THE TRADE ELASTICITIES OF EXPORT DEMAND FOR THREE CARICOM MEMBER COUNTRIES: AN APPLICATION OF THE BOUNDS TEST FOR COINTEGRATION

1. Introduction

Guyana (GY), Jamaica (JA), and Trinidad and Tobago (TT) are three CARICOM member countries that have, over the years, participated in IMF based stabilization programs. For these countries, an important element in their stabilization programs has been the adjustment of the exchange rate to restore equilibrium in their balance of payments. With the success of this policy turning very much on whether the sum of the price elasticities of import and export demands exceeds unity, one finds, in the literature on CARICOM economies, studies by Gafar (1995) and Modeste (2011, 2009) that report estimates of the price elasticity of import demand for Guyana, Jamaica, and Trinidad and Tobago. Beyond the published pieces by Gafar and Modeste, there is an abundance of studies reporting estimates of the price elasticity of import demand for both developing and industrial countries alike. For examples of these, see Houthakkar and Magee (1969), Khan and Ross (1977), Salas (1982), Giovannetti (1989), Senhadji (1998), Dutta and Ahmed (1999), Tang (2003), Matsubayashi and Hamori (2003), Harb (2005), Razafimahafa and Hamori (2005), and Oteng-Abayie and Frimpong (2008), among others. On the export side, there are many studies that have likewise reported price elasticities of export demand for industrial and developing countries, including Trinidad and Tobago. Some examples of these studies are Houthakker and Magee (1969), Khan (1974), Marquez and McNeily (1988), Bahmani-Oskoee and Niroomand (1998), Senhadji and Montenegro (1999), Arize (2001,1990), Guisan and Cancelo (2002), Narayan and Narayan (2004), Khedhiri and Bouazizi (2007), Husein (2008), and Hamori and Matsubayashi (2009). However, as far as could be ascertained, no estimates of the price elasticity of export demand for Guyana, or Jamaica have been published. To fill this void and to provide new

estimates for Trinidad and Tobago, the purpose of this paper is to estimate for the three CARICOM member countries their long-run and short-run trade elasticities of export demand.

This will be done using the bounds test for analyzing level relationships within the conditional autoregressive distributed lag (ARDL) framework. As explained by Pesaran *et al*., 2001, the bounds test removes the need to know the integration status of the regressors in the model if the computed F-statistic for the bounds test falls outside of the critical F-values for the I (0) and I (1) bounds. If, however, the value of the computed F-statistic lies within the F-values for the I (0) and I (1) bounds, then it would be necessary to determine the order of integration for the variables underlying the model.

The rest of this paper is organized as follows. In Section 2 of this paper, the traditional export demand function that is to be estimated is presented. In Section 3, the results derived from estimating the export demand model will be presented and discussed. In Section 4, the conclusions and policy implications of the results will be given.

2. Export demand model

To study the demand for exported goods from Guyana, Jamaica, and Trinidad and Tobago, a traditional export demand model is used. In keeping with that model, the demand for exports is assumed to be a function of the following variables: (1) the price for the country's exported goods; (2) the exporting country's domestic price for foreign currency; (3) the alternative price encountered by prospective buyers of the exported goods; and (4) the level of foreign activity. In terms of an equation, the demand for exports can be written as:

$$x_t = f(xp_t, er_t, wxp_t, wy_t), \quad f_{xp} < 0,\ f_{er} > 0,\ f_{wxp} > 0,\ f_{wy} > 0 \qquad (1)$$

where x is the volume of exports, xp is the home country's export price index, er is the domestic price for foreign currency, wxp is the competitor's export price index, wy is the foreign economic activity variable, and t is time. In this model, it is expected that the demand for exports will fall when the price for exports goes up. At the same time, the demand for exports is expected to rise when there is an increase in the domestic price for foreign currency, or an increase in the competitor's price for the exported goods, or an increase in the level of foreign economic activity. For this study, the following Arize (1990) type export demand equation will be estimated for Guyana, Jamaica, Trinidad and Tobago, respectively:

$$\ell \mathrm{n} x_t = \alpha_0 + \alpha_1 \ell \mathrm{n} xp_t + \alpha_2 \ell ner_t + \alpha_3 \ell \mathrm{n} wxp_t + \alpha_4 \ell \mathrm{n} wy_t + e_t \quad (2)$$

where *ln* is the natural logarithm, *e* is the error term, α_0 is a constant, and α_1, α_2, α_3, α_4 are the elasticities for the different independent variables in the model. The other symbols in equation (2) were defined earlier in the text.

To implement the bounds test and to estimate the long-run and short-run prices and income elasticities of export demand, three equations are to be estimated. The first equation is designed to determine if there is a cointegrating relationship among the variables in the export demand function using the bounds test. For this test, the following conditional vector equilibrium correction model is specified:

$$\begin{aligned}\Delta \ell nx_t = {} & \beta_o + \Sigma_{i=1}^{n} \beta_{1i} \Delta \ell nx_{t-i} + \Sigma_{i=0}^{p1} \beta_{2i} \Delta \ell nxp_{t-1} + \Sigma_{i=0}^{pz} \beta_{3i} \Delta \ell ner_{t-i} + \\ & + \Sigma_{i=0}^{ps} \beta_{4i} \Delta \ell nwxp_{t-i} + \Sigma_{i=0}^{p4} \beta_{5i} \Delta \ell nwy_{t-i} + \beta_6 lnx_{t-1} + \beta_7 lnxp_{t-1} \\ & + \beta_8 lner_{t-1} + \beta_9 lnwxp_{t-1} + \beta_{10} lnwy_{t-1} + \mu_t \end{aligned} \quad (3)$$

where $\Delta \ell \mathrm{n} x$, $\Delta \ell \mathrm{n} xp$, $\Delta \ell \mathrm{n} er$, $\Delta \ell \mathrm{n} wxp$, and $\Delta \ln wy$ are the first differences of the natural logarithmic values for the variables *x*, *xp*, *er*, *wxp*, and *wy*, respectively. In this test, equation (3) will be estimated with and without the lagged levels of variables – x_{t-i}, xp_{t-1}, er_{t-1}, wxp_{t-1} and wy_{t-1}. The results from the estimation of these versions of equation (3) are then used to calculate the Wald or F-statistic for the test on the joint significance of the coefficients for the lagged values of the level effect variables. The null and alternative hypotheses for this F-test are as follows:

$$H_0: \beta_6 = \beta_7 = \beta_8 = \beta_9 = \beta_{10} = 0$$
$$H_A: \beta_6 \neq \beta_7 \neq \beta_8 \neq \beta_9 \neq \beta_{10} \neq 0$$

For a given level of significance, α, if the computed F-value is higher (lower) than the upper (lower) critical bound value then the null hypothesis of no cointegration is rejected (accepted). If, however, the computed F-value lies within the upper and lower critical bounds value, a conclusive inference cannot be made. More information on the order of integration for the underlying explanatory variables would be required in order to reach a conclusion.

Assuming that the empirical analysis of equation 3 establishes the existence of a long run relationship between the dependent variable, *x*, and the independent variables, *xp*, *er*, *wxp*, and *wy*, the second equation to be estimated is the following:

$$\begin{aligned}\ell nx_t = {} & \delta_0 + \Sigma_{i=1}^{p} \delta_{1i} \ell nx_{t-1} + \Sigma_{i=1}^{q1} \delta_{2i} \ell nxp_{t-i} + \Sigma_{i=1}^{q2} \delta_{3i} \ell ner_{t-i} + \Sigma_{i=1}^{q3} \delta_{3i} \ell nwxp_{t-i} + \\ & + \Sigma_{i=1}^{q4} \delta_{4i} \ell nwy_{t-i} + e_t \end{aligned} \quad (4)$$

This equation is the long-run ARDL expression of the demand for exports. It provides estimates of the various long-run trade

elasticities of export demand. The third and final equation to be estimated provides the short-run elasticities for the traditional export demand model using an error correction framework. This latter model is expressed as follows:

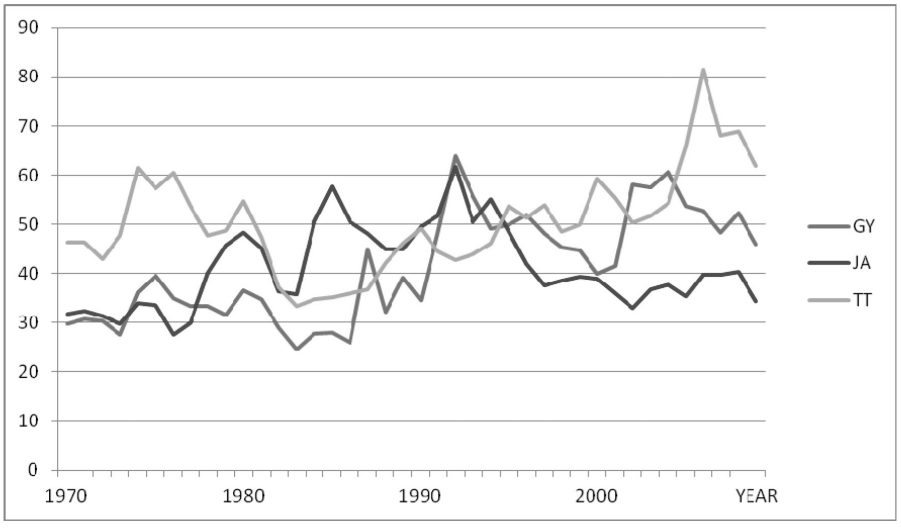
$$\Delta\ell nx_t = \phi_0 + \Sigma_{i=1}^{p}\, \phi_{1i}\, \Delta\ell nx_{t-i} + \Sigma_{i=0}^{q1}\, \phi_{2i}\, \Delta\ell nxp_{t-i} + \Sigma_{i=0}^{q2}\, \phi_{3i}\, \Delta\ell ner_{t-i} + \Sigma_{i=0}^{q3}\, \phi_{4i}\, \Delta\ell nwxp_{t-i} + \Sigma_{i=0}^{q4}\, \phi_{5i}\, \Delta\ell nwy_{t-i} + n\ ect_{t-1} + e_t \quad (5)$$

where *ect* is the error correction term. The ϕ's are the short-run coefficients for the export demand model. The parameter η, meanwhile, measures the speed of adjustment to equilibrium in the model.

3. Results

The economies of GY, JA, and TT are relatively small, with *per capita* income reaching levels of $2,683US, $4,566US and $15,782US, respectively, in 2009. Based on national income data, these economies are also quite open. For as shown in Figure 1, the export to GDP ratios in these economies are quite high. Indeed, over the period 1970 to 2009, exports averaged about 41.3%, 41.1%, and 50.4% of GDP in GY, JA, and TT, respectively. In light of the sizeable contribution of exports to GDP in these economies, it is important to know how responsive the demand for these countries' exports is to economic variables representing: (a) the level of foreign

Figure 1 - *Export Share in GDP (in %)*



economic activity; and (b) the level of price competiveness for exports. In studying this relationship, annual data for the period 1970 to 2009 are used. For all countries, with the U.S. being a major trading partner, the foreign economic activity variable was represented by the U.S. index of industrial production. To gauge the level of price competiveness for these countries exports, various price variables were used. For the competitor's price index, the U.S. consumer price index, in the case GY and JA, and the U.S. producer price index for industrial commodities, in the case of TT were used as proxies in the regression analysis. The domestic price for foreign currency was measured by the exporting country's domestic price for the U.S. dollar. The home country's export price, meanwhile, was measured by each country's export unit price index. Finally, the value of each country's real exports was determined by deflating the value of each country's total exports by the country's export price index. These data were taken from various sources, such as the International Monetary Fund, International Financial Statistics; the Inter-American Development Bank, Economic and Social Progress in Latin America; the United Nations Statistics Division, National Accounts Statistics; United Nations Conference on Trade and Development (UNCTAD), Handbook of Statistics; and the Economic Report of the President published by the United States Government Printing Office. Table 1 provides some basic descriptive statistics for these different variables.

The first step in estimating the export demand model is to conduct the bounds test for cointegration. In that test, the F-statistic for the joint hypothesis that the level effect variables in equation (3) are not present is calculated. These computed F-values along with the critical F-values for a given level of significance and a specific sample size are reported in Table 2 for all three countries. Taken as a whole, these cointegration results indicate that for the export demand model as shown in equation (2), the null hypothesis of no cointegration is to be rejected at the 10% level of significance for all three countries.

With exports and its determinants being cointegrated, the next step in the analysis is to estimate the long-run model of export demand using as ARDL specification. The results from that estimation are reported in Table 3. For all three countries the estimated elasticities are statistically significant with their correct theoretical signs.

Moreover, in all three countries, the competitor's export price index is seen to be exerting the strongest pull on export demand.

TABLE 1 - *Descriptive Statistics for Variables in the Export Demand Model*

Country/Variables	Mean	Media n	Standard Deviation	Coefficient of Variation (%)
A: Guyana				
ln x	4.60	4.59	0.30	6.52
ln xp	6.65	7.02	2.32	34.88
ln er	3.13	3.48	2.00	63.89
B: Jamaica				
ln x	4.56	4.61	0.25	5.48
ln xp	4.59	4.56	1.95	45.48
ln er	2.13	1.86	1.68	78.87
C: Trinidad and Tobago				
ln x	5.17	5.18	0.48	9.28
ln xp	4.19	4.41	0.96	22.91
ln er	1.34	1.44	0.46	34.32
D: United States				
ln USCPI	4.71	4.84	0.52	11.06
ln USPPI-IC	4.59	4.73	0.45	9.80
ln USIP	4.25	4.23	0.30	7.05

Notes: USCPI= U.S. consumer price index; USPPI-IC= U.S. producer price index for industrial commodities; USIP=U.S. index of industrial production. All other symbols are defined in the text.

The estimated elasticity for this variable ranges from 2.98 in GY to 4.50 in JA; its value in TT is 3.31. These results suggest that a 1% increase in U.S. prices is likely to increase the demand for exported goods from GY, JA, and TT by about 2.98%, 3.31%, and 4.5% respectively. The own-price elasticities of export demand also carry their correct theoretical sign. With values that are less than 1, the price elasticity of export demand is inelastic in all three countries. According to the results, a 1% increase in the price for exports should lead to a fall in the quantity of exported goods demanded form GY, JA, and TT by about 0.77%, 0.59, and 0.57%, respectively. Looking at the elasticities for the foreign economic activity variable, the results indicate that these elasticities are positive in all three countries. For GY and TT, the estimated elasticities are inelastic with values of 0.72 and 0.55, respectively. In the case of JA, however, the estimated elasticity, for the foreign economic activity variable, is elastic, with a value of 1.83. Finally, the elasticities for the foreign exchange rate variable are positive in all three countries. The results

TABLE 2 - *Bounds Test for Cointegration*

Equation no.	Country	Calculated F-statistic	Bounds Critical Value 10%[α] I(0)	I(1)	k	ARDL Specifications	Conclusion
3	Guyana	6.712	2.667	3.820	4	(1,1,1,0,1)	Reject the null hypothesis of no cointegration
3	Jamaica	6.482	2.667	3.850	4	(4,0,0,03)	Reject the null hypothesis of no cointegration
3	Trinidad and Tobago	6.610	2.667	3.850	4	(3,0,1,0,0)	Reject the null hypothesis of no cointegration

k refers to the number of regressors.

[α] The critical values for the bounds test were extrapolated from Narayan (2005) case III, unrestricted intercept and no trend.

TABLE 3 - *Results for the Long-Run Export Demand Model (Eq.4)*

A: GUYANA – ARDL (1,1,1,0,1)

Regressors	Coefficients	t-statistics
Constant	2.691***	2.193
$\ell n\ er_t$	0.605***	3.035
$\ell n\ xp_t$	-0.779***	-5.702
$\ell n\ wxp_t$	2.983***	1.498
$\ell n\ wy_t$	0.720***	1.438

B: JAMAICA – ARDL (4,0,0, 0,3)

Regressors	Coefficients	t-statistics
Constant	3.891***	2.128
$\ell n\ er_t$	0.419***	2.666
$\ell n\ xp_t$	-0.595***	-4.796
$\ell n\ wxp_t$	4.530***	3.022
$\ell n\ wy_t$	1.836***	2.770

C: TRINIDAD & TOBAGO – ARDL (3,0,1,0,0)

Regressors	Coefficients	t-statistics
Constant	-1.441***	-1.453
$\ell n\ er_t$	0.259***	1.525
$\ell n\ xp_t$	-0.572***	-3.023
$\ell n\ wxp_t$	3.316***	3.900
$\ell n\ wy_t$	0.553***	1.814

Notes: The dependent variable is $\ell n x_t$. The following three asterisks, ***, indicate statistical significance at the 10% level.

indicate that a 1% increase in the domestic price for foreign currency should result in an increase in the demand for exported goods from GY, JA, and TT by about 0.6%, 0.41%, and 0.25% respectively.

The final model to be estimated in this study is the short-run model for export demand as represented by equation (5). The results from that estimation are reported in Table 4.

TABLE 4 - *Results for the Short-Run Error Correction Model (Eq.5)*

	GUYANA		JAMAICA		TRINIDAD & TOBAGO	
Variables	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	-0.059	-1.088	-0.037	-0.718	-0.243***	-2.237
$\Delta\ell n\ er_t$	0.654***	4.437	0.623***	4.596	0.140***	2.259
$\Delta\ell n\ xp_t$	-0.794***	-8.274	-0.747***	-7.813	-0.343***	-2.016
$\Delta\ell n\ wxp_t$	1.791***	1.831	4.787***	2.857	2.577***	3.260
$\Delta\ell n\ wy_t$	1.581***	1.436	1.569***	2.970	1.112***	1.945
ect_{t-1}	-0.505***	-3.817	-0.385***	-2.057	-0.239***	-3.155
Adj-R^2	0.70		0.73		0.50	
F-statistic	15.948		8.642		5.377	
JB statistic	0.526 (0.768)		1.048 (0.592)		1.40 (0.495)	
BG(2) statistic	0.564		3.404		1.772	
ARDL specification:	(1,0,0,0,0)		(4,0,2,1,2)		(2,0,0,1,1)	
Akaike Information Criterion (AIC)	-0.648		-1.416		-1.345	
Schwarz Criterion (SC)	-0.349		-0.777		-0.918	

Notes: The dependent variable is Δlnx_t. The following three asterisks, ***, indicate statistical significance at the 10% level. JB stands for the Jarque-Bera test of normality. BG stands for the Breusch-Godfrey test for autocorrelation.

With the parameter η, for the one-period lagged error correction term, being negative and statistically significant in all three countries, the results further support the notion that for GY, JA, and TT there is a long-run relation between the variables in the export demand equation. Moreover, these results suggest that when the demand

for exports is greater than the long-run level, there is a significant downward adjustment in demand in the following period in all three countries. For the other variables in the short-run model, three points are worth emphasizing. The first point is that in all three countries the estimated elasticities for these variables – Δ*lner*, Δ*lnxp*, Δ*lnwxp*, and Δ*lnwp* – are all statistically significant with their correct signs. The second point is that in all three countries the estimated elasticites for the variables Δ*lnwy*, and Δ*lnwxp* are greater than 1. For the Δ*lnwy* variable, this means that in the short-run the demand for exported goods from GY, JA, and TT would in general rise faster than the rate of expansion in U.S. industrial activity. For the Δ*lnwxp* variable, these results suggest that there should be a robust expansion in the demand for goods exported by GY, JA, and TT when there are increases in U.S. prices. The third point is that in all three countries the estimated elasticities for the variables Δ*lnxp*, and Δ*lner* are less than 1. For the export price variable, this means that the quantity of goods exported for GY, JA, and TT are price inelastic. While for the exchange rate variable, the results suggest that in all three countries the responsiveness of export demand to a change in the exchange rate is also inelastic, in the sense that the percentage change in the quantity of goods demanded is less than the percentage in the foreign exchange rate. Further evaluation of the short-run model also indicate that one cannot reject the null hypotheses of no serial correlation, no non-normally distributed error terms, and no parameter instability.

4. Conclusions and policy implications

This paper estimates long-run and short-run export demand equations for Guyana, Jamaica, and Trinidad and Tobago using an ARDL framework. Before these equations are estimated, however, the paper uses the bounds test for cointegration, as proposed by Pesaran *et al*. (2001), Shin, and Smith, to determine if a long-run relationship exists between the variables in the export demand equation. After establishing the existence of a long-run relationship among the variables, the study proceeds to estimate the long-run and short-run versions of the export demand model. The results from the long-run model indicated that the demand for exported goods from Guyana, Jamaica, and Trinidad and Tobago are price inelastic, with estimated elasticities of -0.779, -0.595, and -0.572, respectively. These estimated elasticities are all statistically significant at the 1% level of significance. The other two price-centered variables in the export demand equation – the foreign exchange rate and the price for

the exporting country competitor's goods – also have their correct signs and are statistically significant. For the latter variable, the results indicated that there is a strong link between that variable and the quantity of exported goods demanded from Guyana, Jamaica, and Trinidad and Tobago. In fact, the data suggest that the cross-price elasticity of export demand is highly elastic with values of 2.98, 4.53, and 3.31, respectively, for Guyana, Jamaica, and Trinidad and Tobago. For the foreign exchange rate variable, the estimated elasticities are inelastic with values of 0.605, 0.419, and 0.259 for Guyana, Jamaica, and Trinidad and Tobago, respectively.

When the short-run results are analyzed for the price-centered variables in the export demand equation, the following generalizations emerge for all three countries:

1. the own price elasticity of export demand is inelastic;
2. the cross-price elasticity of export demand is elastic;
3. the responsiveness of export demand to an adjustment in the foreign exchange rate is inelastic.

It is worth noting, here, that these broad statements about the relationship between export demand and the various types of prices in the export demand model apply not only to the short-run results but also to the long-run results, as well.

Focusing on the foreign economic activity variable, as represented by the level of industrial production in the U.S., one finds, in the long-run, that the demand for goods exported by Jamaica is quite responsive to changes in U.S. industrial activity. The estimated elasticity for this variable, in the case of Jamaica is 1.836. In the case of Guyana, and Trinidad and Tobago, this variable has an estimated elasticity of 0.72 and 0.55, respectively. These results suggest that the demand for exported goods from Guyana, and Trinidad and Tobago are less responsive to changes in industrial activity in the U.S. compared to Jamaica. Looking at the short-run, however the results suggest that in all three countries the demand for exported goods is highly responsive to changes in U.S. industrial activity.

From a policy making perspective, the results in this paper suggest at least two things. First, the results suggest that policymakers in the three Caribbean countries should pay special attention to the secular trends and cyclical variations in U.S. economic activity particularly as they relate to industrial production and prices. For by so doing, the policymakers can get a better understanding of the foreign conditions that affect the demand for their countries exports. Second,

the results suggest that policy-makers should focus on implementing policies that are designed to improve the competitiveness of their countries exports. With a ranking by the World Economic Forum (2010) within the bottom 50% of the Global Competitiveness Index, these economies if they are to grow their exports and expand their economies must improve in this area.

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ABSTRACT

This paper estimates long-run and short-run trade elasticities of export demand for Guyana, Jamaica, and Trinidad and Tobago. To that end, a traditional export demand model is estimated for all three countries in the study using the bounds test for analyzing level relationships within the conditional autoregressive distributed lag (ARDL) framework. This study finds that for all three countries the price-centered variables in the model are statistically significant with their correct theoretical signs in the long-run and short-run. Moreover, the study finds that for all three countries, the estimated coefficients for the foreign activity variable are positive and statistically significant in both the long-run and the short-run.

Keywords: Export Demand, Bounds Test for Cointegration, Guyana, Jamaica, Trinidad and Tobago

JEL Classification: F14, O54

RIASSUNTO

L'elasticità della domanda dell'export in tre paesi membri CARICOM: un'applicazione del bounds test di cointegrazione

Questo studio stima l'elasticità nel lungo e nel breve periodo della domanda dell'export in Guyana, Giamaica e Trinidad e Tobago. A questo fine si utilizza un modello tradizionale di domanda dell'export per i tre paesi considerati nello studio, utilizzando il bound test per analizzare le relazioni a intervallo distribuito autoregressivo condizionale. Questo lavoro evidenzia che per tutti e tre i paesi le variabili del modello basate sul prezzo sono statisticamente significative con i loro segni teoricamente corretti nel lungo e nel breve periodo. Inoltre vi è evidenza che per i tre paesi i coefficienti stimati per la variabile attività straniere sono positivi e statisticamente significativi sia nel lungo sia nel breve periodo.