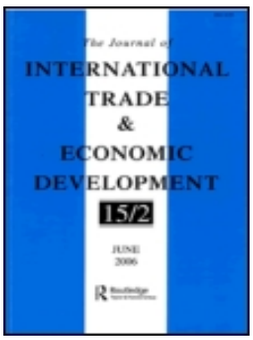

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Product-level estimation of import demand: Simulating the effects of tariff harmonisation

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Developing countries have traditionally used import tariffs to protect infant industries and raise revenues to finance government expenditure plans. This approach, however, has tended to protect inefficient industries and to some extent hindered economic development. A disaggregated import demand model is estimated using monthly observations on 91 of the most frequently imported product items in Barbados. The results are then employed to evaluate the feasibility of harmonising tariff rates to some single rate across product categories. The results suggest that the estimation of aggregate import demand equations is not accepted by the data and therefore could result in misleading inferences. The policy simulation exercise indicates that a single applied tariff at the 30% level would essentially be revenue neutral, while rates above this level would lead to reductions in tax receipts.

Keywords: imports; panel data; price elasticity; tariffs; trade reforms

1. Introduction

Imports are a key component of all Caribbean economies. Given the limited availability of natural resources in the Caribbean, imports are fundamental inputs for regional industries, particularly tourism. Imports can also positively affect economic growth if import productivity increases the rate of investment in domestic capital relative to the import intensive industries (James 2006). 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% of GDP, or about 37 percentage points higher than the average for the rest of the world. In Guyana, the ratio reached as high as 124%, with most of the other countries falling in the 60% to 80% of GDP range.

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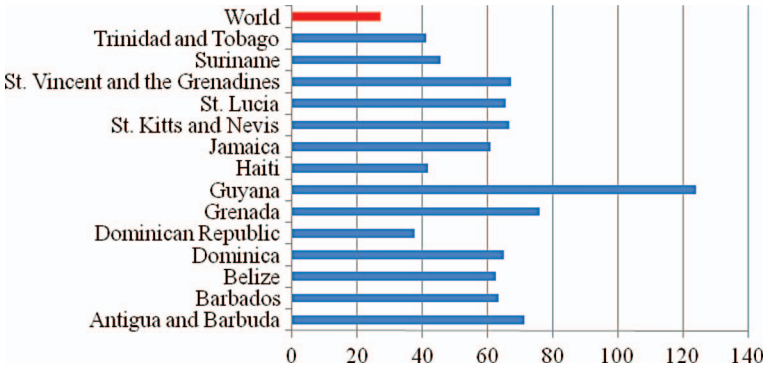

Figure 1. Imports of goods and services (% of GDP, 2005).
Source: World Development Indicators Online.

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 United States and other developed countries). Moreover, this interaction has tended to focus on employing differing econometric techniques to estimate aggregate demand functions. Building on this literature, this study attempts to provide a product-level assessment of import demand in Barbados using monthly observations on 91 products at the four-digit Standard International Trade Classification (SITC) level between January 2000 and September 2008.

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 (Mah 1993; Zietz and Pemberton 1993; Bahmani-Oskooee and Rhee 1997). 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 particularly 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, i.e. a single tariff rate applied to all imported products.

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 essential determinants of aggregate import growth in these territories. 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 a link between economic development and the elasticity of demand of imports. The authors reported that in most countries the income elasticity coefficient fell below unity, suggesting that the demand for imports is inelastic.

The current study is most closely related to Shiells (1991) which estimates disaggregated import demand functions for the United States to test the hypothesis that errors may result from using unit-value indexes as measures of import prices. In the study, the quantity of imports demanded for a given commodity group is regressed on current as well as lagged prices of imports and competing domestic goods, economic output and quarterly dummy variables to account for seasonality. The lags of imports and output are assumed to follow a gamma distribution. Estimating the model using autoregressive two-stage least-squares, Shiells reports that for most commodity groups the import price elasticity was negative and greater than one, while the output elasticity varied from commodity to commodity. Overall, the study suggested that using unit-value indices did not introduce significant bias into the regression results. The present study differs from Shiells (1991) in three main areas: (1) the model explicitly considers the effects of import duties, rather than subsuming them in import prices; (2) a panel estimation approach is employed, which allows the author to consider both the space and time dimensions; and (3) the results are utilised to consider the potential implications of tariff harmonisation.

The remainder of this article is structured accordingly: following the introduction, Section 2 outlines the methodological strategy employed to estimate the disaggregated import demand functions, while Section 3 offers an assessment of the product-level trends in imports in Barbados. Section 4 provides a discussion of the findings of the article. Finally, Section 5 summarises the main policy implications and concludes.

2. Econometric strategy

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). Estimating a traditional demand function for imports using this approach can be somewhat difficult due to the interaction between supply and demand. Murray and Ginman (1976), therefore, note that this problem has been traditionally solved by assuming that supply elasticity is infinite: an almost unlimited supply of a product or

service at a given price. Such an assumption is likely to hold if one is dealing with small open economy such as Barbados, which given its size is a price taker. Assuming a log-linear specification, this study therefore estimates the import demand function as:

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

where, β and γ are the income and relative prices elasticities of demand, respectively, ϕ is the elasticity of demand with respect to duties applied, 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. All estimated equations include seasonal dummy variables as well as an AR term. Equation (1) is estimated for each of the 91 products under the assumption that expenditure shares are constant fractions of total expenditure.

The model estimated above allows one to compare the responsiveness of various commodities to changes in income, prices and duties. It is expected that non-durable products, in general, should be less responsive to changes in both prices and income as theory suggest that the greater the percentage of income spent on a commodity, the greater its elasticity is likely to be. Because most durable items tend to represent a large proportion of the consumer's budget, the price elasticity of demand for these items should, on average, be higher than those for smaller budget non-durable items. Similarly, since duties magnify price changes, a similar reasoning should therefore be applied to the elasticity of imports relative to import duties. As most durable items can be considered luxuries, the income elasticity of demand for these items should, in general, be greater than that of non-durables.

Equation (1) allows the coefficients in the model to vary across each product group. This flexible specification permits the evaluation of a number of restrictions that are usually imposed when an aggregate import demand function is estimated. One of the main assumptions of this framework is that the coefficients of the import demand function can be restricted to some representative aggregate demand function. To test this hypothesis, we employed the test for poolability under the general assumption that $\varepsilon \sim N(0,\Omega)$ (see Baltagi 2005, 55–56). F-tests are also undertaken on price, income and the applied duties coefficients to check if they can be restricted across product groups.

The estimated model is then employed to conduct a simulation regarding the potential effects of tariff harmonisation on import demand and tariff receipts. This simulation assumes that the estimated coefficients presented are likely to remain unchanged, at least in the short term. Various tariff harmonisation levels are considered: (1) 10%; (2) 20%; (3) 30%; (4) 40%;

and (5) 50%. To account for any potential multiplier effects, income is increased by $\Delta y = \frac{1}{1-c}\Delta d$, where c is the marginal propensity to consumer, under the various tariff harmonisation scenarios. This income effect attempts to account for the impact of higher disposable incomes on the demand for imports.

3. Data sources and descriptive statistics

Disaggregated monthly observations on imports at the four-digit SITC level for 91 products between January 2000 and September 2008 are utilised in the study. The dataset represents 35% of the total consumer goods imported into the island. 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: BDS$2 = US$1). Data on the actual applied duties were 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 2 provides the kernel density graphs (non-parametric estimates of the probability density function) for all the variables used in the study. The density functions for all the variables do not have the shapes expected of normally distributed variables. In the case of product-level variables, real imports, price and applied tariffs follow a tent-shaped distribution. This preliminary analysis is in line with the calculated skewness and kurtosis statistics presented in Table 1. For all of the categories considered the skewness statistic is less than one indicating that the data are skewed to the left. There are particularly long left tails for beverages, breads and biscuits, feeding stuffs for animals and dairy product imports. Only in the case of chemical and related products is the measure of kurtosis close to three, for all the other product categories the relatively large kurtosis statistics suggests that importation of the respective product volume into the island have a peaked distribution.

In terms of the comparison between durable and non-durable goods, the statistics in Table 1 implies that durable goods imports tend to be less volatile than that for non-durables. The coefficient of variation for durable goods imports into the island was 0.131, compared to 0.216 non-durable goods imports. The finding that the volatility of durable goods is lower than that for non-durables is not surprising, as businesses tend to vary their orders for non-durables in an attempt to reduce losses due to spoilage. The skewness and kurtosis of both series depart significantly from that expected from a series that is normally distributed. The calculated skewness and kurtosis for non-durable goods were -1.267 and 8.874, respectively, while

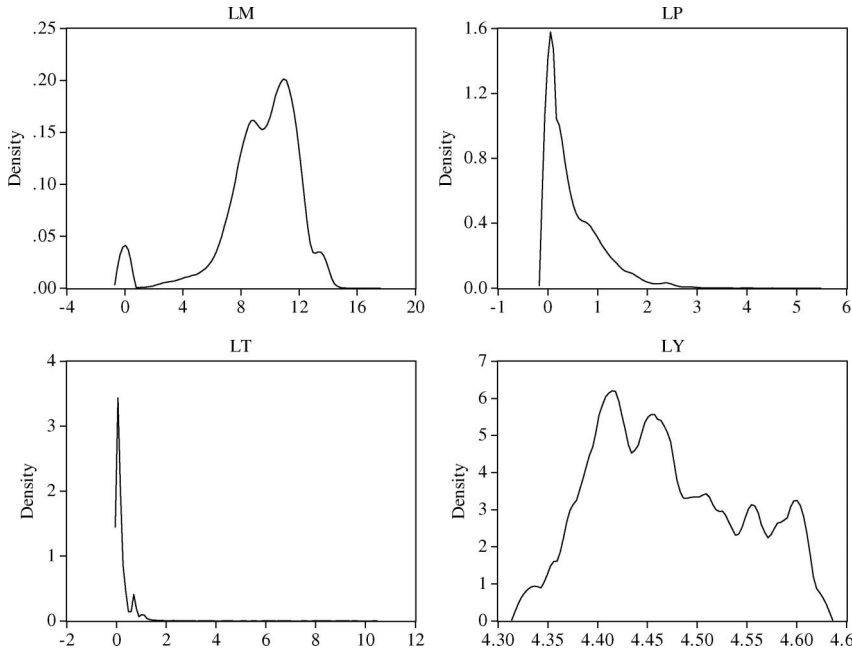

Figure 2. Kernel density graphs for real imports, relative import prices and duties applied.

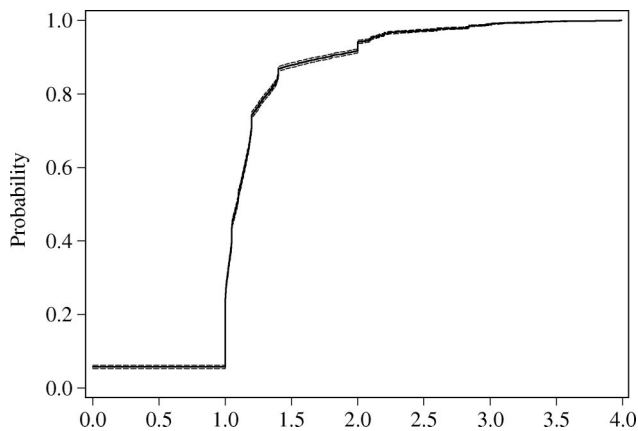

Figure 3. Empirical cumulative distribution of applied tariffs.

that of durable goods were −0.446 and 4.616. The Jarque-Bera test confirmed that both series are non-normal, suggesting that orders for imported goods are subject to infrequent extreme outliers. Figures 3 and 4

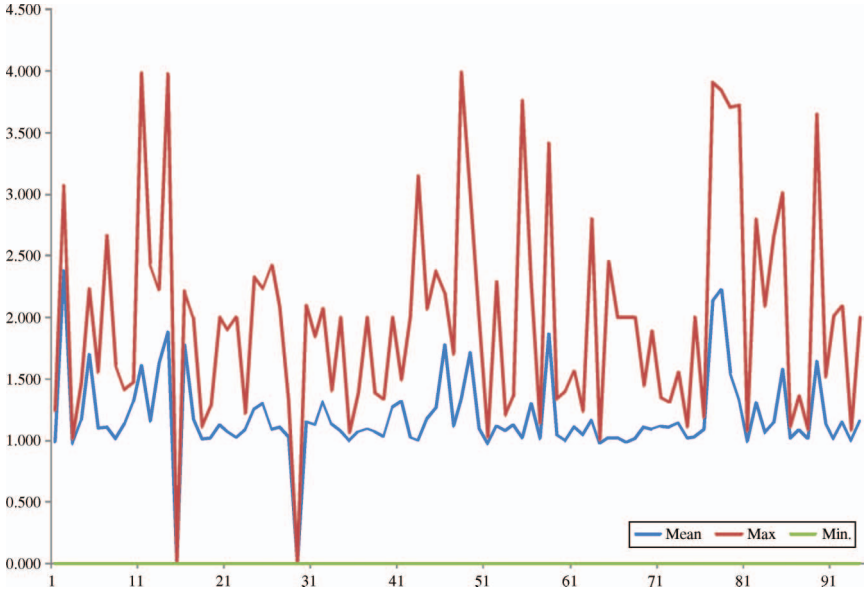

Figure 4. Maximum and minimum applied tariffs (1 + t) for various imported product categories.

suggest that most of the applied tarrifs tend to range between 0% and 60% over the review period, with the tarrifs on some items rising to above 200%.

To further evaluate the dynamic properties of the series, panel unit root statistics were calculated for the product-level series, real imports, relative prices and duties applied, while the usual time series augmented Dickey–Fuller (ADF) statistic was applied to income. Four panel unit root statistics (Levin, Lin and Chu t* 2002; Im, Pesaran and Chin w* 2003; ADF Fisher chi-square; and PP Fisher chi-square) were calculated and the results are provided in Table 2. The *p*-values provided in the table in square brackets suggest that the null hypothesis of a unit root in the series employed in this study could not be accepted at normal levels of testing.

4. Empirical findings

4.1. Estimated equation

The pooled import demand equation results, which are similar to the traditional aggregate demand function that would normally be estimated, are provided in Table 3. In accordance with *a priori* reasoning, the coefficient on the price and applied tariff variables are negative and statistically significant, while the null hypothesis that the income elasticity can be restricted to zero could not be rejected at normal levels of testing. These results suggest that increases in the prices and tariffs on imported

Table 1. Descriptive statistics for various import categories.

	Mean	Max.	Min.	Coef. Var.	Skew.	Kurt.	Obs.
Beverages	*10.772*	*13.061*	*5.788*	*0.107*	*−1.312*	*9.363*	*105.000*
Aerated beverages	13.437	14.338	11.665	0.035	−0.936	4.185	105.000
Flavoured preparations	10.588	11.746	8.108	0.059	−1.053	4.886	105.000
Flavoured syrups	8.768	12.470	6.957	0.135	1.306	4.319	105.000
Malted beverages	11.621	14.390	0.000	0.150	−4.338	26.491	105.000
Orange juice	10.906	12.647	7.996	0.082	−0.381	3.184	105.000
Pineapple juice	9.309	12.772	0.000	0.178	−2.469	13.114	105.000
Meats and fish	*9.156*	*11.782*	*4.151*	*0.245*	*−1.074*	*7.045*	*105.000*
Bacon	4.852	8.804	0.000	0.564	−0.577	2.229	105.000
Beef	11.661	13.351	9.824	0.044	−0.219	4.601	105.000
Corned beef	10.529	12.554	0.000	0.178	−3.954	21.016	105.000
Flying fish	7.949	11.568	0.000	0.351	−2.104	6.559	105.000
Food preparations	8.714	11.907	6.957	0.122	1.037	3.721	105.000
Luncheon meats	3.848	9.786	0.000	1.026	0.243	1.304	105.000
Mackerels	8.940	11.678	0.000	0.382	−1.821	4.847	105.000
Pork	11.276	12.545	6.849	0.067	−2.162	12.745	105.000
Salmon	8.813	10.582	5.602	0.094	−0.776	4.409	105.000
Salted pork	11.125	12.369	9.816	0.041	0.079	3.170	105.000
Sardines	10.022	11.674	0.000	0.159	−3.493	18.518	105.000
Sausages	7.775	9.905	3.738	0.137	−0.811	4.601	105.000
Sheep	11.646	14.711	10.316	0.051	0.926	8.624	105.000
Tuna	11.061	12.858	9.157	0.055	−0.450	3.990	105.000
Turkey wings	9.134	12.445	0.000	0.400	−2.023	5.343	105.000
Fruits and vegetables	*9.565*	*11.693*	*5.402*	*0.198*	*−1.003*	*5.302*	*104.526*
Bananas	12.204	12.847	11.422	0.020	−0.503	3.642	105.000
Beets	6.391	8.922	0.000	0.288	−1.878	6.981	105.000
Broccoli	10.852	11.564	9.881	0.031	−0.560	3.186	105.000
Cabbage	10.425	11.823	8.103	0.050	−0.866	6.624	105.000
Canned corn	9.158	11.100	3.135	0.129	−1.694	8.984	105.000
Carrots	10.119	11.033	6.485	0.079	−2.645	10.651	105.000
Cucumbers	5.808	10.240	0.000	0.509	−0.781	2.530	105.000
English apples	11.858	12.595	10.685	0.029	−0.625	4.293	105.000
English potatoes	13.557	14.087	13.146	0.012	0.036	3.975	96.000
Grapefruits	9.382	10.953	0.000	0.280	−2.930	10.208	105.000
Grapes	11.093	12.272	10.338	0.028	1.098	4.910	105.000
Lettuce	9.010	11.504	6.019	0.104	0.113	3.012	105.000
Onions	11.275	12.940	7.245	0.115	−1.287	4.033	105.000
Oranges	10.375	12.498	0.000	0.379	−2.255	6.141	105.000
Plantains	11.279	11.998	9.702	0.044	−1.566	5.337	105.000
Pumpkins	9.056	11.351	0.000	0.276	−2.372	8.427	105.000
Sweet potatoes	5.032	10.802	0.000	0.660	−0.438	1.874	105.000
Tomatoes	9.537	14.053	6.468	0.178	0.723	3.580	105.000
Yams	5.316	9.587	0.000	0.555	−0.624	2.351	105.000
Breads and biscuits	*8.518*	*10.381*	*1.523*	*0.218*	*−2.469*	*9.230*	*105.000*
Sweet biscuits	10.644	11.839	3.045	0.148	−3.059	11.478	105.000
Biscuits (other)	6.391	8.922	0.000	0.288	−1.878	6.981	105.000

(*continued*)

Table 1. (*Continued*).

	Mean	Max.	Min.	Coef. Var.	Skew.	Kurt.	Obs.
Condiments, sugars, spices and teas	*9.299*	*12.410*	*5.075*	*0.158*	*−0.566*	*13.223*	*104.182*
Black pepper	8.229	9.596	6.312	0.075	−0.390	3.029	96.000
Brown sugar	8.614	14.006	0.000	0.563	−0.501	1.795	105.000
Curry powder	8.343	11.752	6.435	0.124	0.230	2.772	105.000
Green tea	7.854	9.542	0.000	0.142	−3.418	24.470	105.000
Jams	10.623	12.307	8.586	0.078	−0.584	2.606	105.000
Pepper sauce	7.960	12.822	5.182	0.185	1.746	6.248	105.000
Spices	8.111	10.346	6.260	0.088	−0.007	3.819	105.000
Table salt	8.832	12.470	4.407	0.187	0.010	2.450	105.000
Tomato ketchup	11.527	12.709	6.014	0.105	−2.843	10.864	105.000
Tomato sauce	8.974	16.863	7.633	0.105	5.448	47.178	105.000
White sugar	13.220	14.094	4.997	0.086	−5.915	40.222	105.000
Feeding stuffs for animals	*8.501*	*11.487*	*0.000*	*0.395*	*−2.856*	*18.822*	*105.000*
Cattle feed	6.009	10.087	0.000	0.659	−0.748	1.768	105.000
Poultry feed	10.992	12.887	0.000	0.131	−4.964	35.875	105.000
Dairy products	*9.538*	*12.672*	*4.097*	*0.217*	*−1.546*	*8.549*	*104.571*
Cheese	12.162	13.468	11.154	0.030	0.178	4.960	105.000
Condensed milk	10.943	15.088	0.000	0.183	−4.344	24.038	105.000
Cooking butter	9.092	12.345	2.890	0.132	−2.122	10.988	105.000
Evaporated milk	6.386	12.823	0.000	0.780	−0.273	1.309	102.000
Margarine	8.427	11.622	0.000	0.226	−1.945	8.852	105.000
Mayonnaise	10.686	11.513	8.889	0.051	−1.544	5.563	105.000
Table butter	9.067	11.844	5.749	0.118	−0.770	4.136	105.000
Cereals and cereal preparations	*9.632*	*12.696*	*3.445*	*0.154*	*−1.121*	*6.368*	*105.000*
Corn flakes	9.092	12.345	2.890	0.132	−2.122	10.988	105.000
Rice (bulk)	10.105	14.319	0.000	0.256	−0.426	3.972	105.000
Rice (pack)	10.681	13.693	4.522	0.124	−1.683	8.086	105.000
Oats	8.650	10.427	6.366	0.104	−0.252	2.426	105.000
Animal, vegetable oils and fats	*10.026*	*12.439*	*5.698*	*0.127*	*−0.511*	*6.987*	*105.000*
Corn oil	10.377	11.581	7.143	0.084	−1.744	6.443	105.000
Natural honey	9.245	14.120	7.460	0.156	2.279	7.420	105.000
Peanut butter	9.353	10.541	8.188	0.069	0.122	1.931	105.000
Vegetable oils	11.128	13.513	0.000	0.198	−2.700	12.154	105.000
Chemical and related products	*8.397*	*12.110*	*4.504*	*0.342*	*−0.217*	*3.851*	*103.875*
Detergent	11.774	12.954	9.734	0.054	−0.823	3.382	105.000
Herbicides	9.804	14.471	5.257	0.166	−0.484	3.570	105.000
Insecticides	2.860	11.368	0.000	1.351	0.772	1.882	105.000
Liquid bleach	11.933	13.089	10.841	0.031	−0.070	3.553	105.000
Liquid detergents	9.276	13.083	3.219	0.167	−0.417	5.069	105.000
Mosquito coils	6.416	10.453	0.000	0.560	−0.814	2.134	105.000
Scouring pads	7.455	11.733	5.598	0.179	1.711	5.830	105.000
Scouring powder	7.660	9.731	1.386	0.226	−1.611	5.384	96.000

(*continued*)

Table 1. (*Continued*).

	Mean	Max.	Min.	Coef. Var.	Skew.	Kurt.	Obs.
Durable goods	*8.868*	*11.312*	*5.591*	*0.131*	*−0.446*	*4.616*	*103.615*
Blenders	7.972	9.574	6.333	0.097	−0.159	2.343	105.000
Brooms	5.939	8.868	0.000	0.283	−1.058	5.030	105.000
Colour television	10.999	13.370	9.807	0.049	0.616	5.795	96.000
Deep freezers	8.675	11.773	4.277	0.220	−0.277	2.129	105.000
Electronic irons	8.489	9.965	6.444	0.086	−0.364	2.768	105.000
Electronic stoves	8.489	9.965	6.444	0.086	−0.364	2.768	105.000
Gas stoves	10.504	11.621	8.802	0.060	−0.508	2.904	96.000
Microwave	10.686	11.513	8.889	0.051	−1.544	5.563	105.000
Portable radios	7.973	13.329	0.000	0.286	−1.640	6.936	105.000
Refrigerators	8.508	11.702	6.748	0.112	0.640	3.620	105.000
Room fans	9.782	13.884	7.915	0.079	1.027	9.558	105.000
Vacuum cleaners	8.536	9.623	7.018	0.060	−0.447	3.287	105.000
Washing machines	8.731	11.873	0.000	0.240	−1.715	7.310	105.000

Table 2. Panel unit root statistics for imported goods.

	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat	ADF-Fisher chi-square	PP-Fisher chi-square
lm	−35.593 [0.000]	−45.024 [0.000]	2555.72 [0.000]	3813.73 [0.000]
lp	−38.127 [0.000]	−45.100 [0.000]	2393.37 [0.000]	2518.31 [0.000]
ld	−122.756 [0.000]	−77.001 [0.000]	3414.70 [0.000]	3624.78 [0.000]

Notes: (1) Income had an ADF test statistic of −3.971 which is significant at the 5% level of testing. (2) *P*-values provided in square brackets below coefficients.

Table 3. Pooled import demand results.

Dependent variable: Real import demand	Pooled OLS	Fixed effects
c	9.547 (1.669)***	4.597 (1.402)***
lp	−0.309 (0.048)***	−0.372 (0.069)***
lt	−1.386 (0.052)***	−0.789 (0.132)***
ly	0.063 (0.374)	1.203 (0.314)***
r-squared	0.072	0.580
s.e. regression	2.615	1.760
Obs	9482	9482

Notes: (1) White robust standard errors are provided in parentheses below coefficients. (2) ***indicates significance at the 1% level of testing.

goods leads to a reduction in demand for these items. The coefficient on the relative price variable indicates that the demand for imports in Barbados is relatively price inelastic, i.e. demand is not very responsive to changes in income.

Table 3 provides the results from relaxing the assumption that the equation intercept is the same across all product categories. An F-test was conducted to evaluate whether or not the regression fixed effects could be restricted to zero. The calculated F-statistic was 126.146[0.000], suggesting that the null hypothesis that the fixed effects are not significantly different from zero should be rejected at the levels of testing. Only the fixed effects coefficient estimates are presented in Table 3 as the Hausman test for correlated random effects had a chi-square statistic of 12.371[0.006], indicating that disturbances may be correlated with the explanatory variables making the random effects estimator biased and inconsistent.

The coefficient estimates obtained from the fixed effects specification differ somewhat when compared to the pooled equation results. The elasticity estimate for applied duties remains negative and significant; however, it is now less than one suggesting a less than proportionate response of imports to tariff rate changes. Another change in the estimated equation results is that the income elasticity is now statistically different from zero, with a coefficient greater than zero. This result indicates that a 1% increase in income is likely to lead to a more than 1% rise in imports, and consequently the import to GDP ratio should climb over time. This is indeed the case, as the import to GDP ratio rose from 57% in 2000 to 61% in 2008.

Both the pooled and fixed effects equation results assume that the slope coefficients are the same across each product category. However, given the wide variety of goods imported into most countries this assumption is somewhat heroic. Table 4 provides F-tests for the null hypothesis that the coefficients on relative prices, tariffs and income can be restricted across products. The results provided in the table suggest that the null hypothesis cannot be accepted at the normal levels of testing for all the variables included in the regression model. These results therefore suggest that a disaggregate import demand model appears to be the most appropriate specification.

Major product-level groupings are provided for ease of analysis. In relation to beverages, these products tended to be inelastic in response to price changes (elasticity less than one). Similar findings are obtained in relation to meats, fruits and vegetables, breads and biscuits, condiments,

Table 4. Test for cross-section specific coefficients.

	F-statistic
lp	87.292 [0.000]
lt	1375.598 [0.000]
ly	377.607 [0.000]

Note: *P*-values provided in square brackets below coefficients.

Table 5. Results for individual-specific coefficient estimates.

	lp	*ly*	*lt*
Beverages			
Aerated beverages	−0.237 (0.111)*	0.414 (0.618)	1.373 (2.034)
Flavoured preparations	0.129 (0.090)*	−1.811 (1.030)*	3.152 (4.280)
Flavoured syrups	−0.754 (0.180)*	9.928 (1.214)*	−8.852 (1.406)*
Malted beverages	−0.764 (0.894)	1.699 (2.717)	−5.768 (16.483)
Orange juice	−0.573 (0.151)*	−3.605 (0.928)*	−7.117 (1.838)*
Pineapple juice	−0.566 (0.356)*	−3.552 (1.771)*	−4.484 (1.373)*
Meats and fish			
Bacon	0.766 (0.378)*	14.011 (3.537)*	1.891 (0.673)*
Beef	−1.069 (0.513)*	2.584 (0.935)*	−0.586 (0.747)
Corned beef	−0.778 (0.636)*	−1.659 (2.023)	−14.205 (3.350)*
Flying fish	−0.537 (0.797)	−4.228 (1.875)*	−9.323 (1.728)*
Food preparations	−0.587 (0.094)*	9.369 (0.909)*	−6.597 (1.128)*
Luncheon meats	2.382 (0.730)*	−26.171 (3.318)*	0.51 (0.171)*
Mackerels	−0.993 (0.538)*	−9.941 (4.865)*	−0.997 (1.213)
Pork	0.147 (0.955)	1.486 (1.227)	0.022 (0.039)
Salmon	−0.029 (0.124)	3.748 (1.195)*	3.216 (1.347)*
Salted pork	−1.1 (0.356)*	1.976 (0.749)*	2.515 (3.332)
Sardines	−0.137 (0.215)	−2.221 (1.509)	−14.57 (1.729)*
Sausages	0.221 (0.335)	2.248 (1.348)*	−0.097 (0.097)
Sheep	−1.129 (0.757)*	1.720 (1.002)*	0.01 (0.163)
Tuna	−0.558 (0.176)*	2.849 (0.923)*	1.735 (4.603)
Turkey wings	−1.867 (2.697)	−20.767 (4.464)*	−2.907 (1.201)*
Fruits and vegetables			
Bananas	−0.021 (0.383)	0.095 (0.448)	3.7 (20.765)
Beets	0.133 (1.098)	−2.343 (4.116)	−2.037 (1.335)*
Broccoli	−0.122 (0.074)	3.475 (0.380)*	0.958 (0.391)*
Cabbage	−2.122 (0.592)*	2.234 (0.836)*	−0.774 (0.333)*
Canned corn	−0.137 (0.303)	4.337 (1.225)*	−0.858 (0.286)*
Carrots	0.113 (0.568)	1.295 (1.242)	2.654 (0.622)*
Cucumbers	−0.039 (−0.561)	−8.61 (2.130)*	−7.069 (0.673)*
English apples	−1.064 (0.362)*	0.63 (0.556)*	−0.326 (0.271)*
English potatoes	0.041 (0.166)	0.317 (0.357)	1.84 (0.602)*
Grapefruits	−9.578 (1.854)*	−5.549 (2.507)*	14.700 (4.082)
Grapes	−0.65 (0.153)*	0.282 (0.394)	−1.485 (0.354)*
Lettuce	−1.747 (0.249)*	−0.081 (1.325)	−0.988 (0.337)*
Onions	−6.06 (0.561)*	0.356 (1.200)	−0.696 (0.251)*
Oranges	1.220 (2.412)	−7.463 (3.852)*	11.346 (6.220)*
Plantains	−3.241 (0.978)*	−1.075 (0.854)	26.772 (−27.393)
Pumpkins	−0.93 (0.289)*	0.058 (3.361)	−13.398 (0.773)*
Sweet potatoes	2.758 (1.501)*	−9.495 (3.863)*	−5.107 (1.065)*
Tomatoes	−1.662 (0.212)*	4.209 (1.767)*	−2.996 (0.469)*
Yams	0.567 (0.546)	−10.516 (2.392)*	−8.502 (0.516)*
Breads and biscuits			
Sweet biscuits	0.077 (0.138)	−11.115 (2.270)*	6.244 (1.932)*
Biscuits (other)	0.041 (0.076)	3.707 (0.698)*	−2.428 (1.349)

(*continued*)

Table 5. (*Continued*).

	lp	*ly*	*lt*
Condiments, sugars, spices and teas			
Black pepper	−0.203 (0.116)	0.611 (0.988)	−2.781 (0.838)*
Brown sugar	−1.952 (0.276)*	1.063 (3.671)	−14.151 (1.952)*
Curry powder	−0.356 (0.137)*	0.851 (1.314)	1.134 (0.751)*
Green tea	−0.443 (0.152)*	3.815 (1.192)*	−9.215 (2.834)
Jams	−0.124 (0.113)	1.575 (0.741)*	−3.212 (0.295)*
Pepper sauce	−1.472 (0.166)*	13.224 (1.299)*	−7.519 (1.785)*
Spices	−0.567 (0.088)*	1.623 (0.974)*	−4.406 (4.739)
Table salt	−1.219 (0.268)*	5.959 (2.009)*	−3.132 (2.143)
Tomato ketchup	−1.912 (0.253)*	−2.567 (1.068)*	11.161 (3.889)*
Tomato sauce	−0.109 (0.320)	2.99 (1.542)*	2.562 (1.233)*
White sugar	−6.234 (2.008)*	2.853 (1.159)*	17.765 (5.096)*
Feeding stuffs for animals			
Cattle feed	1.458 (1.168)	−3.343 (2.675)	−10.177 (0.754)
Poultry feed	0.770 (0.665)	3.043 (1.547)*	−15.663 (0.287)*
Dairy products			
Cheese	−0.154 (0.066)*	1.118 (0.605)	0.130 (2.370)
Condensed milk	−0.834 (1.098)	−1.58 (2.573)	−8.776 (4.343)*
Cooking butter	−0.776 (0.213)*	2.53 (1.525)*	−0.083 (0.203)
Evaporated milk	5.596 (0.989)*	−1.172 (3.828)	−7.828 (1.291)*
Margarine	−1.205 (0.315)*	6.136 (1.647)*	−6.549 (1.293)*
Mayonnaise	−0.001 (0.111)	−0.666 (0.765)	5.667 (1.570)*
Table butter	−0.683 (0.295)*	3.044 (1.441)*	−2.384 (1.772)
Cereals and cereal preparations			
Corn flakes	−1.392 (0.390)*	3.046 (3.070)	−6.547 (3.496)*
Rice (bulk)	−1.362 (0.314)*	−1.163 (2.213)	−1.883 (0.288)*
Rice (pack)	−0.772 (0.810)	9.04 (1.458)*	−1.444 (1.671)
Oats	−0.102 (0.262)	8.014 (1.233)*	0.762 (4.195)
Animal, vegetable oils and fats			
Corn oil	0.366 (0.285)*	−2.155 (1.370)*	2.648 (1.162)*
Natural honey	−0.521 (0.202)*	6.02 (1.719)*	−6.206 (1.763)*
Peanut butter	−0.106 (0.147)	1.507 (0.894)*	3.568 (0.931)*
Vegetable oils	−1.7 (0.339)*	2.249 (1.763)	−16.401 (1.289)*
Chemical and related products			
Detergent	−1.921 (0.646)*	1.291 (0.797)*	−7.963 (1.275)*
Herbicides	0.549 (0.498)	2.286 (2.195)	−3.633 (0.314)*
Insecticides	−0.267 (0.529)	35.179 (2.830)*	−0.689 (0.258)*
Liquid bleach	0.035 (0.061)	1.358 (0.557)*	−0.392 (0.459)
Liquid detergents	−0.472 (0.200)*	7.379 (1.220)*	−2.021 (0.195)*
Mosquito coils	−0.289 (−0.401)	3.861 (−4.375)	−1.037 (0.128)*
Scouring pads	−0.081 (0.146)	8.217 (1.394)*	−1.200 (0.195)*
Scouring powder	−0.121 (0.451)	3.051 (1.601)*	−1.629 (0.164)*
Durable goods			
Blenders	−0.266 (0.158)	5.739 (0.940)*	0.167 (1.150)
Brooms	−0.156 (0.322)	4.229 (1.181)*	−0.923 (0.110)*
Colour TVs	8.625 (7.948)	2.567 (0.674)*	1.251 (1.448)

(*continued*)

Table 5. (*Continued*).

	lp	*ly*	*lt*
Deep freezers	−14.388 (3.378)*	20.376 (1.546)*	−0.069 (0.637)
Electronic irons	−0.675 (0.683)	1.301 (0.679)*	1.532 (0.555)
Electronic stoves	15.326 (8.833)*	3.073 (1.080)*	1.392 (1.066)*
Gas stoves	12.638 (−15.971)	0.05 (−0.822)	3.277 (1.515)*
Microwave	−0.027 (−1.861)	0.46 (−0.676)	4.583 (1.186)*
Portable radios	23.793 (4.667)*	3.437 (2.580)*	−11.326 (0.708)*
Refrigerators	1.257 (0.408)*	3.861 (1.181)*	−3.741 (1.485)*
Room fans	0.084 (0.176)	3.318 (0.834)*	5.67 (1.164)*
Vacuum cleaners	2.053 (1.284)*	1.821 (0.789)*	2.109 (0.885)*
Washing machines	−0.397 (1.049)	12.165 (2.049)*	−2.798 (3.593)

Notes: (1) White robust standard errors are provided in parentheses below coefficients. (2) *indicates significance at the 10% levels of testing. (3) Seasonal dummies included in regressions.

Table 6. Forecast evaluation statistics for model.

	RMSE	MAPE	Thiel
Disaggregated model	2.224	14.249	0.112
Pooled model	2.700	19.786	0.139
Morgan–Granger–Newbold (1977) Test	−0.337 (0.028)		

sugars, spices and teas, dairy products and animal vegetable oils and fats. In contrast, cereals and cereal preparations as well as durable goods were more responsive to price changes. As it relates to cereals and cereal preparations, the price elasticity of demand coefficient exceeded one for all of the statistically significant price elasticity coefficients in this category. On a more general level, for durable goods the absolute value of the price elasticity tended to exceed one in most instances.

4.2. Tariff harmonisation

The disaggregated import demand equation estimated in Section 4.1 can be used for a number of policy simulations. In this study, the model is employed to assess the possibility of converging tariff rates to some single rate across product categories. Such a change would greatly simplify import procedures for businesses, reduce the administrative burden for government and encourage domestic competition.

Before this simulation is conducted, however, the forecasting properties of the disaggregated equation are first assessed by comparing the forecasts generated to those from the pooled equation. Both equations are estimated over a restricted sample of 2000M1 to 2006M12. The equations are then

Table 7. Simulated effects of tariff harmonisation on import demand (deviation from baseline value).

Import category	S1 ($t = 10\%$)	S2 ($t = 20\%$)	S3 ($t = 30\%$)	S4 ($t = 40\%$)	S5 ($t = 50\%$)
Aerated beverages	1.022	1.007	0.993	0.981	0.969
Bacon	2.719	1.565	0.504	−0.478	−1.393
Bananas	0.922	0.974	1.022	1.067	1.108
Beef	1.114	1.037	0.967	0.902	0.841
Beets	0.959	0.986	1.011	1.034	1.055
Black pepper	0.493	0.833	1.145	1.434	1.703
Blenders	1.188	1.061	0.945	0.838	0.737
Broccoli	1.089	1.029	0.973	0.922	0.874
Brooms	1.289	1.095	0.916	0.750	0.596
Brown sugar	1.117	1.038	0.966	0.899	0.837
Cabbage	1.302	1.099	0.912	0.739	0.578
Canned corn	1.238	1.078	0.931	0.795	0.668
Canned sausages	1.091	1.029	0.973	0.921	0.872
Carrots	1.204	1.067	0.940	0.823	0.714
Cattle feed	0.998	0.998	0.998	0.998	0.998
Cheese	1.036	1.011	0.989	0.968	0.948
Colour television	0.933	0.977	1.018	1.055	1.090
Condensed milk	1.034	1.011	0.990	0.970	0.952
Cooking butter	1.043	1.014	0.987	0.962	0.939
Corn oil	1.079	1.026	0.977	0.931	0.889
Corned beef	1.143	1.047	0.958	0.876	0.800
Cornflakes	1.175	1.057	0.949	0.848	0.755
Cucumber	1.321	1.105	0.907	0.723	0.552
Curry powder	0.862	0.954	1.039	1.118	1.191
Deep freezers	0.572	0.858	1.122	1.365	1.592
Detergent	1.060	1.019	0.982	0.947	0.915
Disinfectant	3.020	1.664	0.418	−0.737	−1.811
Electric irons	1.161	1.053	0.953	0.860	0.774
Electric stoves	0.998	0.998	0.998	0.998	0.998
English apples	1.032	1.010	0.990	0.971	0.953
English potatoes	1.106	1.035	0.969	0.908	0.852
Evaporated milk	1.028	1.009	0.991	0.975	0.960
Flavoured preparations	0.994	0.998	1.001	1.004	1.007
Flavoured syrups	1.037	1.011	0.988	0.967	0.946
Flying fish	0.960	0.986	1.011	1.033	1.054
Food preparations	1.640	1.210	0.815	0.449	0.109
Gas stoves	0.959	0.986	1.010	1.033	1.054
Grapefruits	1.548	1.180	0.842	0.528	0.237
Grapes	0.963	0.988	1.010	1.031	1.050
Green tea	0.265	0.757	1.210	1.629	2.020
Herbicides	1.031	1.010	0.990	0.972	0.955
Insecticides	1.471	1.154	0.863	0.594	0.343
Jams	1.152	1.050	0.955	0.868	0.787
Lettuce	5.711	2.551	−0.356	−3.048	−5.553
Liquid bleach	1.116	1.038	0.966	0.899	0.838

(*continued*)

Table 7. (*Continued*).

Import category	S1 ($t = 10\%$)	S2 ($t = 20\%$)	S3 ($t = 30\%$)	S4 ($t = 40\%$)	S5 ($t = 50\%$)
Liquid detergent	1.005	1.001	0.998	0.995	0.992
Luncheon meat	1.054	1.017	0.984	0.953	0.924
Mackerels	1.362	1.119	0.895	0.688	0.495
Malted beverages	−2.215	−0.061	1.922	3.757	5.465
Margarine	0.571	0.858	1.122	1.367	1.595
Mayonnaise	1.068	1.022	0.980	0.941	0.904
Microwaves	1.402	1.132	0.883	0.653	0.439
Mosquito coils	0.926	0.975	1.021	1.063	1.102
Natural honey	0.953	0.984	1.013	1.039	1.063
Oats	1.228	1.075	0.933	0.803	0.681
Onions	1.395	1.130	0.886	0.659	0.449
Orange juice	1.446	1.147	0.871	0.616	0.378
Oranges	1.007	1.002	0.997	0.993	0.989
Other biscuits	0.968	0.989	1.008	1.026	1.043
Peanut butter	0.654	0.886	1.099	1.296	1.480
Pepper sauce	1.004	1.001	0.998	0.996	0.993
Pineapple juice	1.868	1.286	0.749	0.253	−0.209
Plantains	0.892	0.964	1.030	1.092	1.149
Pork	0.781	0.928	1.063	1.187	1.303
Portable radios	1.082	1.027	0.976	0.929	0.885
Poultry feed	1.122	1.040	0.964	0.894	0.829
Pumpkins	1.587	1.193	0.830	0.494	0.182
Refrigerators	1.153	1.050	0.955	0.867	0.785
Rice (bulk)	1.239	1.078	0.931	0.794	0.667
Rice (pack)	0.932	0.977	1.019	1.057	1.093
Room fans	1.405	1.133	0.883	0.651	0.436
Salmon	1.067	1.022	0.980	0.942	0.906
Salted pork	1.144	1.047	0.958	0.875	0.798
Sardines	1.046	1.015	0.986	0.959	0.934
Sauce (other)	1.124	1.040	0.963	0.891	0.825
Sausages	0.998	0.998	0.998	0.998	0.998
Scouring pads	1.170	1.055	0.950	0.853	0.762
Scouring powder	1.432	1.142	0.875	0.628	0.398
Sheep	1.161	1.052	0.953	0.861	0.775
Spices	1.074	1.024	0.978	0.935	0.895
Sweet biscuit	1.305	1.100	0.911	0.736	0.573
Sweet potatoes	0.591	0.865	1.116	1.349	1.566
Table butter	1.199	1.065	0.942	0.828	0.721
Table salt	1.374	1.123	0.892	0.678	0.479
Tomato ketchup	1.222	1.073	0.935	0.808	0.690
Tomato sauce	0.839	0.947	1.046	1.137	1.223
Tomatoes	1.115	1.038	0.966	0.900	0.838
Tuna	1.090	1.029	0.974	0.922	0.874
Turkey wings	0.131	0.713	1.249	1.745	2.207
Vacuum cleaners	1.042	1.013	0.987	0.963	0.940
Vegetable oils	1.405	1.133	0.882	0.651	0.435

(*continued*)

Table 7. (*Continued*).

Import category	S1 ($t = 10\%$)	S2 ($t = 20\%$)	S3 ($t = 30\%$)	S4 ($t = 40\%$)	S5 ($t = 50\%$)
Washing machines	1.650	1.214	0.812	0.441	0.095
White sugar	0.987	0.996	1.003	1.010	1.017
Yams	0.999	0.999	0.999	0.999	0.999
Mean	1.099	1.032	0.971	0.914	0.861

Table 8. Simulated effects of tariff harmonisation on tariff revenue (deviation from baseline value).

Import category	S1 ($t = 10\%$)	S2 ($t = 20\%$)	S3 ($t = 30\%$)	S4 ($t = 40\%$)	S5 ($t = 50\%$)
Aerated beverages	0.957	0.998	1.017	1.027	1.032
Bacon	3.593	1.928	0.281	−1.287	−2.769
Bananas	0.851	0.962	1.047	1.119	1.182
Beef	1.050	1.031	0.991	0.945	0.898
Beets	0.792	0.960	1.070	1.155	1.226
Black pepper	0.325	0.794	1.200	1.566	1.902
Blenders	1.127	1.059	0.970	0.877	0.785
Broccoli	0.986	1.018	1.012	0.993	0.969
Brooms	1.232	1.099	0.942	0.782	0.627
Brown sugar	1.049	1.032	0.992	0.945	0.897
Cabbage	1.231	1.106	0.944	0.777	0.612
Canned corn	1.169	1.078	0.959	0.836	0.714
Canned sausages	1.011	1.021	1.003	0.976	0.945
Carrots	1.141	1.065	0.966	0.863	0.762
Cattle feed	0.140	0.874	1.303	1.607	1.843
Cheese	0.937	0.999	1.025	1.038	1.044
Colour television	0.710	0.941	1.096	1.218	1.321
Condensed milk	0.965	1.002	1.015	1.019	1.018
Cooking butter	0.994	1.008	1.005	0.997	0.986
Corn oil	1.005	1.018	1.004	0.982	0.957
Corned beef	1.070	1.041	0.986	0.925	0.862
Cornflakes	1.094	1.053	0.980	0.900	0.819
Cucumber	1.277	1.111	0.927	0.745	0.570
Curry powder	0.748	0.934	1.078	1.202	1.313
Deep freezers	0.248	0.785	1.228	1.617	1.970
Detergent	0.957	1.007	1.020	1.019	1.012
Disinfectant	3.913	2.020	0.184	−1.550	−3.183
Electric irons	1.093	1.048	0.980	0.905	0.830
Electric stoves	0.140	0.874	1.303	1.607	1.843
English apples	0.916	0.995	1.032	1.053	1.066
English potatoes	1.046	1.029	0.992	0.949	0.905
Evaporated milk	0.952	0.999	1.019	1.029	1.034

(*continued*)

Table 8. (*Continued*).

Import category	S1 ($t = 10\%$)	S2 ($t = 20\%$)	S3 ($t = 30\%$)	S4 ($t = 40\%$)	S5 ($t = 50\%$)
Flavoured preparations	0.926	0.988	1.026	1.053	1.075
Flavoured syrups	0.862	0.989	1.052	1.089	1.114
Flying fish	0.858	0.971	1.047	1.108	1.159
Food preparations	1.663	1.241	0.817	0.412	0.028
Gas stoves	0.792	0.960	1.070	1.154	1.224
Grapefruits	1.550	1.202	0.849	0.511	0.189
Grapes	0.890	0.976	1.036	1.084	1.125
Green tea	−0.196	0.642	1.357	1.997	2.582
Herbicides	0.952	1.000	1.019	1.028	1.032
Insecticides	1.450	1.178	0.881	0.589	0.307
Jams	1.075	1.044	0.985	0.919	0.851
Lettuce	9.761	3.983	−1.483	−6.601	−11.394
Liquid bleach	1.047	1.032	0.992	0.946	0.898
Liquid detergent	0.900	0.986	1.036	1.070	1.096
Luncheon meat	0.984	1.009	1.010	1.002	0.990
Mackerels	1.329	1.127	0.912	0.702	0.501
Malted beverages	−5.076	−0.926	2.773	6.153	9.277
Margarine	0.378	0.815	1.186	1.518	1.821
Mayonnaise	0.997	1.014	1.006	0.990	0.971
Microwaves	1.371	1.145	0.901	0.662	0.433
Mosquito coils	0.831	0.960	1.054	1.133	1.201
Natural honey	0.831	0.965	1.056	1.128	1.189
Oats	1.153	1.074	0.965	0.849	0.734
Onions	1.369	1.140	0.900	0.668	0.446
Orange juice	1.426	1.162	0.885	0.616	0.360
Oranges	0.909	0.988	1.033	1.063	1.085
Other biscuits	0.864	0.973	1.045	1.101	1.148
Peanut butter	0.534	0.860	1.139	1.389	1.618
Pepper sauce	0.906	0.987	1.033	1.065	1.090
Pineapple juice	1.952	1.339	0.735	0.162	−0.380
Plantains	0.763	0.941	1.075	1.187	1.286
Pork	0.703	0.912	1.089	1.247	1.390
Portable radios	1.012	1.019	1.002	0.977	0.950
Poultry feed	1.072	1.036	0.983	0.928	0.873
Pumpkins	1.600	1.225	0.837	0.462	0.104
Refrigerators	1.040	1.042	0.999	0.941	0.879
Rice (bulk)	1.177	1.079	0.956	0.831	0.708
Rice (pack)	0.828	0.960	1.055	1.133	1.201
Room fans	1.381	1.143	0.897	0.658	0.431
Salmon	0.985	1.012	1.010	0.999	0.982
Salted pork	1.066	1.041	0.988	0.927	0.864
Sardines	0.971	1.006	1.014	1.013	1.007
Sauce (other)	1.022	1.032	1.002	0.960	0.914
Sausages	0.140	0.874	1.303	1.607	1.843
Scouring pads	1.083	1.051	0.984	0.909	0.832
Scouring powder	1.408	1.157	0.891	0.631	0.383

(*continued*)

Table 8. (*Continued*).

Import category	S1 ($t = 10\%$)	S2 ($t = 20\%$)	S3 ($t = 30\%$)	S4 ($t = 40\%$)	S5 ($t = 50\%$)
Sheep	1.080	1.047	0.984	0.914	0.841
Spices	1.005	1.016	1.004	0.984	0.960
Sweet biscuit	1.236	1.107	0.943	0.773	0.606
Sweet potatoes	0.225	0.783	1.236	1.633	1.991
Table butter	1.131	1.063	0.969	0.871	0.773
Table salt	1.339	1.132	0.910	0.692	0.482
Tomato ketchup	1.168	1.072	0.958	0.841	0.728
Tomato sauce	0.743	0.929	1.079	1.209	1.327
Tomatoes	1.034	1.030	0.997	0.955	0.911
Tuna	1.024	1.022	0.998	0.968	0.935
Turkey wings	−0.128	0.646	1.331	1.953	2.528
Vacuum cleaners	0.950	1.002	1.021	1.028	1.029
Vegetable oils	1.373	1.146	0.901	0.660	0.428
Washing machines	1.674	1.244	0.814	0.403	0.014
White sugar	0.918	0.985	1.028	1.060	1.086
Yams	0.787	0.969	1.075	1.150	1.209
Mean	1.012	1.023	1.004	0.974	0.940

used to predict product-level imports for 2007M1 to 2008M9. The calculated forecast evaluation statistics are provided in Table 6. All three forecast evaluation statistics suggest that the results of the disaggregated model were much closer to the actual values when compared to those from the pooled model. The Morgan–Granger–Newbold test (Granger and Newbold 1977), which evaluates the statistical significance of the two forecasts, suggests that this difference was also statistically significant at normal levels of testing.

Given that the model generates forecasts that are relatively close to actual values, the model is then employed to simulate the impact of tariff harmonisation on import demand as well as tariff revenues. Table 7 provides the deviation of the import values from the simulated baseline values. The baseline assumes that applied tariffs are set at the sample mean for tariffs over the period January 2000 to September 2008. Five tariff harmonisation scenarios are considered: (1) 10%; (2) 20%; (3) 30%; (4) 40%; and (5) 50%. The results are provided in Table 7. On average, the results suggest that as a result of harmonisation of applied tariffs to a level of 10%, the demand for imports is likely to rise by about 10%. In contrast, harmonisation to an applied tariff of 20% would lead to a mean increase in imports of 3%. Tariff harmonisation at higher levels would lead to reductions in imported goods.

The impact of tariff harmonisation on tariff revenues is provided in Table 8. At the 10% level, the rise in import demand more than offsets the reduction in tariff rates and therefore leads to a 1.2% increase in tariff

duties. In contrast, tariff harmonisation at the 20% level resulted in a 2.3% expansion in tariff revenues relative to the baseline. Harmonisation of tariffs at the 30% level would essentially be revenue neutral, while rates any higher than this level would lead to a reduction in lower tax receipts.

5. Conclusions

Imports are very important to most industries in Caribbean economies. On average imports of goods and services represent about 64% of GDP for Caribbean countries, 37% percentage points above the average for the world. Understanding the factors that influence import demand in the Caribbean is crucial to the development of any foreign policy on the part in these countries (Lewis-Bynoe et al. 2002).

The present study uses disaggregated monthly observations on imports at the four-digit SITC level for 91 products between January 2000 and September 2008. The pooled import demand equation (which is similar to the traditional aggregate demand function that would normally be estimated elsewhere) had negative and statistically significant coefficients on the price and applied tariff variables. The null hypothesis that the income elasticity can be restricted to zero could not be rejected at normal levels of testing in this model. The coefficient on the relative price variable suggests that the demand for imports in Barbados is relatively price inelastic. Allowing the intercept to vary did not change the sign or significance of the elasticity of applied duties, albeit now less than unity. This suggests that tariff rate changes result in a less than proportionate response in the import volume demanded. Additionally, the income elasticity was now statistically different from zero, and had a coefficient greater than zero. This result implies that a 1% increase in income is likely to lead to a more than 1% rise in imports, and consequently the import to GDP ratio should climb over time.

The use of an F-test rejected the null hypothesis that the coefficients on relative prices, applied tariffs and income can be restricted across product groups. Thus, for policy simulations on possible tariff changes the disaggregated import demand equation was used. On average, the results suggested that as a result of harmonisation of applied tariffs to a level of 10%, the demand for imports is likely to rise by about 10%, while harmonisation to an applied tariff of 20% would lead to a mean increase in imports of 3%. Tariff harmonisation at higher levels would lead to reductions in imported goods. Concomitantly, at the 10% level, the rise in import demand more than offsets the reduction in tariff rates and therefore leads to a 1.2% increase in tariff duties. Tariff harmonisation at the 20% resulted in a 2.3% expansion in tariff revenues relative to the baseline. Harmonisation of tariffs at the 30% would essentially be revenue neutral, while rates any higher than this level would lead to a reduction in lower tax receipts.

In concluding, this study has demonstrated that there are definitely benefits to be accrued from the use of micro-econometric techniques to analyse issues surrounding import demand. However, we would argue that it is crucial that further research, expanding the basket of products be undertaken. Nonetheless, from this study it was identified that the best approach for Barbados, in light of talks on tariff harmonisation, would be an approach harmonising tariff to a level below or equal to the 30% level. Such attempts at harmonisation would enhance the process of administering duties, reduce administrative costs as well as enhance the ease of doing business. Administering duties is often somewhat contentious given product innovations and the invoicing practices of business. With a common tariff across all product groups, the ease of administering duties would be enhanced greatly. In a similar vein, given the simplicity of a single tariff system, it would be significantly easier to implement cost saving measures in regards to tax administration. Finally, having a single tariff would also reduce the uncertainty surrounding goods into the island and should therefore smooth the process of doing business.

References

Bahmani-Oskooee, Mohsen, and Hyun-Jae Rhee. 1997. Structural change in import demand behaviour, the Korean experience: A reexamination. *Journal of Policy Modeling* 19, no. 2: 187–93.

Baltagi, Badi H. 2005. *Econometric analysis of panel data*. West Sussex: John Wiley & Sons Ltd. 55–6.

Birchwood, Anthony, and Julia Jhinkoo. 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, Timothy A., W. Charles Sawyer, and Richard L. Sprinkle. 1989. An empirical examination of the structural stability of disaggregated US import demand. *Review of Economics and Statistics* 71, no. 2: 337–41.

Gafar, John. 1995. Some estimates of the price and income elasticities of import demand for three Caribbean countries. *Applied Economics* 27, no. 11: 1045–8.

Granger, Clive W.J., and Paul Newbold. 1977. *Forecasting economic series*. New York: Academic Press.

Im, Kyung So, M. Hashem Pesaran, and Yongcheol Shin. 2003. Testing for units roots in heterogeneous panels. *Journal of Econometrics* 115, no. 1: 53–74.

James, Vanus. 2006. Import productivity growth, capital deepening and Caribbean development: Some theoretical insights. In *Finance and real development in the Caribbean*, ed. Anthony Birchwood, and Dave Seerattan, 223–36. Trinidad and Tobago: Caribbean Centre for Monetary Studies.

Levin, Andrew, Chien-Fu Lin, and Chia-Sang James Chu. 2002. Unit root test in panel data: Asymptotic and finite-sample properties. *Journal of Econometrics* 108, no. 1: 1–24.

Lewis-Bynoe, Denny, Jennifer Griffith, and Winston Moore. 2002. Trade liberalisation and the manufacturing sector: The case of a small developing country. *Contemporary Economic Policy* 20: 272–87.

Mah, Jai Sheen. 1993. Structural change in import demand behaviour: The Korean experience. *Journal of Policy Modeling* 15, no. 2: 223–7.

Maxwell, Chanelle, and Winston Moore. 2004. External price competitiveness and trade in the Caribbean. *Money Affairs* 17, no. 2: 137–54.

Murray, Tracy, and Peter J. Ginman. 1976. An empirical examination of the *traditional aggregate* import demand model. *Review of Economics and Statistics*. 58, no. 1: 75–80.

Shiells, Clinton R. 1991. Errors in import-demand estimates based upon unit-value indexes. *Review of Economics and Statistics* 73, no. 2: 378–82.

Zietz, Joachim, and Donald K. Pemberton. 1993. Parameter instability in aggregate US import demand functions. *Journal of International Money and Finance*. 12, no. 6: 654–67.