# The Nexus Between Economic Development and Import Demand in CARICOM Economies.

By: Anthony Birchwood and Julia Jhinkoo.

**Presented at the XXXIX Annual Caribbean Centre for Monetary Studies Conference**
**Best Western Belize Biltmore Plaza**
**6-9 November 27**
**Belize City**

***Abstract***

Many CARICOM member countries reflect perennial current account deficits. While these deficits may be related to the excessive demand for imports, it may be the case that the demand for imports are useful for driving growth of the regional economies. As a result, the study investigates the nexus between economic development and the demand for imports in the CARICOM area with a view to understanding the implications of economic development for import demand. To conduct the investigation, the study employs cointegration and vector error correction methodologies.

## Introduction

The study seeks to examine the implications of economic development for income demand elasticity of imports with respect to the economies in the Caribbean Community member countries (CARICOM). Surprisingly, in spite of the vast literature available internationally, there is a paucity of literature applied to these economies on this topic. The most notable of these studies would be Gaffer (1988), and Gaffer (1995). Yet, an examination of the issue is critical to an understanding of the external balance as most Caribbean economies

continue to record large current account deficits. Caribbean economies face the issue therefore, concerning how can national and regional economic policies be crafted around the demand for imports to improve the soundness of economic planning.

Similar to Lo et al. (2006), the study examines the responsiveness of imports to changes in the income of Caribbean economies, to see if this is related to their level of development. Moreover, the study allows for the idea advanced by James (2006), that imports can add the impetus to economic growth if import productivity increases. James contended that the impact of import demand can be strengthened by the rate of growth of investment in domestic capital relative to the import intensive sector. Thus he argued that the productive use of foreign exchange can increase import productivity.

Accordingly in this study, the investigation is conducted ex-post, to see what stylized facts can be gleaned with respect to the level of development and import elasticity of demand in the CARICOM region. If the more developed economies exhibit low income elasticity, then it can suggest that these economies were better able to combine imports with domestic capital and therefore reduce their reliance on imports over time. However, if the more wealthy exhibit higher income elasticity of import demand, then this can have implications for the pattern of import demand. In addition, the dynamic relationship in the import demand function would be examined through the use of impulse analysis.

This study contributes to the literature by examining the issue concerning the relation between development and income elasticity of imports within a trading block. It also incorporates the real exchange rate rather than just simply the price ratio as is done in other models.

The investigation of these matters are influenced by the fact that where external current account deficits are extremely large, it places an ever increasing burden on these countries to seek redress through capital flows, which in some cases has lead to a huge debt overhang. This can thwart the ability of these member countries to meet the convergence criterion established by CARICOM for the formation of a single currency.

To conduct the investigation, the income elasticity of imports is estimated for the period 1984 to 2006 with respect to GDP and the elasticity results are compared to the level of economic development attained in 2006. This is suggestive of the idea that the level of development in 2006 may have been achieved through a process of accumulation of imported capital which exhibited a long term impact on the economy. Thus, the study examines the link between the current level of development and import elasticity based on historical import demand.

**LITERATURE REVIEW**

The importance of income elasticity of demand for imports can be captured from the Keynesian view. In this view, import demand is principally a function of output, as employment is assumed to be variable and prices are assumed to be sticky. As such, income provides the purchasing power and can be used as a proxy for scale in the context of the new trade theories which lay emphasis on imperfect competition, see Hong (1999).[1] The Keynesian view predicts that the marginal income propensity to import should be 1 since there is nothing to cause a change in the ratio of import to output. As such,

[1] Keynes analysis contrasts with the neoclassical world where relative prices are seen as critical to the import demand function.

$\frac{M_{t+1}}{Y_{t+1}} = \frac{M_t}{Y_t}$ and income elasticity of demand for imports should be equal to one.

There have been much difficulty finding unitary income elasticity as suggested by Keynesian analysis, see Table 1. Theoretically, much of the blame has been attributed to the quality of the price indexes. For example, Hong (1999) noted that the literature has attributed this to a few factors including incomplete coverage of goods by price indicies causing an underestimation of price effects and an overestimation of income effects. Moreover, these indicies may focus primarily on the prices of final goods and ignore intermediate production processes. Furthermore, these indicies may not cover inter-industry imports of goods.

**Table 1: Comparison of Import Elasticity Estimates**

| STUDY | ESTIMATION PERIOD | METHOD OF ESTIMATION | COUNTRY OF STUDY | Y | Pm/Pd | ER | GIR/GDP |
|---|---|---|---|---|---|---|---|
| Yadav (1975) | 1956-1972 | Cointegration | Canada | 1.11 | -2.49 | | |
| Bautista (1978) | | GMM | Philippines | 1.112 | -0.445 | 0.738 | |
| Thursby and Thursby (1984) | 1957-1977 | OLS | Canada | 1.35 | -0.46 | | |
| | 1960-1978 | | Germany | 1.59 | -0.3 | | |
| | 1957-1977 | | Japan | 1.17 | -0.33 | | |
| | 1957-1977 | | UK | 1.12 | 0.14 | | |
| | 1955-1978 | | USA | 1.72 | -0.2 | | |
| Faini, Pritchett and Clavijo (1988) | | GMM | Costa Rica | 1.5 | | | 0.03 |
| | | | Ghana | 0.42 | | | 0.05 |
| | | | Ecuador | 0.08 | | | 0.21 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Dominican Republic<br>Salvador | 1.13<br>0.68 | | | 0.11<br>0.04 |
| Gafar (1988) | 1967-1984 | OLS | Trinidad and Tobago | 2.9055 | -0.5665 | | |
| Deyak,Sawyer and Sprinkle (1993) | 1958-1989 | Cointegration | Canada | 1.66** | | 0.79 | |
| Gafar (1995) | 1961-1990<br>1961-1986<br>1967-1970 | OLS and Cochran-Orcutt | Guyana<br>Jamaica<br>Trinidad and Tobago | 1.34<br>2.59<br>2.4 | -0.55<br>-0.48<br>-0.52 | | |
| Tambi (1998) | 1970-1994 | Cointegration | Cameroon | 0.656 | -0.863 | 0.295 | |
| Arize and Shwiff (1998) | 1973-1995 | Cointegration | USA<br>UK<br>Japan<br>Italy<br>Germany<br>France<br>Canada | 1.88<br>2.08<br>0.98<br>1.11<br>1.95<br>1.16<br>1.93 | -0.64<br>-0.61<br>-0.02<br>-0.42<br>-0.15<br>-0.07<br>-0.56 | | |
| Thomakos and Ulubasoglu (2002) | 1970-1995 | GMM | Turkey | | | | |
| Islam and Hassan (2004) | 1974-1998 | Cointegration | Bangladesh | 1.833 | -0.401 | | -0.542 |
| Narayan and Narayan (2005) | 1970-2000 | Bounds testing Approach to Cointegration | Fiji | In this study Y was disaggregated. | -0.3805 | | |
| Dutta and Ahmed (2006) | 1960-1992 | Cointergaion | India | -0.03 | -0.37 | | |

In the new trade theories, higher output countries are expected to reflect higher import elasticity as they would be better able to attract foreign direct investment from more firms owing to their increased capacity.[2]

The empirical literature that exists on import demand for developed and developing countries is somewhat extensive, but there are a limited number of studies that are actually done on Caribbean countries. In the Caribbean, imports are a major component of a country's expenditure, and by extension current account deficits exist

[2] See for example Barrel and Dées (2005)

in most of the Caribbean countries[3]. Imports are usually shown to be related to changes in income, foreign prices, domestic prices and either explicitly or implicitly, the exchange rate.

In the existing literature on import demand, the import demand function is most commonly estimated as:

$$M = f(P_d, P_f, Y) \quad \ldots\ldots(1)$$

Where:

$M$ = Quantity of the import commodity $P_f$ = Price of Imports

$P_d$ = Price of domestic products $Y$ = Income

The specification of the import demand equation is based on the conventional demand theory obtained from neoclassical economy and the income as suggested by the Keynesian view.[4] A key assumption also made in most of the studies is the assumption of imperfect substitution, that is, it is assumed that neither imports nor exports are perfect substitutes for domestic goods of the countries under consideration, Mervar (1993); Dutta and Ahmed (2006).

Gafar (1988) looked at the determinants of import demand in Trinidad and Tobago for the period 1967-1984. He found that relative prices and real income are important factors influencing the demand for imports. Then Gafar (1995) also estimated income elasticities of import demand for three CARICOM countries- Guyana, Jamaica and

[3] Countries that have a Current account deficit in 2006 are: The Bahamas, Barbados, ECCU, Guyana, and Jamaica.

[4] Microeconomic theory regards demand functions to be homogenous of degree zero in prices and money income; this proposition is commonly referred to as "*absence of money illusion*". This implies that if one multiplies all prices and money income by a positive number, the quantity demand will remain unchanged. Narayan and Narayan (2005).

Trinidad and Tobago, where it was again found that relative prices were important to import demand.

Internationally, studies also investigated the dynamics of the import demand function. The general finding was that imports tended to respond slowly to changes in relative prices and exchange rates, while responding almost instantaneously to real GDP.[5]

Recent studies used different expenditure components rather than aggregate income to examine the income determinants.[6] The macro-components of final expenditure are: exports, private consumption, public consumption and investment. This recent approach is favoured to the traditional approach by the authors because it brings two main advantages. Firstly, the traditional import demand model assumes that the import content of each macro-component of final expenditure is the same. Hence, if the different macro-components of final expenditure have different import contents, then the use of a single demand variable in the aggregate import demand function will lead to aggregation bias. Secondly, a model that incorporates the macro-components of final expenditure, by virtue of eliminating aggregation bias, will have better forecasting powers than the standard import demand models. Disaggregated demand functions are perceived to be superior, but for this paper income is aggregated due to limitations in collecting the necessary data.

Another modification of the traditional model has been the inclusion of the exchange rate. Yagei (2001) defined an exchange rate as a price of one country's money in terms of another's. The exchange rate

[5] See for example, Bautistia (1978); Deyak, Sawyer and Sprinkle (1993); Thomakos and Ulubasoglu (2004); Islam and Hassan (2004) and Lo, Sawyer and Sprinkle (2007).
[6] See for example, Abbot and Sddighi, 1996; Min et al, 2002; Tang, 2003 and Narayan and Narayan, 2005.

of a country is one of the most important prices in an open economy as it not only determines the flow of goods, services and capital in a country, but it also strongly influences the balance of payments, inflation and other macroeconomic variables. Some studies that have examined the exchange rate have focused on its volatility, noting that volatility of the exchange rate can have either negative or positive effects on trade volumes and specifically import flows.[7]

It is not surprising that some studies have postulated that there is a need to explore greater the nature and impact of foreign exchange constraints on import demand. Islam and Hassan (2004) incorporated the foreign exchange constraint in the traditional import demand function by using international reserves as a percentage of GDP to measure the level of openness of the economy.

## MODELLING AN IMPORT-DEMAND FUNCTION FOR THE CARICOM

Influenced by both Keynesian and Neoclassical economics, it is typical to investigate the import demand by hypothesizing that import demand is a function of relative prices and real income (see for example, Choudhry ,1958;Bautista ,1978; Thursby and Thursby ,1984; Gafar ,1988; Deyak, Sawyer and Sprinkle ,1993 ;Islam and Hassan ,2004; Narayan and Narayan ,2005 and Dutta and Ahmed ,2006).

$$M = f(Y, P,)$$

However recent studies have sought to control for the foreign exchange constraint, see for example (Islam and Hassan (2004) and Faini et al. (1988). Similarly, we would incorporate the foreign

[7] See Deyak, Sawyer and Sprinkle (1993); Arize and Shwiff (1998); Islam and Hassan (2004) and Lo, Sawyer and Sprinkle (2007)

exchange constraint into the traditional model to see its effects. Hence, import demand can also be expressed as:

$$M = f(Y, P, R)$$

In modeling an import demand function, the log-linear specification is preferable to the linear formulation[8], hence the import demand for the CARICOM economies can be specified as follows:

$$\ln Mqd = a + b\ln Yd + c\ln REER + u \quad \ldots(1)$$

$$\ln Mqd = a + b\ln Yd + c\ln REER + d\ln Ry + u \quad \ldots(2)$$

where, $Mqd$, is real aggregate imports. Hence, we deflate the value series of imports c.i.f. by a measure of prices to obtain real quantity of imports.

$Y$ is real income ($YD$); the while $P$ is the relative prices of imports (REER), which is obtained by, $P_f / P_d * ER$. It should be noted that the US CPI acts as a proxy for $P_f$; while the country's domestic CPI acts as a proxy for $P_d$.

The foreign exchange constraint $(R)$ is represented by using the variable RY which is the Gross International Reserves as a percentage of GDP. This is also an indication of the openness of the economy. Based on the literature, the expected signs are as follows: $b > 0$, $c < 0$ and $d > 0$.

We employ cointegration techniques to estimate the import demand function. Firstly, in order to determine the order of integration of the variables three widely used techniques were used: Dickey- Fuller (DF unit-root test), Augmented Dickey-Fuller (ADF unit-root test) and Phillips-Perron (PP unit-root test). Following this, a VEC is formed and the dynamic relations are discussed.

[8] See Islam and Hassan ,2004; Narayan and Narayan ,2005 and Dutta and Ahmed ,2006. The log form has the advantages of reducing heteroskedasticity, and the coefficient directly indicates elasticity.

## DATA AND VARIABLES

For the purpose of this study data were accumulated for the following variables: Domestic Price ($P_d$); Foreign Price ($P_f$); Real GDP Volume-1995 prices ($RY_d$); Real Growth rate of GDP ($RY_g$); Real Imports (Mqd); Gross International Reserves (Rd) and Exchange Rate (ER). The countries focused on were Antigua and Bermuda; The Bahamas ; Barbados ; Belize ; Dominica; Grenada; Guyana; Jamaica; St. Kitts and Nevis; St. Lucia; St. Vincent and the Grenadines and Trinidad and Tobago. However, lack of availability of data for Antigua and Bermuda and The Bahamas forced us to not include them in the study.

Data were sourced from the various issues of the International Financial Statistics, which is a publication of the IMF and the various central banks of the respective countries in the study. Quarterly or monthly data would have been a more appropriate time series, but due to its unavailability for some of the countries, annual data was used. This is a limitation because of the relative shortness of the series; as such the various models must be interpreted with care.

### Stylized Facts

Being small open economies, the import to GDP ratio can be expected to be high relative to GDP for CARICOM economies. Table 3 uses 5-year averages to compare the import to GDP ratio for all economies used in the study. The ratio ranged between 0.25 and 0.85 with the smaller economies in CARICOM – Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia and St. Vincent and the Grenadines – tending to generally exhibit larger ratios compared to the larger economies. A careful inspection of the ratios suggests that the smaller territories are even more open than the larger ones.

**Table 2 : Average import to GDP Ratio**

| TIME | ANT | BAR | BHA | BZ | DOM | GRE | GY | JAM | SKN | SLU | SVG | TT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1984-1986** | 0.849 | 0.509 | 1.309 | 0.674 | 0.678 | 0.661 | 0.477 | 0.475 | 0.809 | 0.661 | 0.850 | 0.246 |
| **1987-1991** | 0.761 | 0.389 | 0.789 | 0.582 | 0.763 | 0.616 | 0.721 | 0.441 | 0.845 | 0.768 | 0.835 | 0.270 |
| **1992-1996** | 0.715 | 0.371 | 0.315 | 0.429 | 0.604 | 0.555 | 0.969 | 0.470 | 0.526 | 0.662 | 0.627 | 0.299 |
| **1997-2001** | 0.575 | 0.439 | 0.360 | 0.517 | 0.611 | 0.691 | 0.824 | 0.407 | 0.551 | 0.597 | 0.605 | 0.446 |
| **2002-2006** | 0.677 | 0.470 | 0.328 | 0.548 | 0.627 | 0.711 | 0.719 | 0.431 | 0.620 | 0.648 | 0.636 | 0.355 |
| **Mean for entire period** | 0.72 | 0.44 | 0.62 | 0.55 | 0.66 | 0.65 | 0.74 | 0.44 | 0.67 | 0.67 | 0.71 | 0.32 |
| **Std. Dev.** | 0.10 | 0.06 | 0.43 | 0.09 | 0.07 | 0.06 | 0.18 | 0.03 | 0.15 | 0.06 | 0.12 | 0.08 |
| **coef. Var.** | 0.14 | 0.13 | 0.70 | 0.16 | 0.10 | 0.10 | 0.24 | 0.06 | 0.22 | 0.09 | 0.17 | 0.25 |

Notes: Average refers to the average of import to GDP ratio. Data are obtained from the IFS statistics.

Based on the Keynesian approach, there should not be significant variability in the import to GDP ratio over time. The coefficient of variation showed that the variability was more pronounced in the Bahamas, Trinidad and Tobago, Guyana and St. Kitts and Nevis in that order.

Notwithstanding this, the evidence suggest that import growth tended to follow the same economic cycle as GDP growth, given that they were significantly correlated with respect to all the economies considered, except for St. Kitts and Nevis and Trinidad and Tobago, see Table 3. Non significance of the correlation with respect to St. Kitts and Nevis and Trinidad and Tobago remained regardless of whether income was measured in nominal or real terms. For the other countries, however, the correlated pattern tended to be consistent with the Keynesian literature which suggests that the import to GDP ratio should not change significantly from year to year, given the significant correlation of growth in both variables. Moreover, the growth of GDP and real imports were not significantly different within each country, as exhibited by the ANOVA statistic in Table 5.

**Table 3: Correlation between growth of real imports and GDP growth**

| | ANT | BAR | BHA | BZ | DOM | GRE | GY | JAM | SKN | SLU | SVG | TT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Real Imports and Nominal GDP | 0.14 | 0.48** | 0.50** | 0.13 | 0.36* | 0.68*** | 0.89*** | 0.86*** | 0.11 | 0.50** | 0.34 | 0.12 |
| Real Import Growth and Real GDP growth | 0.37** | 0.58*** | 0.6*** | 0.633*** | 0.52** | 0.70*** | -0.01 | 0.13 | -0.09 | 0.66*** | 0.4** | 0.12 |
| Anova F statictic with respect to Real Import Growth and Real GDP Growth | 0.06 | 0.03 | 0.26 | 0.03 | 0.06 | 0.54 | 0.24 | 0.41 | 0.23 | 0.10 | 0.05 | 0.04 |

The foreign exchange constraint exhibited volatility within and between CARICOM countries. The variation within countries were reflective of their economic cycles. Thus, the results suggest that GDP should be a significant factor in explaining the demand for imports.

**Table 4 :Correlation with per capita income**

| | with TT | without TT |
|---|---|---|
| GIR | 0.72 | -0.19 |
| Imports | 0.43 | -0.24 |
| Import/GDP | -0.63 | -0.06 |
| GIR/GDP | 0.1 | 0.61 |
| Import/GIR | -0.43 | -0.39 |
| Growth Rate of Import | 0.13 | 0.27 |
| Elasticity of Import | 0.32 | 0.61 |

## EMPIRICAL ANALYSIS

*Unit –Root Tests*

The time series properties of the data during the period 1984-2006 is analysed using the Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF), and Phillips- Perron (PP) unit root tests. The unit root tests are performed on both levels and fist and second differences of all the variables. The results are contained in the appendix.

Cointegration Tests

A long term cointegrating relationship could not be found for The Bahamas or Barbados when the traditional model was used or when the foreign exchange constraint is introduced into the model. However, cointegration held for the other countries and the results are reported in Table X.

*Cointegration Tests*

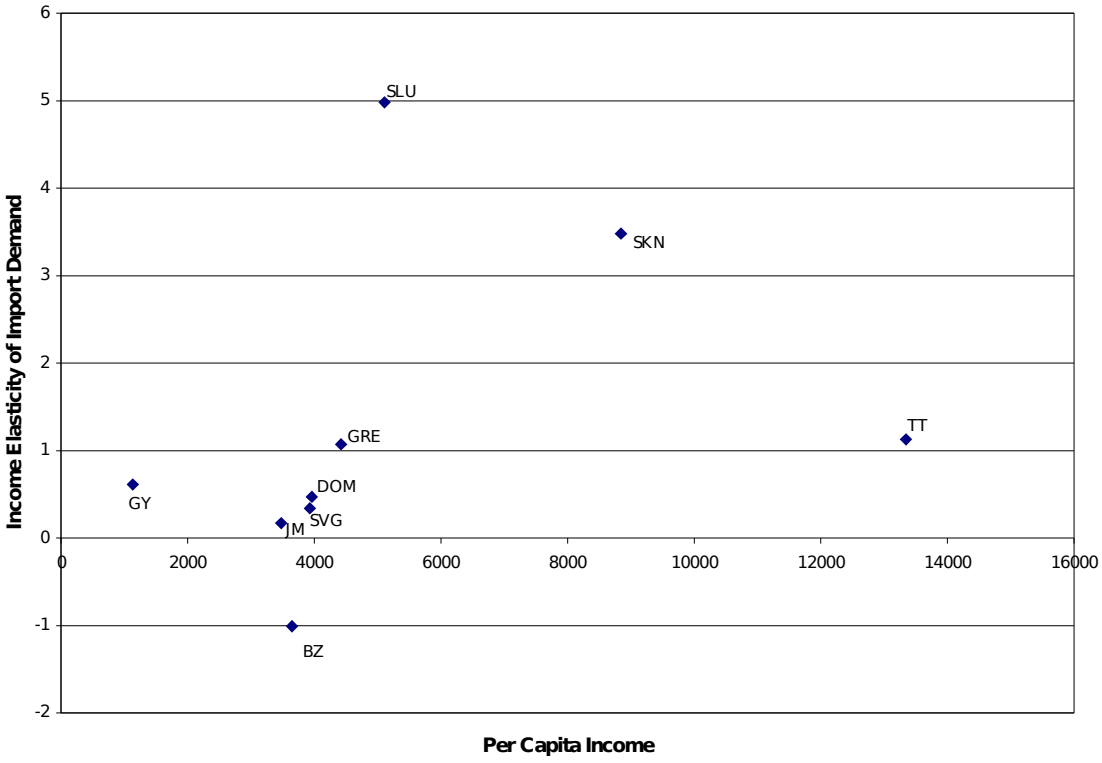
| COINTEGRATION RESULTS | | | | | | |
|---|---|---|---|---|---|---|
| | | | Normalized Cointegrating Coefficients | | | |
| **COUNTRY** | **TRACE STATISTIC** | **MAX-EIGEN VALVE** | **LMQD** | **LREER** | **LYD** | **C** |
| Belize | 37.9** | 23.71** | 1 | 13.3 | -1.01 | -0.79 |
| Dominica # | 35.98*** | 24.05* | 1 | -0.14 | 0.47 | - |
| Grenada | 47.03*** | 31.76*** | 1 | 1.32 | 1.07 | -7.07 |
| Guyana | 49.0*** | 34.25*** | 1 | -2.26 | 0.61 | 11.6 |
| Jamaica | 46.84*** | 29.12*** | 1 | 0.42 | 0.17 | 3.4 |
| St. Kitts and Nevis # | 30.57** | 18.37* | 1 | 18.43 | 3.48 | - |
| St. Lucia | 45.92*** | 32.26*** | 1 | -16.5 | 4.98 | -18.8 |
| St. Vincent and the Grenadines | 40.1*** | 24.29** | 1 | 1.67 | 0.34 | -2.53 |
| Trinidad and Tobago | 43.57*** | 24.93** | 1 | -3.7 | 1.13 | 0.69 |
| #: The trend assumption used was that there was a Linear deterministic trend. | | | | | | |
| *** : 1%<br>** : 5%<br>* : 10% | | | | | | |

When the price variables are considered, the conventional negative coefficient on the real exchange rate was obtained only for four of the nine countries – Dominica, Guyana, St. Lucia and Trinidad and Tobago. Of these four countries, demand was only price inelastic with respect to Dominica, suggesting that its imports may be necessities, while demand was elastic for the other territories. The elasticity results were above the conventional levels in the literature, which are usually found to be under one, see Table X. However, the high price elasticity could partially have resulted from the multiplication of the nominal exchange rate by the relative prices, rather than simply the relative price variable used in the literature.

Whereas price elasticity carried the wrong sign for most regressions, income elasticity carried the correct sign for eight of the nine cointegrating equations. The exception was Belize, where income

elasticity was negative. In fact, both the price elasticity and income elasticity for Belize carried the wrong sign. For the other countries, income elasticities ranged from 0.17 to 4.98. Four countries, Dominica, Guyana, Jamaica, and St. Vincent and the Grenadines, recorded elasticities under 1. At the same time, 3 countries, Grenada and Trinidad and Tobago turned out to exhibit unitary elasticities, consistent with the Keynessian literature. The remaining countries, St. Kitts and Nevis and St. Lucia recorded elasticities 3.48 per cent and 4.98 per cent.

**Chart X**




The relationship between per capita income for 2006 and income elasticity of demand for imports were then examined, see Figure x. When the correlation for the entire sample is 0.32. Evidently, however, Trinidad and Tobago is an outlier among the countries exhibiting a long-term cointegrating relationship. The exclusion of Trinidad and Tobago turned out to yield a significant correlation of

0.61. This would indeed support the hypothesis by Lo et al. (2007) that the more developed countries, when measured in terms of income per capita, tend to exhibit higher income elasticity of import demand.

Table X displays the cointegrating results for those countries for which a long-term relationship was found when the import constraint is added to the traditional import demand function. A few facts can be observed. Its only with respect to St. Vincent and the Grenadines, and Trinidad and Tobago, did all the signs follow the conventional expectation. Moreover, with the inclusion of the import constraint, income elasticity was under one for all territories suggesting that countries were limited to importing necessities.

**Table 5 Inclusion of Foreign Exchange Constraint in Import Demand Function**

| COINTEGRATION RESULTS WITH IMPORT CONSTARINT | | | | | | |
|---|---|---|---|---|---|---|
| **COUNTRY** | **TRACE STATISTIC** | **MAX-EIGEN VALVE** | **LMQD** | **LREER** | **LYD** | **LRY** |
| Jamaica | 53.77*** | 36.49*** | 1 | 1.04 | 0.24 | -0.14 |
| St. Kitts and Nevis | 49.60*** | 28.77** | 1 | 7.08 | -0.51 | 2.07 |
| St. Vincent and the Grenadines | 40.66** | 23.72** | 1 | -2.05 | 0.58 | 0.39 |
| Trinidad and Tobago | 45.08*** | 29.46*** | 1 | -1.12 | 0.77 | 0.17 |
| | | | | | | |
| *** : 1%<br>** : 5%<br>* : 10% | | | | | | |

## Conclusion

Similar to international studies, the result suggests that a positive relationship exists between economic development and elasticity within the CARICOM trading block. For most of these countries, the income elasticity of import demand fell under one, suggesting that these countries were confined to importing necessities. However, given that some countries reflect income elasticity well over one, that a heterogenous mix of policies is more appropriate for the trading

block, if those with chronic external current account difficulties are to benefit substantially.

In addition, the price elasticity of import demand was more highly variable and inconsistent with respect to its direction. Thus, the estimation results suggest that income elasticity has a wider applicability to deriving import demand in CARICOM compared to price.

The inclusion of the import constraint was not very successful as most of the countries failed to reflect a stable long term relationship accordingly. Only a few countries, St. Vincent and the Grenadines, and Trinidad and Tobago exhibited a stable long-term relationship with the signs with respect to the other regressors in the model exhibiting the correct signs.

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Appendix A

| TABLE : UNIT ROOT TEST RESULTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **VARIABLE** | **METHOD OF UNIT ROOT TEST** | **LEVEL** | | | **1st DIFFERENCE** | | | **2nd DIFFERENCE** | | |
| | | C | C+T | N | C | C+T | N | C | C+T | N |
| lMqd_BZ | ADF | -0.63 | -2.71 | 1.93 | -3.61*** | -3.52* | -3.11*** | - | - | - |
| lMqd_BZ | Max. DF | -2.5 | -2.87 | - | -3.65*** | -3.68** | - | - | - | - |
| lMqd_BZ | PP | -0.63 | -2.2 | 1.93 | -3.61** | -3.51* | -3.11*** | - | - | - |
| lREER_BZ | ADF | -1.58 | -2.13 | 0.98 | -3.49** | -3.53* | -3.3*** | - | - | - |
| lREER_BZ | Max. DF | -0.72 | -2.22 | - | -3.2*** | -3.62** | - | - | - | - |
| lREER_BZ | PP | -2.28 | -1.99 | 1.71 | -3.51** | -3.26* | -3.31*** | - | - | - |
| lYd_BZ | ADF | -1.73 | -1.06 | 3.98 | -3.24** | -3.75** | -2.05** | - | - | - |
| lYd_BZ | Max. DF | -0.9 | -1.98 | - | -3.08*** | -3.66** | - | - | - | - |
| lYd_BZ | PP | -1.64 | -1.19 | 3.13 | -3.23** | -3.75** | -1.95* | - | - | - |
| lYr_BZ | ADF | -3.33** | -3.36* | -0.52 | - | - | -3.07*** | - | - | - |
| lYr_BZ | Max. DF | -3.31*** | -3.56** | - | - | - | - | - | - | - |
| lYr_BZ | PP | -2.32 | -2.32 | -0.52 | -2.83* | -2.47 | -2.96*** | - | -5.48*** | - |
| | | | | | | | | | | |
| lMqd_DOM | ADF | -3.55*** | -5.06*** | 0.93 | - | - | -4.34*** | - | - | - |
| lMqd_DOM | Max. DF | -1.86* | -4.88** | - | - | - | - | - | - | - |
| lMqd_DOM | PP | -1.72 | -2.3 | 0.63 | -2.93* | -2.73 | -2.86*** | - | -3.54* | - |
| lREER_DOM | ADF | 0.6 | -2.11 | 2.42 | -4.7*** | -4.23** | -3.77*** | - | - | - |
| lREER_DOM | Max. DF | 0.55 | -2.05 | - | -4.78*** | -4.33*** | - | - | - | - |
| lREER_DOM | PP | 1.68 | -1.91 | 2.86 | -4.78*** | -8.22*** | -3.77*** | - | - | - |
| lYd_DOM | ADF | -5.5*** | -1.92 | 1.23 | - | -3.9** | -1.55 | - | - | -6.23*** |
| lYd_DOM | Max. DF | -0.43 | -1.65 | - | -2.01** | -3.16** | - | - | - | - |
| lYd_DOM | PP | -5.05*** | -1.85 | 3.15 | - | -3 | -1.55 | - | -7.53*** | -6.37*** |
| lYr_DOM | ADF | -1.2 | -1.7 | -1.23 | -4.03*** | -4.32** | -3.89*** | - | - | - |
| lYr_DOM | Max. DF | -1.17 | -1.87 | - | -4.0*** | -4.75*** | - | - | - | - |
| lYr_DOM | PP | -1.32 | -1.87 | -1.28 | -4.03*** | -3.93** | -4.0*** | - | - | - |
| | | | | | | | | | | |
| lMqd_GRE | ADF | -1.3 | -3.28 | 1.9 | -6.00*** | -5.88*** | -5.12*** | - | - | - |
| lMqd_GRE | Max. DF | -0.81 | -3.24** | - | -5.86*** | - | - | - | - | - |
| lMqd_GRE | PP | -1.63 | -3.34 | 1.9 | -6.05*** | -5.9*** | -5.1*** | - | - | - |
| lREER_GRE | ADF | -2.43 | -2.44 | 2.03 | -3.8*** | -4.05** | -3.32*** | - | - | - |
| lREER_GRE | Max. DF | -1.1 | -2.2 | - | -3.9*** | -4.24*** | - | - | - | - |
| lREER_GRE | PP | -3.36** | -2.97 | 1.97 | - | -4.00** | -3.26*** | - | - | - |
| lYd_GRE | ADF | -3.92*** | -2.31 | 1.5 | - | -6.35*** | -1.92* | - | - | - |
| lYd_GRE | Max. DF | 0.32 | -1.77 | - | -2.1** | -6.49*** | - | - | - | - |
| lYd_GRE | PP | -3.39** | -2.31 | 4.49 | - | -6.21*** | -2.5** | - | - | - |
| lYr_GRE | ADF | -0.42 | -2.49 | -0.75 | -3.83*** | -4.06** | -3.9*** | - | - | - |
| lYr_GRE | Max. DF | -0.81 | -1.71 | - | -3.87*** | -4.59*** | - | - | - | - |
| lYr_GRE | PP | -1.13 | -2.14 | -0.89 | -5.34*** | -5.43*** | -5.35*** | - | - | - |
| | | | | | | | | | | |
| lMqd_GY | ADF | -2.19 | -1.34 | -0.12 | -5.81*** | -6.77*** | -5.95*** | - | - | - |
| lMqd_GY | Max. DF | -1.83* | -2.09 | - | - | -6.28*** | - | - | - | - |
| lMqd_GY | PP | 2.2 | -0.69 | -0.12 | -5.81*** | -8.15*** | -5.95*** | - | - | - |
| lREER_GY | ADF | -4.39*** | -6.63*** | 0.73 | - | - | -2.46** | - | - | - |
| lREER_GY | Max. DF | 1.93* | -2.82 | - | - | -2.52 | - | - | -7.13*** | - |
| lREER_GY | PP | -2.55 | -2.88 | 1.23 | -7.42*** | -10.27*** | -6.81*** | - | - | - |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| lYd_GY | ADF | -3.84*** | -2.94 | 0.32 | - | -2.51 | -0.87 | - | -11.05*** | -11.46*** |
| lYd_GY | Max. DF | -1.73* | -2.9* | - | - | - | - | - | - | - |
| lYd_GY | PP | -2.33* | -0.67 | 2.07 | - | -4.39** | -2.23** | - | - | - |
| lYr_GY | ADF | -16.34*** | -9.56*** | -1.95** | - | - | - | - | - | - |
| lYr_GY | Max. DF | -1.43 | -1.8 | - | -2.89*** | -3.05* | - | - | - | - |
| lYr_GY | PP | -1.75 | -1.13 | -2.07** | -3.03** | -3.28* | - | - | - | - |

| TABLE : UNIT ROOT TEST RESULTS cont'd | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **VARIABLE** | **METHOD OF UNIT ROOT TEST** | **LEVEL** | | | **1st DIFFERENCE** | | | **2nd DIFFERENCE** | | |
| lMqd_JAM | ADF | -0.88 | 0.62 | -0.94 | 0.1 | -0.06 | -0.08 | 1 | 0.5 | 0.93 |
| lMqd_JAM | Max. DF | -1.16 | -1.72 | - | -0.97 | -1.84 | - | -1.17 | -2.18 | - |
| lMqd_JAM | PP | -0.88 | 0.62 | -0.94 | 0.1 | -0.06 | -0.08 | -1.09 | -1.18 | -1.06 |
| lREER_JAM | ADF | -2.03 | -3.44* | -0.31 | -2.94* | - | -3.03*** | - | - | - |
| lREER_JAM | Max. DF | -2.16** | -3.35** | - | - | - | - | - | - | - |
| lREER_JAM | PP | -1.52 | -2.12 | 0.42 | -3.91** | -3.76** | -3.92*** | - | - | - |
| lYd_JAM | ADF | -2.05 | -0.96 | 1.38 | -2.13 | -2.88 | -1.1 | -2.61* | -2.58 | -2.69* |
| lYd_JAM | Max. DF | -0.76 | -2.82 | - | -2.2** | -2.91* | - | - | - | - |
| lYd_JAM | PP | -1.53 | -0.71 | 3.6 | -1.48 | -1.75 | -1.01 | -2.64 | -2.5 | -2.71*** |
| lYr_JAM | ADF | -1.3 | -3.29* | -1.2 | -6.22*** | - | -6.12*** | - | - | - |
| lYr_JAM | Max. DF | -1.23 | -3.14* | - | -6.2*** | - | - | - | - | - |
| lYr_JAM | PP | -1.22 | -3.04 | -1.32 | -6.14*** | -6.04*** | -6.04*** | - | - | - |
| | | | | | | | | | | |
| lMqd_SKN | ADF | -1.85 | -2.11 | 0.3 | -4.14*** | -4.04** | -4.13*** | - | - | - |
| lMqd_SKN | Max. DF | -1.85 | -2.11 | 0.3 | -4.14*** | -4.04** | -4.13*** | - | - | - |
| lMqd_SKN | PP | -1.93 | -2.23 | 0.3 | -4.14*** | -4.04** | -4.13*** | - | - | - |
| lREER_SKN | ADF | -1.85 | -1.74 | 0.01 | -4.10*** | -5.08*** | -4.23*** | - | - | - |
| lREER_SKN | Max. DF | -1.48 | -1.72 | - | -4.22*** | -5.35*** | - | - | - | - |
| lREER_SKN | PP | -1.88 | -1.63 | 0.01 | -4.09*** | -5.08*** | -4.22*** | - | - | - |
| lYd_SKN | ADF | -3.61** | -2.38 | 8.09 | - | -3.58* | -1.17 | - | - | -7.34*** |
| lYd_SKN | Max. DF | 0.64 | -1.69 | - | -2.82*** | -3.76** | - | - | - | - |
| lYd_SKN | PP | -3.58** | -2.44 | 5.32 | - | -3.60* | -0.92 | - | - | -8.87*** |
| lYr_SKN | ADF | -1.31 | -1.83 | -0.95 | -4.57*** | -4.64*** | -4.67*** | - | - | - |
| lYr_SKN | Max. DF | -1.38 | -1.92 | - | -4.57*** | -4.76** | - | - | - | - |
| lYr_SKN | PP | -1.31 | -1.83 | -0.95 | -4.59*** | -5.05*** | -4.67*** | - | - | - |
| | | | | | | | | | | |
| lMqd_SLU | ADF | -4.06*** | -3.41 | 1.1 | - | -4.24*** | -3.66*** | - | - | - |
| lMqd_SLU | Max. DF | -1.71* | -2.05 | - | - | -4.44*** | - | - | - | - |
| lMqd_SLU | PP | -3.65** | -2.59 | -1 | - | -4.25** | -3.65*** | - | - | - |
| lREER_SLU | ADF | -0.66 | -0.35 | -1.05 | -0.85 | -1.4 | -0.72 | -4.72*** | -5.08*** | -4.65*** |
| lREER_SLU | Max. DF | -1.23 | -1.91 | - | 1.11 | -2.04 | - | -4.8*** | -5.32*** | - |
| lREER_SLU | PP | 0.7 | 1.75 | -0.92 | -0.85 | -1.48 | -0.72 | -4.72*** | -5.18*** | -4.66*** |
| lYd_SLU | ADF | -7.74*** | -2.78 | 1.74 | - | -3.32* | -1.66* | - | - | - |
| lYd_SLU | Max. DF | -0.17 | -1.69 | - | -2.5** | -3.53** | - | - | - | - |
| lYd_SLU | PP | -4.71*** | -2.78 | 3.81 | - | -3.31* | -1.48 | - | - | -8.27*** |
| lYr_SLU | ADF | -2.52 | -0.71 | -1.13 | -3.09** | -3.25* | -3.17*** | - | - | - |
| lYr_SLU | Max. DF | -1.45 | -1.62 | - | -2.68*** | -3.08** | - | - | - | - |
| lYr_SLU | PP | -1.24 | -1.17 | -0.89 | -3.03** | -3.4 | -3.14*** | - | -6.81*** | - |
| | | | | | | | | | | |
| lMqd_SVG | ADF | -1.13 | -1.92 | 1.49 | -4.58*** | -4.46*** | -4.16*** | - | - | - |
| lMqd_SVG | Max. DF | -0.71 | -1.2 | - | -4.7*** | -4.7*** | - | - | - | - |
| lMqd_SVG | PP | -1.1 | -1.96 | 1.49 | -4.58*** | -4.45** | -4.16*** | - | - | - |
| lREER_SVG | ADF | -1.92 | -2.39 | 1.33 | -4.45*** | -4.41*** | -4.26*** | - | - | - |
| lREER_SVG | Max. DF | -1.21 | -2.42 | - | -4.52*** | -4.62*** | - | - | - | - |
| lREER_SVG | PP | -1.91 | -2.45 | 1.41 | -4.45*** | -4.41** | -4.26*** | - | - | - |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| lYd_SVG | ADF | -2.67* | -2.18 | 7.78 | - | -3.36* | -0.88 | - | - | -8.45*** |
| lYd_SVG | Max. DF | 0.55 | -1.66 | - | -2.99*** | -3.51** | - | - | - | - |
| lYd_SVG | PP | -2.45 | -2.15 | 5.21 | -2.95* | -3.51* | -0.75 | - | - | -8.95*** |
| lYr_SVG | ADF | -2.19 | -2.01 | -1.4 | -3.8*** | -3.71** | -3.9*** | - | - | - |
| lYr_SVG | Max. DF | -1.66* | -1.89 | - | - | -3.76** | - | - | - | - |
| lYr_SVG | PP | -2.34 | -2.21 | -1.32 | -3.76** | -3.66** | -3.87*** | - | - | - |

| TABLE : UNIT ROOT TEST RESULTS cont'd | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **VARIABLE** | **METHOD OF UNIT ROOT TEST** | **LEVEL** | | | **1st DIFFERENCE** | | | **2nd DIFFERENCE** | | |
| lMqd_TT | ADF | -0.88 | -3.06 | 0.47 | -5.84*** | -5.59*** | -5.67*** | - | - | - |
| lMqd_TT | Max. DF | -0.94 | -2.73 | - | -4.38*** | -5.71*** | - | - | - | - |
| lMqd_TT | PP | -0.77 | -3.06 | 0.56 | -5.84*** | -5.59*** | -5.62*** | - | - | - |
| lREER_TT | ADF | -3.15** | -2.3 | 0.47 | - | -7.11*** | -5.38*** | - | - | - |
| lREER_TT | Max. DF | -1.97** | -2.21 | - | - | -7.2*** | - | - | - | - |
| lREER_TT | PP | -3.15** | -2.14 | 0.47 | - | -6.91*** | -5.36*** | - | - | - |
| lYd_TT | ADF | 3.36 | -1.63 | 5.38 | -2.93* | -4.19** | -1.33 | - | - | -4.08*** |
| lYd_TT | Max. DF | 0.39 | -1.5 | - | -2.75*** | -4.57*** | - | - | - | - |
| lYd_TT | PP | 4.16 | -1.59 | 4.69 | 2.76* | -5.13*** | -1.07 | - | - | -7.43*** |
| lYr_TT | ADF | -3.13** | -0.66 | -10.36*** | - | -18.92*** | - | - | - | - |
| lYr_TT | Max. DF | -1.61 | -4.21*** | - | -4.29*** | - | - | - | - | - |
| lYr_TT | PP | -1.63 | -2.97 | -0.96 | -4.47*** | -4.53*** | -4.58*** | - | - | - |

NOTE: - *** : 1%
** : 5%
* : 10%