

Online Publication Date: 15th June 2012
Publisher: Asian Economic and Social Society



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Citation: Santiago Grullón (2012) "A Co-integration Analysis of the Dominican Republic's Aggregate Import Demand Function under a Floating Exchange Rate Regime", Asian Economic and Financial Review, Vol. 2, No. 2, pp. 282-289.



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Abstract

This paper presents an empirical examination of the responsiveness of aggregate imports to variations in relative prices and domestic economic activity in the Dominican Republic under a floating exchange rate regime implemented in 1985. Using the 'bounds' testing approach to co-integration of Pesaran et al. (2001) and a method developed by Bårdsen (1989) to derive long-run price and income elasticities of import demand for the period of 1985-2005, the findings show the existence of a co-integration relationship between imports, relative prices and domestic income. Total imports have a long-run price demand elasticity of -1.61, indicating that relative prices have a strong effect on their demand and thus signifying that the demand for imports is strongly affected by domestic inflationary pressures. Moreover, the long-run domestic income demand elasticity is +1.24, demonstrating that imports are strongly affected by domestic economic activity. This latter result is shown to have important implications for sustainable economic growth in the Dominican Republic, particularly in the light of its recent membership in the Central American Free Trade Agreement (DR-CAFTA).

Introduction

In the early 1980's in response to a deceleration of growth and balance of payments difficulties attributed to trade distortions caused by an inward-oriented model - in which a market-determined exchange rate (applying to imports of consumer goods) and a fixed exchange rate (pertaining to some imports of capital and intermediate goods) existed simultaneously - the government of the Dominican Republic began to put into practice various measures designed to reduced the demand for imports of substitutable non-capital goods (World Bank 1985). Initially, this involved the transfer of various categories of previously-subsidized imports under the fixed-parity exchange rate system between the peso and U.S. dollar to a flexible-market-determined exchange rate system (Serulle and Boin, 1984:299). Because the market-determined exchange rate was more expensive than the government-established rate, the transfer of various categories of imports from the fixed to the flexible-exchange rate

system was designed to reduce the demand for foreign-produced goods. However, the key component of this regime-switch originated with the signing in 1983 of an International Monetary Fund (IMF) three-year extended fund facility (EFF) agreement which called for the implementation of various measures including the substitution of the fixed-parity exchange rate system by a floating-exchange rate regime, and the devaluation of the Dominican peso by replacing the fixed one-for-one exchange rate between the Dominican peso and the US dollar with a three-for-one exchange rate - which took effect in January 1985.

The devaluation of the Dominican currency was intended to make all foreign-made goods more expensive to Dominican residents, thereby reducing their importation and increasing domestic production. These changes in relative prices were the mechanism through which movements in the exchange rate were expected to reduce the demand for foreign-produced substitutable non-capital goods. Thus,

the aim of this paper is to quantify the responsiveness of imports to variations in relative prices and in domestic economic activity in the Dominican Republic under the floating exchange rate regime implemented in 1985. Toward this end we use the 'bounds' testing approach to co-integration of Pesaran et al. (2001) and a method developed by Bårdsen (1989) to derive long-run price and income demand elasticities for import demand.

Model Specification, Econometric Methodology, and Data Sources

In standard form, the import demand for a commodity *i* can be expressed by the following function:

$$M_i = f(P_i, P_j, Y) \dots \dots \dots (1)$$

where: *M_i* is the quantity of commodity *i* imported per unit of time, *P_i* is the price of commodity *i*, *P_j* is the price of competing commodity *j*, and *Y* is a measure of the purchasing power of consumers. Equation (1) allows us to identify three important characteristics of the standard demand equation. The first is that there exists an inverse relationship between the demand for commodity *i* and its price. Thus, a decrease (increase) in the price of commodity *i* will result in an increase (decrease) in the quantity demanded of this commodity, other things being equal.

Secondly, on the assumption of substitution between commodity *i* and commodity *j*, the price level effect of commodity *j* on the demand for commodity *i* is expected to be positive. That is, when the price of commodity *j* goes up consumers will reduce their consumption of commodity *j* and increase their consumption of commodity *i*. Thirdly, there exists a positive relationship between the quantity demanded of commodity *i* and the purchasing power of consumers. Thus, if there is an increase (decrease) in their income, consumers will be willing to purchase a larger (smaller) quantity of commodity *i* at all prices, other things being equal. If we assume that the values of the demand for commodity *i* follow a linear trend, then the relationship between import of commodity *i* and relative-price and

real income can be expressed by regressing the quantity of commodity *i* imported on the set of independent variables, all in period *t*. Thus,

$$M_i = a_0 + a_1(P_i/P_j) + a_2Y + u \dots \dots \dots (2)$$

It is expected that *a₁* will be negative and *a₂* positive. Despite its advantage, the functional form expressed by equation (2) suffers from two weaknesses (Goldstein and Khan 1976). First, when we measure the sensitivity of the demand function to a one percent change in any of its explanatory variables, the estimate of the degree of responsiveness can vary considerably at different points along the regression line. Second, sometimes time-series data follow a non-linear trend and hence the linearity assumption has to be abandoned. When this is the case, then it can be assumed that the data approximate a geometric progression by transforming the linear equation into a logarithmic equation. This allows the geometric progression to approximate a straight line.

For these reasons, many researchers prefer to use a logarithmic formulation of the import demand equation (Khan 1974; Goldstein and Khan 1976; Gafar 1988, 1995; Doroodian et al. 1994). Khan (ibidem), for instance, prefers the logarithmic form because it allows the dependent variable to react proportionately to a rise and fall in the independent variables. Because it imposes a relation of constant elasticity between the dependent variable and the explanatory variables, the log formulation avoids the problem of drastic variations in the elasticities as the dependent variable rises or falls (Khan ibidem). An elasticity measures the sensitivity of the demand function to a one percent change in one independent variable while all other variables are held constant. A large (small) elasticity implies that the demand function is very sensitive (insensitive) to a one percent change in one of the independent variables. The standard demand function is assumed to be homogeneous of degree zero in prices and income, which implies an absence of money illusion (Gafar 1988). Thus, if all prices and incomes, say, are doubled, real demand for commodity *i* will remain constant and only nominal values will vary. It follows that the demand for this commodity can be expressed in terms of real relative prices and real income

(Gafar *ibidem*). This specification imposes the restriction that the influences of the two price variables are equal in magnitude but opposite in sign (Doroodian et al.1994). Thus, in logarithmic form, Equation (2) takes the form of:

$$\log M_t = a_0 + a_1 \log(P_i/P_j) + a_2 \log Y + u_t \dots \dots (3)$$

The parameters a1 and a2 are the relative-price and income elasticities of demand, respectively.

The methodological framework for conducting the empirical analysis uses the recently developed ‘bounds’ testing approach to the analysis of level relationships of Pesaran et al. (2001). These researchers have developed a method for the analysis of time series that takes into consideration whether the variables under consideration are stationary or non-stationary. Failure to take into account the time series properties of the underlying variables can lead to spurious results and invalid inferences. One way to avoid the problems of ‘spurious results’ is to estimate a dynamic function which includes lagged dependent and independent variables, i.e., an error correction model (ECM).

Pesaran et al. (*ibidem*) have extended and formalized an unrestricted error correction model (UECM) to test for the existence of co-integration between the dependent variable and its determinants. The theoretical logic behind the concept of co-integration is that although the dependent variable and its determinant(s) may be individually non-stationary, over the long-run they will nonetheless tend to move together, so that a linear combination of them will be stationary (Engle and Granger 1987). Moreover, “[d]ata generated by such a model are sure to be co-integrated” (Granger 2004:422). This follows directly from Granger’s Representation Theorem which states that if the dependent variable and the independent variable(s) are co-integrated, then an ECM representation generates co-integrated series (Engle and Granger *ibidem*). According to Harris (1995:25), “the practical implications of Granger’s theorem for dynamic modelling is that it provides the ECM with immunity from the spurious regression problem, provided that the terms in levels co-integrate.” The UECM-

based bounds testing approach has been chosen to estimate the import demand function for the following reasons.

First, it does not require that the order of integration of the underlying regressors be ascertained prior to testing the existence of co-integration between the dependent variable and the independent variables. It thus eliminates the uncertainty associated with pre-testing the order of integration. Second, it can be applied to studies that have a small sample size, as is the case in the present inquiry. Several researchers applied this approach in relatively small sample sizes. Pattichis (1999) estimated a disaggregated import demand function for Cyprus employing annual data for 1975-1994 (twenty observations). Chang et al. (2005) calculated an import demand equation for South Korea using yearly data for 1980-2000 (twenty-one observations). Jeon (2009) employed the bounds testing approach to obtain estimates of the long-run income elasticity of demand for imports and exports in China for 1979-2002 (twenty-four observations). Thus, an import demand function for the Dominican Republic can be expressed within an Unrestricted Error Correction Model (UECM) as follows:

$$\Delta \log M = \alpha_0 + \alpha_1 \log(RPM)_{t-i} + \alpha_2 \log Y_{t-i} + \alpha_3 \log M_{t-i} + \sum_{i=0}^l \alpha_4 \Delta \log(RPM)_{t-i} + \sum_{i=0}^l \alpha_5 \Delta \log Y_{t-i} + \sum_{i=0}^l \alpha_6 \Delta \log M_{t-i} + u_t^{i=l} \dots \dots (4)$$

where Δ is the first difference operator, M is imports at constant 1970 Dominican pesos, RPM is the relative price of imports (ePf/Pd), defined as the ratio of the product of the nominal exchange rate between the D.R. peso and the U.S. dollar (e) and the price of imports (Pf) to the domestic price level expressed by the implicit price deflator of the Dominican gross domestic product (Pd). The variable Y is a measure of domestic economic activity - the gross domestic product of the Dominican Republic; and u is the error term.

In performing the UECM estimation, the maximum number of lags of the terms in levels is set equal to one, and on the first-differenced variables the process starts off from a maximum of three lags, then the optimum number is chosen based on the Akaike’s

Information Criterion (AIC), the Ramsey RESET test, and the adjusted R2. Thus, the formulation with the lowest AIC, the Ramsey RESET test results for the best-fit specification, and the highest adjusted R2 is selected. In Equation (4) and following Bårdsen (1989), the long-run elasticity derived for the relative-price variable (ψ) is $-(\alpha_1/\alpha_3)$ and for the measure of domestic economic activity (π) is $-(\alpha_2/\alpha_3)$. After estimating Equation (3) the Wald F-test is used to assess the significance of the lagged level explanatory variables by imposing the following restrictions:

$$H_o : \alpha_1 = \alpha_2 = \alpha_3 = 0 \text{ (no co-integration exists)}$$

$$H_A : \alpha_1 \neq \alpha_2 \neq \alpha_3 \neq 0 \text{ (co-integration exists)}$$

Pesaran et al. (2001) provide two sets of critical value bounds covering the two polar cases of the included lagged level explanatory variables (see Table A1 in the Appendix). If the computed Wald F-statistic falls below the lower bound, for example, then this would lead us to conclude that there is no co-integration between the terms in levels. If, on the other hand, the computed F-statistic exceeds the upper bound of the critical value, then the alternative hypothesis of co-integration between the terms in levels will be accepted.

The empirical analysis uses annual statistics. Following Serrano et al. (1999) the data used in the econometric analysis were converted into index numbers with 1985 = 100. Data on the Dominican Republic's gross domestic product (Y) and total imports of goods and services (M) were downloaded from the Dominican Central Bank's web site. They are available in current and in constant 1970 pesos and have been used to calculate the implicit GDP deflator, and the import price index. Data on the exchange rate between the Dominican peso and the United States dollar are from the International Monetary Fund's International Financial Statistics Yearbook.

Empirical Results

The results of estimating the import demand function are presented in Table 1. The Wald F-statistic is 22.88 and exceeds the upper bounds value at each of the three levels of significance

(see Table A1 in the Appendix). Accordingly, this result indicates that there exists a co-integrated relationship between the growth of the economy, relative prices, and imports. The estimated long-run price elasticity of import demand of -1.61 shows that a one

Table 1: Price (ψ) and Income Elasticities (π) and Wald F Test of Imports Demand: Summary

Price (Ψ)	-1.61
Income (π)	1.24
Wald F Test	22.88

percent change in relative prices produces an opposite effect of 1.61 percent on total imports. Hence, imports are strongly responsive to relative-price variations. The estimated long-run domestic income elasticity of import demand indicates that a one percent rise in domestic economic activity produces a 1.24 percent increase on total imports, and thus shows that imports are strongly affected by domestic economic activity.

The above-unity long-run price elasticity of demand for imports shows that imports are highly responsive to relative price variations, which in turn indicates that the demand for imports is strongly affected by domestic inflationary pressures. Thus, and according to Tang and Nair (2002:295), any rise in domestic inflation would have a direct upward impact on the volume of imports. This notion proves to be valid for the Dominican Republic. Table A3 presents data on the GDP price deflator, total imports, and gross domestic product for 1960-2005. During the period of interest, the GDP deflator expanded at an annual average rate of 19.2 percent. That is, at more than twice the rate of expansion posted in the course of the period of 1960-1984 during which the growth model was based on an import-substitution strategy. Moreover, imports expanded at a higher rate during the 1985-2005 period than during the previous interval, despite a lower average rate of economic growth.

Summary and Conclusions

This paper presented an empirical examination of the Dominican Republic's import demand function. Using the 'bounds' testing approach

to co-integration of Pesaran et al. (2001), the results indicate that there exist a long-run equilibrium relationship between total imports, relative prices and domestic income. The estimated long-run price elasticity of imports (-1.61) has the expected sign and indicates that relative prices exert an above-unity effect on imports, which indicates that the demand for imports is highly responsive to domestic inflationary pressures. Furthermore, the estimated long-run domestic income demand elasticity is above unity, and thus shows that imports are strongly affected by domestic economic activity.

These conclusions have important implications for the potential adverse effects of trade liberalization on the Dominican Republic's merchandise and service account, especially in the light of its recent membership in a regional economic integration agreement between the United States, Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua. The

Dominican Republic-Central American Free Trade Agreement (DR-CAFTA) calls for the immediate elimination of tariffs on more than 80 percent of United States exports of consumer, agricultural and industrial products to the participating countries, with the rest to be phased out over the next 10 years. By opening up prematurely the Dominican market to imports of United States and other CAFTA agro-industrial and light consumer products, DR-CAFTA can, because of the high income elasticity of demand for imports and their high responsiveness to domestic price pressures, render local producers of these goods unable to compete with cheaper and better imports. Thus, this agreement has the potential to deal a substantial blow to the Dominican manufacturing sector by displacing small local import-competing chains of production that lack the capacity to survive entry into their markets by resource-rich large multinational corporations capable of competing both on better quality and lower prices.

Appendix A

Table A1: Critical Value Bounds for the Wald F-Statistic

Level of Significance	Lower Bound Value I(0)	Upper Bound Value I(1)
1%	5.15	6.36
5%	3.79	4.85
10%	3.17	4.14

Source: Pesaran et al. (2001), Table C1.iii:Case III: Unrestricted intercept and no trend.

Table A2: Estimated UECM for Total Imports, 1985-2005

Dependent Variable: Total Imports

Included observations: 18 after adjusting endpoints

Regressor	Coefficient	t-Statistic	Probability
Constant	8.78	8.11	0.00
LogY (-1)	1.64	4.86	0.00
LogRPM (-1)	-2.12	-7.99	0.00
LogM (-1)	-1.32	-5.96	0.00
DlogY(-2)	0.90	1.76	0.10
DlogRPM	-1.24	-8.78	0.00
Elasticity			
Price (Ψ)	-1.61		
Income (π)	1.24		
Model Criteria			
R^2	0.91		
Adjusted R^2	0.84		
DW	2.47		
SER	0.05		
Diagnostic Tests			
	[1]	[2]	[3]
Breusch-Godfrey LM	0.92 (0.36)	0.41 (0.68)	1.13 (0.40)
ARCH	1.18 (0.29)	0.74 (0.50)	0.88 (0.37)
Ramsey RESET			

Table A3: Growth Rate of GDP Deflator, Imports , and GDP (%) 1960-2005

Period

Period	GDP Deflator	Imports	GDP
(1)	(2)	(3)	(4)
1985-2005	19.2	11.0	4.3
1960-1984	8.0	8.0	5.7

Appendix – B

Chart B1: CUSUM Test for UECM for Total Imports, 1985-2005

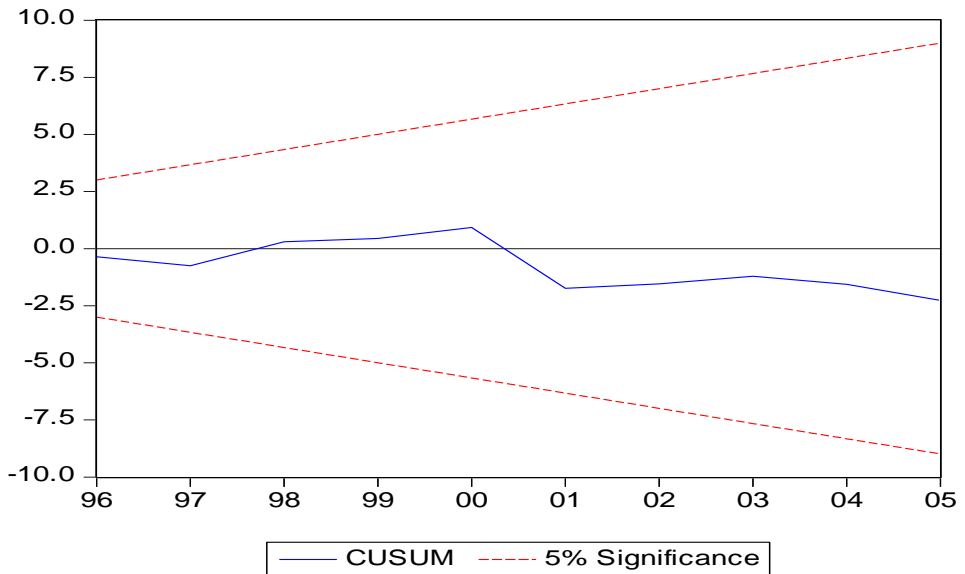
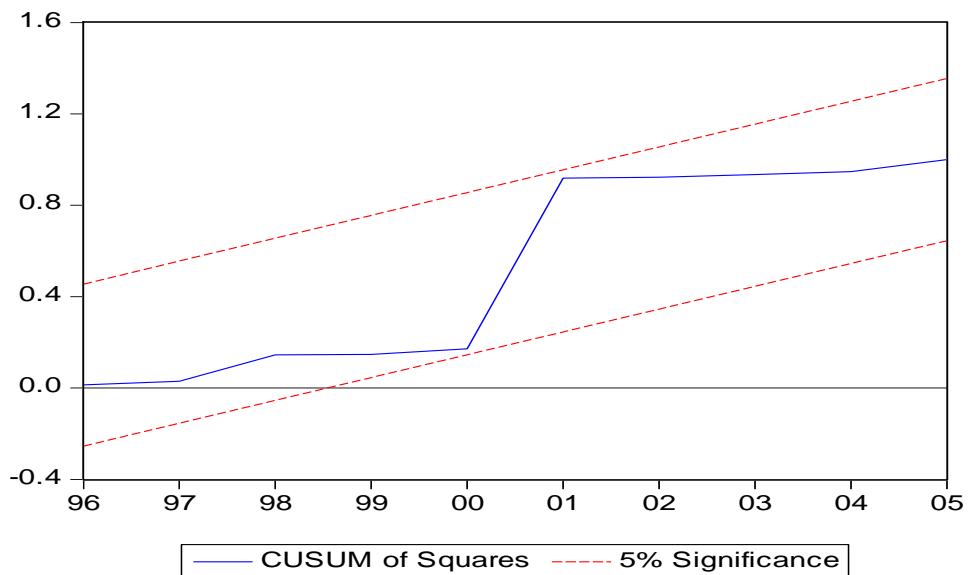


Chart B2: CUSUM of Squares Test for UECM for Total Imports, 1985-2005



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