Current Account Deficit Sustainability: The Case of Barbados

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Abstract

This paper investigates the sustainability of the current account deficit in Barbados over the period 1960 to 2006. Various unit root and cointegration techniques are employed to determine whether the country is satisfying its intertemporal budget constraint. The cointegration regressions suggest that the current account of Barbados is sustainable and that deviations from long-run equilibrium between real exports and imports are corrected in the short-run with imports making the adjustment.

JEL Classification: F30; F32

Key words: Current account deficits; Sustainability; Intertemporal Budget Constraint

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1 Introduction

Although a country may be able to sustain current account deficits by borrowing from abroad in the short-run, if such deficits persist for a long period, then its ability to service its external obligations will be questioned. Moreover, the current account is an important barometer to both policymakers and investors as it represents the country's economic performance (Baharumshah et al., 2003). Barbados' current account position has historically been one of mainly deficits and, more importantly, it has been a decade since the current account has recorded a surplus, the last one being in 1996. Indeed, since 1997 the current account deficit has increased from 2.2 percent of Gross Domestic Product (GDP) to 8.4 percent in 2006, and on average represents 6.7 percent of GDP over the 10-year period (Figure 1).

Temporary current account deficits are not 'bad', as they reflect the reallocation of capital to a country where capital is more productive. However, long or persistent deficits can have serious effects, such as; high domestic interest rates relative to foreign counterparts, while simultaneously imposing an excessive burden on future generations and thus lowering the standard of living (see Wu et al., 1996). The persistent current account deficits in Barbados since 1996 have raised concerns about the country's ability to service its debt. The inability of the economy to earn sufficient foreign capital has resulted in the deficits being financed mainly through international borrowing. At some point in time, the combination of; the inability to earn sufficient foreign capital, increasing debt and recurrent deficits will cause lenders to question the ability of the country to service and repay its debt. Also, the fact that government has borrowed to boost the level of foreign reserves and possibly to maintain its fixed exchange rate regime has made it paramount that the sustainability of the deficits be investigated.

In this regard, the literature suggests several measures of sustainability, including: the ratio of the country's foreign indebtedness to GDP, as an indicator of a country's ability to service its debt (Krugman, 1989); the real rate of interest on national debt adjusted for output and population growth (Cohen, 1988; Cohen and Katseli, 1985; Vinals and

Cuddington, 1988); and, the proportion of foreign net worth held in a particular country's debt (Isard and Stekler, 1985). However, the majority of recent works on sustainability advocate using an intertemporal budget approach, which is basically assessing whether or not a nation is satisfying its budget constraint over a defined time period. Wickens and Uctum (1993) suggest that a country with initial net national indebtedness will satisfy its intertemporal budget constraint (IBC) if it has future current account surpluses that are expected to be sufficient to service and repay its debt, or if it has sufficient initial net national assets to offset expected future current account deficits.

Section 2 traces the current account developments in Barbados during the period 1966 to 2006. Section 3 provides the theoretical background, while section 4 outlines the econometric methodology. Section 5 provides the results and analysis and section 6 concludes the paper and offers some policy implications.

2. Current Account Developments in Barbados

Barbados' current account position has fluctuated over the years, characterised predominantly by longer periods of deficits. The period between the 1970's and 1980's marked the transition of Barbados' economy from an agricultural and manufacturing base economy to one of tourism. The export of sugar was the main source of foreign exchange up to the 1960s. However, poor management, stagnant world sugar prices and rising production cost eroded the profitability of the industry and eventually led to its decline. Brathwaite and Codrington (1982) note that the decline of sugar was sharpest in the 1967 to 1972 period. Growth in the manufacturing and tourism industries however partially compensated but generated a substantial requirement for imports.

Tourism eventually replaced sugar as the major foreign exchange earner, but soon suffered a severe blow in the early 1970s, as a result of rising oil prices and air transport cost coupled with recession in the world economy. Thus, the years 1971 to 1976 were a period of real economic decline, marked by increasing current account deficits. Attempts at diversification, aided by government incentives for manufacturing and import trade restrictions, help to boost the light manufacturing industry (Hilaire, 2000). Increased manufacturing output along with a recovering tourist industry saw the deficit improve between 1977 and 1980.

The slide in sugar profitability continued into the 1980's, while tourism output began to decline due to external forces, mainly a fall-off in global tourist travel. At the same time, recessions in the United States and United Kingdom led to a drop in merchandise exports, however imports continued to grow as a result of higher international fuel prices. The poor performance of the traditional foreign currency earning sectors caused the deficit to worsen in 1981, by more than five times the previously recorded value. This placed additional pressure on the foreign reserves. Consequently, the country was forced to seek funding from the International Monetary Fund (IMF) in 1982. The ensuing structural adjustment program involved wage and fiscal restraint, which increased the island's external competitiveness. The revival of the world economy, along with the promotion of offshore financial services helped to improve the economic conditions in Barbados and propelled the current account position from one of deficit to three consecutive years of surpluses over the period 1984 to 1986.

The economy moved towards the 90's with a current account surplus. However, imports were increasing steadily while exports declined, resulting in a current account deficit by 1990. The falloff in exports reflected a faltering manufacturing sector, as the Trinidad and Tobago market contracted, and a drop in the production of electrical components as a number of large multinational companies such as Intel and CORCOM relocated their businesses from Barbados in the face of changing production technologies. In addition, the crisis in the Middle East culminated in the Gulf War in 1991 and caused a sharp reduction in tourist expenditure, leading to a further worsening of the current account deficit (Jordan and Sunielle, 2005). By August of that that year, the reserves had declined to less than three weeks of imports of goods and services. Again, this prompted the government to seek funding from the IMF. A reduction in credit availability along with a cut-back and restructuring in Government expenditure helped to avoid a possible devaluation of the currency. The policies aimed at reducing the level of expenditure included a 20 percent tax increase on luxury imports, 8 percent cut in nominal public sector wages and lay-offs of 11 percent of public workers. Monetary policy was also used to dampen credit to the public and private sector; the liquid asset requirement and minimum deposit rates were raised and the ceiling on loan rates was removed to discourage borrowing. Collectively, these policies resulted in a 23 percent decline in imports between 1991 and 1992, while the fiscal deficit as a percentage of nominal GDP also decreased by about 6 percentage points during the same period. Consequently, the current account moved from a deficit of 1.3 percent of GDP in 1991 to a surplus of 9.1 percent in 1992. Surpluses were recorded from 1992 to 1997 as exports along with tourist receipts expanded. The buoyant tourist industry along with a strengthening private sector, influenced additional spending in the form of imports, causing the merchandise trade balance to worsen and by 1997 the current account was again in deficit.

From 1997 to the present period, current account deficit have persisted, with 2003 being the highest on record. However, this was a period of increasing economic output led primarily by the non-traded (net foreign exchange using) sectors and thus much of the imports contributed to the expansion of the economy. Moreover, during the period 2003 to 2005, retained imports expanded by 11.5 percent, 17.8 percent and 11.3 percent respectively, however much of this was related to construction activity in preparation for the hosting of Cricket World Cup 2007. A significant proportion of the increases in these latter years also reflected an almost doubling of the fuel import bill in the face of rising international oil prices. Nonetheless, the current account as a percentage of GDP rose significantly, moving from 6.8 percent at the end of 2002 to 12.5 percent in 2005. Presently, the deficit stands at 8.4 percent of GDP as a result of a 7.8 percent decrease in the trade deficit and a 9.0 percent expansion in travel expenditure.

3. A Framework for Assessing Sustainability

Current account sustainability is most commonly assessed within the intertemporal balance model, which gained popularity following the works of Hakkio and Rush (1991) and Husted (1992).[1] In this model the balance of the current account must satisfy the expected intertemporal balance to ensure current account sustainability. The model begins by noting that an open economy faces the following budget constraint for each period *t*:

$$C_t = Y_t + B_t - I_t - (1 + r_t)B_{t-1} \tag{1}$$

where C_t is current consumption; Y_t is output; I_t is investment; r_t is the one period world interest rate; B_t is international borrowing, which could be positive or negative; and $(1 + r_t)B_{t-1}$ is the initial external debt of country.

Since the budget constraint must be satisfied for all periods, it can be iterated forward to give the intertemporal budget constraint as:

$$B_t = \sum_{i=1}^{\infty} \mu_i [Y_{t+i} - C_{t+i} - I_{t+i}] + \lim_{i \to \infty} \mu_i B_t \tag{2}$$

where $\mu_i = \prod_{j=1}^{i} \left(1/(1 + r_{t+j} \right)$ is the product of the first *i* discount factors. In addition, since $Y_t - C_t - I_t = X_t - M_t$ represents the trade balance (*TB*) in period $_t$, equation 2 can be written as:

$$B_t = \sum_{i=1}^{\infty} \mu_i [TB_{t+i}] + \lim_{i \to \infty} \mu_i B_t \tag{3}$$

When the limit term in equation 3 is zero, the current value of the country's external debt is equal to the sum of present discounted value of future trade balances. If the limit term is nonzero and B_0 is positive, then the current stock of external debt is bigger than the

[1] Other notable studies include (Apergis et al., 2000; Arize, 2002; Baharumshah et al., 2003; Cashin and McDermott, 1998; Fountas and Wu, 1999; Irandoust and Sjoo, 2000; Mann, 2002; Milesi-Ferretti and Razin, 1996; Wickens and Uctum, 1993)

present value of future trade balances and the country is said to be ‘‘bubble-financing’’ its external debt, meaning that its debt is in a “bubble” and the current account is not sustainable. Conversely, a nonzero limit term and negative B_0 means that the country is making Pareto inferior decisions (Husted, 1992). Thus, from a theoretical perspective one is interested in whether the data are consistent with the limit term being equal to zero.

Empirical tests of this limiting condition follow along the lines of Hakkio and Rush (1991), Husted (1992) and Greenidge et al. (2006). Basically, it is assumed that the world interest rate is stationary with unconditional mean r, thus equation 3 can be expressed as:

$$M_t + rB_{t-1} = X_t + \sum_{i=0}^{\infty} \frac{\Delta X_{t+1} - \Delta Z_{t=1}}{(1+r)^{i-1}} + \lim_{i \to \infty} \frac{B_{t+1}}{(1+r)^{i-1}} \tag{4}$$

where Δ is the first difference operator and $Z_t = M_t + (r_t - r)B_{t-1}$ is expenditure on imports as well as net interest payments. Subtracting X_t from both sides and multiplying by minus 1 gives the current account of the economy:

$$CA_t = X_t - M_t - rB_{t-1} = \sum_{i=0}^{\infty} \frac{\Delta Z_{t=1} - \Delta X_{t+1}}{(1+r)^{i-1}} - \lim_{i \to \infty} \frac{B_{t+1}}{(1+r)^{i-1}} \tag{5}$$

Finally, under the assumption that X_t and Z_t are both *I(1)* processes with stationary error processes, and that the limit term of Equation 5 approaches zero, Equation 5 can be written in standard regression format as:

$$X_t = \alpha + bMM_t + \varepsilon_t \tag{6}$$

where a necessary condition for the country to be satisfying its intertemporal budget constraint is that ε_t be stationary, which means that if *X* and *MM* are *I(1)* then they are cointegrated. However, no cointegration between *X* and *MM* would indicate that the country fails to satisfy its budget constraint, and is therefore evidence against the sustainability of the current account balance. The sufficient condition for the intertemporal budget constraint to be satisfied is the existence of a cointegrating vector between *X* and *MM* of the form (1,-1) such that ε_t is a stationary process, implying that the two series would never drift too far apart.

However, the condition b=1 is not, strictly speaking, a necessary condition for the intertemporal budget constraint to hold. Hakkio and Rush (1991) showed that when *X* and *MM* are in levels, as opposed to a percentage of GDP or in per capita terms, $0 < b < 1$ is a sufficient condition for the budget constraint to be obeyed, implying current account sustainability.

4. Econometric Methodology

Unit Root Analysis

A first step in testing for cointegration between two variables is to determine the order of integration of the two series. In this regard, a battery of stationarity tests is applied to the levels and first differences of the variables. The first test is that of augmented Dickey-Fuller (ADF) test for unit roots based on the regressions:

$$\Delta X_t = \alpha_1 + \beta_{1t} + \delta_1 X_{t-1} + \sum_{j=1}^{J} \alpha_j \Delta X_{t-j} + \gamma_t \qquad (7)$$

and

$$\Delta MM_t = \alpha_2 + \beta_{2t} + \delta_2 MM_{t-1} + \sum_{j=1}^{J} \alpha_j \Delta MM_{t-j} + \varpi_t \qquad (8)$$

where J in the regressions is chosen so that it is sufficiently large to ensure that the error term is free of significant serial dependence. The null hypothesis of non-stationarity is rejected if $\delta_1(\delta_2)$ is significantly negative. The next test is the Phillips-

Perron, PP, (1988) which, instead of adding differenced terms as explanatory variables to correct for higher order serial correlation, makes the correction on the t-statistic of the δ coefficient. However, the PP test, as originally defined, suffers from severe size distortions when there are negative-moving average errors (see Schwert 1989, and Perron and Ng, 1996). Although the ADF test is more accurate under such conditions, its power is still affected. In lieu of this we use both the Elliot, Rothenberg, and Stock (*ERS)* Point Optimal test (1996), which has improved power characteristics over the ADF test, and the Ng and Perron (2001) testing procedure (*NP*) which exhibits less size distortions compared to the PP test (both tests are well documented in the literature and are therefore only summarised in Appendix A).

However, all the above tests take a unit root as the null hypothesis, which means that they have a high probability of falsely rejecting the null of non-stationarity when the data generation process is close to a stationary process (Blough, 1992; Harris, 1995). Therefore, we also utilise the KPSS test described in Kwiatkowski *et al.*(1992) where the null hypothesis is specified as a stationary process.

Finally, if there appears to be a shift or structural break in the series then we need to take account of this as it could distort the above tests. To deal with this we follow the procedure in Saikkonen and Lütkepohl (2002) and Lanne *et al.* (2002), where a shift function is added to the ADF above and the deterministic term is first estimated by generalised least squares (GLS) under the unit root null hypothesis and subtracted from the original series. Then an ADF type test is carried out on the adjusted series which also includes terms to correct for estimation errors in the parameters of the deterministic part. The critical values for the new ADF statistic are given in Lanne *et al*. (2002). See Saikkonen and Lütkepohl (2000; 2002) for more details on the specification of the various shift function.

Cointegration Analysis

Johansen cointegration analysis

Once it is established that the two series are *I(1)* the next step is to test for the existence of a long-run relationship between them. In this regard, we rely on the multivariate framework proposed by Johansen (1988) and Johansen and Jurelius (1990), which is shown to possess several[2] advantages over the residual-based Engle-Granger two-step approach. In conducting the test, consider a vector autoregressive model (VAR) of the form:

$$Y_t = \eta + \sum_{i=1}^{p} \Pi Y_{t-i} + \varsigma_t \qquad (9)$$

where $Y = [X_t, MM_t]'$, η is a 2×1 vector of deterministic variables, Π is a 2×2 coefficient matrix and ς is a 2×1 vector of disturbances with normal properties. If there exist a cointegrating relationship between real exports and real imports then Equation 9 may be reparameterised into a vector error correction model (VECM):

$$\Delta Y_t = \eta + \sum_{i=1}^{p-1} \Phi_i \Delta Y_{t-i} + \Pi Y_{t-1} + \varsigma_t \qquad (10)$$

[2] See Phillips (1991), Gonzalo (1994) and Johansen and Jurelius (1990) for a further discussions on the advantages of the Johansen procedure.

where Δ is the first difference operator, and Φ is an 2×2 coefficient matrix. The rank, *r*, of Π determines the number of cointegrating relationships. If the matrix Π is of full rank or zero, the VAR is estimated in levels or in first differences respectively, since there is no cointegration amongst the variables. However, if the rank of Π is less than *n* then there exist $2\times r$ matrices β (the cointegrating parameters) and α (the adjustment matrix, which describes the weights with which each variable enters the equation) such that $\Pi = \alpha\beta'$, and Equation 10 provides the more appropriate framework. The Π matrix is estimated as an unrestricted VAR and tested to see whether the restriction implied by the reduced rank of Π can be rejected.

The test statistics for determining the cointegrating rank of the Π matrix are the trace statistic given by $Q_t = -T\sum_{i=T-1}^{k}\log(1-\lambda_i)$, for $r = 0,1,...,k-1$ and λ_i = the i^{th} largest eigenvalue and the maximum eigenvalue statistic, which is given by $Q_t = -T\log(1-\lambda_{T-1}) = Q_T - Q_{T+1}$.

Johansen cointegration analysis with structural breaks

If the data and unit root analyses suggest structural breaks then we employ the test specification and procedure detailed in Johansen *et* al. (2000).[3] The authors generalised the multivariate likelihood procedure of Johansen (1988) by allowing up to two structural breaks, either in levels only or in levels and trend jointly, to be added to the specification.

Assume there are two breaks, in which case the sample can be split into three periods (q=3) and equation 10 is specified as:

$$\Delta Y_t = \eta E_t + \sum_{i=1}^{p}\sum_{j=2}^{q} K_{j,i} D_{j,t-1} + \sum_{i=1}^{p-1}\Phi_i \Delta Y_{t-i} + \alpha\begin{pmatrix}\beta\\ \mu\end{pmatrix}'\begin{pmatrix}Y_{t-1}\\ tE_t\end{pmatrix} + \varsigma_t \qquad (11)$$

[3] Gregory and Hansen (1996) propose a test for cointegration in the presence of structural breaks by allowing for a level shift, or a shift in both the level and slope. However, it appears that the results depend on the normalisation chosen, and seasonal and short-run dynamics are neglected.

where E_t is a vector of *q* dummy variables $E_t = (E_{1,t},...E_{q,t})'$ with $E_{j,t} = 1 \quad (j = 1,...,q)$ if observation *t* belongs to the *j*th period and zero otherwise, with the first *p* observations set to zero; and $D_{j,t} = 1 \quad (j = 2,...,q \; and \; i = 1,...,p)$ is a dummy that equals unity if observation *t* is the *i*th observation of the *j*th period. The hypothesis for determining the cointegration rank is formulated as before except that the asymptotic distribution now depends on the number of non-stationary relationships, the location of the break points and the trend specification. In this regard, the critical values as well as the p-values of all Johansen trace tests are obtained by computing the respective response surface according to Johansen *et al*. (2000)[4].

Dynamic OLS (DOS) analysis with structural breaks

To ensure the robustness of our results we also utilise the Stocks and Watson (1993) dynamic ordinary least squares (DOLS), which is an alternative to the maximum-likelihood estimator of Johansen (1988; 1995), primarily because it is known to have superior performance in small samples like ours. Moreover, Stock and Watson (1993) show that the DOLS estimator is at least asymptotically equivalent to the maximum likelihood estimator of Johansen (1988) in the case where the variables are *I(1)*. (see also Caporale and Pittis, 1999; Park and Phillips, 1988; Phillips, 1991; Watson, 1994). Moreover, the DOLS approach provides unbiased and asymptotically efficient estimates, even in the presence of endogenous regressors. It does so by including the leads of the first differences of the *I(1)* variables as regressors. It also corrects for serially correlated errors with the inclusion of the lags of the first differences of the *I(1)* variables. Thus, the estimation of the long-run relation for Equation 6 is based on the following regression:

$$X_t = \alpha + bMM_t + \sum_{j=-K}^{K} \lambda_j \Delta MM_{t-j} + \sum_{i=1}^{j} \delta_i D_{it} MM_t + \nu_t \tag{7}$$

[4] This is done using MALCOM 2.9, (available from www.greta.it/malcom/index_malcom.htm).

where $i = 1,...,J;\ D_{it} = 0\ if\ t \in (1,...T_i);\ and\ D_{it} = 1\ if\ t \in (T_i + 1,...N)$, where T_i is the date in which the *i*th identified structural break occurs; and, the inclusion of ΔMM_{t+j} takes care of the possible endogeneity feedback from real exports to real imports and results in consistent estimates, even under conditions of two-way exogeneity.[5] The equation is estimated in most cases with *K=1*, but then a 'general to specific' procedure[6] is applied to reduce the model to a more parsimonious congruent specification where only significant variables are retained.

In order to investigate the short-run dynamics, the estimates from Equation 7 can be used to formulate a general error correction model of the form:

$$\Delta X_t = \sum_{j=1}^{p} \varphi_j \Delta X_{t-j} + \sum_{j=0}^{p} \phi_j \Delta MM_{t-j} + \zeta_j \sum_{j=1}^{p} \left(X_{t-1} - bMM^*_{t-1} - \sum_{i=1}^{j} \delta_i D_{it} MM_t \right) + \varepsilon_t \qquad (8)$$

which specifies changes in exports as a function of lagged values of the first difference of the two nonstationary variables and the stationary combination of the nonstationary variables, which represents the long-run relation between exports and imports. This long-run relation is given by *b* and is our indicator of current account sustainability, while $\left(X_{t-1} - bMM^*_{t-1} - \sum_{i=1}^{j} \delta_i D_{it} MM_t \right)$ can best be interpreted as a measure of current account disequilibrium and ζ_t is the speed of adjustment back to equilibrium. In estimating Equation 8, a general-to-specific approach will be used in order to reduce it to a more parsimonious representation.

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[5] See Ahmed and Rogers (1995, pp.361) for further discussion.
[6] See Campos *et al*.(2005) for a detailed exposition on the general-to-specific approach to econometric modelling.

5. Data and Empirical Results

Data

This study uses annual frequency data spanning the period 1960 to 2006. Consistent with the theoretical framework, exports include exports of goods and services, while imports is defined as imports of goods and services plus net transfer payments and net interest payments. Both series are measured in real terms using the GDP deflator and expressed in natural logarithms. Data are obtained from the Central Bank of Barbados databank.

It is quite evident from Figure 2 that there is co-movement between the two series over the sample period. Moreover, this relationship appears to be relatively steady except from the period, mid-sixties to mid-seventies. Thus, based on this visual inspection of the two series, we would expect to find that they are cointegrated. Figure 2 also shows possible structural breaks at the beginning of the 1980s and around 1992, which are consistent with the discussion in section 2 and will be taken into consideration in the upcoming analysis.

Results for Unit Root Analysis

The results for the analysis of the stationary properties of the series are presented in Table 1. All the tests are in agreement and indicate that both series are non-stationary in levels, $I(1)$, and stationary in their first differences, $I(0)$, at the 1 percent level, for the entire sample.

Given that the possibility of shifts or structural breaks in the series as noted above, we follow the procedure in Saikkonen and Lütkepohl (2002) and Lanne *et al.* (2002), as discussed in the methodology section. In this regard, instead of using break dates based on our visual inspection we follow Lanne *et al*. (2001) and chose a reasonably large AR order and then use a sequential testing procedure to pick the break date which minimises the GLS objective function used to estimate the parameters of the deterministic part. The dates suggested by this procedure coincide with those from our visual inspection (see Figures 3 and 4).

Figure 3a shows real exports and the resulting shift function for the test with a break at 1981. The shift function is significant with a t-statistic of 2.867, while the test statistic for the null hypothesis of a unit root with this function incorporated is -1.378, which is insignificant even at the 10 percent level. Figure 3b depicts the test for a structural break in exports in 1992. The resulting test statistic of -1.167 is also insignificant. Thus, we conclude that real exports are indeed *I(1)*.

In the case of real imports, the t-statistic on the shift function at 1981 proved insignificant and therefore we only test for a break at the 1992. The results are presented in Figure 4 and the t-statistic of 16.346 is highly significant, while the unit root test statistic is -0.254 indicates that we cannot reject the null hypothesis that the series contains a unit root.

Results for Cointegration Analysis

Johansen cointegration analysis

The cointegration rank test is more efficient if carried on a data congruent VAR and thus we begin by estimating an unrestricted VAR with a maximum lag length of 4. Two dummies representing structural breaks in 1981 and 1992 are included. The three selection criteria employed (the Akaike information, Schwarz Bayesian and Hannan-Quinn) all suggest a lag length of 1. Further tests confirm that the residuals of the VAR(1) model do not suffer from non-normality, serial correlation or heteroskedasticity. A misspecification test was also carried out. Having verified a data consistent VAR specification, we proceed to check for a cointegrating relation among the variables.

The results are presented in Table 2. The trace statistics show that there is one cointegrating vector, that is, the rank, r, of $B(1)=1$. Starting with the null hypothesis of no cointegration (*r* = *0*), the trace statistic is 40.43, which is well above the 90 percent critical value of 36.1. Hence, it rejects the null hypothesis *r* = *0*, in favour of the alternative r = 1. However, the null hypothesis of r ≤ 1 cannot be rejected even at the 10 percent level of significance. Consequently, we conclude that there is only one cointegrating relationship between *X* and *MM*.

To derive the long-run estimates, an exact identification in sequential order is imposed. Since there is only one cointegrating vector, this entails first normalising on *MM*, then checking the significance of the error correction-term in the two resulting dynamic equations, then repeating the process by normalising *X*. This procedure indicates that the normalisation on *MM* produces an error-correction model in which the error-correcting term is significant only in the *MM* equation, while with the normalisation on *X* the error-correcting term is insignificant in the *X* equation but significant and positively signed in *MM* equation.

Hence, we proceed by normalising on *MM* and the results are presented in Table 3 along with some standard diagnostic test statistics for the error correction model. The estimated long-run relationship is thus $MM = 1.086X$, which is highly significant with a t-statistic of 9.274. Note that this implies that *X* is weakly exogenous in the cointegrating system with *MM* responding to disequilibrium. In other words, short-run deviations from the equilibrium relationship result in real imports adjusting to restore equilibrium. This is consistent with the stylised facts in Barbados where, in times of large current account deficits, policy measures are usually directed at curbing imports in the short-run while various incentives are given to boost exports in the medium to long-term.

For a sustainable relation, *b* should be equal to 1 and the results here suggest that it is not significantly different from 1. Moreover, recursive estimation[7] of the cointegration relationship indicates that it is quite stable over the sample period (see Figure 5). Thus, the evidence from the Johansen procedure points to the long-run sustainability of the current account for Barbados.

[7] See Greenidge *et al.* (2006) for an exposition of this procedure as it relates to the sustainability of fiscal deficit.

Dynamic OLS (DOS)

The final step in our empirical analysis is to further check the robustness of the above findings by re-estimating the long-run equilibrium relationship using the DOLS method. The estimation results are reported in Table 4 and are consistent with those from the Johansen procedure. In addition, the estimated model is well-behaved and passed the battery of diagnostic tests (the notes beneath the Table explain the various tests), indicating that it does not suffer from miss-specification, autocorrelation, heteroscedasticity or non-normality of the residuals and can therefore be accepted with a high degree of confidence. Furthermore, testing the restriction of the null hypothesis that the long-run coefficient parameter *b = 1*, gives: $\chi^2(1) = 0.06[p - value = 0.796]$, which implies that the current account deficit of Barbados is sustainable.

6. Conclusion

The purpose of this study is to investigate the sustainability of the current account of Barbados by merging the popular Husted (1992) testing procedure with recent econometric analysis. The procedure utilised here is to estimate cointegration between exports and imports plus net transfer payments and net interest payments, allowing for structural breaks. Cointegration tests based on both the Johansen and DOLS approaches support the existence of long-run equilibrium between real exports and imports with a cointegrating factor not significantly different from 1. The empirical findings therefore suggest that the current account of Barbados has in fact been sustainable (and does not violate its intertemporal budget constraint).

Another significant finding is that the stable long-run relationship between real exports and imports is defined as one where deviations from this equilibrium are corrected in the short-run with imports making the adjustment. Thus, policies to curb aggregate demand are effective in pushing the economy towards achieving external balance in the short-term, while polices to boost exports are more suited towards the medium and long-term planning.

The onus is therefore on policymakers to extend this favourable track record into the future to ensure that future policy decisions continue in the tradition of prudent current account management that has been established. This implies that the immediate future requires the current account deficit to be reduced. Of course this is in the face of the new challenges posed by recent moves to open up the capital account and deregulate domestic interest rates. It will be necessary to balance the need for policies which can increase competitiveness and stimulate growth against the need to maintain external balance in order to preserve Barbados' good stability record. One way to achieve this is to integrate current account targets into the overall framework of macroeconomic management, whereby policies are designed to ensure that the current account balances on average over the medium term (roughly a five-year period).

Figure 1: Current Account (percent of GDP at market prices)

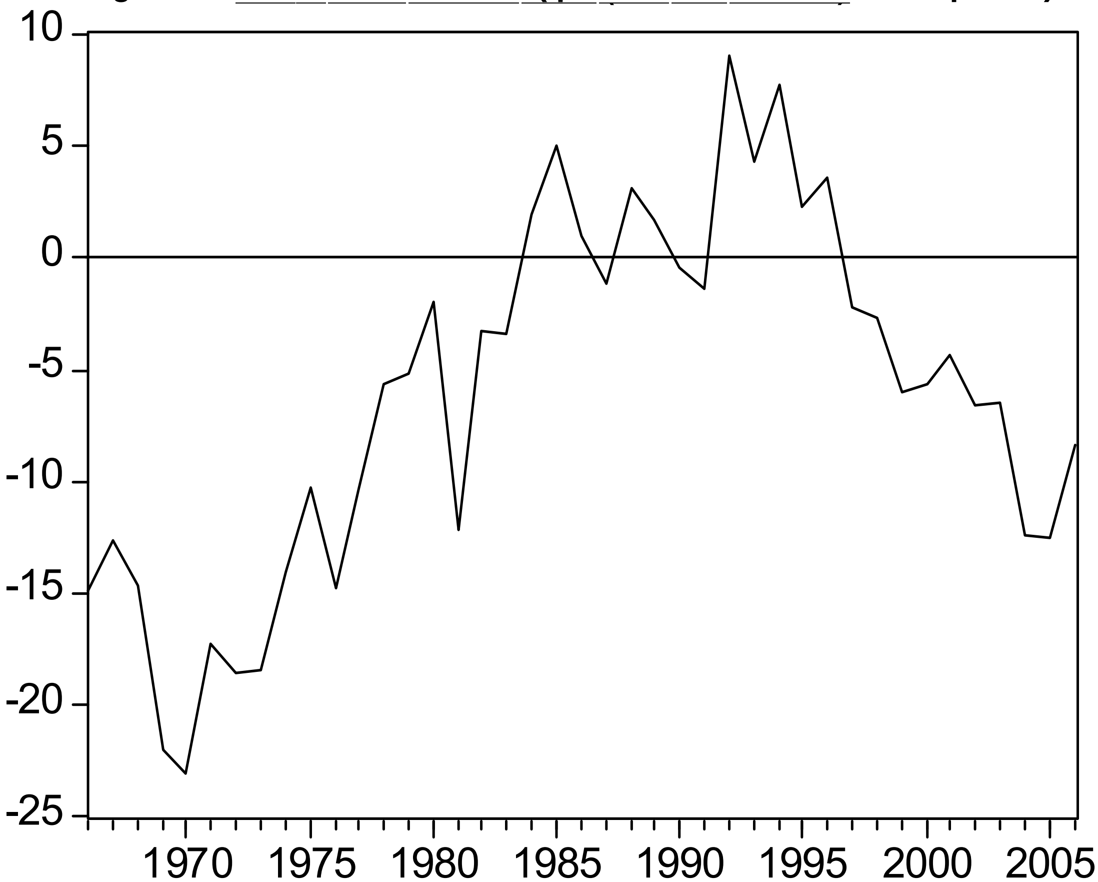

Figure 2: Real Exports of Goods and Services and Real Imports of Goods and Services (including net transfers and net income payments)

Figure 3a: Exports – Unit Root Test with Structural Break at 1981

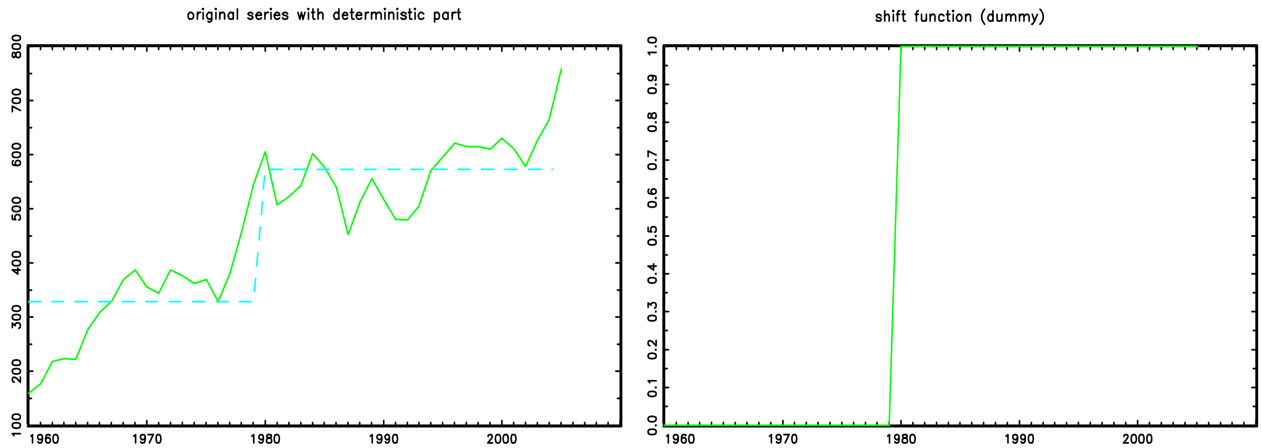

Figure 3b: Exports – Unit Root Test with Structural Break at 1992

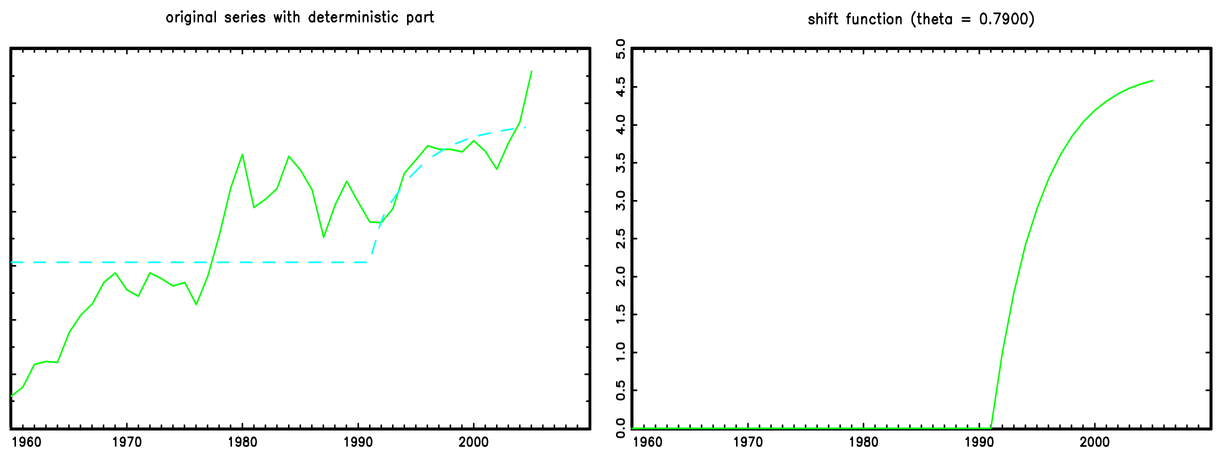

Figure 4: Imports – Unit Root Test with Structural Break at 1992

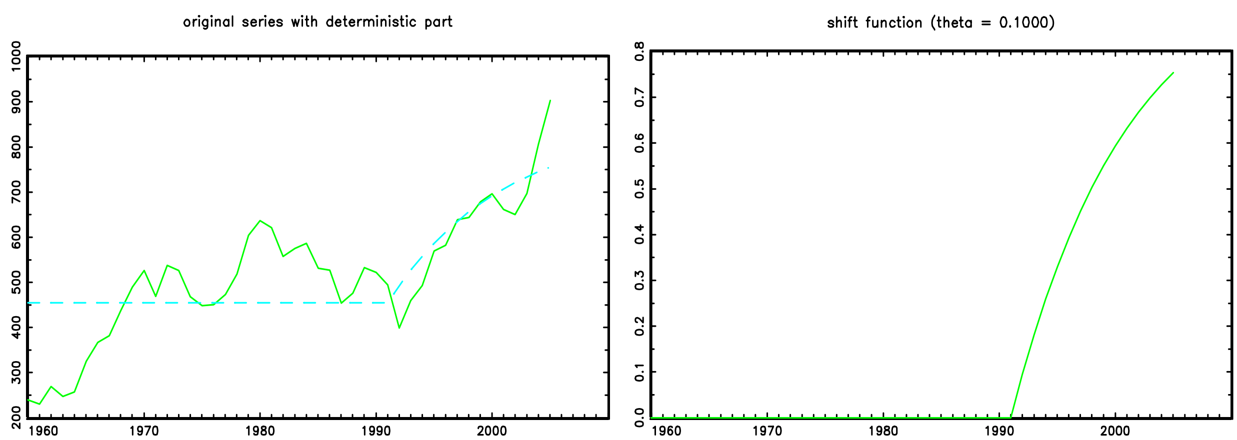

Figure 5: Recursive Estimates of the Cointegrating Relationship

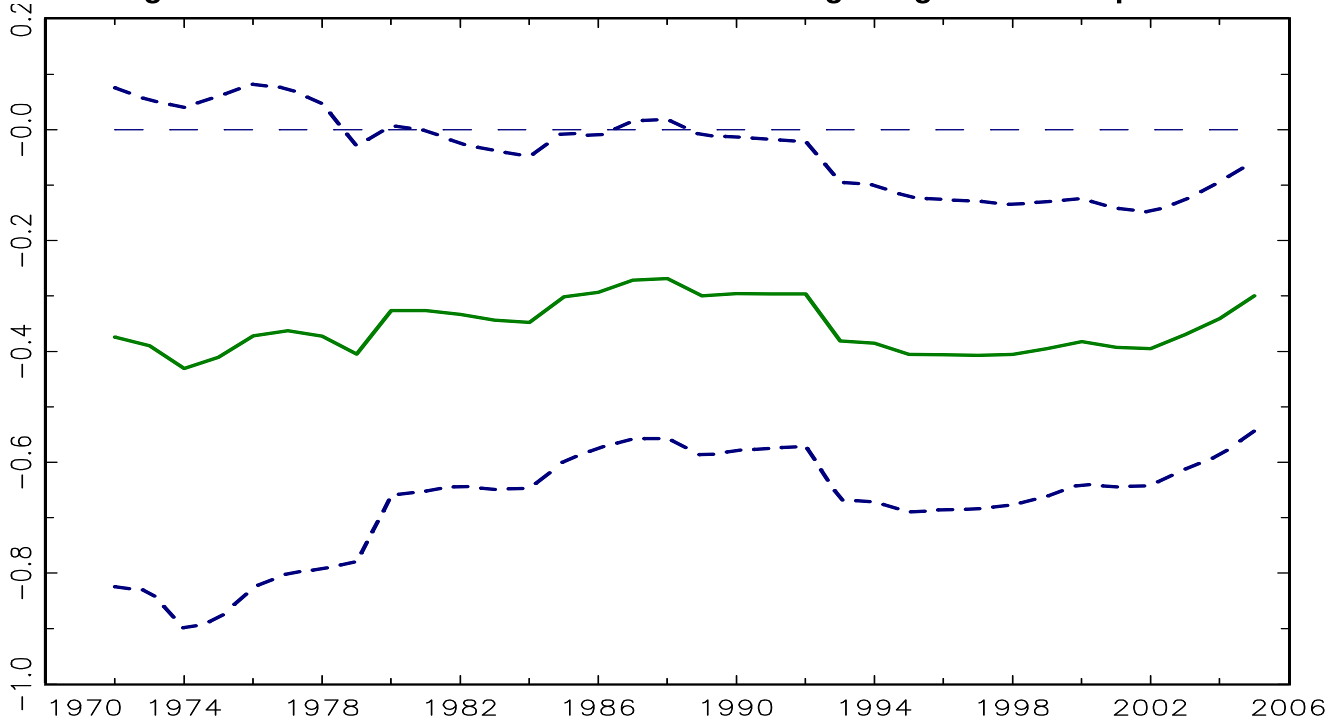

Table 1: Results of Tests for Stationarity

	X	ΔX	MM	ΔMM
ADF	-1.118	-5.206***	-0.232	-4.941***
PP	-0.832	-5.504***	-0.498	-4.820***
KPSS	0.827***	0.169	0.676**	0.138
ERS	52.899	1.541***	41.665	1.762***
MZ_{α}	1.262	-21.125***	2.619	-20.691***
MZ_t	0.745	3.133***	1.253	-3.082***
MSB	0.590	0.148***	0.479	0.149***
MP_T	29.96	1.560***	26.275	1.648***

*, ** and *** indicate rejection of the null hypothesis at the 10 percent, 5 percent, and 1 percent levels, respectively. Δ denotes the first difference of the original series.

Table 2: Johansen Trace Test for Cointegration

Null	Alternative	Statistic	P-value	90 percent	95 percent	99 percent
r = 0	r = 1	40.43**	0.0020	28.65	31.11	36.10
r ≤ 1	r = 2	13.81	0.1315	14.19	16.23	20.52

Table 3: Results of Cointegrating VAR Regression

Estimation of Equation 11	
$\begin{bmatrix} \Delta MM_t \\ \Delta X_t \end{bmatrix} = \begin{bmatrix} \underset{(-3.365)}{-0.167} & \underset{(2.893)}{0.064} & \underset{(-2.955)}{-0.204} \\ \underset{(-1.824)}{-0.073} & \underset{(1.560)}{0.054} & \underset{(0.998)}{0.107} \end{bmatrix} \begin{bmatrix} D_{1981,t} \\ D_{1992,t} \\ \eta \end{bmatrix} + \begin{bmatrix} \underset{(-2.964)}{-0.300} \\ \underset{(0.382)}{0.048} \end{bmatrix} \begin{bmatrix} \underset{(---)}{1.000} & \underset{(-9.274)}{-1.087} \end{bmatrix} \begin{bmatrix} MM_{t-1} \\ X_{t-1} \end{bmatrix} + \begin{bmatrix} \varsigma_{MM,t} \\ \varsigma_{X,t} \end{bmatrix}$	
Implied cointegrating vector is $\underset{[9.274]}{MM = 1.086X}$ **with ECT = -0.3001**	
R^2	0.523
DW	1.918
SC	0.019 (0.891)
RESET	0.367 (0.544)
Norm	0.765 (0.682)
HET	0.183 (0.669)

The F-statistic for the respective test are shown (unless indicated otherwise) and the associated P-value in parentheses. T-statistics are in square brackets. *DW* is the Durbin-Watson statistic. *SC* is the Lagrange multiplier test of residual serial correlation (Chi-square of degree 1). *FF* is the Ramsey's RESET test for incorrect functional form using the square of the fitted values (Chi-square of degree 1). *Norn* is the test for normality of the residuals based on the Jarque-Bera test statistic (Chi-square of degree 1). *HET* is the Heteroskedasticity test based on the regression of squared residuals on squared fitted values

Table 4: Dynamic OLS Model

$$MM_t = \underset{(0.003^{+++})}{0.014} + \underset{(0.105^{+++})}{0.986*X_t} - \underset{(0.167^{+})}{0.236*\Delta X_{t-1}} - \underset{(0.063^{++})}{0.236*D_{1981,t}} - \underset{(0.027^{+++})}{0.227*D_{1992,t}}$$

$R^2 = 0.85$; JOINT - F(4,37) = 53.42 [0.000]; DW =1.56; AR- F(2,35) = 1.038 [0.232];

ARCH- F(1,35) = 0.792 [0.380]; Norm. -$\chi^2(2)$ = 1.039 [0.595]; HET- F(6,30) = 0.525 [0.785];

RESET - F(1,36) = 0.060 [0.808]; Chow(1981) = 0.802[0.832]; Chow(1992) = 1.380 [0.263].

Notes: Heteroscedasticity and autocorrelation consistent standard errors are in parentheses. $^{+}$, $^{++}$ and $^{+++}$ denotes significance at the 10 percent, 5 percent and 1 percent level respectively. The F-statistic for the respective diagnostics tests are shown and the associated p-value in square brackets. R^2 is the fraction of the variance of the dependent variable explained by the model and *JOINT* is a test of the joint significance of the explanatory variables, *DW* is the Durbin Watson statistic, *AR* is the Lagrange multiplier test for *p-th* order residual autocorrelation correlation, *RESET* = Ramsey test for functional form mis-specification (square terms only); *Norm* is the test for normality of the residuals based on the Jarque-Bera test statistic (χ^2 (2)). *ARCH* is the autoregressive conditional heteroscedasticity for up to *p*-th order (see Engle, 1982a). *HET* is the unconditional heteroscedasticity test based on the regression of squared residuals on the squared fitted values. Finally, *Chow (n)* is Chow's (1960) test for parameter constancy based on breakpoints in the sample (two breakpoints are tested - the sample mid-point and 90th percentile).

Appendix A: The Elliot, Rothenberg, and Stock (*ERS)* Point Optimal and Ng and Perron tests

The ERS based on a quasi-differencing regression of the form:

$$d(y_t|a) = d(x_t|a)'\delta(a) + \eta_t$$

where y_t is the series in question, x_t may contain a constant only or both a constant and a time trend, and a is proxied by $\overline{a}$ which is computed as $\overline{a} = 1 - 7/T$ *and* $\overline{a} = 1 - 13.5/T$ in the presence of a constant and a constant and time trend respectively. The ERS point optimal test statistic of the null that $\alpha = 1$ against the alternative that $\alpha = \overline{a}$ is given by $P_T = \left[SSR(\overline{a}) - \overline{a}SSR(1)\right]/f_0$ where *SSR* is the sum of squared residuals and f_0 is an estimator for the residual spectrum at frequency zero. In making inferences, the test statistic calculated is compared with the simulation based critical values of ERS.

The *NP* procedure involves four test statistics. The first calculates the ERS point optimal statistic for the GLS detrended data ($y_t^d = y_t - x_t'\hat{\delta}(\overline{a})$) as:

$$MP_T^d = \begin{cases} \left(\overline{c}^2 T^{-2} \sum_{t=1}^{T} \left(y_{t-1}^d\right)^2 - \overline{c}T^{-1}\left(y_T^d\right)^2 / f_0\right) & if \;\; x_t = \{cons\tan t\} \\ \left(\overline{c}^2 T^{-2} \sum_{t=1}^{T} \left(y_{t-1}^d\right)^2 + (1-\overline{c})T^{-1}\left(y_T^d\right)^2 / f_0\right) & if \;\; x_t = \{cons\tan t, trend\} \end{cases}$$

The other three are modifications of the PP statistics (the Z_α and Z_t statistics of Phillips and Perron and the Bhargava statistic) with corrections for size distortions in the case of negatively correlated residuals. There are given as:

$$MZ_{\alpha}^{d} = \left(T^{-1}(y_T^d)^2 - f_0\right) / \left(2\sum_{t=2}^{T}(y_{t-1}^d)^2 / T^2\right)$$

$$MZ_t^d = MZ_a \times MSB$$

$$MSB^d = \left(\sum_{t=2}^{T}(y_{t-1}^d)^2 / T^2 f_0\right)^{1/2}$$

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