	Δ mb⇒Δ er	4.4		

Notes: All of the reported causality test results as judged by their respective F-statistics are significant at least at 0.05 levels. The three asterisks denote significance at 0.10 levels. In the case of bi-direction causality tests, the first F-statistics refer to the left-hand side variables causing the right-hand side variables, while the second F-statistics refer to the significance of reverse causation. Ordering does not require the use of tri-variate causality technique to resolve the causal direction in an event of bi-directional causation. Note that the definition of Granger causality is used here, although the term 'causality' is not an acceptable philosophical concept because it is based on information. The logarithmic form of a money multiplier is mm, and a currency demand deposit ratio is cudd. The rest of the variables maintain their definitions.

Table 3. Results of Johansen's Cointegration Test of [*r mb p y pcr g bd er*], 1962.2 - 1993.4

H_1	λ_{max}	C.V.	H_1	λ_{trace}	C.V.
$r = 1$	85.75	51.99*	$r \geq 1$	260.37	165.58*
$r = 2$	52.71	46.45*	$r \geq 2$	174.62	131.70*
$r = 3$	39.69	40.30	$r \geq 3$	121.91	102.14*
$r = 4$	29.11	34.40	$r \geq 4$	82.22	76.07
$r = 5$	22.21	28.14	$r \geq 5$	53.10	53.12
$r = 6$	14.51	22.02	$r \geq 6$	30.89	34.91
$r = 7$	10.43	15.67	$r \geq 7$	16.38	19.96
$r = 8$	5.94	9.24	$r \geq 8$	5.94	9.24

Notes: The * denotes significance at 0.05 level, λ_{max} is likelihood ratio (LR) based on maximal eigenvalue of the stochastic matrix, and λ_{trace} is LR based on trace of the stochastic matrix.

The estimated VECM showed that interest rate and budget deficits were two endogenous variables in the system. The AIC and SBIC were –210.97 and –210.74, respectively, for interest rate, 177.54 and 177.77, respectively, for the budget deficit, and 285.13 and 285.36, respectively, for real income. The error correction (EC) term was

power. See also Dickey and Rossana (1994, p. 348).

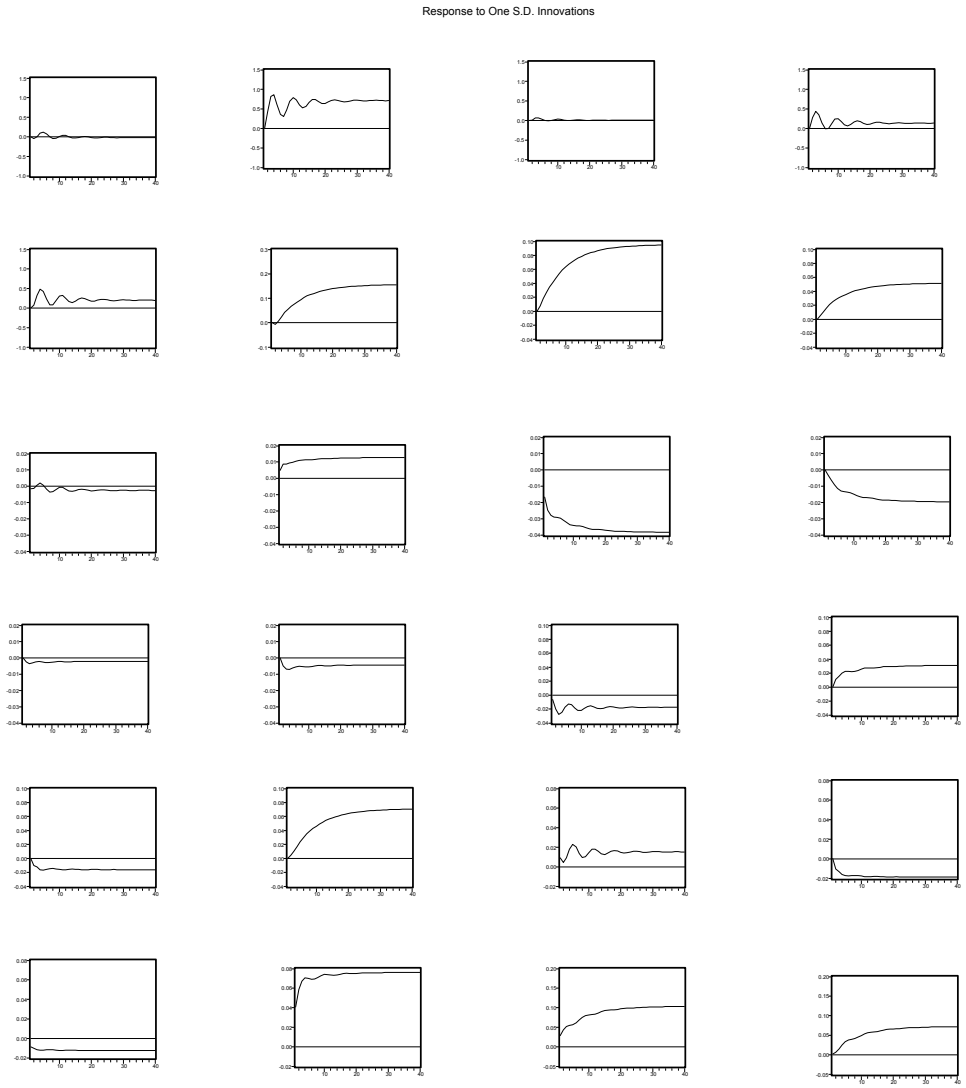
–0.82[10.88] for interest rate equation and was significant at 0.05 levels; while the budget deficits' equation has an EC term of –0.003[1.66] which was significant at 0.10 levels. The real income has EC term of –0.009[0.85] and was insignificant. The *t*-ratios were reported in the square bracket. The leading VECM employed in the study has interest rate as endogenous variable. The long-run estimates of VECM: [*r mb p y pcr g bd er*] which included an intercept term were estimated by OLS, dynamic OLS (DOLS) which used the Newey-West adjusted standard errors with Parzen's weights and truncation lags of twelve to correct heteroscedasticity and serial correlation problems, maximum likelihood procedure (MLP) which used Newton-Raphson iterative method for convergence using a second order auto-regressive process, and Johansen cointegration estimates. See Table 5.

The long-run results in Table 5 showed that interest rates were increased significantly at 0.01 levels by changes in prices, real income, budget deficits and exchange rates, while growth in monetary base, private sector claims to credit and government spending reduced interest rates, although only the government spending was significant at 0.05 levels. This latter evidence followed from the fact that the base money caused government spending as shown in Table 2, or that seigniorage derived from an increase in the base money was passed on to the government to finance its expenditure. The long-run interest rate equation also indicated that government spending encompassed the base money. These results were supported by the identifying restrictions in Table 4, and the impulse response functions in Figure 1.

Table 4. Tests of Restricted Normalize Cointegrated Johansen Estimation of [*r mb p y pcr g bd er*], 1962.2 - 1993.4

Restrictions: (i)				(ii)			(iii)	
A	B	C	D	A	B	C	A	B
1	1	1	1	1	1	1	1	1
1	0	1	1	0	1	1	1	0
0	0	1	1	1	0	0	1	0
0	0	1	0	1	1	0	1	0
1	0	1	1	1	1	1	1	0
1	1	0	1	1	1	1	0	1
1	1	0	1	1	1	1	0	1
1	1	1	1	1	0	0	0	1
1	1	1	1	1	1	1	0	1
Likelihood ratios for validating the restrictions								
□ $\chi^2(20) = 144.4^*$				□ $\chi^2(15) = 92.3^*$			□ $\chi^2(10) = 46.7^*$	

Notes: The log likelihood ratios' statistics are calculated by Johansen's maximum likelihood procedure (MLP), and are used to test whether the hypothesized restricted cointegrated vectors lie in the space spanned by the cointegrated estimates. See also Table 5.



Notes: Response of: (1) *r* to *mb*, (2) *r* to *p*, (3) *r* to *pcr*, (4) *r* to *bd*, (5) *r* to *er*, (6) *mb* to *y*, (7) *p* to *y*, (8) *p* to *g*, (9) *y* to *r*, (10) *y* to *mb*, (11) *y* to *p*, (12) *y* to *g*, (13) *y* to *bd*, (14) *y* to *er*, (15) *pcr* to *r*, (16) *pcr* to *g*, (17) *pcr* to *bd*, (18) *g* to *y*, (19) *bd* to *r*, (20) *bd* to *mb*, (21) *bd* to *pcr*, (22) *bd* to *g*, (23) *er* to *p*, and (24) *er* to *g*

Figure 1. Impulse Response Functions of Selected Variables due to one s.d. shock in others

Table 5. Long-run Estimates of [*r mb p y pcr g bd er*] using *r* as a Dependent Variable, 1962.2 - 1993.4

Regression	OLS	DOLS	MLP	Johansen
mb	–0.777	–0.777	–0.189	–0.170
	[1.448]	[1.609]	[0.543]	[0.306]
p	14.306	14.306	7.358	13.899
	[3.671]	[6.687]	[2.154]	[4.633]
y	14.165	14.165	8.106	8.806
	[5.170]	[6.614]	[3.563]	[2.867]
pcr	–1.848	–1.848	–0.470	–0.339
	[1.381]	[1.941]	[0.514]	[0.302]
g	–6.450	–6.450	–4.846	–7.600
	[1.793]	[3.029]	[1.581]	[4.093]
bd	0.200	0.200	0.576	0.746
	[0.206]	[0.228]	[0.647]	[0.313]
er	4.376	4.376	4.908	2.087
	[2.967]	[6.196]	[3.969]	[1.716]
intercept	–44.165	–44.165	–24.194	–22.588
	[4.396]	[5.389]	[3.105]	

Notes: The notations maintain their definitions. The figures in square brackets are the *t*-ratios. OLS are ordinary least squares' estimators, DOLS is dynamic OLS, MLP is maximum likelihood procedure which uses Newton-Raphson's iterative method for convergence using second order auto-regressive processes, and Johansen is Johansen's cointegrating estimate.

The generalized method of moments (GMM) estimates of budget deficits' equation not reported in the text showed that growth in government spending, interest rate and depreciation augmented budget deficits, although only the former was significant at 0.01 levels. Innovations in economic growth, private sector claims to credit and monetary base reduced the budget deficits. Thus, increased sale of treasury bonds immediately reduced current interest rates and generated seigniorage revenues which were used to finance the budget deficits. See Champ and Freeman (2001).

The *t*-ratios of the estimated VECM in Table 5 and zero restriction tests on the distributed lags of the individual coefficients in Table 4 yielded similar results, with the latter reinforcing the former in situations where the significant levels were marginal. In the main, the results confirmed the existence of the long-run price-real output inverse relationship, inflationary financing, the ineffectiveness of financial intermediation to promote economic growth, and the fact that exchange rates were influenced by both monetary and fiscal policies. See Table 2.

3.1. Impulse Response Functions and Innovation Accounting Results

The VECM obtained by ordering the included variables and imposing a long-run restriction without any arbitrary impositions is [*r mb p y pcr g bd er*]. It is estimated to discuss the short-run and medium-term dynamic policy implications of the model by examining the impulse response functions and innovations accounting estimates which are reported for up to forty-step-ahead, our assumed medium term, in Table 6 and Figure 1.

The response of *mb*, *p* and *g* to one standard deviation (s.d.) shock in *y* was positive. See panels 6, 7 and 18 of Figure 1. The response of *p*, *pcr*, *bd* and *er* to one s.d. shock in *g* was positive as shown in panels 8, 16, 22 and 24, respectively. Similar positive response was obtained for *r* and *er* due to one s.d. shock in *p* as shown in panels 2 and 23, and the response of the variance of *y* to one s.d. shock in *mb* was also positive as depicted in panel 10.

The response of *y* to one s.d. shock in both *p* and *g* were significantly negative, and so was the response of *bd* to one s.d. shock in *mb*. See panels 11, 12 and 20. This meant that inflation shock in the economy was immediate although it did not reach its peak till five years. However, contrary to Friedman's (1968) observation, the duration was much longer than five years. See also Ghartey (2001, p. 426). Additionally, increases in the base money yielded seigniorage which was used to finance the budget deficit.

There was, however, a mild negative response of *y* to one s.d. shock in *r*, *bd* and *er* as depicted in panels 9, 13 and 14 of Figure 1. Similar mild negative response was obtained for *pcr* due to one s.d. shock in *r* and *bd* as shown in panels 15 and 17, and the response of *bd* due to one s.d. shock in *pcr* was depicted in panel 21. Thus, increases in interest rates, budget deficits, and depreciation retarded economic growth and foster financial disinter mediation, while reduction in budget deficits slightly improved the process of financial intermediation.

The response of *r* to one s.d. shock in *mb* and *pcr* were not discernible. See panels 1 and 3. However, the response of *r* to one s.d. shock in *bd* and *er* fluctuated positively in the first three quarters ahead and continued thereon positively at a much lower rate as shown in panels 4 and 5.

This meant that inflation was monetized as monetary policy was fed into government spending which then caused inflation, and the availability of credit claims to the private sector inched up real economic growth and reduced prices. Government spending, interest rates, and own shocks augmented the budget deficits, while shocks due to credit claims to the private sector slightly reduced the budget deficits. Increases in the base or inside money resulted in economic growth, although the latter caused increase in prices, government spending and fed back into the base money.

In Table 6, innovations' accounting estimates indicated that 100% of the *r* variance was explained by own innovations. At the forty-step-ahead about 11% of the variance in *r* continued to be explained by own shocks, while about 28% and 54% of the shocks were explained by *p* and *y*, respectively. The high interest rates in the country were driven in part by rising inflation and transactions. About 97% of the variance in *mb* was

explained by own shocks in the first-step-ahead. At the forty-step-ahead, the explanation of the *mb* variance by own innovations dropped to about 43%, while innovations in *y*, *p* and *r* explained 20%, 17% and 7%, respectively.

The variance of *y* was due to about 41% of its own innovations and about 53% of the shocks in *p* at the first-step-ahead. By the forty-step-ahead, the shocks in *p* explained about 71%, while shocks in *g* and *mb* explained about 16% and 18%, respectively. The variance of *p* was explained by about 91% of its own shocks at the first-step-ahead. At the forty-step-ahead, explanation from own shocks dropped to about 38%, while shocks in *y* and *g* explained about 45 and 14%, respectively.

The variance of *g* was explained by nearly 94% of its own shocks in the first-step-ahead. At 10-year ahead, the variance of *g* was explained by about 54% of its own shocks and about 29% by shocks in *y*; while shocks in *p* and *mb* explained about 7% and 5%, respectively. The variance of *bd* was explained by about 41% of its own shocks, and about 53% by shocks in *g* at the first-step-ahead. At 10-year ahead, about 75% of the *bd* variance continued to be explained by shocks in *g*, more than 12% by its own shocks, and about 4% by shocks in *mb*. Of the remaining variance of *bd*, shocks in *r* and *er* explained about 3%, respectively.

The forecast error of *er* at the first quarter ahead was explained by about 70% of its own shocks, 17% by shocks in *p*, about 8% by shocks in *r* and 3% by shocks in *y*. At the forty-step-ahead, own shocks explained about 10%, while shocks in *p*, *y* and *g* explained 24%, 52%, and 11%, respectively. Thus, in the medium term increased in government spending, prices and transactions were the primary factors that caused depreciation in the country. See Table 6.

Table 6. Innovation Accounting of [*r mb p y pcr g bd er*], 1962.2 - 1993.4

r:	Innovations in:							
h	*r*	*mb*	*p*	*Y*	*pcr*	*g*	*bd*	*er*
1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	89.5	0.0	4.1	2.4	0.0	2.1	1.7	0.1
4	51.9	0.1	18.1	15.4	0.1	6.0	4.4	3.9
8	45.5	0.2	18.0	24.3	0.1	4.2	3.1	4.4
40	11.5	0.1	28.0	54.3	0.0	1.1	1.7	3.2
mb:								
1	3.4	96.6	0.0	0.0	0.0	0.0	0.0	0.0
2	5.0	93.1	1.0	0.0	0.1	0.5	0.0	0.2
4	7.6	86.4	3.4	0.3	0.1	1.5	0.4	0.2
8	7.5	75.8	7.8	3.5	0.2	3.5	1.5	0.2
40	6.6	43.2	16.6	20.4	0.2	7.6	4.8	0.4

Table 6. (Continued)

r:	Innovations in:							
	r	*mb*	*p*	*y*	*pcr*	*g*	*bd*	*er*
p:								
1	2.7	6.6	90.7	0.0	0.0	0.0	0.0	0.0
2	2.7	5.6	85.4	3.4	0.0	1.3	0.4	1.1
4	1.1	3.9	72.7	15.1	0.1	5.3	0.6	1.3
8	1.1	3.1	55.3	29.3	0.1	10.4	0.2	0.5
40	0.7	2.3	37.7	45.5	0.1	13.6	0.0	0.0
y:								
1	0.4	4.7	53.5	41.3	0.0	0.0	0.0	0.0
2	0.2	6.5	57.0	33.7	0.0	0.7	0.3	1.5
4	0.2	6.6	61.6	24.5	0.1	3.3	0.7	3.0
8	0.4	7.6	65.3	15.1	0.2	8.3	0.5	2.5
40	0.3	8.0	70.9	2.5	0.3	16.4	0.3	1.3
pcr:								
1	0.5	0.4	0.3	0.9	97.9	0.0	0.0	0.0
2	3.4	1.6	0.7	2.9	89.0	1.0	0.7	0.0
4	7.2	0.9	1.0	4.8	80.3	3.1	2.0	0.6
8	5.7	0.5	0.9	8.6	74.2	5.7	3.0	1.4
40	4.5	0.2	0.2	21.5	57.4	10.7	3.4	2.0
g:								
1	0.0	0.2	0.1	0.0	5.5	94.4	0.0	0.0
2	0.0	3.6	0.2	0.5	3.9	90.1	0.4	0.2
4	0.2	5.4	0.6	3.3	3.0	83.7	1.1	0.2
8	0.2	5.8	2.9	11.8	2.2	73.1	1.1	0.2
40	0.2	4.7	7.4	28.9	1.3	54.4	0.8	0.4
bd:								
1	2.7	0.0	0.0	0.4	2.3	53.4	41.0	0.0
2	1.3	1.3	0.3	0.9	2.2	63.2	30.5	0.3
4	2.5	2.5	0.9	1.2	2.1	69.3	19.9	1.5
8	3.6	3.6	0.6	0.7	2.1	70.9	16.3	2.2
40	3.2	4.4	0.1	0.4	2.0	75.0	12.1	2.6
er:								
1	8.1	0.2	17.2	2.8	0.2	0.1	1.5	69.8
2	4.4	2.1	19.7	10.2	0.3	0.3	3.6	59.3
4	1.6	1.8	21.9	21.5	0.3	2.3	3.4	46.9
8	2.3	0.9	23.1	34.5	0.3	6.2	2.3	30.3
40	1.2	0.1	24.1	52.3	0.3	10.8	0.8	10.5

Notes: The number of steps ahead is listed under *h*, and the figures are percentages of the expected squared prediction error produced by innovations.

3.2. Sensitivity Analysis

The more robust λ_{Max} test from Johansen cointegration showed that there were two endogenous variables which were interest rates and budget deficits.[7] Following the superior diagnostics and dynamics of VECM with interest rates as endogenous, cointegration was used as the identifying restriction for the sensitivity analysis. The variance decompositions of the models at the forty-step-ahead were pre-ordered by pair-wise correlation and causation tests in Table 2 to obtain the following VECM: A = [*r mb p y pcr g bd er*], B = [*r mb p g pcr bd y er*], C = [*r mb g bd pcr p y er*] and D = [*r pcr mb p y g bd er*]. The results in Table 7 were very robust and consistent throughout the different models, and lent credibility and affirmation to the main findings. Unlike Ghartey (2001, p. 429), correlation and Granger causality were not required to pre-order the included variables to identify the VECM in Jamaica.

Table 7. Sensitivity Analysis Using Innovation Accounting at Forty-Step-Ahead, 1962.2 - 1993.4

		Innovations in:							
Var.		*r*	*mb*	*p*	*y*	*pcr*	*g*	*bd*	*er*
r:	A	11.5	0.1	28.0	54.3	0.0	1.1	1.7	3.2
	B	11.5	0.1	28.1	54.8	0.6	1.1	0.6	3.2
	C	11.5	0.1	28.7	54.8	0.3	1.0	0.4	3.2
	D	11.5	0.1	28.4	53.7	0.3	1.1	1.7	3.2
mb:	A	6.6	43.2	16.6	20.4	0.2	12.4	0.0	0.4
	B	6.6	43.2	16.6	20.2	0.6	12.2	0.1	0.4
	C	6.6	43.2	15.8	20.2	0.4	13.1	0.2	0.4
	D	6.6	42.8	16.5	20.6	0.5	12.4	0.0	0.4
p:	A	0.7	2.3	37.7	45.5	0.1	13.6	0.0	0.0
	B	0.7	2.4	37.7	44.7	1.4	12.8	0.3	0.0
	C	0.7	2.4	36.3	44.7	0.8	14.2	0.7	0.0
	D	0.7	2.4	37.8	45.5	0.0	13.6	0.0	0.0
y:	A	0.3	8.0	70.9	2.5	0.3	16.4	0.3	1.3
	B	0.3	8.0	70.9	2.4	0.2	16.6	0.4	1.3
	C	0.3	8.0	69.1	2.4	0.1	18.8	0.0	1.3
	D	0.3	8.3	70.1	2.4	0.7	16.4	0.3	1.3

[7] "Johansen and Juselius (1990) suggest that the maximal eigenvalue test has greater power than the trace test ...." See Dickey and Rossana (1994, p.348).

Table 7. (Continued)

		Innovations in:							
Var.		*r*	*mb*	*p*	*y*	*pcr*	*g*	*bd*	*er*
pcr:	A	4.5	0.2	0.2	21.5	57.4	10.7	3.4	2.0
	B	4.5	0.2	0.2	13.6	72.4	2.2	4.7	2.0
	C	4.5	0.2	0.2	13.6	73.3	2.2	3.8	2.0
	D	4.5	0.1	0.4	15.3	63.6	10.7	3.4	2.0
g:	A	0.2	4.7	7.4	28.9	1.3	54.4	0.8	2.3
	B	0.2	4.7	7.4	27.8	1.4	54.3	2.0	2.3
	C	0.2	4.7	6.0	27.8	1.2	55.5	2.3	2.3
	D	0.2	4.8	7.2	29.8	0.4	54.4	0.8	2.3
bd:	A	3.2	4.4	0.1	0.4	2.0	75.0	12.1	2.6
	B	3.2	4.4	0.1	0.8	0.5	76.5	11.8	2.6
	C	3.2	4.4	0.1	0.8	0.4	76.4	12.1	2.6
	D	3.2	4.8	0.1	0.5	1.5	75.0	12.1	2.6
er:	A	1.2	0.1	24.1	52.3	0.3	10.8	0.8	10.5
	B	1.2	0.1	24.1	52.7	0.9	10.4	0.1	10.5
	C	1.2	0.1	23.4	52.7	0.5	11.4	0.1	10.5
	D	1.2	0.1	24.1	52.5	0.0	10.8	0.8	10.5

Notes: A = [*r mb p y g pcr bd y er*], B = [*r mb p g pcr bd y er*], C = [*r mb g bd pcr p y er*], and D = [*r pcr mb p y g bd er*].

Thus, government spending exacerbates the growing budget deficits, and was inflationary; interest rates were highly sensitive and were driven by inflation and real output; depreciation was contractionary and was caused by rising inflation, government spending and transactions; monetary expansion was influenced mostly by increase in transaction, prices and government spending. Credit claims to private sectors were largely self-financed and modestly driven by economic transactions and government spending; were affected negatively by increase in interest rates, budget deficits and depreciation; were insensitive to increase in monetary base, and were largely exogenous.

4. CONCLUSION

A VECM was estimated to examine the relationship among interest rates, monetary base, credit claims to the private sector, real output, prices, government spending, budget deficits and exchange rates, with cointegrating regression as the identifying restriction. The variables were stationarized at degree unity by both ADF and PP tests. The unit lag

was chosen from different information criteria to be optimum, and was adopted for the study because its estimated coefficients conform to economic theory. The system was triangularized to orthogonal form by ordering the variables according to the results of the residual correlation of innovation matrix and bi-variate Granger causality tests. The VECM indicated that interest rate and budget deficits were the only two endogenous variables in the list of variables included in the model, and the former was used as the leading equation because its EC term was highly significant and yielded better dynamics than the latter. Cointegration was adequate means of identifying the VAR model. Sensitivity analysis shows that there was no need to use correlation or Granger causality to pre-order the included variables to obtain robust results.

In the long-run, price-real output relationship was inverse in the country and the fiscal deficits were monetized. However, in the short-run, whereas the inverse price-real output relationship still exists, money was non neutral which can be explained by Lucas' information mis-perception, and more so by Taylor's relative-price theory because of the myriads of militant unions in the country. The use of seigniorage revenues to finance government expenditures worsened the budget deficits. Additionally, interest rates in the country were insensitive to increase in the base money and credit claims to the private sector, but were largely driven by rising transactions and inflation. Growth in the credit claims to private sectors reduced the budget deficits, but its effect on economic growth was minimal. An expansion in government spending was contractionary, but inflationary. It also resulted in depreciation and exacerbated the budget deficits. Therefore, we recommend that the country follows monetary discipline, cuts fiscal expenditure and employs sound regulatory actions to reduce both the present value of the national debt and growing fiscal deficits to crowd in private businesses, reduce the incidence of high inflation, prevent further bankruptcies and bank failures, and promote economic growth.

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