Estimation of U.S. Demand for Imported Shrimp by Country: A Two-stage Differential Production Approach

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Abstract

The demand for imported shrimp in the United States by country of origin is estimated by using the two-stage differential production method. Conditional and unconditional own/cross price elasticities are derived. We further project how countervailing duties imposition by U.S. affect source-specific shrimp imports. The results from aggregate level data show that overall the own-price elasticities indicate that U.S. demand for imported shrimp is inelastic. U.S. total shrimp imports would experience an increase despite the countervailing duties, which may not be effective.

Key Words: shrimp, import demand, elasticities, differential production approach, countervailing duties

JEL Codes: Q11; Q13; Q17.

U.S. shrimp imports, valued at $4.5 billion in 2012, increased nearly 43% from 1999, with an average annual growth rate of 3.3%. Shrimp imports accounted for 27 percent of the value of total edible fishery products imports. Seven major suppliers have accounted for most of these imports. These exporting countries include China, Ecuador, India, Indonesia, Mexico, Thailand, and Vietnam. In 2012, imports from these seven countries accounted for 88 per cent of the total U.S. shrimp imports by value. Thailand is the biggest source, accounting for about 25% of the imports in 2012. U.S. shrimp consumers rely heavily on imports, which provided 93% of the

total supply in 2011.

Due to increased imports, the domestic production of shrimp has been deceasing. Breaded shrimp production declined almost by half, from $463,781 thousand in 2002 to $240,976 thousand in 2011. U.S. landings of shrimp in 2011 were nearly 312.7 million pounds valued at almost $518 million. Gulf region landings have the largest share among all regions, accounting almost 68 percent of the national total with 212 million pounds. As in previous years, Gulf shrimpers are seeing prices forced downward by competition from imported shrimp that sells for less. All the while, they are hit with higher operating costs, especially for diesel fuel.

Increases in U.S. shrimp imports have been sustained by increases in United States per capita shrimp consumption. Shrimp has been the most consumed seafood in the U.S. since 2001, followed by canned tuna and salmon. In 1999, per capita shrimp consumption was 3.0 pounds, while U.S. per capita shrimp consumption was 4.2 pounds in 2011 (National Marine Fisheries Services, 2012)

In response to the increase in shrimp imports and falling shrimp prices, aggravated by the 2010 BP oil spill, the Coalition of Gulf Shrimp Industries launched a petition in December 2012, that alleged that material injury by subsidized imports from China, Ecuador, India, Indonesia, Malaysia, Thailand, and Vietnam. The petition requested the U.S. International Trade Commission (USITC) and the U.S. Department of Commerce (USDOC) to impose duties on imports from these countries. In August 2013, the Department of Commerce found that certain frozen warmwater shrimp from China, Ecuador, India, Malaysia, and Vietnam received countervailable subsidies ranging from 18.1 %, 10.1 % to 13.5 %, 10.5 % to 11.1 %, 10.8 % to 54.5% and 1.1 % to 7.8 %, respectively. The Commerce Department found no subsidization of imports from Indonesia and Thailand. In order to offset foreign governments subsidies,

countervailing duties are to be set in accord with subsidy rates for those affected countries if approval is made by the USITC.

There is a large body of literature on demand for different seafood species. However, studies on shrimp, which is the mostly consumed seafood in the U.S., are relatively few compared to other fish species. Jones and Harvey (2006) examined the effect of countervailing duties on US shrimp imports by a Central Bureau of Statistics (CBS) model using aggregate shrimp import data from January 1995 to December 2005. They found that countervailing duties imposed by the U.S. on six major shrimp exporting countries did not have the intended effect of reducing U.S shrimp imports. Jones, et al. (2008) estimated the U.S. demand for domestic and imported shrimp differentiated by exporting country from January 1995 to December 2005 using a Netherlands Central Bureau Statistic (CBS) demand system model. They test the monthly seasonality and stability of demand from each country and found that despite the countervailing duties imposed by the United States, shrimp demand from these countries remained fairly stable. Kuchler, Krissoff, and Harvey (2010) used weekly household food purchase data (1998-2006) and a Linear Approximated Almost Ideal Demand System (LA-AIDS) model to estimate the retail demand for shrimp in the US. They accounted for regulations that required country-of-origin labels (COOL) in the demand systems and found that consumers do not respond to the new country-of-origin labels on shrimp.

In this article, the import demand for shrimp differentiated by country of origin is estimated for the US using a two-stage production approach. The aim of this article is threefold. First, we empirically estimate the demand for imported shrimp in the United States by country of origin. From this, we obtain conditional and unconditional elasticities from estimated import

demand parameters. Finally, we use the estimated parameters to project the impact of import duties on source-specific imports.

Empirical methods

Four demand systems are commonly used to analyze agricultural import demand: Almost Ideal Demand System (AIDS), the Rotterdam, National Bureau of Research (NBR), and Central Bureau of Statistics (CBS) models. All of these models are based on consumer theory and derived from utility maximization problem. They assume that the imports are final goods.

The differential production approach is firstly introduced by Laitinen (1980) and Theil (1980). Empirical applications of the differential production method to import demand include Davis and Jensen (1994); Koo et al. (2001); Washington and Kilmer (2002); Muhammad (2007, 2009); and Muhammad and Ngeleza (2009). These studies argue that the final goods assumption is conceptually misspecified, given the nature of international trade, where traded goods require further processing or go through a number of domestic channels (e.g., transportation, storing, and retailing.) before reaching the consumer. Adding value is inevitable in these processes. Therefore it is more accurate to treat imported products as inputs. In addition, another disadvantage about the import demand derived from the consumer utility maximization problem is that identical preferences and wealth effects across consumers must hold for aggregation. This assumption is so strong that even a slight difference in consumer preferences makes it invalid. Consequently, the property of symmetry will rarely hold. In contrast, the aggregation comes naturally as long as each firm is assumed to be price taker and profit maximizing, which is reasonable.

In this article, the behavior of aggregated shrimp importers in the U.S. is considered. According to a survey conducted by the United States International Trade Commission (USITC,

2013), most of the importers sell imported shrimp to distributors. In this context, it is appropriate to view imported shrimp as an intermediate rather than a final product.

Following Laitinen (1980) and Theil (1980), the differential production model for the US demand of imported shrimp can be expressed through two equations. Equation (1), called the differential total import equation, is derived from the first-order condition of the profit maximization problem, where marginal cost equals marginal revenue:

$$\Delta X_t = \varphi \Delta p_t + \sum_{j=1}^{N_1} \pi_j \Delta w_{jt} + \sum_{k=1}^{N_2} \pi_k \Delta w_{kt} + e_t \quad (1)$$

where ΔX_t is the finite version of the Divisia volume index, which is a measure of changes in total imports or real import expenditures.

$\Delta X_t = \sum_{i=1}^{n} \bar{f}_{it} \Delta x_{it}$, $\bar{f}_{it} = (f_{it} + f_{it-12})/2$, and $\Delta X_t = \log(x_{it}) - \log(x_{it-12})$. f_{it} is the factor share of imports from source country i in the total cost of all shrimp imports ($w_i x_i / \sum_{i=1}^{n} w_i x_i$); w_i and x_i are the price and quantity, respectively, of shrimp from exporting country i; $i, j \in$ {China, Ecuador, India, Indonesia, Mexico, Thailand, Vietnam and the rest of the world (ROW)}. w_{kt} is the price for other inputs such as the price of labor (wages) and the price of other inputs. N is the total number of inputs used, consisting of two groups: the number individual imports / source countries (N_1) and the number of other inputs (N_2). p is the output price.

Monthly data are used for estimation, so the twelfth-differencing is used to correct for seasonality of each variable (Seale, Marchant, and Basso, 2003). $\Delta w_t = \log(w_{it}) - \log(w_{it-12})$ and $\Delta p_t = \log(p_{it}) - \log(p_{it-12})$. φ and π are the parameters to be estimated, where φ is the own-price elasticity of supply, measuring the impact of percentage changes in output price on total imports and π is the elasticity of supply with respect to input prices, measuring the impact of percentage changes in input prices on the Divisia index. e_t is a random disturbance term.

Equation (2), called the differential derived demand equation (expressed in 12-month finite log changes) or the differential factor allocation model/import allocation model, is derived from the cost minimization problem where costs are minimized subject to a general logarithmic production function (Theil, 1980). It includes a system of import demand equations for the various exporting countries.

(2) $$\bar{f}_{it}\Delta x_{it} = \theta_i \Delta X_t + \sum_{j=1}^{N} \pi_{ij}\Delta w_{jt} + u_{it}$$

where x_{it}, X_t, w_{jt}, $\bar{f}_{it}$ are as defined in Equation (1). θ_i and π_{ij} are the parameters to be estimated, where θ_i is the marginal factor share coefficient and π_{ij} measures the conditional price effects. u_{it} is a random disturbance term.

As in all the demand models derived from utility maximization, the differential demand model derived from profit-maximization problem also satisfies the following theoretical considerations: Adding up $\sum_i \theta_i = 1$, $\sum_i \pi_{ij} = 0$; Homogeneity $\sum_j \pi_{ij} = 0$; Symmetry $\pi_{ij} = \pi_{ji}$.

Elasticities

From the differential derived demand model, we get the conditional own-price/cross-price elasticities and the conditional elasticity with respect to total imports:

(3) $$\eta_{xw}^{c} = \frac{\pi_{ij}}{\bar{f}_i}$$

(4) $$\eta_{xX}^{c} = \frac{\theta_i}{\bar{f}_i}$$

The conditional own-price/cross-price elasticity, η_{xw}^{c}, $measures$ how the source-specific quantity reacts to changes in its own price and prices of other exporting countries, holding total imports constant. The conditional Divisia index elasticity, η_{xX}^{c}, measures the impact of changes in total imports on shrimp import from a given country.

By substituting the right hand side of Equation (1) for the Divisia index term in Equation (2), we can get the unconditional elasticity of derived demand with respect to output price and the other input price, and the unconditional own-price/cross-price elasticities:

$$\eta_{xp} = \frac{\Delta x_i}{\Delta p} = \frac{\theta_i}{\bar{f}_i}\varphi, \tag{5}$$

$$\eta_{xw_k} = \frac{\Delta x_i}{\Delta w_k} = \frac{\theta_i}{\bar{f}_i}\pi_k, \tag{6}$$

$$\eta_{xw_j} = \frac{\Delta x_i}{\Delta w_j} = \frac{\theta_i}{\bar{f}_i}\pi_j + \frac{\pi_{ij}}{\bar{f}_i}. \tag{7}$$

The unconditional elasticities of demand for an individual import with respect to domestic prices and labor cost, respectively, as expressed in Equation (5) and (6), measure the impact of percentage changes in output price and labor cost on shrimp imports from country *i*. The unconditional own-price/cross-price elasticity of import demand, as in Equation (7), measures the total impact of changes in the price of imports from country j on imports from country *i*. It consists of two effects: the effect of a price change on total import expenditures, $\theta_i\pi_j$ and the impact of relative price changes on individual import demand, π_{ij}, conditional on constant total imports expenditures.

Data and summary statistics

The data consists of monthly import expenditures and quantities by country from January 1999 to December 2012. These numbers are obtained from U.S. Department of Agriculture, Foreign Agriculture Service, Foreign Agricultural Trade Statistics. Import values are on a cost-insurance-freight basis. The seven major exporting countries are China, Ecuador, India, Indonesia, Mexico, Thailand, and Vietnam. ROW (rest of the world) is an aggregation of the exporting countries not specified. Using expenditures and quantities, unit values are calculated as proxies for import

prices (dollar per pound). Imported Shrimp is an aggregation for 31 products of 10-digit HS codes, including all types of preparation.

For the output price, we use ex-warehouse selling prices in New York Frozen Seafood market published weekly by National Marine Fisheries Services. They are reported by original receivers (importers, brokers, etc.) in the New York Metropolitan area in US$ per pound. The import-share weighted average price for headless shell-on frozen shrimp 26/30 (count) of India (black tiger), Mexico (white No 1) and Thailand (white) is used for the output price.

Due to the paucity of data, we only include labor cost to account for the domestic costs for importers. The price of labor is represented by the national average weekly wage (per capita) for Fish and seafood merchant wholesalers (North American Industry Classification System (NAICS) code 42446) from the Quarterly Census of Employment and Wages, Bureau of Labor Statistics. We assume that each month in a quarter has the same average weekly wage.

A summary of the descriptive statistics is presented in Table 1. During the data period, Thailand had the largest average share (31.57%), accounting for almost one third of total US shrimp imports. The ROW came in second with an 18% share, while China and Mexico had the smallest shares (6.18% and 7.35%, respectively). Vietnam and Mexico shrimp were the most expensive, on average, with prices at $5.31 and $4.92 /lb, respectively. The mean price of China shrimp was the lowest of all imported products ($2.67/lb).

[Place Table 1 Approximately Here]

Empirical Results and discussion

The parameters in equations (1) and (2) are assumed constant and the error terms normally distributed, then the covariance of e_t and u_{it}, which suggests that the total import equation and the import demand system can be estimated separately (Theil, 1980: 92–94). The total import

expenditure equation is estimated using the OLS (ordinary least squares) method.

The derived demand system of equations has the same set of explanatory variables and three theoretical restrictions (adding up, homogeneity, symmetry) are imposed on the system. We estimate them jointly with the seemingly unrelated regression (SUR) procedure in Stata (Cameron and Trivedi, 2010). The random disturbances are assumed to be uncorrelated across observations but are correlated across equations for the same observations. The contemporaneous covariance matrix of the residuals is singular (Parks, 1969). In order to deal with the singularity problem of the import demand system, the ROW equation was dropped for estimation. Parameter estimates obtained in this manner are invariant with respect to the equation deleted (Barten, 1969). The estimates in the ROW equation are obtained by using the adding-up property.

Table 2 presents estimation results for the total imports equation (Equation 1). The output price coefficient estimate was positive as expected, but not significant. This may be due to the fact that we only use the averaged price across country for frozen shrimp 26/30 (count) while the import shrimp data are an aggregation of all types of preparation. Wages had a negative impact on total imports, though this impact was not significant. This may be the result of using average weekly wage for each month, where monthly changes in wages had little impact on total imports. The impact of source-specific prices on total imports is significant for China, India, Indonesia and Thailand.

Coefficients for Indonesia and Thailand have the expected negative signs while coefficients for China and India are positive signs. This may be because China and India either have relatively low prices or small shares compared to Thailand and Indonesia. Total shrimp imports still increase despite of the increase in these two countries' export prices. The

insignificant coefficients for Ecuador, Mexico, Vietnam and ROW prices indicate that as each export price increased, total US shrimp did not significantly change, other things constant.

[Place Table 2 Approximately Here]

Conditional derived import demand estimates for US shrimp imports are presented in Table 3. Marginal factor share estimates indicate the relationship between total import expenditures and source-specific imports. They are all positive as expected and statistically significant except for Indonesia and Ecuador. Consistent with their import share, Thailand has the largest increase (0.39) as total import expenditures increase by one unit. Vietnam and China have relatively smaller increases, 0.20 and 0.13 respectively, still larger than India (0.12), ROW (0.06). Mexico has the smallest increase (0.05).

Own-price estimates are all negative as expected, and smaller than unity in absolute value. The cross-price parameter estimates reveal the substitute or complementary relationship between products from two countries. A significant competitive relationship is found between China and Vietnam (0.05); Ecuador and India (0.04); Ecuador and Indonesia (0.05); Ecuador and ROW (0.06); India and Thailand (0.04); Indonesia and ROW (0.07); Mexico and Vietnam (0.05). China and Indonesia shrimp have a complementary relationship (-0.05).

[Place Table 3 Approximately Here]

Table 4 presents the estimates of the conditional elasticities of derived demand for imported shrimp (all elasticities are calculated at sample means). Divisia index elasticities, which measure the responsiveness of source-specific imports to changes in total imports, indicate that a one-percent increase in total imports increased the US imports of shrimp from these countries by their elasticity values. Compared to other exporters, the Divisia index elasticities for China, 2.07, is the largest, indicating that the majority of the increase in total imports would come from China.

This is might due to the fact that China became a member of the World Trade Organization (WTO) in 2001, and has boosted its shrimp exports since that time. The Divisia index elasticities for Vietnam, India, Thailand and Mexico are 1.89, 1.63, 1.24, and 0.71 respectively, indicating that these countries are expected to gain market share as US shrimp imports increase.

The conditional own-price/cross-price elasticities evaluate the impact of import price changes on source-specific imports, on the conditional that total imports are constant. These elasticities have the same signs as the coefficient estimates in Table 3. All of the conditional own-price elasticities are negative as expected. The conditional own-price elasticity of Ecuador is -1.41, larger than 1 in absolute value, indicating shrimp imports from Ecuador are sensitive to own price changes. All other own-price elasticities are smaller than 1 in absolute value, indicating inelastic demands. The majority of the significant cross-price elasticities are positive and smaller than unity, showing that shrimp from these countries have substitutes relationships and the competition among them is not so strong.

[Place Table 4 Approximately Here]

Unconditional elasticities of the derived demand are presented in Table 5. All of the unconditional output price elasticities are positive, which are consistent with the Divisia index elasticities in Table 4. Though they have much smaller magnitudes. This is due to the negligible effect of changes in output price on total imports, which is incorporated into these elasticities. Compared to the elasticities in Table 4, unconditional own-price/cross-price elasticities in Table 5 take consideration of the indirect impact, which is the effect of a price change on total import expenditures. All the significant unconditional own-price elasticities are negative, except for China (0.96). As expected, they indicate an inverse relationship between source-specific import quantities and prices. U.S. demand is elastic for Ecuador shrimp (-1.48), and inelastic for

Thailand (-0.81), Mexico (-0.53), and Indonesia (-0.51) shrimp. This implies that an increase in shrimp prices from the latter three countries would result in a less than proportionate decrease in import quantities demanded by the United States. It is likely that these countries could increase their export revenues by raising their prices or reducing their supplies. For instance, Indonesia shrimp has the most inelastic demand by U.S importers. A 1% increase in its shrimp price will result in a decrease in exports by only 0.51%, so total revenue would increase.

For the most part, cross price elasticities are positive, implying that shrimp demand exhibits a substitute relationship between countries. Intensive price competition is found among three countries China, India and Vietnam. Also, strong complementary relationships are found between China and Indonesia (-1.74); Vietnam and Indonesia (-1.13); India and Indonesia (-0.96). These complementary effects are mainly due to the negative relationship between the price of Indonesia shrimp and total US imports. Aggregate level data used in the analysis may also contribute to these results.

[Place Table 5 Approximately Here]

The Impact of Tariffs on Import Demand

Unconditional elasticities are used for projections to analyze the ramifications of tariff policies because they capture the complete effect of price changes (Davis and Jensen, 1994). Following the method proposed by Kastens and Brester (1996), the forecasting equation using unconditional elasticities is specified as:

$$(8) \quad x_{it} = \left[\eta_{xp}\left(\frac{p_t - p_{t-12}}{p_{t-12}}\right) + \sum_{j=1}^{N_1}\eta_{xw_j}\left(\frac{w_{jt} - w_{jt-12}}{w_{jt-12}}\right) + \sum_{k=1}^{N_2}\eta_{xw_k}\left(\frac{w_{kt} - w_{kt-12}}{w_{kt-12}}\right)\right] x_{it-12} + x_{it-12}$$

Equation (8) states that the quantity imported from country *i* in month *t* is a function of the quantity imported that same month the previous year, and the 12-month percentage changes

in output price, source-specific import prices and resource prices. As the estimated coefficients for output and labor prices are not statistically significant, we assume that there is no change in output price and wages and the production capacities of exporters are unlimited. Unconditional elasticities calculated at the mean for the 12 months in 2012 are used for projection for US shrimp imports of 2013. Import demand projections are based on the tariff scenario that the following average countervailing subsidy rates are imposed: 18.16%, 11.77%, 10.84%, and 4.52% for China, Ecuador, India and Vietnam respectively. Imported quantity and market share projections are presented in Table 6.

[Place Table 6 Approximately Here]

Under the tariff scenario, surprisingly, total US shrimp imports are projected to increase by 5.24% (from 1,178 million lbs to 1,240 million lbs). Only Ecuador and Indonesia are projected to decrease by 8.17% and 1.55%, respectively. All other countries would increase their exports. Vietnam is projected to increase by as much as 34.98% despite of the tariff imposition and becomes the largest beneficiary. This is due to the strong competitive relationship between Vietnam and China, indicated by significant positive cross-price elasticities. China has the largest imposed import tariff, which will divert the imports to its substitute country, Vietnam. Thailand is spared from the import tariff, so its exports would increase by 10.24%, given strong competitive relationships with China and India. For all the countries affected by countervailing duties, only Ecuador is projected to decrease its exports, while others would increase exports despite the import tariffs. The total market share of these penalized countries would only decrease by 1%. Based on the results from this study, the proposed countervailing duties don't have the intended effect on U.S. shrimp imports. This is similar to the findings of Jones and Harvey (2006) and Jones et al. (2008).

Summary and Conclusion

In this study, we examined the factors that determine the demand for imported shrimp in U.S. by using a differential production approach. Unconditional demand elasticities calculated from import demand estimates are used for simulating the effect of countervailing duties imposed by the United States on its import demand by country. Overall the own-price elasticities indicate that U.S. demand for imported shrimp is inelastic. For the most part, cross price elasticities are positive, implying that shrimp demand exhibit a substitute relationship between countries.

Contrary to expectations, U.S. total shrimp imports would experience an increase from all exporting countries except for Ecuador and Indonesia, despite countervailing duties. Vietnam would have the greatest increase and Thailand would likely remain the dominant supplier for the U.S. shrimp imports.

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Table 1. Descriptive Statistics on US Imports of Shrimp by Country: January 1999-December 2012

	China	Ecuador	India	Indonesia	Mexico	Thailand	Vietnam	ROW
Import price ($ per lb)								
Mean	2.67	3.13	4.19	3.98	4.92	3.81	5.31	3.31
Standard deviation	0.47	0.63	0.51	0.66	0.95	0.75	0.80	0.47
Minimum	1.59	2.27	2.45	2.43	2.98	2.65	3.86	2.47
Maximum	4.64	5.21	5.40	5.65	8.39	6.44	8.04	4.88
Import quantity (1,000 lbs)								
Mean	8,312.86	9,236.34	6,267.52	8714.58	5,687.39	28,917.01	7,101.78	17,705.54
Standard deviation	5,504.85	3,998.79	3,562.64	4,700.18	5,807.20	10,386.36	3,762.69	4,951.31
Minimum	745.38	2,325.66	1,414.05	1,791.92	102.29	7,321.33	367.07	7,502.55
Maximum	25,417.32	18,791.55	18,957.99	19,932	25,249.33	54,978.23	16,504.25	30,845.76
Import share (%)								
Mean	6.18	8.93	7.66	10.01	7.35	31.57	10.30	18.00
Standard deviation	3.31	4.65	3.51	5.01	6.15	6.09	3.72	5.88
Minimum	0.64	2.23	1.93	2.09	0.13	13.17	1.41	8.02
Maximum	17.12	29.08	18.30	23.37	25.99	46.56	18.87	36.14

	Output price ($ per lb)	Wage index
Mean	4.57	785.58
Standard deviation	0.83	88.77
Minimum	3.39	640
Maximum	6.72	1003

Table 2. Estimated Coefficients for the Total Import Equation of US Imported Shrimp

Output price	Wage	Input price coefficients (π_j)							
(φ)	(π_k)	China	Ecuador	India	Indonesia	Mexic	Thailand	Vietnam	ROW
0.036	-0.220	0.691***	-0.215	0.636***	-0.455**	0.049	-0.417**	-0.069	-0.072
(0.158)	(0.531)	(0.173)	(0.151)	(0.123)	(0.201)	(0.069)	(0.205)	(0.140)	(0.171)
R^2=	0.343								

Note: ***, **, * indicate significance levels of 1%, 5% and 10% respectively.
Asymptotic standard errors are in parentheses.

Table 3. Conditional Derived Demand Parameter Estimates for US Imported Shrimp by Country

	Price coefficients(π_{ij})								Marginal Factor Shares (θ_i)
	China	*Ecuador*	*India*	*Indonesia*	*Mexico*	*Thailand*	*Vietnam*	*ROW*	
China	-0.030	0.008	0.012	-0.051***	0.004	0.017	0.051***	-0.011	0.133***
	(-0.019)	(-0.014)	(-0.012)	(-0.014)	(-0.01)	(-0.022)	(-0.016)	(-0.017)	(-0.016)
Ecuador		-0.120***	0.037***	0.046***	-0.014	0.012	-0.031*	0.063***	0.027*
		(-0.022)	(-0.013)	(-0.016)	(-0.010)	(-0.022)	(-0.017)	(-0.019)	(-0.02)
India			-0.064***	-0.016	0.002	0.036**	0.002	-0.011	0.123***
			(-0.015)	(-0.014)	(-0.008)	(-0.018)	(-0.014)	(-0.016)	(-0.013)
Indonesia				-0.043*	0.003	0.015	-0.029*	0.074***	0.017
				(-0.025)	(-0.009)	(-0.024)	(-0.017)	(-0.019)	(-0.013)
Mexico					-0.041***	0.019	0.047***	-0.021*	0.052***
					(-0.011)	(-0.014)	(-0.011)	(-0.012)	(-0.016)
Thailand						-0.093**	0.007	-0.016	0.391***
						(-0.043)	(-0.023)	(-0.026)	(-0.024)
Vietnam							-0.029	-0.019	0.199***
							(-0.024)	(-0.02)	(-0.017)
ROW								-0.059*	0.058***
								(-0.030)	(-0.018)
Equation R^2	0.595	0.637	0.623	0.552	0.366	0.765	0.604		

Note: Asymptotic standard errors are in parentheses.
Homogeneity and symmetry are imposed.
*, **, and *** indicate significance level of 10%, 5% and 1% respectively.

Table 4. Conditional Total Import and Price Elasticities of the Derived Demand for Imported Shrimp

Exporting Country	Price elasticities								Total Imports
	China	*Ecuador*	*India*	*Indonesia*	*Mexico*	*Thailand*	*Vietnam*	*ROW*	
China	-0.476	0.125	0.201	-0.799***	0.067	0.269	0.790***	-0.178	2.074***
	(0.311)	(0.23)	(0.194)	(0.23)	(0.156)	(0.349)	(0.244)	(0.26)	(0.246)
Ecuador	0.094	-1.409***	0.434***	0.541***	-0.174	0.142	-0.358*	0.731***	0.316*
	(0.172)	(0.26)	-0.156)	(0.19)	(0.122)	(0.257)	(0.193)	(0.226)	(0.175)
India	0.17	0.491***	-0.849***	-0.219	0.031	0.484**	0.032	-0.139	1.630***
	(0.164)	(0.177)	(0.211)	(0.189)	(0.109)	(0.246)	(0.186)	(0.21)	(0.171)
Indonesia	-0.512***	0.463***	-0.166	-0.438*	0.036	0.159	-0.285*	0.741***	0.168
	(0.148)	(0.162)	(0.143)	(0.258)	(0.092)	(0.244)	(0.166)	(0.191)	(0.134)
Mexico	0.059	-0.204	0.032	0.05	-0.562***	0.273	0.642***	-0.289*	0.706***
	(0.137)	(0.143)	(0.113)	(0.126)	(0.154)	(0.202)	(0.15)	(0.162)	(0.213)
Thailand	0.055	0.038	0.116**	0.05	0.063	-0.296**	0.024	-0.05	1.239***
	(0.071)	(0.07)	(0.059)	(0.077)	(0.047)	(0.137)	(0.074)	(0.083)	(0.075)
Vietnam	0.477***	-0.289*	0.023	-0.269*	0.442***	0.07	-0.273	-0.181	1.888***
	(0.147)	(0.156)	(0.133)	(0.156)	(0.104)	(0.221)	(0.23)	(0.189)	(0.163)
ROW	-0.063	0.345***	-0.058	0.409***	-0.117*	-0.087	-0.106	-0.323	0.322
	(0.095)	(0.107)	(0.088)	(0.105)	(0.065)	(0.146)	(0.11)		

Note: Asymptotic standard errors are in parentheses and are calculated using the delta method.
*, **, and *** indicate significance level of 10%, 5% and 1% respectively.

Table 5. Unconditional Elasticities of the Derived Demand for US Imported Shrimp

Exporting Country	Elasticities								
	Output price	Unconditional own and cross-price							
		China	*Ecuador*	*India*	*Indonesia*	*Mexico*	*Thailand*	*Vietnam*	*ROW*
China	0.074***	0.958***	-0.320	1.519***	-1.741***	0.169	-0.596*	0.647***	-0.328
	(0.009)	(0.315)	(0.235)	(0.216)	(0.246)	(0.156)	(0.336)	(0.245)	(0.268)
Ecuador	0.011*	0.313*	-1.477***	0.635***	0.397**	-0.158	0.010	-0.379**	0.708***
	(0.006)	(0.190)	(0.262)	(0.162)	(0.200)	(0.122)	(0.250)	(0.193)	(0.226)
India	0.058***	1.297***	0.141	0.187	-0.960***	0.110	-0.196	-0.081	-0.257
	(0.006)	(0.185)	(0.180)	(0.192)	(0.195)	(0.109)	(0.238)	(0.186)	(0.209)
Indonesia	0.006	-0.396**	0.427***	-0.059	-0.514**	0.045	0.089	-0.296*	0.729***
	(0.005)	(0.155)	(0.165)	(0.138)	(0.258)	(0.092)	(0.240)	(0.166)	(0.191)
Mexico	0.025***	0.547***	-0.356**	0.481***	-0.271*	-0.527***	-0.022	0.593***	-0.340**
	(0.008)	(0.190)	(0.149)	(0.160)	(0.155)	(0.154)	(0.207)	(0.151)	(0.162)
Thailand	0.044***	0.911***	-0.227***	0.904***	-0.513***	0.124***	-0.813***	-0.062	-0.140*
	(0.003)	(0.077)	(0.072)	(0.064)	(0.084)	(0.047)	(0.132)	(0.075)	(0.084)
Vietnam	0.068***	1.783***	-0.694***	1.223***	-1.127***	0.535***	-0.718***	-0.403*	-0.318*
	(0.006)	(0.168)	(0.159)	(0.144)	(0.168)	(0.103)	(0.217)	(0.231)	(0.188)
ROW	0.012	0.160*	0.276**	0.147*	0.263**	-0.101	-0.222	-0.128	-0.346
		(0.095)	(0.107)	(0.088)	(0.105)	(0.065)	(0.146)	(0.110)	

Note: *, **, and *** indicate significance level of 10%, 5% and 1% respectively.
Asymptotic standard errors are in parentheses and are calculated using the delta method.

Table 6. Projected US Shrimp Imports Given Impositions of Countervailing Duties on Four Countries

Exporter/ product	Baseline (2012)		Projections given the tariff impositions			
	Quantity (1000Lbs)	Market Share (%)	Projected Quantity (1000lbs)	Quantity Change (1000lbs)	Change (%)	Projected market share (%)
China	78,625	7	80,126	1,501	1.91	6
Ecuador	179,693	15	165,020	14,673	-8.17	13
India	144,611	12	148,259	3,648	2.52	12
Indonesia	163,312	14	160,787	2,525	-1.55	13
Mexico	58,277	5	61,300	3,023	5.19	5
Thailand	300,031	25	330,763	30,732	10.24	27
Vietnam	90,746	8	122,490	31,744	34.98	10
ROW	163,488	14	171,801	8,313	5.08	14
Total US imports	1,178,783	100	1,240,546	61,763	5.24	100