SEAFOOD IMPORT DEMAND AND ITS EFFECTS ON CARIBBEAN FISHERIES PRODUCTION

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ABSTRACT

The present study employs a cointegration method and error correction model to analyze the long-run relationship and short-run adjustment of aggregated seafood import demand function for selected Caribbean countries. The results show that there exists a long-term equilibrium relationship between Caribbean seafood import and related factors. Import demand elasticity is 1.72. Exchange rate has negative an effect on seafood imports, a one percent increase in exchange rate causes 1.55 percent decrease in seafood imports. Income has positive effect on seafood imports; a one percent income increase causes seafood imports to increase 0.22 percent. Tourist arrivals have positive effects on seafood imports, a one percent increase in tourist revenue cause 1.17 percent increase in seafood imports. Seafood imports have a significant negative effect on domestic fisheries production. The study suggests an outward shift of world seafood supply in the Caribbean region. The shift causes import price to decrease, and domestic seafood production to decrease as well. A tariff policy and a supply expansion both reduce imports, and enhance domestic production and producers' surplus. However, tariff policy reduces consumer surplus, while supply expansion increase consumer surplus.

Key words: Seafood, import demand, cointegration, economic surplus

INTRODUCTION

Caribbean countries imported an average of 126,398.5 tons of seafood per year, equal to $U.S. 196.32 million per year during the period 1976 to 2006 (FAO, 2009). Seafood imports to the Caribbean include categories, such as fin fish, crustacean and mollusk, fish meal, and other fish products. High-valued seafood include crustacean and mollusk, with average unit value of $U.S. 5.19 per kilogram, accounting for about 3% of total seafood import volume, and about 10% of total seafood import value. Low-valued seafood products include fin fish, fish meal and other fishery products, with average unit value of U.S. $1.45 per kilogram, accounting for 97% of total imports, and 90% of total import value. Imports of high-valued products have been increasing faster than low-valued products during 1976 to 2006 (FAO 2009). Seafood import price is increasing in nominal term, but decreasing in real terms. Seafood import has been increasing faster among the group of countries which have tourist revenue accounting for more than 20 percent of their total GDP (FAO, 2009).

Caribbean economies are deeply integrated into the global economy and rely heavily on international trade of goods and services. Many Caribbean countries depend on imports for food consumption and capital goods (Pollard et al., 2008). The Caribbean region is a net food importer (McIntyre, 1995). Therefore, recent world food price crises, with doubling international food price index between 2006 and 2008 (World Bank, 2009a), have created uncertainty for the regional food security (Caribbean Community Secretariat, 2008). Seafood imports make up a large share of Caribbean seafood consumption and any price changes are bound to affect the economic growth and development of these small nation states and weaken their ability to provide their citizens the animal proteins necessary to maintain a healthy diet. Therefore, it is important to examine factors affecting seafood import demand, and to evaluate costs and benefits of interventions to promote domestic seafood production in the region. The present study has three objectives: (1) to examine factors effecting Caribbean seafood import demand; (2) to test causal relationships between domestic seafood production and imports; and (3) to analyize effetcs of policies that reduce imports, and promote domestic production. The paper is organized with the following sections: conceptual framework, empirical estimation, policy discussion, and conclusion.

CONCEPTUAL FRAMEWORK

The motivation of international trade is to seek economic efficiency through specialization and division of labor. People trade goods and services because they face different relative prices for the same goods and services. There are many factors determining relative prices, such as, resource endowment and factor productivity, market structure, exchange rate, and trade barriers. However, relative import price can be used to explain the above factors. Import demand is part of the total demand, and equal to domestic demand minus domestic supply. The import demand function is $M(P) = D(P, Y(P)) – S(P) = M(P, Y)$. Where, M is import quantity, D is domestic demand, S is domestic production, Y is domestic real income, and P is product price. Expected effect of price (P) on import quantity is negative, $\partial M/\partial P = \partial D/\partial P + (\partial D/\partial Y) *(\partial Y/\partial P) - \partial S/\partial P < 0$ because $\partial D/\partial P < 0$, $\partial D/\partial Y > 0$, $\partial Y/\partial P < 0$, and $\partial S/\partial P > 0$. Expected effect of income (Y) on import quantity (M) is positive, if import is a normal good, $\partial M/\partial Y = \partial D/\partial Y > 0$, and negative if import is an inferior good, $\partial M/\partial Y = \partial D/\partial Y < 0$. Following Khan and Ross (1977), the import demand equation is linearized as such:

$$M^*_t = \alpha_0 + \alpha_1 P_t + \alpha_2 Y_t + \varepsilon_t \qquad (1)$$

where, M^*_t is market equilibrium import quantity at time t. Whenever there is a shock in the market, import will adjust toward the equilibrium quantity (M^*_t). However, there are costs involved in the adjustments. Importation of goods requires time to produce goods, to transport products, and to deliver to consumers. Khan and Ross (1977) proposed a partial adjustment import demand model in which changes of imports at time t (ΔM_t) is related to the difference between equilibrium import demand at time t (M^*_t) and actual imports at time t-1 (M_{t-1}): $\Delta M_t = \gamma (M^*_t - M_{t-1})$. Where, $\Delta M_t = M_t - M_{t-1}$, and γ is the coefficient of adjustment ($0 \leq \gamma \leq 1$). Substitute the solution for M^*_t from partial adjustment into (1), to obtain:

$$M_t = \gamma\alpha_0 + \gamma\alpha_1 P_t + \gamma\alpha_2 Y_t + (1- \gamma) M_{t-1} + \gamma\varepsilon_t \quad (2)$$

The relative price is the ratio of import price in domestic currency over prices of domestically produced goods. The specification conforms to the neoclassical trade theory of comparative advantage. The empirical import demand model is:

$$M_t = M\left(\frac{e * P_{im}^{usd}}{P_d}, M_{t-1}, Y_t\right) \quad (3)$$

where, P_{im}^{usd} is import unit value in U.S. dollars. Exchange rate (e) is introduced to transform import unit value into local currency. The exchange rate is the price of foreign currency ($*) in terms of domestic currency ($), $e = \$/\$^*$. Therefore, seafood import price can be expressed in domestic currency as $e*P_{im}^{usd}$. P_d is price level of domestic goods and services. The uses of P_d vary across studies. Legion et al. (1996) used domestic catfish price for P_d in an estimation of catfish import demand; Narayan and Narayan (2005) used price of domestic goods and service for P_d. In this study, consumer price index (CPI) is used for P_d to represent domestic price level of goods and services.

Tourism is an important economic sector in the Caribbean. Discussion of the linkage between tourism and agriculture are found in Momsen (1998) and Torres (2003). The potential effects of tourism on seafood import can be determined in several ways. First, tourism increase demand for seafood imports, since tourist arrivals generates further demand for goods and services including seafood products. Second, a rise in tourists may increase income of local people, and in turn, stimulates demand for imported seafood. Third, tourists bring more foreign currency into local economies, and cause an appreciation of the domestic currency. Therefore, a tourist variable can be included in the import demand model to test different effects of tourism on seafood imports.

In a partial equilibrium trade model, import and domestic production have a direct, negative relationship, and the concern of present study is the causal direction of the relationship. The expansion of seafood imports in Caribbean during last 15 years can be explained by three different market forces. The first can be an increase in domestic demand. The increase in domestic demand shifts the excess demand curve outward. Higher excess demand will cause import volume and import price to increase. In this case, domestic demand and domestic supply will both increase. Second, there is a decrease of domestic supply and the inward shift of domestic supply shifts the excess demand curve outward. As a result, import volume and import price will both increase. Hence, quantity demanded and domestic supply will both decrease. The third market force can be an increase of world supply, equaling to a shift out of excess supply. In this case, import volume increases, import price decreases, domestic demand increases and domestic supply decreases.

Domestic fishery production in the Caribbean has been decreasing in the last two decades. The decreasing can be a result of internal reasons such as, over exploitation, resource depletion, poor investment and management of fishery resources, and competition for resources and water use from tourism. The opposing argument is that the reduction in domestic production is a result of foreign seafood competition. Therefore, domestic production can be included in the import demand function to test causal relationships between imports and domestic production. The empirical import demand equation is specified as:

$$\log(M_t) = a_0 + a_1*\log(P^{usd}_{im\ t}/CPI_t) + a_2*\log(e_t) + a_3*\log(M_{t-1}) + a_4*\log(Y_t) + a_5*\log(Tour_t) + a_6*\log(Q_d) + u_t \quad (4)$$

The sign of the parameter a_1 is expected to be negative. The parameter a_2 is expected to be negative because an increase in exchange rate, equivalent to a depreciation of domestic currency, makes imports more expensive to domestic buyers. The parameter a_3 should be positive and smaller than 1, since $a_3 = 1 - \gamma$, where $0 < \gamma < 1$. The parameter a_4 and a_5 are expected to be positive. The expected sign of a_6 is negative. The causality test will be employed to confirm a hypothesis that the behavior of domestic production series can explain the behavior of seafood import series, and vice versa.

EMPIRICAL ESTIMATIONS

A time series variable is stationary when its stochastic properties, such as mean, variance and covariance are invariant with respect to time (Kennedy, 2008). It is well known that ordinary least squares (OLS) method using nonstationry time-series data produces spurious regressions (Granger and Newbold, 1974). Granger (1981), Engle and Granger (1987) introduced the concept of cointegration, and a method to estimate economic models with cointegrated nonstationary time-series data. If a group of economic time series data have an equilibrium or economic relationship, they can not move independently from each other (Ender, 2004); in other words, those economic time series should be cointegrated. Engle and Granger (1987) proved that a group of time-series variables are cointegrated when (i) all the variables are integrated to the same oder d; and (ii) there exists at least one linear combination of variables that is integrated to the order d-b, where b > 0. The cointegration method allows us to find the long-term equilibrium relationship among nonstationary economic variables. In the short-term, any diviation from the equilibrium will die out gradually. The error-correction model estimates short-term dynamics of variables that are influenced by deviations from long-run equilibrium in previous periods (Engle and Granger, 1987).

Data for seafood import volumes, and values into Caribbean countries were collected from FAO Fishstat Database (FAO, 2009). Data on GDP and population were collected from World Development Indicator (WDI) database (World Bank, 2009). Data on CPI and exchange rates were collected from the International Financial Service (IFS) database (IMF, 2009). Data on domestic fishery production (Q_d) were from FAO Fishstat Database (FAO, 2009). Data on tourism arrivals to Caribbean countries were collected from the Caribbean Tourism Organization's database. Caribbean countries covered in the present study are Aruba, Antigua and Barbuda, Bahamas, Barbados, Cayman Islands, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Netherlands Antilles, Puerto Rico, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, and Virgin Islands (U.S.). All data are available in annual basis for the study period of 1976 to 2006.

Unit-root Tests

A time-series variable is integrated to the order d when its d^{th} difference is stationary. In economics, most macroeconomic variables are integrated to the order 1. Therefore, the present study employs Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981) to check first difference stationary, or unit root, among investigated time series variables. The general form of ADF test is: $\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{i=2} \beta_i \Delta y_{t-i+1} + a_1 t + \varepsilon_t$. We first check the null hypotheis of $\gamma = 0$, using critical value of tau (τ_τ) = - 3.60 at sample size = 25. Then we test another null hypothesis of $a_0 = \gamma = a_1 = 0$, using the critical value of phi (Φ_2) = 5.68. If we fail to reject both null hypotheses above, the series (y_t) has unit root. The results are presented in table 1, showing that all variables have unit root.

Table 1. Augmented Dickey-Fuller Test for Unit Roots

Variables	τ	Pr < τ	Φ	Pr > Φ	Conclusion
$\log(Q_{im})$	-2.28	0.4298	2.64	0.6598	I(1)
$\log(P_{im}/CPI)$	-2.86	0.1890	4.09	0.3859	I(1)
log(e)	-2.42	0.3625	3.38	0.5204	I(1)
log(GDP)	-0.72	0.9622	1.78	0.8224	I(1)
log(Tour)	-1.72	0.7146	1.61	0.8544	I(1)
$\log(Q_d)$	-1.37	0.8476	2.14	0.7549	I(1)

Since all variables are integrated to the same order 1, we can conduct a cointegration test, then estimate the long-term equilibrium relationship among the variables.

Cointegration Test

Engle and Granger (1987) have proposed a two-step method to test cointegration in a single-equation model. The basic of Engle-Granger method is based on testing for unit root in cointegrating regression residuals. However, there are some limitations to the Engle-Granger method. First, OLS method for cointegrating regression requires us to choose a regressand among the variables, the estimation of cointegrating parameters is sensitive to the choice of the regressand. Second, when there are more than two variables, the number of cointegrating relationships can be more than one, which the OLS method for cointegrating regression will not be able to estimate all these relationships, and can produce inconsistent estimates of these multiple sets of cointegrating parameters (Kennedy, 2008). In dealing with the above issues in Engle-Granger method, Johansen (1988) has developed a method to test cointegration in multiple-equation models. The Johansen method views all variables as being endogenous, and forming a vector autoregressive (VAR) equation to test for cointegration. The Johansen cointegration test is developed from a vector autoregressive model: $Z_t = A_1Z_{t-1} + A_2Z_{t-2} + A_3Z_{t-3} + \ldots + A_mZ_{t-m} + \varepsilon_t$. Substacting each side by Z_{t-1} and going through manipulations, to obtain: $\Delta Z_t = \Pi Z_{t-1} + \sum_{i=1}^{m-1} \Gamma_i \Delta Z_{t-i} + \varepsilon_t$. Where. $\Pi = - I + A_1 + A_2 + \ldots + A_m$, and $\Gamma_i = - \sum_{j=i+1}^{m} A_j$. The rank of matrix Π is equal to the number of independent cointegrating vectors of Z variables. Johansen and Juselius (1990) developed a maximum likelihood method to test the number of estimated cointegrating vectors and to estimate those cointegrating vectors. However, multiple cointegrating vectors cause difficulties to identify the true economic equilibrium relationship among variables. Researchers often deal with multiple cointegrating vectors by ignoring those vectors that have no economic meaning.

The results of cointegration test for Caribbean seafood import demand model are presented in table 2. The cointegration rank test starts with null hypothesis of r = 0. Trace statistic rejects the null hypothesis because computed trace statistic of 100.57 is greater than the critical value of 93.92. The second step involves a null hypothesis of r = 1 and the trace test fails to reject the null hypothesis since computed statistics (65.35) is smaller than the critical value (68.68).

Table 2. Cointegration Rank Test

H0: Rank = r	H1: Rank > r	Eigen-value	λ_{Trace}	5% Critical Value

0	0	0.69	100.57	93.92
1	1	0.54	65.36	68.68
2	2	0.40	41.87	47.21
3	3	0.33	26.44	29.38
4	4	0.26	14.45	15.34
5	5	0.16	5.25	3.84

Therefore, there exists only one cointegrating relationship among variables. The most theoretically sound long-term cointegrating vector is: $\log(Q_{im})_t = 17.09 – 1.72*\log(P_{im}/CPI)_t – 1.55*\log(e)_t + 0.22*\log(GDP)_t + 1.17*\log(Tour)_t – 0.83*\log(Q_d)_t$. The long-term equilibrium relatioship among the variable conforms to the theoritical import demand model. Seafood import negatively affects import quantity. A one percent increase in import price will cause import quantity to reduce by 1.72 percent in the long-term. Exchange rate has a negative effect on seafood import as expected. A one percent increase in exchange rate will cause 1.55 percent decrease in seafood imports. Doemstic production has a negative relationship with import quantities. Both income and toursist arrivals have positive effects on seafood imports. Seafood import is income inelastic, 0.22, or seafood import is a normal good. Tourism plays a significant role in seafood importation. A one percent increase in tourist arrivals increases seafood imports by 1.17 percent.

Error-correction

The main idea of the error correction mechanism is that a proportion of disequilibrium from one period is corrected in the next period. The general form of an ECM model is: $\Delta x_t = \pi_0 + \pi\ x_{t-1} + \pi_1\ \Delta x_t + \pi_2\ \Delta x_{t-1} +\ldots+ \pi_P\ \Delta x_{t-P} + \varepsilon_t$. Where, $x_t = (x_{1t}, x_{2t}, x_{3t}, \ldots x_{nt})$, Δ is the difference operator, π_0 is a vector of intercepts, π is error correction (n x n) maxtrix, π_i is the coefficient (n x n) matrix. The estimate of error-correction model is presented in table 3. The results show that short-run effects of all investigating variables are not significant, except import price. Import price negatively affects import quantity demanded. Import demand elasticity is 1.25 in the short-term.

Table 3. Error-correction Model

Parameter	Estimate	t Value	Pr > |t|
$\Delta\log(P_{im}/CPI)_t$	-1.246***	-5.53	<.0001
$\Delta\log(e)_t$	-0.713	-1.61	0.1207
$\Delta\log(Q_d)_t$	-0.321	-1.10	0.2824
$\Delta\log(GDP)_t$	-0.078	-0.40	0.6954

Δlog(Tour)$_t$	-0.294	-0.67	0.507
μ^s_{t-1}	-0.477**	-2.37	0.0264
DW	1.99		

Notes: (i) Error-correction term, $\mu^s_{t,}$; (ii)*significant at 10%, **significant at 5%, *** significant at 1%.

POLICY IMPLICATION ON DOMESTIC PRODUCTION

The results in previous sessions show a negative relationship between domestic production and seafood imports. The data on seafood imports show that real seafood import price was decreasing, at the same time, seafood import volume was increasing. The data suggest that there is an outward shift in seafood world supply to the Caribbean, which causes import price and domestic production to decrease. Granger causality tests confirm that seafood import has a causal effect to domestic production. In addition, relationship between domestic production and import can be examined when investigating the relationship between domestic production and import price. In partial equilibrium trade models, import is a substitute for domestic production. A higher import price lowers seafood import quantity demanded, and stimulates domestic production. According to production theory and law of one price, import price is assumed to equal to domestic product price. CPI is proxy for input price level. Profit maximizing firms will end up with a supply function which has a positive relationship with product price and negative relationship with input price. The estimate of domestic seafood supply is $\log(Q_d)_t = 14.15 + 0.463*\log(P_{im}) - 0.489*\log(CPI)$. Supply elasticity is 0.463. The present study confirms that imports and domestic production have a negative relationship, and seafood import expansion causes domestic production to decrease.

Seafood imports increase the dependence of the Caribbean on foreign fish production. In addition, seafood imports compete with and take over the market of domestically produced seafood. The Caribbean needs to promote its fishery sector to reduce levels of imports, minimize market risks and enhance its food security. There are two possible policies to promote domestic fisheries, such as import restriction and domestic production support. The first option relates to trade policies such as exchange rate manipulation, tariff and non-tariff trade barriers. The second option relates to production expansion policies, such as extension services, research and information diffusion, credit, and input programs. The partial equilibrium trade model allows us to analyze the welfare changes of each policy option mentioned above. Equilibrium displacement model (EDM) of Caribbean seafood trade is generalized as:

$$D^* = -\eta_d P_d^* \quad \text{(Domestic demand)} \tag{5}$$

$$S^* = \varepsilon_d P_d^* + \varepsilon_a A^* \quad \text{(Domestic supply)} \tag{6}$$

$$M^* = \varepsilon_m P_m^* \quad \text{(World supply)} \tag{7}$$

$$P_d^* = P_m^* + t^* \quad \text{(Prices equation)} \tag{8}$$

$$D^* = k_d S^* + k_m M^* \quad \text{(Partial equilibrium of trade)} \tag{9}$$

where, (*) is the symbol for percentage change of the variables, D is domestic demand, S is domestic supply, P_d is domestic price, M is import, P_m is import price, A is a supply shifter, variable t is import tariff, k_d is the share of domestic supply in total consumption, and K_m is the share of imports in total consumption. To substitute D* from (5) and S* from (6) into (9) yields $-\eta_d P_d^* = k_d (\varepsilon_d P_d^* + \varepsilon_a A^*) + k_m M^*$. We can specify import demand function as $M^* = -\eta_m P_m^* = -\eta_m (P_d^* - t^*)$, where η_m is import demand elasticity. Substitution for M* to get: $-\eta_d P_d^* = k_d (\varepsilon_d P_d^* + \varepsilon_a A^*) - k_m \eta_m (P_d^* - t^*)$. Domestic demand elasticity (η_d) is not estimated directly, but it can be derived from previous result as: $\eta_d = (-k_d \varepsilon_d + k_m \eta_m) - \varepsilon_a A^*/P_d^* - k_m \eta_m t^*/P_d^*$. Technology (A) and tariff (t) are exogenous factors in the system from (5) through (9). Price changes do not affect supply shifter and tariff, $\partial A/\partial P_d = 0$ and $\partial t/\partial P_d = 0$. Therefore, the terms $A^*/P_d^* = (\partial A/\partial P_d)^*(P_d/A)$ and $t^*/P_d^* = (\partial t/\partial P_d)^*(P_d/t)$ are zero. So, domestic demand elasticity will be $\eta_d = -k_d \varepsilon_d + k_m \eta_m = 0.277$, because $\eta_m = 1.72$, $\varepsilon_d = 0.463$, $k_d = 0.661$, $k_m = 0.339$. The supply shifter elasticity (ε_a) is assumed to be equal to 1.0 for convenience in simulation. The world seafood supply elasticity (ε_m) is assumed to be infinity, since Caribbean countries are small, open economies.

The average import tariff on seafood product to the Caribbean region is 35 percent (Ford and Rawlins, 2007). The effects of a tariff are described in the figure 1. A tariff increase is equal to an upward, vertical shift up of the excess supply curve. The predicted effects are domestic price increasing, import price decreasing, domestic production increasing, domestic demand and import decreasing. The changes in economics surplus of producers and consumers are computed as $\Delta PS = P_d S_0 P_d^* (1 + S^*/2)$, and $\Delta CS = - P_d D_0 P_d^* (1 + D^*/2)$. Where, ΔPS and ΔCS are the changes of producers' surplus and consumers' surplus; S_0 is initial supply quantity, assumed equal to average domestic production, 246,615.1 tons; P_d^* is percentage change in domestic price; S* is percentage change in domestic supply; D* is percentage change in domestic demand. The effects of a tariff increase of one percent are simulated in two scenarios, $\varepsilon_m = 2$, and ε_m = infinity (table 4). In case of $\varepsilon_m = 2$, a one percent increase in tariff (t) will cause 0.54 percent increase in domestic price and 0.46 percent decrease in import price. Producer surplus increases by $U.S. 2.06 million a year. Consumer surplus decreases by $U.S. 3.11 million a year. Hence, total surplus decreases by $U.S. 1.05 million per annum. In case of ε_m = infinity, a tariff generates more producer surplus,

$U.S. 3.84 million a year, but also greater loss of consumer surplus, $U.S. 5.78 million a year. Total surplus decreases $U.S. 1.95 a year.

The effects of supply expansion are described in figure 4. An outward shift of domestic supply cause the excess demand to shift to the left. The excess demand inward shift will reduce import price and import quantity. Domestic price is also decreasing. Lower domestic price causes seafood demand to increase. The changes in economic surplus of producers and consumers are computed as $\Delta PS = P_d\ S\ (P_d^* - V_d^*)\ (1 + S^*/2)$, where $V_d^* = -\varepsilon_a^* A/\varepsilon_d$, and $\Delta CS = -\ P_d\ P_d^*\ D\ (1 + D^*/2)$. The effects of a one percent increase in domestic supply, for both scenarios of $\varepsilon_m = 2$ and ε_m = infinity, are presented in table 4. Domestic supply expansion generates higher welfare to producers and consumers, and helps Caribbean countries to save foreign exchange from the purchase of imports. Total economic surplus of a one percent increase in domestic supply is $U.S. 9.31 million a year and $U.S. 8.29 million a year when $\varepsilon_m = 2$, and ε_m = infinity.

Table 4. Welfare Analysis of Tariff and Supply Expansion Policies

Variables	Unit	Tariff		Supply expansion	
		$\varepsilon_m = 2$	$\varepsilon_m = +\infty$	$\varepsilon_m = 2$	$\varepsilon_m = +\infty$
P_d^*	%	0.538	1.000	-0.524	0.000
P_m^*	%	-0.462	0.000	-0.524	0.000
D*	%	-0.149	-0.277	0.145	0.000
S*	%	0.249	0.463	0.757	1.000
M*	%	-0.925	-1.720	-1.048	-1.950
ΔPS	1000 $US/year	2061.67	3838.80	6272.32	8291.14
ΔCS	1000 $US/year	-3112.14	-5784.88	3038.58	0.00
ΔTS	1000 $US/year	-1050.48	-1946.08	9310.89	8291.14

CONCLUSION

Seafood import demand function is estimated for the Caribbean market. Seafood import demand elasticity is 1.72. Exchange rates have negative effects on seafood imports. Income has positive effect on seafood import demand. Tourist arrivals have positive effects on seafood imports. Import price is the major factor affecting seafood imports. Seafood imports have a significant negative effect on domestic production, transmitted through import price. The study suggests an outward shift of world seafood supply in Caribbean region. The shift causes import price to decrease, and domestic seafood production to decrease. Tariff and supply expansion policies both reduce import and enhance domestic production. Both policies increase producers' surplus, but tariff policy reduces consumer surplus, and supply expansion increase consumer surplus. Small open economies, like the Caribbean States, must be selective in the adoption of policy instruments to stimulate domestic production. A production expansion policy is more appropriate and effective than a tariff in expanding production and net economic surplus. However, a production expansion subsidy must be financed from local government funds which are not always available.

REFERENCE

Caribbean Tourism Organization (2009) *Caribbean Tourism Performance Reviews & Prospects*. Retrieved August 8, 2009, from http://www.onecaribbean.org/statistics/annualoverview/

Dickey, D. and Fuller, W. A. (1981) Likelihood ratio statistics for autoregressive time series with unit root. *Econometrica,* 49: 1057-72

Ender, Walter (2004) *Applied Econometric Time Series*. John Wiley & Sons.

Engle, Robert F. and Granger, C. W. J. (1987) Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, Vol. 55, No. 2: 251-76

Food and Agriculture Organization (2009) *Fishstat plus database*. Retrieved May 02, 2009, from http://www.fao.org/fishery/statistics/software/fishstat/en

Ford, J. R. Deep and Rawlins, G. (2007) Trade policy, trade and food security in the Caribbean. In *Agricultural trade policy and food security in the Caribbean: structural issues, multilateral negotiations and competitiveness*, ed. J.r. Deep Ford, Crescenzo dell'Aquila, and Piero Conforti, 7-73. FAO, Trade and Market Division.

Granger, C. and Newbold, P. (1974) Spurious regression in econometrics. *Journal of Econometrics No.2: 111-20.*

Granger, C. W. J. (1981) Some properties of time series data and their use in econometric model specification. *Journal of Economietrics* 16(1981): 121-30.

IMF. (2009) *International Financial Service (IFS) database*. Retrieved Feb. 16, 2009, from http://www.imfstatistics.org/imf/

Johansen, S. (1988) Statistical analysis of cointegratingv. *Journal of Economic Dynamics and Control*, 12: 231-54.

Johansen, S. and Juselius, K. (1990) Maximum likelihood estimation and inference on cointegration with application to demand for money. *Oxford Bulletin of Economics and Statistics*, 52: 169-210.

Kennedy, P. (2008) *A guide to econometrics*. Blackwell Publishing.

Khan, M. S. and Ross, K. Z. (1977) The functional form of the aggregate import demand equation. *Journal of International Economics* Vol.7: 149-160.

Ligeon, C., Jolly, C. M. and Jackson, J.D. (1996) Evaluation of the possible threat of NAFTA on U.S. catfish industry using a traditional import demand function. *Journal of Food Distribution Research* Vol. 27, Issue 2: 33-41.

McIntyre, Arnold Meredith (1995) *Trade and economic development in small open economies: The case of the Caribbean countries*. Praeger Publishers.

Momsen, J. H. (1998) Caribbean tourism and agriculture: new linkage in the glabal era?. In Globalization and neoliberalism: the Caribbean context, ed. Thomas Klak, 115-135. Rowman & littlefield Publisher.

Narayan, S. and Narayan, P. K. (2005) An empirical analysis of Fiji's import demand function. *Journal of Economic Studies*. Vol. 32, No. 2: 158-68.

Pollard, Walker A., Christ, N., Dean, J., and Linton, K.. (2008) *Caribbean region: Review of economic growth and development*. Retrieved June 25, 2009, from http://www.usitc.gov/publications/332/pub4000.pdf

Torres, Rebecca (2003) Linkages between tourism and agriculture in Mexico. Annals of Tourism Research, Vol. 30, No. 3: 546–66.

World Bank (2009) *World development indicator*. Retrieved May 02, 2009, from http://web.worldbank.org/wbsite/external/datastatistics

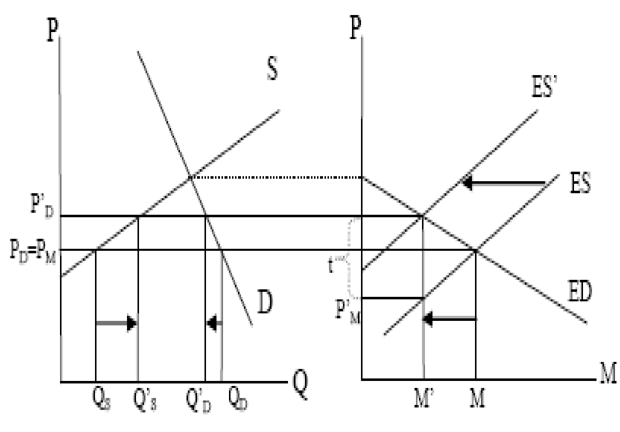

Figure 1. Partial Equilibrium Trade Model with a Tariff's Effects

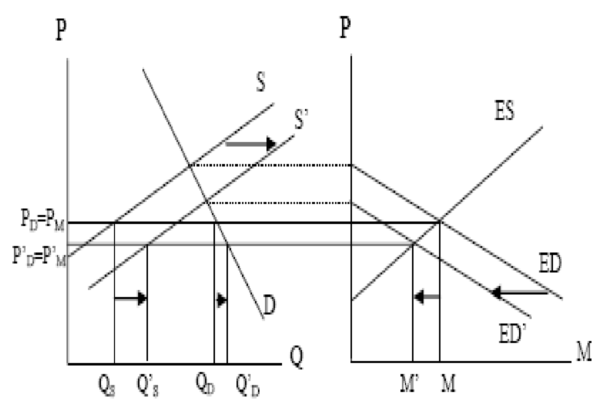

Figure 2. Partial Equilibrium Trade Model with a Supply Expansion's Effects