PRIVATE INVESTMENT IN GUYANA: A COINTEGRATION STUDY

by

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Introduction

All countries which make up the English speaking Caribbean - from Jamaica in the north to Guyana in the South - are under tremendous pressure from International lending agencies to allow the private sector to play a greater role. Not only is the state being discouraged from further participation in productive economic activity but is being actively encouraged to privatise all current holdings.

If this is to be successful, the role of private investment will be pivotal. In particular, it will be extremely important in the first instance to establish what determines the quantum of investment that this sector is willing to undertake. In this paper, we propose to begin this exercise by looking at the particular case of Guyana. Why this choice?

Firstly, by the late 1960's, Caribbean leaders had become disillusioned with the so-called "Industrialisation by Invitation" programme. It was felt (with much justification) that the private sector, on which this programme was fundamentally premised, was not (incapable of?) responding to the challenges (Best (1980), Carrington (1968), Jefferson (1972)) and the state in most countries began playing a more active role.

It is probably no exaggeration to say that, from 1970 onwards, nowhere was state intervention more intense than in Guyana where, at the highest point, President Burnham boasted that more than 80% of the country's economy was in one way or another under the control of the state. However, private enterprise was never officially discouraged provided, as Burnham himself said, it went beyond the confines of "buying and selling". One immediately obvious and interesting question (not only to Guyana but to the

entire Caribbean) would be: in these very extreme circumstances, was there any evidence to suggest that there was "crowding out"?

Since 1988, the Guyana has made something of an about turn and, as has occurred in Jamaica, the state has all but abandoned its role in economic matters.

The second reason for studying the Guyanese experience is more practical: the statistical authorities in that country, unlike most of their counterparts in the rest of the Commonwealth Caribbean, have systematically collected data, not only on total investment, but have also disaggregated this total into private and public (including state enterprises) investment. True enough (as we will re-emphasize in the body of the text), these data are far from perfect but the effort made has been commendable all the same. In Trinidad & Tobago for instance (the only other country with which a comparison can be made in this regard), this effort has only just begun and data on private and public investment (similar in intent to Guyana's) have only recently been collected (and not yet published) for the period 1982 -89.

It is proposed, in this study, to establish the principal determinants of private investment in Guyana using the cointegration three-step approach of Engle and Granger (E-G) (1987). In addition to attempting to answer the "crowding out" question posed above, an attempt will be made to answer other questions as: are investors sensitive to interest rates and to what extent is the McKinnon-Shaw hypothesis verified? It is hoped that the answers obtained to these and other questions will be of some validity to other countries of the Caribbean and not only Guyana.

A Private Investment Function for Guyana

Table 1 displays the evolution of the private and public investment rates (ratio of investment to GDP) for Guyana from 1970 to 1990:

Table 1

Private and Public Investment Rates: 1970 - 1990 (%)

	Private Investment	Public Investment
1970	12.57	10.54
1971	6.97	11.82
1972	7.90	12.32
1973	6.82	17.67
1974	6.81	16.23
1975	5.89	21.04
1976	6.16	31.25
1977	5.33	20.44
1978	3.71	15.38
1979	4.90	19.61
1980	7.63	22.15
1981	6.89	26.30
1982	4.15	22.13
1983	4.09	22.82
1984	4.71	18.24
1985	2.80	18.08
1986	2.70	23.70
1987	3.40	29.80
1988	3.12	18.39
1989	21.65	27.89
1990	25.66	36.52

Source: Bank of Guyana

Apart from the fact that the figures for 1989 and 1990 look rather suspect (they will not be used in the empirical analysis to follow), the salient feature here is that public investment is considerably in excess of private investment after 1970. For the developing countries sampled in Pfeffermann and Madarassy (P-M) (1992), it is the opposite situation which is normally the case. The private investment rate fell off suddenly after 1970 and gradually

declined (except for an unusual rise in 1980 and 1981). The public investment rate, on the other hand, rose to attain a summit of 31 % of GDP in 1976 and fluctuated mildly thereafter around fairly high levels. The decline in the overall investment rate during the 1980's is also observed for most of the countries sampled in the P-M study.

The behaviour of private investment in developing countries has been studied, among others, by Galbis (1979), Sundararajan and Thakur (1980), Tun Wai and Wong (1982), Blejer and Khan (1984) and Greene and Villanueva (1991). A wide range of determinants has been identified including the level and growth rate in national income and cost-of-capital (interest rates). In the case of the latter, the debate has been extended by McKinnon (1973) and Shaw (1973) to allow for the possibility of a positive relationship between private investment and interest rates. Simply put, their argument is premised on the hypothesis that higher interest rates attract higher levels of savings and, although demand for investment will be choked off, actual (realised) investment will in fact be higher because of the greater availability of funds.

Some other determinants identified are the corresponding level of public investment, the level of external indebtedness, and the rate of inflation. The relationship between private and public sector investment is a measure of crowding out and may be positive (if in fact there is "crowding in") or negative. In addition, a country with a large external debt should find it difficult to attract private investment (especially from abroad) as purchases of materials, payments of dividends and so on would normally require the use of foreign exchange on which debt servicing

may have a first claim. Finally, it is frequently suggested that "high inflation rates may be inimical to strong private investment" which is indeed verified by Greene and Villaneuva (1991).

The general functional form which will be the subject of empirical investigation in this paper will be

$$I_p = I_p(Y, R, I_g, D, P)$$

where

I_p = Private Investment
Y = National Income
R= Interest Rate
I_g = Public Investment
D = External Debt
P = Rate of Inflation

Modelling Methodology and Data

Two specifications of the general investment function outlined in the previous section will be studied in this paper. They are:

Equation 1

$$\ln I_p = a_0 + a_1 \ln Y + a_2 \ RL + a_3 \ln I_g + a_4 \ln D$$

where ln means the natural logarithm, I_p, I_g and Y are expressed in constant values, RL is the real loan rate and D external indebtedness in US dollars.

Equation 2

$$i_p = a_0 + a_1 \ln Y + a_2 \ RL + a_3 \ i_g + a_4 \ln D$$

where i_p and i_g are private and public investment rates respectively.

It will be noticed that the inflation rate (P) does not appear explicitly in these equations but it is implicitly taken into account in the definition of the real loan rate:

$$RL = \frac{(1+R)}{(1+P)} - 1$$

There were some data problems to contend with, some more severe than others. Firstly, all the data used were available from the publications of the Bank of Guyana but the study was limited to the use of annual data for the period 1970-1990 because of the unavailability or unreliability of data for longer periods or different frequencies. Secondly, the private investment series was an

amalgam of both fixed investment and investment in stocks. Thirdly, although the constant (1985) GDP values were obtained directly from the publications of the Bank of Guyana, there were no constant price data for either private or public investment. In addition, there was no immediately obvious deflator for these values and the Retail Price Index (1985 = 1.0) was used. This logarithmic difference of this index was also used to measure the inflation rate which was then used to calculate the real prime loan rate.

Equations 1 and 2 are hypothesised to be long run or cointegrated models, using the E-G terminology. A major focus of the current paper is to establish them as such. The first step in this exercise requires that each variable appearing in the equations be tested for unit roots using the well known Dickey-Fuller (DF) tests (see, for instance, Dickey et al (1986)). The second step is to fit equations 1 and 2 using Ordinary Least Squares which, though super consistent under cointegration, may be biased in small samples - see Engle and Granger (1987). The third step, which is based on the Granger Representation Theorem and which requires that all variables entering equations 1 and 2 be either I(0) or I(1), is the establishment of an Error Correction Model (ECM). The results obtained from each of the following steps are presented and analysed below.

Testing for Unit Roots

Table 2 below displays the D-F T-statistics used for testing for unit roots of orders 1 and 2. Using the critical values of the D-F test tabulated by MacKinnon (1990), the loan rate is established as an I(0) and all other series as I(1) at the 10% level of significance at least. Since, for these tests to be valid, the residuals based on the regressions should be empirical white noise, we also show the values of the F statistic due to Breusch (1978) and Godfrey (1978) for 1 lag (2 for the case of ig) together with the significance level associated with this value

Table 2

Dickey-Fuller T and Other Statistics for Variables Employed

Variable	I(1) Test	I(2) Test	F	Sig. Level for F
ln Ip	-0.6835	-3.7107**	0.1393	0.7149
ip	-0.0287	-3.3833**	0.0002	0.9887
ln Ig	-1.7035	-2.8504*	0.4651	0.5088
ig	-2.2249	-4.6512***	2.5011	0.1178
ln Y	0.0609	-2.7005*	0.6067	0.4481
ln D	-1.2854	-3.1632**	0.0015	0.9697
RL	-2.9851*	n.a.	0.1237	0.7307

* Sig. at the 10% level
** Sig. at the 5% level
***Sig at the 1% level

Since these tests are only asymptotically valid, great care should be taken in their application when, as is the case here, the samples used are (very) small. The economist should never abandon his own judgement and, in particular, should examine plots of the variables such as those presented in Figures 1 to 7. Fortunately, these plots do not appear to contradict the conclusions arrived at above.

Private Investment (constant prices)
Logs and 1st Differences

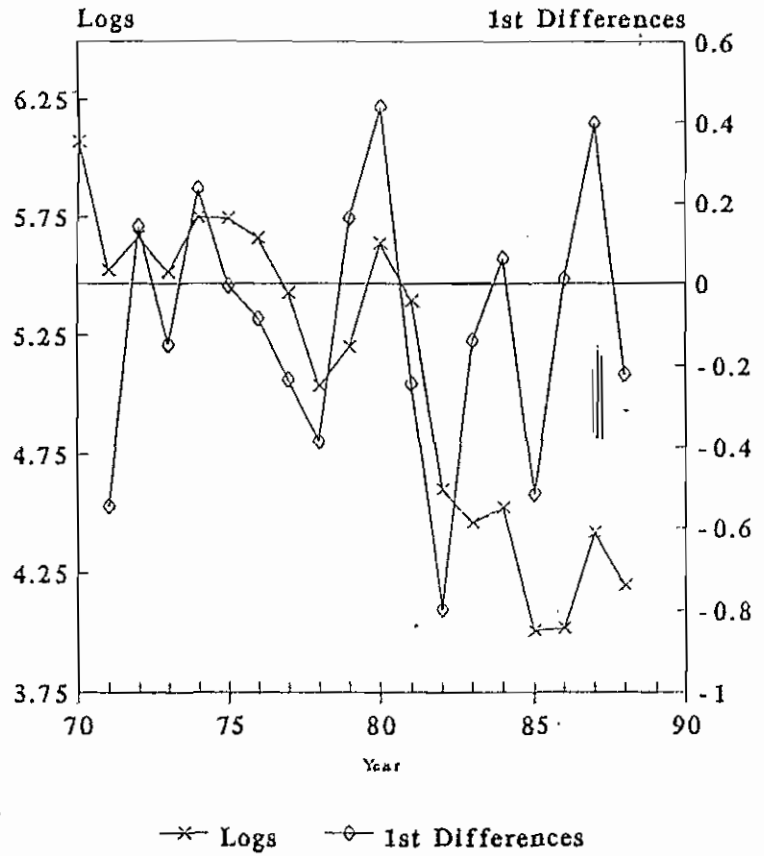

Figure 1

Private Investment Ratio
Levels and 1st Differences

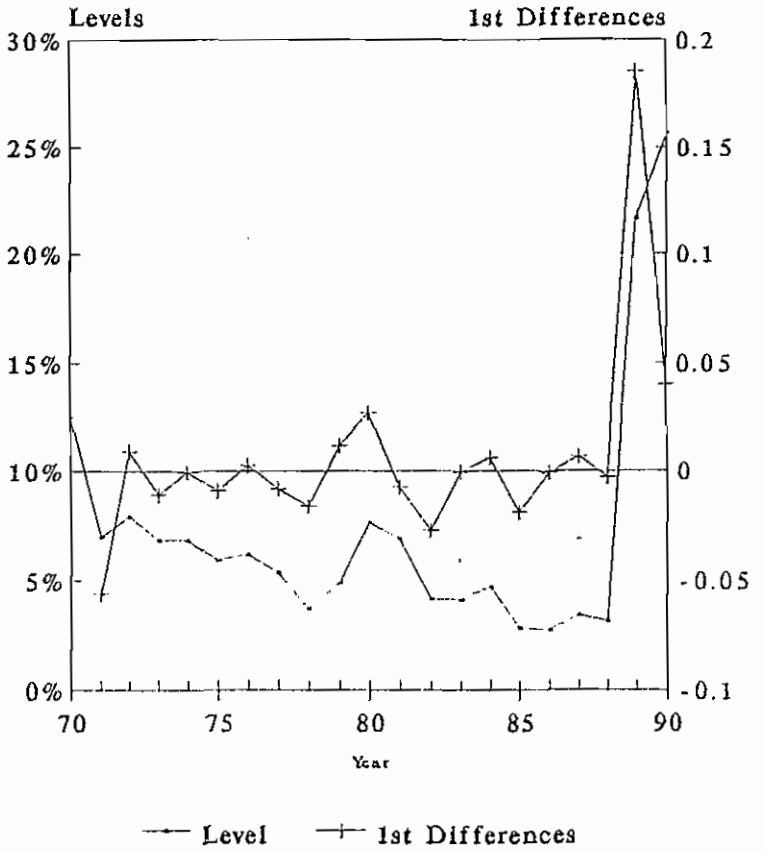

Figure 2

Public Investment (constant prices)

Logs and log 1st Differences

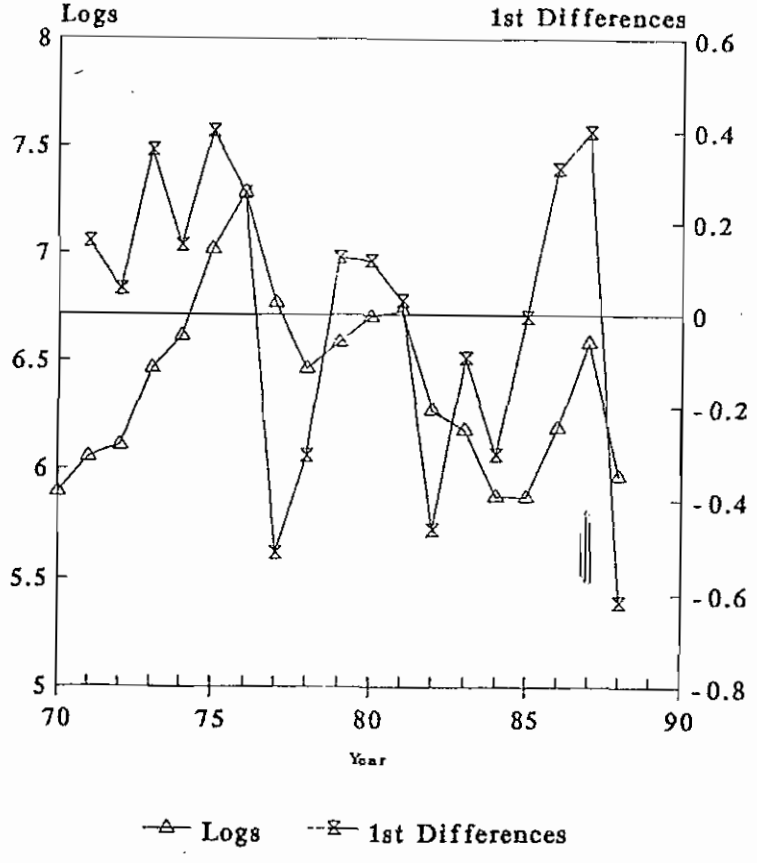

Figure 3

Public Investment Ratio

Levels and 1st Differences

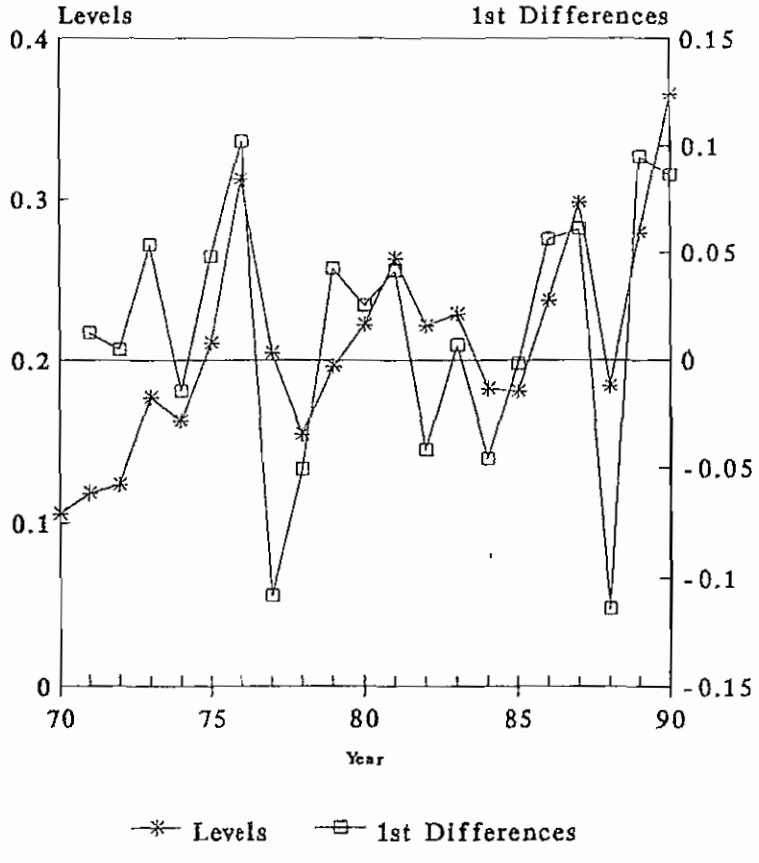

Figure 4

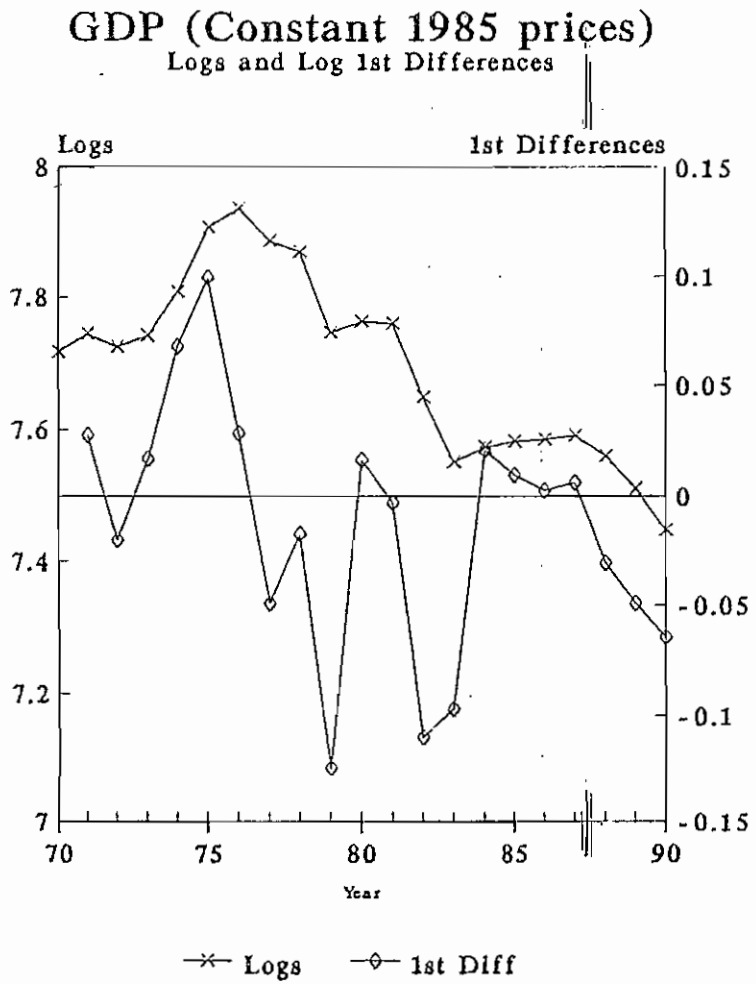

Figure 5

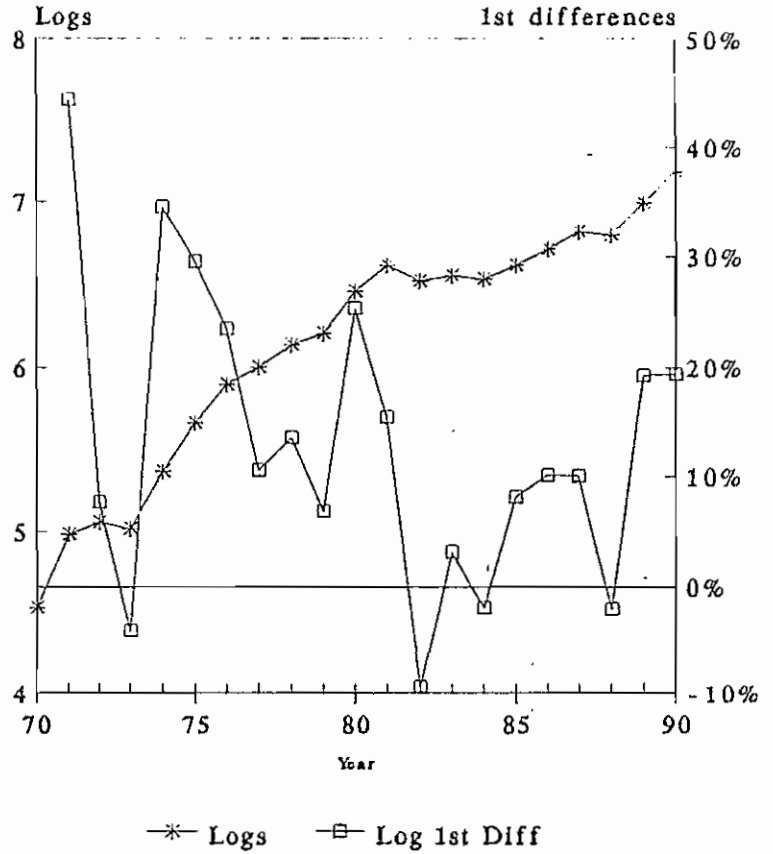

Figure 6

Real Loan Rate of Interest

Levels and 1st Differences

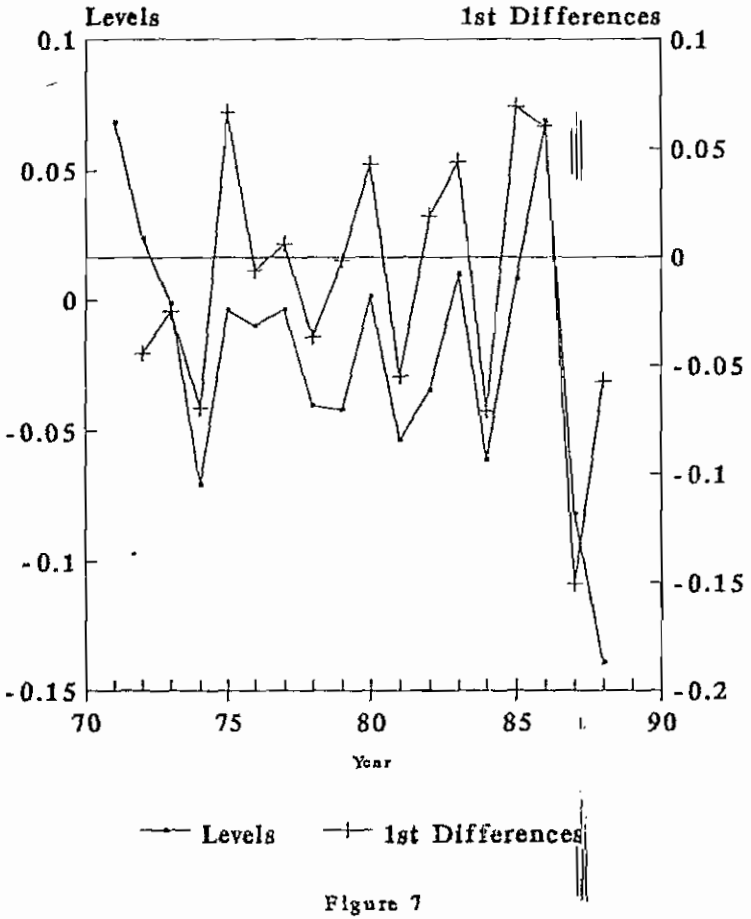

Figure 7

Cointegration Tests

The cointegration method requires the application of Ordinary Least Squares (OLS) to equations 1 and 2. The OLS residuals are then checked for stationarity using procedures suggested in the E-G article such as the D-F or Cointegrating Durbin Watson (CRDW) tests. Once this is satisfied, we may conclude that we have a cointegrating vector.

But this cointegrating vector is usually not unique, and others may be sought by swapping the left hand side variable with any of the right hand side variables and redoing the regression. If there should be more than one cointegrating vector (there usually is), then Bangerjee et al. (1986) have argued that the preferred vector should be the one having the highest R^2 value. This procedure is followed in this paper.

Tables 3 and 4 provide a summary of results obtained by applying OLS, respectively, to equations 1 and 2 and their associated re-arranged specifications. A dummy variable (DUM) having unit value in 1980 and 1981 and zero elsewhere was introduced to capture the unusual rise in private investment in 1980 and 1981.

In both cases, the originally proposed specifications have the superior cointegrating vectors. In fact, on the basis of the D-F test of the residuals, which Engle and Granger (1987) found to be the most powerful, only these two equations properly qualify as true cointegrating vectors. In addition, the fitted values from both these equations were used to derive fitted values of current value private investment and, in figures 8 and 9, these are compared to the actual values (1971-1988) supplied by the Bank of Guyana. The fits are clearly eminently reasonable.

Of the two, however, there seems to be some justification for according a marginal preference to equation 1. The coefficients all have the signs predicted by economic theory and are all significant based on the standard Student T tests. In equation 2, on the other hand, the income variable clearly has the wrong sign and, apart from the debt variable, the others are not significant at an acceptable level.

Table 3

Selected Statistics Based on Cointegrating Regressions: Equation 1

Dependent Variable	Constant	ln Ip	ln Y	RL	ln Ig	ln D	DUM	R2	DW	D-F
ln Ip	-2.28		1.173 [1.786]	-1.455 [1.858]	0.392 [2.134]	-0.713 [8.136]	0.688 [5.537]	0.944	2.19	-5.8278*
ln Y	5.73	0.1791 [1.786]		0.2651 [0.7829]	0.1151 [1.4862]	0.0599 [0.6980]	-0.1157 [1.3573]	0.787	1.88	-3.282
RL	-0.1285	-0.1536 [1.8582]	0.1833 [0.7829]		0.0453 [0.6574]	-0.1369 [2.2427]	0.1185 [1.7422]	0.092	1.58	-4.5307
ln Ig	-11.432	0.702 [2.1338]	1.3504 [1.4862]	0.768 [0.6574]		0.6479 [2.7684]	-0.4161 [1.4635]	0.738	1.77	-5.2318
ln D	3.0504	-1.1865 [8.1287]	0.6519 [0.6980]	-2.1571 [2.2427]	0.6017 [2.7684]		0.876 [5.2948]	0.906	1.83	-1.968

* = Significant at 10% level

T ratios of coefficients are in [ ]

Table 4

Selected Statistics Based on Cointegrating Regressions: Equation 2

Dependent Variable	Constant	ip	ln Y	RL	ig	ln D	DUM	R2	DW	D-F
ip	0.269		-0.008 [0.5258]	-0.0359 [1.200]	0.057 [1.570]	-0.0281 [7.182]	0.0341 [7.2615]	0.887	2.45	-6.0357*
ln Y	9.1353	-2.8303 [0.5258]		-0.3881 [0.6618]	1.1742 [1.7516]	-0.251 [1.6359]	0.1773 [0.8895]	0.279	0.653	-2.9517
RL	1.5361	-2.9844 [1.200]	-0.9072 [0.6618]		0.2772 [0.7826]	-0.1259 [1.7120]	0.1146 [1.2218]	-0.041	1.47	-3.9607
ig	-2.1343	2.9919 [1.5701]	0.1734 [1.7516]	0.1752 [0.7826]		0.1404 [2.7498]	-0.0999 [1.3564]	0.364	2.09	-5.4107
ln D	12.5175	-28.898 [7.1818]	-0.7265 [1.6359]	-1.559 [1.7120]	2.7524 [2.7498]		1.048 [5.9490]	0.916	2.13	-2.1855

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Private Investment
Actual and Fitted Values, Eq.1

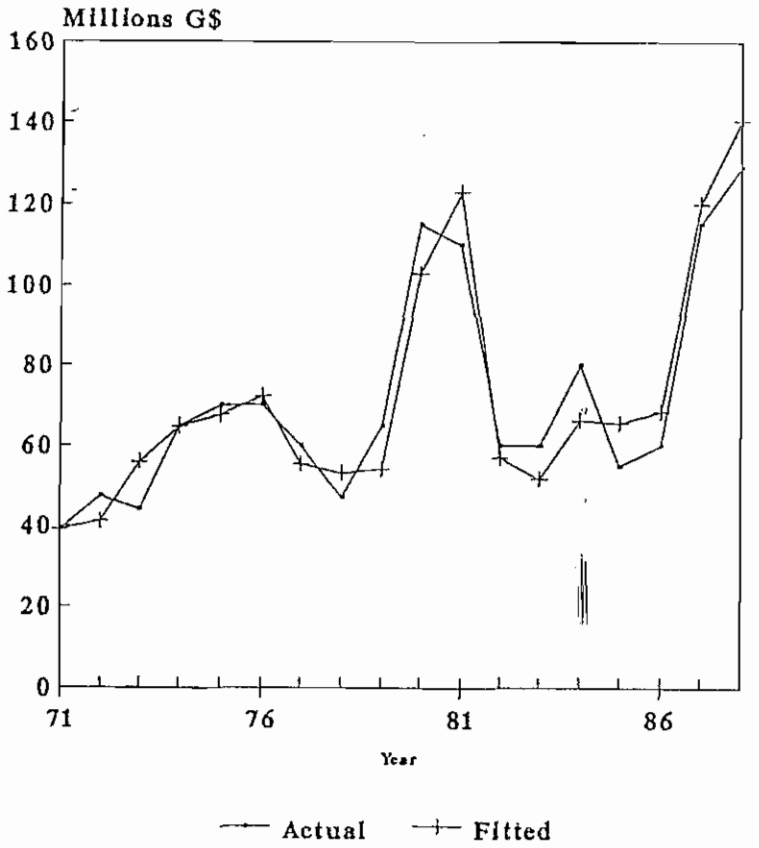

Figure 8

Private Investment
Actual and Fitted Values, Eq.2

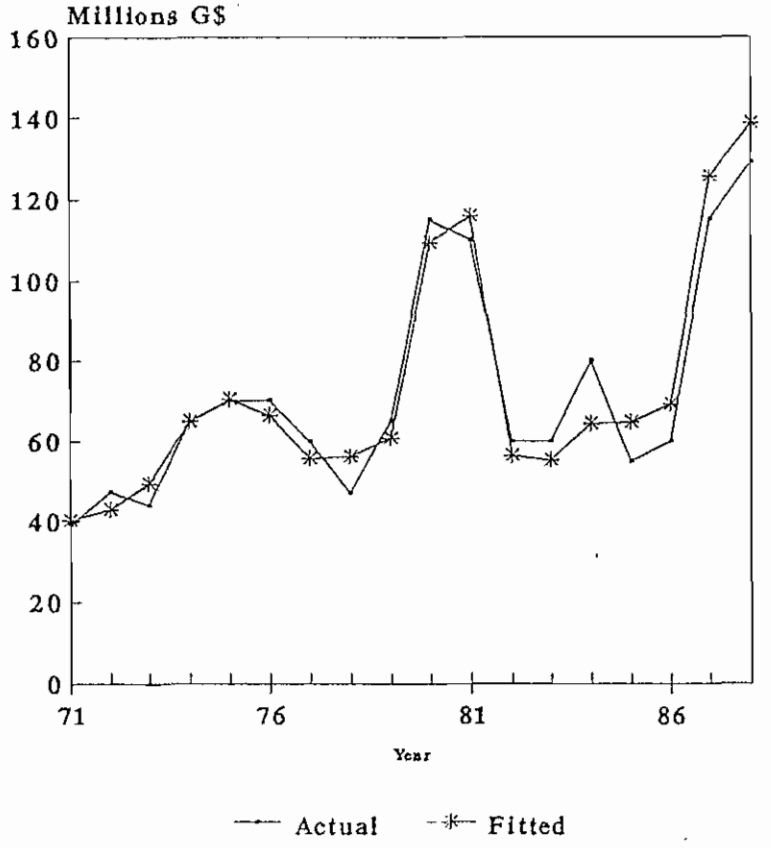

Figure 9

There are some useful conclusions which can be drawn from these results. In the first place, there seems to be no strong evidence in favour of the crowding out hypothesis and, if anything, private investment seems to take its inspiration from public sector investment activity. This is not a surprising result and has nothing to do with any specificity about the Guyana case. Both the studies of Tun Wai and Wong (1982) and Greene and Villanueva (1991) which covered a wide cross section of developing countries arrived at a similar conclusion.

Secondly, private investment seems to be relatively sensitive to the cost of capital and, using equation 1 as our point of reference, a 1% increase in the real loan rate leads to a 1.45% fall in private investment. This provides evidence in favour of the neo-classical position that investment and interest rates are negatively related and appears to give the lie to the McKinnon-Shaw hypothesis in the case of Guyana.

It is the level of external indebtedness, however, which seems to have the greatest powers of dissuasion over private investors, at least in the long run. This is not at all surprising in the case of Guyana which is one of the most heavily indebted countries in the world and which has even in the most recent past had tremendous difficulty in meeting its debt commitments even to official lenders. The resulting pressure on foreign exchange availability would necessarily have adverse effects on investor confidence.

Error Correction Models

The third step in the E-G methodology is the construction of ECM's capable of capturing the short run response of private investment in Guyana to external stimuli. The "error correction" for each of the specifications 1 and 2 is approximated in each case by the OLS residuals of the cointegrated regression and denoted, respectively, as EC1 and EC2.

The Granger Representation Theorem allows for an almost unlimited number of possible specifications of the ECM and in this study, for any such specification to be satisfactory, it had to satisfy the following tests (carried out in the order indicated):

1. The Breusch-Godfrey (B-G) F test
2. The Ramsey (1969) RESET test
3. The White (1980) Heteroscedasticity test
4. The Jarque-Bera (J-B) (1980) normality test
5. The ARCH test (Engle (1982))

Tables 5 and 6 below display the retained specifications together with the statistics (as well as their significance levels) associated with the above named tests. B is the backshift operator: $B^k X_t = X_{t-k}$

Table 5
Error Correction Model for Equation 1
(and associated statistics)

$$(1-B)\ \ln I_p = \underset{(2.4940)}{2.50(1-B)^2\ \ln Y} + \underset{(2.040)}{0.393(1-B)\ \ln I_g} - \underset{(1.794)}{0.951\ EC1(-1)}$$

R2 = 0.419 DW = 1.71

F (B-G, 1 lag) =	0.229	Sig. Level = 0.640
F (B-G, 2 lags) =	1.144	Sig. Level = 0.351
F (B-G, 3 lags) =	0.795	Sig. Level = 0.521
RESET (1) =	1.955	Sig. Level = 0.183
RESET (2) =	0.993	Sig. Level = 0.395
RESET (3) =	0.663	Sig. Level = 0.589
WHITE =	0.596	Sig. Level = 0.728
J-B =	1.154	Sig. Level = 0.561
ARCH (1) =	0.991	Sig. Level = 0.337
ARCH (2) =	2.337	Sig. Level = 0.139
ARCH (3) =	0.991	Sig. Level = 0.328

Table 6

Error Correction Model for Equation 2

(and associated statistics)

$$(1-B)\, i_p = 0.098(1-B)^2 \ln Y - 1.175\ EC2(-1)$$
$$(2.4940) \qquad\qquad (2.040)$$

R2 = 0.244 DW = 1.80

F (B-G, 1 lag) = 0.075 Sig. Level = 0.789
F (B-G, 2 lags) = 3.386 Sig. Level = 0.066
F (B-G, 3 lags) = 2.319 Sig. Level = 0.127

RESET (1) = 0.688 Sig. Level = 0.420
RESET (2) = 0.585 Sig. Level = 0.569
RESET (3) = 0.566 Sig. Level = 0.646

WHITE = 1.781 Sig. Level = 0.197

J-B = 0.560 Sig. Level = 0.756

ARCH (1) = 0.398 Sig. Level = 0.538
ARCH (2) = 0.424 Sig. Level = 0.610
ARCH (3) = 0.219 Sig. Level = 0.881

The diagnostic statistics speak favourably of the ECM specifications retained. Once again, the results for equation 1 are slightly better. It is seen that, in the short run, private investors respond more readily to changes in income and, to a lesser extent, to changes in public investment. Interest rates and external indebtedness play a considerably reduced role and in fact it was impossible to establish an ECM involving these variables which was more satisfactory than those presented above.

Conclusion

In this paper we looked at private investment behaviour in Guyana using the Engle-Granger cointegration approach. We concluded that, in the long run, private investment activity depended to a large extent on external indebtedness and was negatively related to this variable. It also was related (negatively) to the real loan rate and (positively) to income and public investment. This last point is a refutation of the "crowding out" hypothesis which is similar to results obtained for other developing countries.

In the short run, income - or rather changes in income - is the principal influence on private investment behaviour. Investors seem to take less account of the other items in the short run.

We feel fairly certain that the results obtained here are applicable to other Caribbean countries. They contain some valuable lessons for informing policy measures in the current thrust towards greater private sector activity in the Caribbean region.

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