A MICROECONOMIC APPROACH TO MODELLING IMPORT DEMAND

by

Winston Moore, Diego Morris

and

Kazon Simmons
Department of Economics
University of the West Indies
Cave Hill Campus
Bridgetown
BB11000, Barbados
Email: winston.moore@cavehill.uwi.edu
Tel.: 1 (246) 417-4279
Fax: 1 (246) 417-4260

Presented at the Annual Review Seminar
Research Department
Central Bank of Barbados
July 27-30, 2009

A MICROECONOMIC APPROACH TO MODELLING IMPORT DEMAND

By

Winston Moore[1]**, Diego Morris** and **Kazon Simmons**

ABSTRACT

The conventional import demand function relates the aggregate value of imports to aggregate income and some measure of relative prices. This paper estimates models of the long-run import demand for 92 products imported into Barbados. The approach allows the authors to compare the income and price elasticities of demand for various products. The results should be of use to trade analysts and businesspersons.

***JEL Classification*:** F1; D1; O54

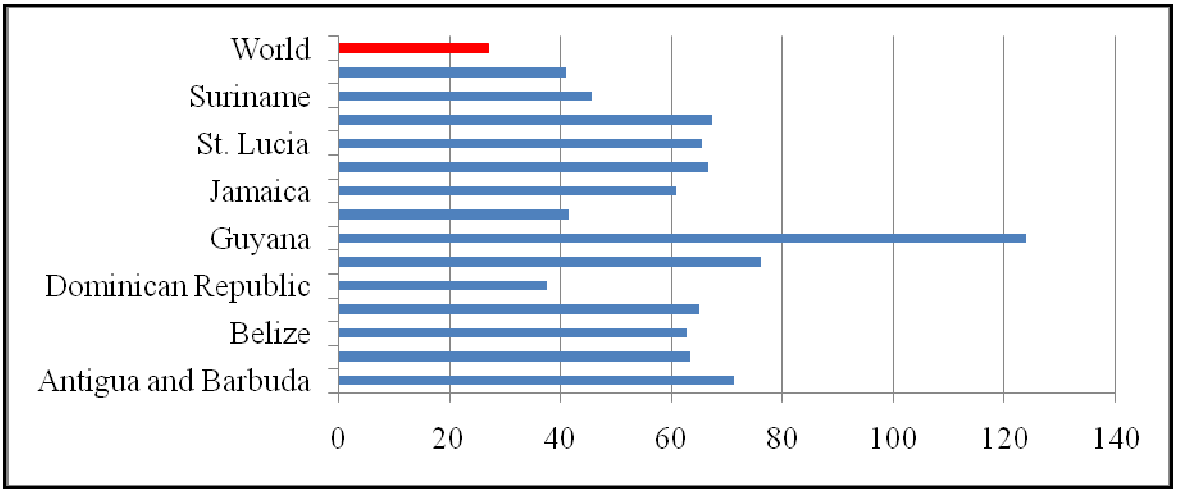
***Keywords**:* Imports; Demand; Elasticity; Caribbean

[1] Corresponding Author: Winsotn Moore, Department of Economics, University of the West Indies, Cave Hill Campus, Bridgetown, BB11000, Barbados. Tel.: +246-4174279; Fax:+246-4174260; Email: winston.moore@cavehill.edu.bb

1. Introduction

Imports are a key component of all Caribbean economies. Given the limited availability of natural resources in the Caribbean imports are key inputs for regional industries, particularly tourism. James (2006) notes that positive effects of imports on growth can be advanced if import productivity increases as well as if the rate of investment in domestic capital relative to the import intensive sectors increases. Figure 1 plots the ratio of imports of goods and services to GDP for 14 Caribbean territories in 2005. On average imports of goods and services, represent about 64 percent of GDP, 37 percent percentage points above the average for the world. In Guyana, the ratio reached as high as 124 percent, with most of the other countries falling in the 60 to 80 percent of GDP range.

Figure 1: Imports of Goods and Services (% of GDP, 2005)



Source: World Development Indicators Online

Given the importance of imports to regional economies, it is important to understand the factors that influence import demand in the Caribbean. Gafar (1995) estimated income elasticities for three Caribbean countries (Guyana, Jamaica and Trinidad and Tobago) and found that relative prices and real income were the most important determinants of aggregate import growth in the Caribbean. Similar results were obtained by Maxwell and Moore (2004) using panel cointegration techniques and annual observations on 12 Caribbean countries. Birchwood and Jhinkoo (2007) tested the hypothesis of James (2006) that there is link between economic

development and the elasticity of demand of imports. The authors reported that in most countries the income elasticity fell below unity, suggesting that most countries were import elastic.

Much of the previous literature on import demand in the Caribbean and abroad has been either country-specific or looked at import demand for particular regions (see Deyak et al., (1989) for a review of the literature for the US and other developed countries). Building on this literature, this study attempts to provide a product-level assessment of import demand in Barbados using monthly observations on 92 products at the SITC level between January 2000 and September 2008. Furthermore, it expands the analysis by examining the impact of duties on the importing patterns for these products.

There is good reason to think that import demand should be assessed at the product-level rather than at the aggregate level. This is most evidenced by the fact that many previous studies have found that estimates of aggregate import demand have been characterised by parameter instability (Bahmani-Oskooee and Rhee, 1997; Zietz and Pemberton, 1993; Mah, 1993). It is very possible that this parameter instability could be driven by changes in the underlying import demand for particular products or the inclusion of new products in the individual's consumption bundle.

Product-level estimates of import demand are particular useful for policy purposes. Trade negotiators may utilise the estimates provided in this study to conduct simulations of the potential impact of tariff changes. The study's findings may also be employed to illustrate the countries or region(s) with which there is greater need for negotiations as they may represent source markets for respective goods. Fiscal authorities may also find the estimates useful for forecasting future trade tax receipts as well as the effects of tariff harmonisation.

The current study is most closely related to Shiells (1991) which estimates disaggregated import demand functions for the US to test the errors that may result from using unit-value indexes as measures of import prices. The present study differs from Shiells in three main areas: (1) the

analysis covers a greater number of products; (2) more detailed level of product disaggregation is attempted, and; (3) an attempt is made to model the variance of import demand.

The remainder of this study is structured as follows: following the introduction, section 2 provides an assessment of the product-level trends in imports in Barbados between January 2000 and September 2008. Section 3 outlines the methodological approach employed to estimate the disaggregated import demand functions, while section 4 provides an assessment of the results. Section 5 concludes with a summary of the main findings and the policy implications of the results.

2. Data

The study uses disaggregated monthly observations on imports at the 4-digit SITC level for 92 products between January 2000 and September 2008. For each product, the ratio of import values to import quantities is employed as a proxy for the import price of each product. Domestic prices are taken from the retail price index database of the Barbados Statistical Service. All prices are in local currency terms (Barbados' exchange rate is fixed to the US dollar). Data on the actual applied duties was taken from customs database obtained from the Barbados Statistical Service. Real gross domestic product, obtained from the Central Bank of Barbados, is employed as the proxy for domestic activity.

Figure 1: Log of Net Imports of Durable and Non-Durable Goods January 2000 to September 2008

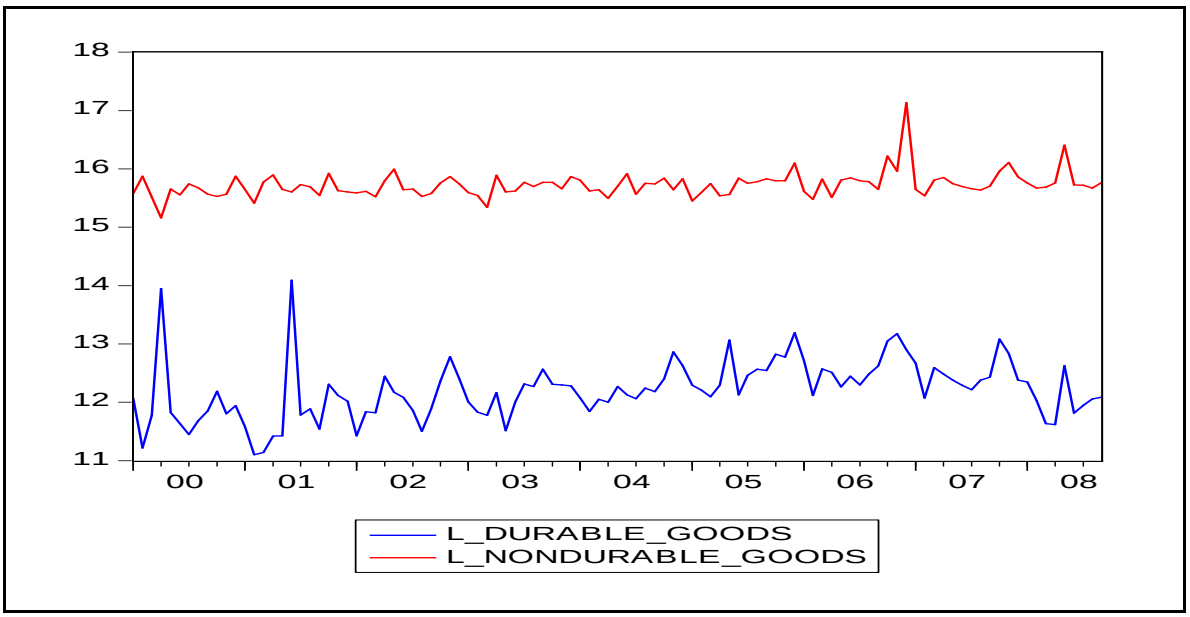


Figure 1 provides a graphical representation the imported quantity durable and non-durable goods. These series are smoothed using the logarithmic transformation. The plotted series suggest that durable goods imports tend to be more volatile than that for non-durables. This could indicate that retailers tend to order non-durable goods on regular basis, while non-durables may only be reordered when stocks reach some minimum threshold.

The greater volatility for durable goods imports is reflected by the relatively higher standard deviation of the durable goods series (0.51) relative to that for non-durables. The skewness and kurtosis of both series depart significant from that expected from a series that is normally distributed. The calculated skewness for non-durable goods was 2.71, while the kurtosis was 18.3. While the skewness of the durable goods was relatively close to zero (0.71), the kurtosis for the series was 4.83. The Jarque-Bera test confirms that both series are non-normal.

Table 1: Descriptive Statistics for Durable and Non-Durable Goods Imports

	Goods	
	Durable	**Non-durable**
Mean	12.21	15.73
Median	12.19	15.71
Maximum	14.09	17.14
Minimum	11.10	15.16
Std. Dev.	0.51	0.22
Skewness	0.70	2.71
Kurtosis	4.83	18.30
Jarque-Bera	23.30	1,152.86
Probability	0.00	0.00
Sum	1,282.21	1,651.18
Sum Sq. Dev.	26.82	5.06
Observations	105.00	105.00

3. Methodology

If there are $i = 1,2,\ldots,k$ products, traditional import demand equations usually relate real imports (m) to real income (y) and the ratio of import prices (P_m) to domestic prices (P_d). Assuming a log-linear specification, this study deviates from the norm and estimates the import demand function as:

$$m_{it} = \alpha_i + \beta_i\, y_{it} + \gamma_i \left(\frac{p_m}{p_d} \right)_{it} + \phi_i\, d_{it} + \varepsilon_{it} \qquad (1)$$

Where, β and γ are the income and relative prices elasticities of demand, respectively, d_{it} represents the duties applied on each product, while ε is an error term which is assumed to be normally distributed with a zero mean and a constant variance. Equation (1) is estimated for each of the 92 products under the assumption that expenditure shares are constant fractions of total expenditure.

Given the relatively high frequency of the data employed, the level of disaggregation of imports utilised in the study and shifts in taste and preferences the ordinary least squares assumption of a zero mean and constant variance is unlikely to hold. If this is the case, one can either use "robust standard errors" or attempt to explicitly model the variance of the error terms. The variance of the error terms from Equation (1) represents import shocks that could have important effects on the balance of payments. As such, for this study an attempt is made to model the associated volatility. The variance of product level imports was modelled using the methodology of the Generalized Autoregressive Conditional Heteroskedasticity (GARCH). In general form, the GARCH (*p*, *q*) model can be written as:

$$\sigma_t^2 = \varpi + \sum_{j=1}^{p} \alpha_j \varepsilon_{t-j}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 \qquad (2)$$

Where, Equation (2) states that the conditional variance of imports depends on a constant (ϖ), the previous periods squared random component of imports (referred to as ARCH effects or the short-run persistence of shocks) and the previous period's variance (the contribution of shocks to long-run persistence, $\alpha + \beta$). Non-negativity of σ_t^2 requires that ϖ, α and β are non-negative, while stationarity requires that $\alpha + \beta < 1$.[2] A value of $\alpha + \beta$ close to zero therefore implies that volatility persistence is high. The GARCH model is suitable when large changes in real imports are expected to be followed by further large changes.

4. Results

The estimation results are presented in Table 1. Of the 92 products analysed, 50% had significant price elasticities, 63% had significant income elasticities and 66% had significant duties elasticities, at least at the 10% level. These proportions will be the focus for any further mention of the respective elasticities. The price elasticities were widely dispersed and had the expected negative signs except for six products (colour television, flying fish, herbicides, luncheon meat, portable radios and vacuum cleaners).

[2] It is also possible to consider so-called integrated GARCH models where $\alpha + \beta = 1$. However, in these models volatility shocks have permanent effects (see Engle and Bollerslev, 1986).

Examination of the income elasticities revealed that the sample comprised of 13 inferior goods, with luncheon meat (-25.269) having the largest elasticity of this group. Surprisingly, of the total, inferior goods - five can be classified as fruits and vegetables.

Table 1: Output Data

Products	Logged Coefficients		
	Duties	Price	Income
Aerated Beverages	0.044***	-0.223***	-0.199
Bacon	0.841***	-1.240***	-0.146
Bananas	-0.021	-0.478	-0.915***
Beef	0.028***	-0.639**	3.504***
Beets	0.999***	-0.551	7.807***
Black Pepper	0.013	-0.207**	-0.238
Blenders	-0.005	-0.302	6.143***
Broccoli	0.025***	-0.162***	3.790***
Brooms	-0.108	-0.612***	4.292
Brown Sugar	0.461***	-2.204***	-20.749***
Bulk Rice	-0.092	-1.547***	-0.950
Cabbages	-0.099***	-2.313***	1.129***
Canned Corn	-0.139***	-0.272	0.252
Canned Sausages	0.111	0.951	-6.860
Carrots	0.359***	-1.236***	1.978***
Cattle Feed	0.713***	1.135	20.009***
Cheese	-0.007	-0.100	-0.025
Color Televisions	0.064***	15.186***	2.712***
Condensed Milk	0.101***	-0.293	2.777***
Cooking Butter	0.054	-0.912***	2.451
Corn Flakes	-0.052	-1.381***	6.521***
Corn Oil	0.202***	-0.199	0.336
Corn Beef	0.175***	-0.585*	4.274**
Cucumbers	-0.063	-1.756***	-1.957
Curry Powder	0.114**	-0.310	1.654
Deep Freezers	0.113***	0.080	17.796***
Disinfectants	0.121***	0.020	-2.244**
Electric Irons	0.079***	-2.159***	2.693***
Electric Stoves	-0.023	0.708	3.928***
English Apples	-0.027**	-0.627**	-0.568
English Potatoes	0.034*	0.081	-0.147
Flavored Syrups	0.059	-1.016***	1.230
Flavoring Preparations	0.119***	0.024	1.425**
Flying Fish	0.004	1.718***	-7.772**
Food Preparations	-0.131***	-0.658***	6.836***
Gas Stoves	0.774***	-6.818	0.491

Products	Logged Coefficients		
	Duties	Price	Income
Grapefruits	0.693***	-0.936***	-0.550
Grapes	-0.067***	-0.177	-0.716**
Green Tea	0.066	-0.259*	4.500***
Herbicides	0.010	0.770**	1.106
Insecticides	0.004	-0.014	13.429***
Jams	-0.074**	-0.113	1.074
Lamb	0.011	-0.163	0.267
Lettuce	0.688***	-0.670***	-2.313***
Liquid Bleach	0.032***	-0.068	1.036**
Liquid Detergents	-0.179***	-0.055	7.631***
Luncheon Meat	0.132	2.132***	-25.269***
Mackerels	1.221***	-0.196***	-1.213
Malt Beverages	0.027	-1.705***	4.308***
Margarine	-0.102**	-1.018***	3.131**
Mayonnaise	0.137***	-0.113	0.557
Microwaves	0.089***	1.873	1.016
Mosquito Coils	0.355***	-0.290	-19.197***
Natural Honey	-0.358***	-0.028	2.518**
Oats	0.061***	0.019	7.544***
Onions	0.273***	-1.238**	3.366***
Orange Juice	-0.065***	-0.757***	-3.287***
Packaged Rice	0.046*	-1.807***	6.463***
Peanut Butter	0.087***	-0.365*	2.238
Pepper Sauce	0.007	-0.786***	7.531***
Pineapple Juice	-0.024	-0.819**	-6.757**
Plantains	0.019	-0.067	2.134***
Pork	0.000	-0.519	1.281
Portable Radios	0.575***	11.141**	4.611***
Poultry Feed	0.028	0.845	1.841
Powdered Detergents	0.074***	-0.056	0.472
Pumpkins	-0.122**	-0.842*	5.404***
Refrigerators	-0.066	1.560	2.422
Room Fans	0.121***	0.177	4.480***
Salmon	0.153***	-0.144	3.531***
Salted Pork	0.024*	-1.060***	1.955***
Sardines	0.211***	0.247	4.362
Sauce Condiments	0.355***	-0.104	1.971***
Sausages	0.053	0.229	2.119
Scouring Pads	-0.333***	-0.373***	0.807
Scouring Powder	0.245*	-0.592	4.380
Spices	0.109***	-0.467***	2.564***
Sweet Potatoes	0.116	-1.257	-12.569***

Products	Logged Coefficients		
	Duties	Price	Income
Sweetened Biscuits	0.426***	-0.257***	-1.486**
Table Butter	0.049	-0.822***	3.678***
Table Salt	-0.226***	-1.080***	3.383*
Tomato Ketchup	0.411***	-0.159	0.380
Tomato Sauce	0.077***	0.132	2.846***
Tomatoes	-0.335***	-0.539**	0.589
Tuna	0.015	-0.404***	3.040***
Turkey Wings	-0.017	-0.470	-1.964**
Unsweetened Biscuits	-0.013	-0.063	4.442***
Vacuum Cleaners	0.117***	4.818***	1.624**
Vegetable Oils	0.108***	-1.271***	6.723***
Washing Machines	0.488***	-0.471	5.788***
White Sugar	0.084***	0.145	0.852*
Yams	0.161***	-3.805***	-5.206***

5. Conclusions

This study investigates the import demand for 92 products on 4-digit SITC level between January 2000 and September 2008, using a GARCH (1,1) methodology. The results of this study have important policy and economic implications for suppliers, domestic producers, trade experts and business persons. Relatively high price elasticity for a product suggests that the competition surrounding this product is intense and therefore pricing strategy is important.

References

Bahmani-Oskooee, M. and Rhee, H-J. (1997) "Structural Change in Import Demand Behaviour, the Korean Experience: A Rexamination," *Journal of Policy Modeling*, Vol. 19(2): 187-193.

Birchwood, A. and Jhinkoo, J. (2007) "The Nexus between Economic Development and Import Demand in CARICOM Economies," paper presented at the 39th Annual Caribbean Centre for Monetary Studies Conference, Belize City, Belize.

Deyak, T.A., Sawyer, W.C. and Sprinkle, R.L. (1989) "An Empirical Examination of the Structural Stability of Disaggregated US Import Demand," *Review of Economics and Statistics*, Vol. 71(2): 337-341.

Gafar, J. (1995) "Some Estimates of the Price and Income Elasticities of Import Demand for Three Caribbean Countries," *Applied Economics*, Vol. 27(11): 1045-1048.

James, V. (2006) "Import Productivity Growth, Capital Deepening and Caribbean Development: Some Theoretical Insights," in Birchwood, A. and Seerattan, D., *Finance and Real Development in the Caribbean*, Caribbean Centre for Monetary Studies, Trinidad and Tobago.

Lewis-Bynoe, D., Griffith, J. and Moore, W.R. (2002) "Trade Liberalisation and the Manufacturing Sector: The Case of a Small Developing Country," *Contemporary Economic Policy*, Vol. 20: 272-287.

Mah, J.S. (1993) "Structural Change in Import Demand Behaviour: The Korean Experience," *Journal of Policy Modeling*, Vol. 15(2): 223-227.

Maxwell, C.T. and Moore, W.R. (2004) "External Price Competitiveness and Trade in the Caribbean," *Money Affairs*, Vol. 17(2): 137-154.

Shiells, C. (1991) “Errors in Import-Demand Estimates Based Upon Unit-Value Indexes,” *Review of Economics and Statistics*, Vol. 73(2): 378-382.

Zietz, J. and Pemberton, D.K. (1993) “Parameter Instability in Aggregate US Import Demand Functions,” *Journal of International Money and Finance*, Vol. 12(6): 654-667.