THE DISTRIBUTED LAG EFFECTS OF EXCHANGE RATE CHANGES ON THE BALANCE OF PAYMENTS: THE EXPERIENCE OF GUYANA

by

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This paper looks at the effects of exchange rate changes on the balance of payments of Guyana. During the 1980's, in response to balance of payments pressure, Guyana devalued its currency on several occasions. But due to elasticity pessimism, researchers such as Blackman, Bennett, Thomas and Witter, have suggested that devaluations would not improve the balance of payments. From their viewpoint, a major effect of a devaluation would just be more inflation. Notwithstanding the popularity of this view, very little systematic analysis has been conducted on this matter for the Guyanese economy. To rectify that, this paper will construct for empirical testing, a simple monetary model of the balance of payments. In keeping with monetary models outlined by Harry Johnson, Robert Mundell, and Connolly and Taylor, this paper hypothesizes that a devaluation by increasing the domestic price level suppresses expenditures. And as this occur, it is then expected that the balance of payments would improve. In a broader sense, the monetary approach suggests that when there is growth in the demand for money relative to the supply of money, either: (1) the balance of payments improves if the exchange rate is fixed, or (2) the exchange rate appreciates, if the exchange rate is flexible, or (3) the balance of payments improves combined with exchange rate appreciation if the exchange rate is managed.

This paper is organised into three sections. Section I builds a simple monetary model of the balance of payments. Section II uses data from the Guyanese experience to estimate the model developed in the previous section. The last section of the paper, Section III, summarises the main points of the study.

SECTION I: MODEL

A major proposition of this study is that with constant growth in income, foreign prices, and domestic credit, a devaluation enhances a country's holdings of international reserves. To empirically test this notion, the following model is sketched. The first equation in the model is the demand for money equation. For this study, it is assumed that the growth in the demand for money is influenced by the domestic rate of inflation, $\hat{p}$, and the growth in output, $\hat{y}$:

$$(1) \qquad \hat{l} = \hat{p} + \phi \hat{y}$$

where $\hat{l}$ = the percentage change in the demand for money; $\hat{p}$ = the percentage change in the domestic price level; $\hat{y}$ = percentage change in real income.

The second equation is the price change equation. Due to lack of homogeneity in the goods market, imperfect competition and information, strategic pricing interactions by domestic and foreign firms, and inertia in consumer spending habits, this model assumes that the domestic rate of inflation is linked to the world's rate of inflation and the rate of change in the domestic price for foreign currency with a lag, that is:

$$(2) \qquad \hat{p} = \sum_{i=o}^{3} \beta o \, \hat{e}_{t-i} + \sum_{i=o}^{3} \beta_o^{*} \, \hat{p}^{*}_{t-i}$$

where $\hat{p}$ = percentage change in the domestic price levels;

$\hat{e}$ = percentage change in the domestic price for foreign currency;

$\hat{p}^*$ = percentage change in the foreign price level;

$$\sum_{i=0}^{3} \beta_0 \hat{e}_{t-i} = \beta_0 \hat{e}_t + \beta_1 \hat{e}_{t-1} + \beta_2 \hat{e}_{t-2} + \beta_3 \hat{e}_{t-3};$$

$$\sum_{i=0}^{3} \beta_0^* \hat{p}^*_{t-i} = \beta_0^* \hat{p}^*_t + \beta_1^* \hat{p}^*_{t-1} + \beta_2 \hat{p}^*_{t-2} + \beta_3^* \hat{p}^*_{t-3};$$

β_i and β_i^* are distributed lag weights that are assumed to lie along a second-order polynomial.

This specification of the price change equation allows the domestic rate of inflation to adjust non-instantaneously to the foreign rate of infation and the depreciation in the exchange rate. Third for the money supply process, it is assumed that one is looking at the consolidated balance sheet for the entire banking system. Within that framework, it is expected that total monetary ~~liabilities~~, M, will be equal to net ~~foreign~~ assets, R and net domestic assets or domestic credit, D. When this identity M = R + D is converted into growth rates, one can write that:

$$(3) \qquad \hat{m} = (R/M)\hat{r} + (D/M)\hat{d}$$

where $\hat{m}$ = percentage change in the money stock;

$\hat{r}$ = percentage change in net foreign assets;

$\hat{d}$ = percentage change in net domestic assets.

Finally, to simplify the analysis, it is assumed that equilibrium prevails in the money market because foreign reserve changes ensure that money supply growth equals money demand growth. As a result, one can write:

$$(4) \qquad \hat{m} = \hat{l}.$$

By substituting (2) into (1), followed by the substitution of the resulting expression, along with (3), into (4) and by rearranging terms, one obtains the following international reserve flow equation:

$$(5) \qquad (\Delta R/M) = \beta_0 \hat{e}_t + \beta_1 \hat{e}_{t-1} + \beta_2 \hat{e}_{t-2} + \beta_3 \hat{e}_{t-3} + \beta_0^* \hat{p}_t^* + \beta_1^* \hat{p}_{t-1}^* + \beta_2^* \hat{p}_{t-2}^* + \beta_3^* \hat{p}_{t-3}^* + \phi \hat{Y} - (\Delta D/M).$$

After allowing for growth in the home economy, and contraction in domestic credit as a proportion of the money stock, equation (5) suggests that exchange rate depreciation as well as growth in the foreign price level will exert a positive impact on the balance of payments expressed as a proportion of the money stock distributed over a period of four years.

SECTION II: EMPIRICAL ANALYSIS

During the 1980's, the official exchange rate for the Guyana dollar vis-a-vis the US dollar was devalued on several occasions. In most instances, these changes in the exchange rate ushered in reforms in the foreign exchange market. Starting from 1981, when the Guyana dollar was devalued by about 18%, the authorities switched from a fixed rate system to one that allowed limited flexibility in the exchange rate. Under this system, a composite basket of currencies was used to determine the external value of the Guyana dollar. After two devaluations in 1984, plus another change in the exchange rate in 1985, and an early devaluation in January 1987, the next major foreign currency reform occurred in February 1987. On this occasion, the authorities established a free foreign exchange market for tourists' expenditures and emigrants' remittances. This free market lasted for only two years. As the authorities in April 1989, once again devalued the currency and at that time unified the exchange rate system. With continued balance of payments pressure, the officials devalued the Guyana dollar in June 1990. But prior to this exchange rate adjustment, the authorities created a three-tier exchange rate system. In 1991, however, a free rate was once again introduced when the foreign exchange market was unified.

For estimation purposes, ordinary least squares with a second degree, four period, polynomial distributed lag for variables $\hat{e}$ and $\hat{p}*$ was used. The sample period was from 1964-1990. All of the data was taken from the International Monetary Fund, International Financial Statistics. For a detailed description of this data, see the appendix.

Table I displays the estimated coefficients for equation 5 when different constraints are imposed on the lagged coefficients for $\hat{e}$ and p*. In most cases, these results show that the estimated coefficients for the international reserve flow equation possess their correct theoretical signs and are statistically significant. A look at the estimated coefficients for the exchange rate variable suggests that the effects of exchange rate adjustment are spread over several periods. In the contemporaneous period, there seems to be very little improvement in the balance of payments. However, over the long-run, the evidence suggests that the multiplier effects of the devaluation grows and becomes stronger. So that within two years, the multiplier effects reaches a peak and thereafter dissipates. This feature of the results is effectively illustrated by the inverted U-shaped curve in Figure I. Another interesting aspect of these results is that they suggest that the pass-through of exchange rate changes to domestic prices is gradual and incomplete even after three years (see Table II). For the variable $\dot{p}^*$, the results show that the impact of this variable on the balance of payments and the domestic rate of inflation is not only exerted gradually but also becomes magnified over the long-run. The mean lag for an improvement in the balance of payments as well as the acceleration in the domestic rate of inflation, in response to the foreign rate of inflation, is estimated to be between one and two years (see Tables I and II). In keeping with the basic principles of the monetary approach, this study also shows that the beneficial effects of a devaluation on the balance of payments could be neutralised if the authorities allowed either domestic credit to expand or the home economy to contract.

As a final test of the model, some additional regressions were run to determine, in a Granger sense, the direction of causation between: (1) international reserve flow and exchange rate depreciation; and (2) international reserve flow and domestic credit expansion. The results from the pair-wise Granger causality tests are reported in Table 3. They show that one must reject the null hypothesis that international reserve flows have not been Granger caused by either the depreciation of the exchange rate or the expansion in domestic credit. At the same time, they suggest that neither the growth in domestic credit nor the depreciation in the exchange rate have been 'Granger' caused by changes in international reserve flows.

SECTION 3: SUMMARY

This paper makes three points. First, it suggests that the effects of exchange rate changes on the balance of payments are not instantaneous but are spread over several periods. Second, it indicates that while the effects of exchange rate depreciation on the balance of payments are by and large positive and significant, they are nevertheless somewhat weak, particularly in the short-run. Third, the study also suggests that the domestic rate of inflation does not adjust instantaneously to changes either in the exchange rate or in the foreign price level.

APPENDIX

The data were obtained from the International Monetary Fund, International Financial Statistics, (IFS). A short description of the data is provided below:

Net Foreign Assets (R):	The data for 1964-1990 was taken from line 31(n), 1991 Yearbook, IFS, pp 406-409.
Domestic Credit (D):	The data for 1964-1990 was computed by subtracting line 37r from 32 in the 1991 Yearbook, IFS, pp 406-409.
Money Stock (M2):	The data for 1964-1990 was computed by adding line 34 and 35 in the 1991 Yearbook, IFS, pp 406-409.
Exchange Rate (E):	The data for 1964-1990 was taken from line de, 1991 Yearbook, IFS, pp 406-409.
Real Income (Y):	This series, for 1964-1990 was constructed by using consumer prices (line 64) to deflate money GNP (line 99a), in 1991 Yearbook, IFS, pp 406-409.
Price Level (P):	The data for 1964-1990 was taken from line 64, 1991 Yearbook, IFS, pp 406-409.
Foreign Price Level(P*):	The data for 1964-1990 was taken from line

REFERENCES

1. Bennett, Karl M. "Exchange Rate Policy in Jamaica: A Critical Assessment". Social and Economic Studies, Vol. 32, No. 4, December 1983, 51-72.

2. Blackman, Courtney N. "The Exchange Rate in the Balance of Payments Adjustment Process of CARICOM States". In Symposium on Exchange Rate Management. Port-of-Spain, Trinidad and Tobago. January 12-14, 1988. DOCUMENTATION.

3. Bordo, Michael David, "The Effects of Monetary Change on Relative Commodity Prices and the role of Long-Term Contracts". Journal of Political Economy, December 1980, 88, No. 6. 1088-109.

4. Chappell, Henry W. Jr. and John T. Addison. "Relative Prices, Concentration and Money Growth". American Economic Review, December 1983, Vol. 73, No. 5, 1122-1126.

5. Connolly, Michael and Dean Taylor. "Testing the Monetary Approach to Devaluation in Developing Countries". Journal of Political Economy, August 1976, Vol. 86, No. 4, pt. 1, 849-859.

6. Dornbusch, Rudiger. "Exchange Rates and Prices". American Economic Review, March 1987, Vol. 77, No. 1, 93-106.

7. International Monetary Fund, International Financial statistics. Yearbook 1991. Washington, D.C. 1991.

8. Johnson, Harry G. "The Monetary Approach to Balance of Payments Theory". In The Monetary Approach to the Balance of Payments, edited by Jacob A. Frenkel and Harry G. Johnson. London: George Allen and Unwin Ltd. 1976.

9. Maddala, G. S. Econometrics, New York: Mc Graw-Hill, 1977.

10 Mann, Catherine. "Prices, Profit Margins and Exchange Rates". Federal Reserve Bulletin, June 1986, 72. 366-79.

11. Mundell, Robert A. Monetary Theory, Pacific Palisades, California: Goodyear 1971.

12. Thomas, Clive Y. "Parallel Foreign Currency Markets and Exchange Rate Management: Experience and Policy in Guyana". In Synposium on Exchange Rate Management. Port-of-Spain, Trinidad and Tobago, January 12-14, 1988. DOCUMENTATION.

13. Witter, Michael. "Exchange Rate Policy in Jamaica: A Critical Assessment". Social and Economic Studies, Vol. 32, No. 4, December 1983, 1-50.

TABLE I

GUYANA'S INTERNATIONAL RESERVE FLOW EQUATION (5)[a]
ESTIMATED COEFFICIENTS

Dependent Variable = ($\Delta R/M$)

Independent Variables	BOTH END CONSTRAINT	NEAR END CONSTRAINT	FAR END CONSTRAINT	NO END CONSTRAINT
$\hat{e}_t$	0.08(3.98)	0.08(1.91)	0.04(0.46)	0.10(0.95)
e_{t-1}	0.12(3.98)	0.12(2.55)	0.11(2.78)	0.16(3.43)
e_{t-2}	0.12(3.98)	0.11 (3.52)	0.13(3.40)	0.14(3.78)
e_{t-3}	0.08(3.98)	0.08(0.94)	0.09(2.77)	0.03(0.29)
$\sum e_i$	0.41(3.98)	0.39(3.52)	0.37(2.78)	0.43(2.46)
Mean Lag	1.5	1.5	1.7	1.2
$\hat{p}^*_t$	0.40(7.17)	0.47(3.63)	0.41(1.40)	-0.88(-1.44)
$\hat{p}^*_{t-1}$	0.60(7.17)	0.68(4.46)	0.58(5.43)	1.28(4.09)
$\hat{p}^*_{t-2}$	0.60(7.17)	0.62(6.82)	0.57(4.37)	1.63 (3.44)
$\hat{p}^*_{t-3}$	0.40(7.17)	0.31(1.65)	0.38(3.14)	0.16 (0.72)
$\sum \hat{p}^*$	1.99(7.17)	2.07(6.82)	1.93(5.43)	2.20(5.34)
Mean Lag	1.5	1.37	1.47	- (b)
$\hat{Y}$	0.46(3.48)	0.47(3.41)	0.49(3.14)	0.70(4.05)
$\Delta D/M$	-0.92(-19.63)	-0.91(17.97)	-0.89(-10.51)	-0.94(-9.19)
$\bar{R}^2$	0.97	0.97	0.97	0.97
D.W.	2.29	2.35	2.32	2.87
F. Statistic	327.89	185.56	181.68	152.6
S.E	0.07	0.08	0.08	0.07

Notes: (a) The figures in parentheses are the t-statistics for the null hypothesis that the coefficient or sum of coefficients is zero. The sample period is 1964-1990. The variables are defined as follows: $\Delta R/M$ = the change in net foreign assets divided by the money stock = the dependent variable; e = the percentage change in the domestic price for foreign currency; $\hat{p}^*$ = the percentage change in the US consumer price index; $\hat{Y}$ = the percentage change in real income; $\Delta D/M$ = the change in domestic credit divided by the money stock; $\bar{R}^2$ = the adjusted coefficient of determination; D.W. = Durbin-Watson statistic; S.E. = standard error of regression;

mean lag = $\sum_{i=0}^{i=3} i\beta_i / \sum_{i=0}^{i=3} \beta_i$;

(b) No mean lag is reported here, as the usefullness of this statistic is questionable when the estimated β's are negative.

TABLE 2
GUYANA'S PRICE CHANGE EQUATION[a]

Dependent Variable = $\hat{p}$

ESTIMATED COEFFICIENTS				
Independent Variables	BOTH END CONSTRAINT	NEAR END CONSTRAINT	FAR END CONSTRAINT	NO END CONSTRAINT
$\hat{e}_t$	0.15(14.86)	0.23(10.63)	0.26(9.031)	0.27(10.95)
e_{t-1}	0.23(14.86)	0.30(14.02)	0.20(13.839)	0.27(8.49)
e_{t-2}	0.23(14.86)	0.18(11.11)	0.13 (5.169)	0.14(6.22)
e_{t-3}	0.15(14.86)	-0.10(-1.63)	0.07(3.08)	-0.80(1.48)
Σe_1	).75(14.86)	0.61(11.11)	0.66(13.89)	0.59(10.79)
Mean Lag	1.5	(b)	1.01	- (b)
$\hat{p}^*_t$	0.27(6.10)	0.46 (5.09)	0.51(2.49)	0.65(1.79)
$\hat{p}^*_{t-1}$	0.40(6.10)	0.59 (5.67)	0.39(6.83)	0.43(3.07)
$\hat{p}^*_{t-2}$	0.40(6.10)	0.38 (6.55)	0.27(3.07)	0.20(0.90)
$\hat{p}^*_{t-3}$	0.27(6.10)	-0.16(-1.15)	0.14(1.64)	-0.01(-0.07)
$\Sigma\hat{p}^*_1$	1.34(6.10)	1.27(6.55)	1.32(6.83)	1.27(4.79)
Mean Lag	1.5	- (b)	1.01	- (b)
$\bar{R}^2$	0.87	0.92	0.92	0.93
D.W.	1.83	1.45	1.59	1.91
F. Statistics	178.09	99.84	98.43	60.75
S.E.	0.07	0.06	0.08	0.05

Notes: The figures in parentheses are the t-statistics for the null hypothesis that the coefficient or sum of coefficients is zero. The sample period is 1964-1990. (b) No mean lag is reported here as the usefulness of this statistic is questionable when the estimated β's are negative.

TABLE 3

PAIRWISE GRANGER CAUSALITY TEST[a]

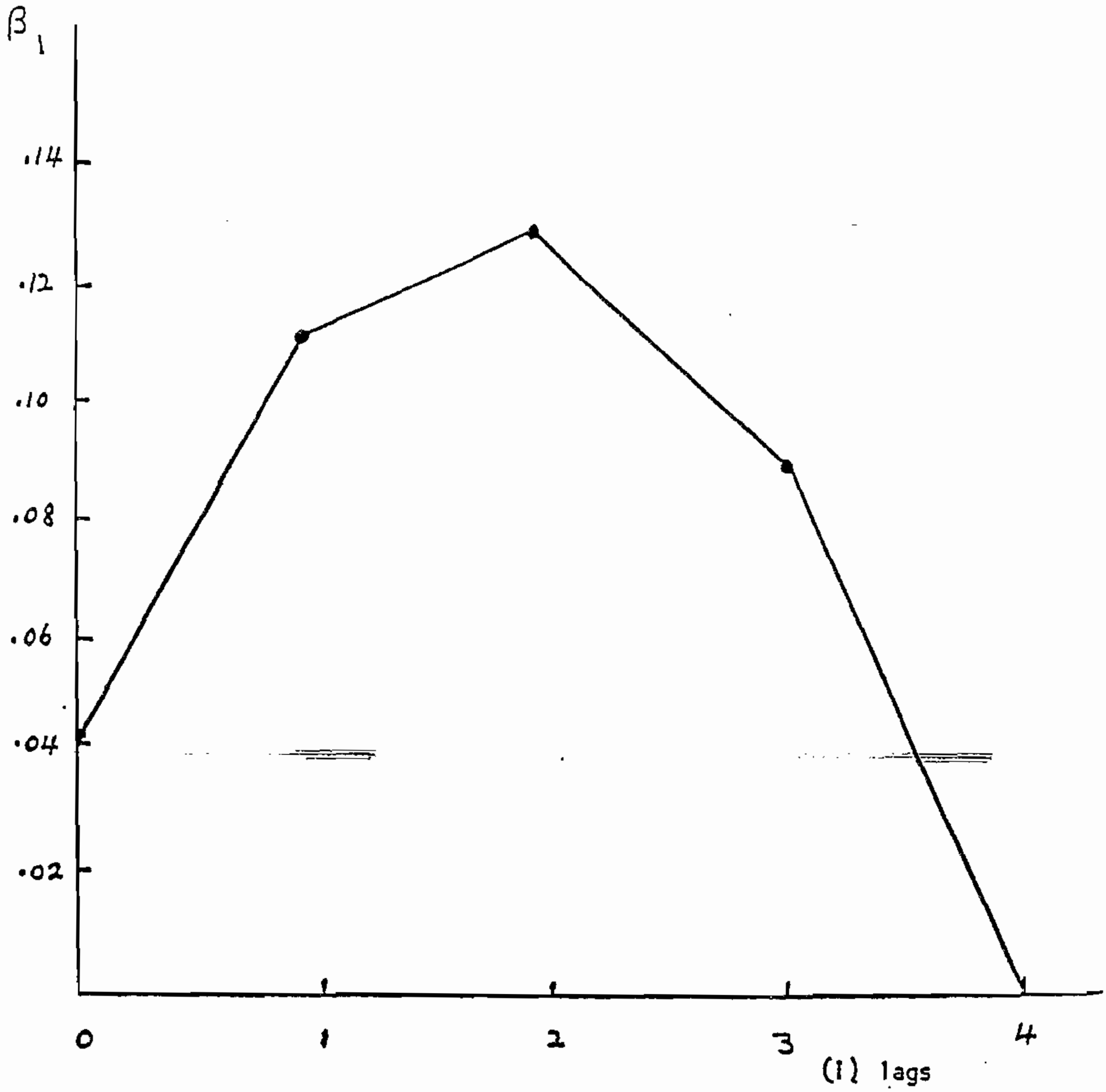
Null Hypothesis	Causality 4 Lags F-Value	P-Value
$(\Delta R/M) \not\longrightarrow \hat{e}$	4.892	0.009
$\hat{e} \not\longrightarrow (\Delta R/M)$	0.986	0.442
$(\Delta R/M) \not\longrightarrow (\Delta D/M)$	2.808	0.061
$(\Delta D/M) \not\longrightarrow (\Delta R/M)$	1.706	0.197

Note: $\not\longrightarrow$ means "was not Granger-caused by ...". The sample period is 1964-1990.

FIGURE 1

THE DISTRIBUTED LAG COEFFICIENTS

THE EXCHANGE RATE VARIABLE[(a)]



Note: (a) The beta coefficients in the above figure are taken from the FAR END CONSTRAINT column of Table 1.