Impact of Increasing Imports on the United States Southeastern Region Shrimp Processing Industry 1973-1996

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Background

The shrimp harvesting sector is the largest component of the southeast United States commercial fishing industry, accounting for 55 to 60 percent of the total value of landings in the region in 1993. The U.S. import market for shrimp was valued at $2.7 billion in 1995. Together, domestic production and imports of the raw product support a large shrimp processing sector, which provides several thousand jobs either directly or indirectly (Keithly, Roberts and Ward, 1993).

In 1975, the National Shrimp Congress filled a petition with the U.S. International Trade Commission (USITC) for import relief pursuant to section 201 of the Trade Act of 1974 (Gulf of Mexico Fishery Management Council, 1981). The USITC started an investigation to determine whether shrimp quantities were imported into United States in such increased amount as to be a substantial cause of serious injury or threat to the domestic industry producing an article like, or directly competitive with the imported product. The USITC commissioners found that shrimp products were not imported in such increased quantities as to be a substantial cause of serious injury or threat to the domestic processing industry. However, the commissioners concluded that the shrimp-harvesting sector was being injured by the increased shrimp imports. Adjustment assistance to the industry was recommended.

In 1984, the U.S. shrimp industry was the focus of another federal investigation conducted under 322(g) of the Tariff Act of 1930 (United States International Trade Commission, 1985). The purpose of the investigation was to evaluate competition affecting the harvesting sector of the U.S. Gulf and South Atlantic

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shrimp fishery industry. In explaining their situation to the trade commission, the U.S. Gulf South Atlantic harvesters claimed that (1) harvesting businesses were being injured by imports and (2) shrimp industries in foreign countries were benefiting from government assistance, artificially allowing their product prices to be more competitive in the U.S. market (Keithly, Roberts and Ward 1993). In spite of their claims, the commission issued a report and no further actions were recommended. However, an analysis of the shrimp industry that focuses on the processing sector industry reveals that imports did have a negative impact. For example, Keithly, Roberts and Kearney (1993) grouped firms in four sizes based upon their deflated value of processed shrimp sales. The following categories were identified: (I) firms with annual deflated processed shrimp sales of less than $250 thousand, (II) firms with annual deflated processed shrimp sales ranging from $250 thousand to $1.0 million, (III) firms with annual deflated processed shrimp sales of $1.0 million to $10.0 million, and (IV) firms with annual deflated processed shrimp sales of $10.0 million or more. Based on that grouping, in 1973 a total of 181 firms was processing shrimp and had a size distribution of: 54 in Size I, 31 in Size II, 58 in Size III, and 38 in Size IV. By 1996, the number of processors had declined to 97 and exhibited the following size distribution: 19 in Size I, 18 in Size II, 35 in Size III, and 25 in Size IV. The purpose of this study is to quantify the effects of increased imports on the shrimp processing industry. The U.S. shrimp industry is divided into harvesting (ex-vessel), wholesale, and retail sectors, and price cost relationships for headless-shell-on shrimp, peeled shrimp, breaded shrimp and other shrimp product forms are analyzed.

Formulation of the Model

The specification in this study follows other studies of Doll (1972), Adams (1984), Adams, Prochaska and Spreen (1987). However, while past studies have focused on the aggregate industry level, this study will attempt to analyze the shrimp industry at the product form level. The selected four shrimp products for this study include headless-shell-on shrimp, peeled shrimp, breaded shrimp and “other” shrimp. The following model includes seven behavioral equations and no identities. All variables cover the period 1973-1996. The deflated prices (base 1996) are in dollar/pound and the quantities are in millions of pounds headless-shell-on equivalent weight basis.

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Retail Demand Equation

The retail demand equation is defined as follows:

$$Q_{dd\,t} = a_1 + a_2 P_{proc,t} + a_3 Y_{disp,t} + a_4 MeatP_t + a_5 ChickP_t + a_6 FishPPI_t + \mu_{1t}$$

The variable Q_{dd_t} represents the U.S. annual consumption of shrimp in time period *t*. It is expressed as the amount of shrimp headless-shell-on equivalent weight basis.

The variable $P_{proc,t}$ is a weighted average retail price for processed shrimp. Doll (1972) conducted a principal component analysis on shrimp prices. He concluded that the wholesale shrimp price is an excellent index for the retail price. Since, no national average shrimp retail price is available, Hu (1983) argued that shrimp wholesale prices are a good proxy for the retail prices. Based on Doll's (1972) findings and Hu's (1983) arguments, the weighted average of different shrimp product prices received by wholesalers was used as a proxy for the retail price. The total shrimp sales per product-forms were converted to the headless-shell-on equivalent weight basis. Then, percentage to the total per year of every product forms were calculated and used as a weight. The weights were multiplied by the corresponding wholesale prices and summed over corresponding years to obtain the retail prices. The sign associated with $P_{proc,t}$ is anticipated to be negative.

The variable $Y_{disp,t}$ is the U.S. real per capita disposable income. It is included in the model as a demand shifter. It is hypothesized that the shrimp demand will increase as U.S. per capita disposable income increases.

The variables $MeatP_t$, $ChickP_t$, $FishPPI_t$ are respectively the U.S. average retail meat prices, the average retail whole chicken fryer prices, and the fish price index. The United States International Trade Commission (1985) found that 80 percent of shrimp shipments are diverted to the restaurant and institutional markets. Within those channels of distribution, shrimp is likely to compete with fish products, meat products and poultry products. An increase in the prices of fish, meat or poultry will likely result in an increase in the U.S. demand for processed shrimp product quantities.

Wholesale Demand Equations

Peeled Shrimp

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The U.S. wholesale demand for the peeled shrimp (DOM_{pp}) is specified as follows

$$DOM_{pp,t} = b_1 + b_2 DOM_{qp,t} + b_3 INV_{p,t-1} + b_4 IMP_{qp,t} + D83 + \mu_{2,t}$$

The variable $DOM_{qp,t}$ is defined as domestic peeled shrimp quantities in time period *t*. Economic theory predicts that shrimp peeled quantities should be negatively related to shrimp prices. The U.S. demand for peeled shrimp is also function of other available supplies. Those supplies include the peeled shrimp held in cold storage ($INV_{p,t-1}$) at the end of the year *t-1* and U.S. imports of peeled shrimp ($IMP_{qp,t}$). A negative relationship is hypothesized between the inventories and import variables and the wholesale demand for peeled shrimp price variable.

The variable $D83$ represents a dummy variable capturing the structural change that occurred in the peeled shrimp imports in 1983. The variable $D83$ is 0 for the years 1973-1982 and 1 for the years 1983-1996. Before 1983, supplies to the U.S. of peeled shrimp from India dominated the imports. India exported a large quantity of low quality product at lower prices during that period (Keithly, 1998). However, the Japanese market became less important to Indian exporters for a variety of reasons (United States International Trade Commission, 1985). Those reasons include heavy stocks of high priced shrimp in Japan, and weak markets for the principal small peeled Indian shrimp in Japan. These factors have acted to depress average prices of Indian shrimp in Japan and caused Indian exporters to channel more products to U.S. and European markets. Additionally, after 1983, shrimp farming expanded in Asian and South American countries. As a result, large quantities and higher quality (Keithly, 1998) of peeled shrimp were diverted to United States. The variable $D83$ should capture any major structural shift in imports.

Headless-Shell-On Shrimp

The U.S. demand for headless-shell-on shrimp ($DOM_{ph,t}$) is specified as follows

$$DOM_{ph,t} = c_1 + c_2 DOM_{qh,t} + c_3 INV_{h,t-1} + c_4 IMP_{qh,t} + \mu_{3,t}$$

The variable $DOM_{qh,t}$ is defined as the domestic headless-shell-on shrimp quantity in period *t*. Based on economic theory, the quantity of headless-shell-on shrimp should be negatively related to its own prices. The

U.S. demand for headless-shell-on shrimp is also function of headless-shell-on quantities held in cold storage ($INV_{h,t-1}$) at the end of the year *t-1* and U.S. imports of headless-shell-on shrimp ($IMP_{qh,t}$) in time period *t*. A negative relationship is expected between the inventories and imports quantities and the shrimp price variable.

Breaded Shrimp

The U.S. demand for breaded shrimp ($DOM_{pb,t}$) is specified as follows

$$DOM_{pb,t} = c_1 + c_2 DOM_{qb,t} + c_3 INV_{b,t-1} + c_4 IMP_{qb,t} + \mu_{4,t}$$

The variable $DOM_{qb,t}$ is defined as the domestic breaded shrimp quantities in time period *t*. Based on economic theory, the shrimp breaded quantities are negatively related to shrimp prices. The U.S. demand for breaded shrimp is also depending on the breaded quantities held in cold storage ($INV_{b,t-1}$) at the end of the year *t-1* and the U.S. imports of breaded shrimp ($IMP_{qb,t}$). It is hypothesized a negative relationship between the inventories and imports variables and the wholesale demand for breaded shrimp price variable.

Other Shrimp

The U.S. demand for "other" shrimp ($DOM_{pc,t}$) is specified as follows

$$DOM_{pc,t} = e_1 + e_2 DOM_{qc,t} + e_3 IMP_{qc,t} + \mu_{5,t}$$

The variable $DOM_{qc,t}$ is defined as the domestic other shrimp quantities in time period *t*. Economic theory predicts that other shrimp quantities must be negatively related to shrimp prices. The U.S. demand for other shrimp is also function of other shrimp ($IMP_{qc,t}$). It is hypothesized a negative relationship between the import variable and the wholesale demand for other shrimp price variable. The U.S. processors do not hold inventories for other shrimp.

Ex-Vessel Demand

The U.S. demand for raw shrimp ($P_{raw,t}$) is specified as follows

$$P_{raw,t} = f_1 + f_2 INV_{h,t-1} + f_3 INV_{p,t-1} + f_4 LAND_t + f_5 IMP_{qh,t} + f_6 IMP_{qp,t} + \mu_{6,t}$$

Based on economic theory, one can expect the ex-vessel shrimp price ($P_{raw,t}$) to be negatively influenced by the U.S. Gulf of Mexico and U. S. South Atlantic landings ($LAND_t$). Imports of headless-shell-on shrimp ($IMP_{qh,t}$) and imports of peeled shrimp ($IMP_{qp,t}$) in time period *t* are hypothesized to have a negative impact on the U.S. ex-vessel shrimp price. Imports of headless-shell-on shrimp and imports of peeled shrimp are included in the model because they are not heavily processed and, they are likely to influence the raw shrimp prices. Additionally, they represent the largest part of the shrimp harvest. The U.S. ending of the year inventories of peeled shrimp ($INV_{p,t-1}$) and headless-shell-on shrimp ($INV_{h,t-1}$) are also included in the model for the same reasons as imports of similar products. The cold storage holdings are expected to have a negative effect on U.S. ex-vessel shrimp price.

Price Linkage model

The price linkage model describes the relationship between retail shrimp prices, wholesale processed shrimp prices and ex-vessel raw shrimp prices. Only one other study was identified that of Adams, Prochaska and Spreen (1987), which determined the price relationships between adjacent market levels for various size classes of raw-headless shrimp. No study has focused on the market level relationships for different shrimp product forms. Because the knowledge of those relationships is important due to their potential effect on the structure of the shrimp industry, the current study expands the Adams model by focusing on several shrimp product forms.

The price linkage (P_{proc}) equation is specified as follows

$$P_{proc} = g_1 + g_2 DOM_{pp} + g_3 DOM_{pc} + g_4 DOM_{ph} + g_5 DOM_{pb} + g_6 P_{raw} + \mu_7$$

The variable $P_{proc,t}$ is the retail shrimp price in time period t, which is hypothesized to be a function of the prices of wholesale peeled shrimp ($DOM_{pp,t}$), wholesale other shrimp ($DOM_{pc,t}$), wholesale headless-shell-on shrimp ($DOM_{ph,t}$), wholesale breaded shrimp ($DOM_{pb,t}$), and South Atlantic and Gulf ex-vessel price ($P_{raw,t}$). A positive relationship is anticipated between ex-vessel, wholesale and retail prices.

Results and Discussion

Structural Equation Analyses

The model was estimated using a three-stage-least-squares procedure. Results indicated a system weighted R-square of 0.9635 suggesting that about 96 percent of the variability in shrimp consumption, domestic wholesale retail and ex-vessel prices can be explained by the changes that affect domestic processed shrimp quantities, shrimp import quantities, landings and shrimp inventories. The system mean square error is 2.036 with 134 degrees of freedom. The value of the mean square error is close to zero suggesting that the model simulate the historical data very closely.

The estimated structural equation results are presented in Table 1. As expected, the retail price for processed shrimp is statistically significant at the 5 percent level and is negative. The relationship between shrimp prices and quantities indicate that a dollars increase in shrimp retail prices leads to 63 million pounds decrease in domestic shrimp consumption. This implies that higher shrimp prices are associated with a leftward movement along the shrimp retail demand curve leading to lower shrimp consumption. Many studies including Doll (1972), Batie (1974), have found that the demand for shrimp is price inelastic. In the estimated shrimp model, the price elasticity of the demand is consistent with previous studies. The calculated elasticity for the U.S. southeastern region shrimp demand is –0.73. This value indicates that a 10 percent increase in the shrimp retail prices leads to 7.3 percent drop in U.S. shrimp consumption. This finding implies that a percentage change in shrimp prices is larger in absolute value than the percentage change in shrimp quantities. Consequently, the total revenues for shrimp retailers will move in the same direction as the shrimp prices, declining when shrimp price declines and rising when shrimp price rises.

The consumer's decisions to purchase shrimp may be influenced by meat, fish, and poultry prices. Results indicate that the variables $MeatP_t$, $FishPPI_t$ are statistically significant at the 5 percent level. An increase by \$1 per pound in meat prices is associated with 224 million pounds increase in shrimp consumption. The impact of red meat price changes on U.S. shrimp consumption is almost equal to the impact of fish price index changes on U.S. shrimp consumption. An increase by one unit in fish price index leads to 253 million pounds increase in U.S. shrimp consumption.

At the wholesale level, findings support a peeled shrimp sector dominated by imports. The import effect increased after 1983 due to the development of shrimp production activities in south Asia and Latin America. The relationship between the wholesale demand prices of shrimp and the import quantities for peeled shrimp can be characterized as being negative and inflexible. An increase in peeled shrimp imports causes the domestic wholesale demand for peeled shrimp to shift leftward resulting in lower shrimp prices. Since the wholesale demand for peeled shrimp was found to be inflexible with respect to prices, the drop in shrimp prices will be associated with an increase in peeled shrimp processor revenues. Additionally, imports of headless-shell-on and canned shrimp have significant and negative impacts on the domestic shrimp processing activity. This relationship can be characterized as being negative and inflexible. This implies that increases in headless-shell-on and canned shrimp imports will respectively shift leftward the wholesale demand curves for those products resulting in lower domestic prices. Because of the lower prices and the elastic nature of the wholesale demand for processed headless-shell-on and canned shrimp, the processors total revenue increases. Lastly, the production of breaded shrimp is a domestic activity and its demand was found to be price inflexible. An increase in the domestic breaded shrimp quantities is associated with lower wholesale prices. This is a movement along the breaded shrimp demand curve. Since the demand is price elastic, the decrease in prices is associated with higher revenues for the processors.

For the ex-vessel demand, the levels of peeled shrimp inventories effect negatively and significantly the demand for raw shrimp while imports of peeled shrimp do not have an effect on the ex-vessel demand. It is surprising that the domestic market absorbs the domestic peeled shrimp imports without affecting the raw shrimp prices. One explanation might be that peeled shrimp are purchased and placed in storage or processed for (breaded shrimp for example) and then stored or placed into marketing channels. In the long run, when inventories facilities processing and other facilities are fully utilized, raw shrimp prices will adjust through a leftward shift in demand. The relationships between peeled product (imports and inventories) and ex-vessel demand can be characterized as elastic. Consequently, the decrease in ex-vessel prices due to imports and inventories for peeled shrimp is associated with higher revenues for the domestic shrimp harvesters. It was also found that import of headless-shell-on shrimp have a significant and negative impact on the ex-vessel demand

for raw shrimp. This implies that the increase in imports will lower the prices for the headless-shell-on shrimp leading to higher domestic consumption. Since headless-shell-on include large sized shrimp, consumer may substitute other shrimp product for the headless-shell. This effect will indirectly impact the ex-vessel price by depressing it. The relationship between the ex-vessel demand and the headless-shell-on imports can be characterized as elastic implying that the decrease in headless-shell-on prices due to imports is associated with increases in revenues for domestic shrimp harvesters. The domestic landings affect significantly and negatively the ex-vessel demand. An increase in South Atlantic and Gulf of Mexico shrimp landings is associated with a movement along the ex-vessel shrimp demand curve and lower ex-vessel shrimp prices. Since the ex-vessel demand is price elastic, the reduced price due to landings is associated with higher revenues for the shrimp harvesters.

Reduced-Form Equation Analysis

The reduced-form of the model expresses each endogenous variable of the model in term of only exogenous variables. A reduced form estimate provides a clearer interpretation of the relationships between endogenous and predetermined variables since the impact of a predetermined variable on each endogenous variable has now been isolated (Adams, 1984). Results presented in table 2 were multiplied by the average increase in different exogenous variables over the period 1973-1996 to assess the real impact of the changes in those variables on the endogenous variables. Results indicated that red meat prices declined over the studied period and that shrimp consumption dropped yearly by 3.60 million pounds. As a result of substitution effect, however, this decline was offset by an 8 million-pound increase in consumption due to the increasing fish price cross-effect.

Imports of peeled shrimp increased by 10.42 millions pounds per year between 1973 and 1996. The impact of that increase on the U.S. shrimp sector can be obtained by multiplying the corresponding coefficients of the reduced-forms equations by 10.42. The impact of higher import quantities is a lowering of the wholesale, ex-vessel and retail prices by respectively 0.04272 dollar per pound, 0.00521 dollar per pound and 0.00729 dollar per pound. The drop in the wholesale, ex-vessel and retail prices is a result of a leftward shift in the corresponding demands.

Following the same reasoning, the import of headless-shell-on is associated with a drop of the wholesale, ex-vessel and retail prices respectively by 0.06867 dollar per pound, 0.02798 dollars per pound, 0.03306 dollar per pound. The lowering in shrimp prices due to increased shrimp imports caused the peeled and headless-shell-on shrimp consumption to increase respectively by 0.4658 million pounds a year and 2.1162 million pounds a year. However, it is suspected that the increase in shrimp consumption due to increase in peeled shrimp imports are higher than 0.4658 million pound a year. The structural variable D83 indicated that peeled shrimp imports were higher by 17 million pounds for the period 1984-1996 when compared to the period 1973-1983. The import impacts on processor margins are: 1) For the peeled shrimp, the drop in the wholesale prices is 0.00729 dollar per pound and the drop in the raw shrimp prices is 0.00521 dollar per pound. Therefore the net drop in the margins is 0.003751 dollars per pound per year for the peeled shrimp. This effect may be larger given the 1983 structural change that led to the increase in import quantities from south Asian and Latin American countries; 2) For the headless-shell on shrimp, the increase in imports is associated with a 0.02798 dollar per pound drop in the ex-vessel prices and a 0.06867drop in the wholesale prices. The net drop in the margins is 0.04069.

These are significant findings because they indicate that imports have detrimentally and negatively effected shrimp prices resulting in the narrowing in processor margins.

Conclusion

The objective of the study was to analyze the impacts of shrimp imports on the United States southeastern region shrimp processing industry. To carry out the first objective, the analysis focused on the four following shrimp product: peeled shrimp, headless-shell-on shrimp, breaded shrimp and other shrimp. A system of equations was developed to analyze the effects of imports on the ex-vessel, wholesale and retail shrimp sectors. The three stages least squares procedure was used to estimate the system of equations. Results indicated that increase in the shrimp imports levels these last years is associated with a drop in wholesale peeled, headless-shell-on and “other” shrimp prices. The wholesale prices dropping at a faster rate than the raw shrimp prices led to a narrowing in processor margins. The narrowing in processor margins accelerated after 1983 when

imports from south Asian and Latin American countries increased. This implies that if this import trend continues, processor margins will continue to fall.

Results also indicated that retail demand is price inelastic while wholesale demands are elastic with respect to prices except in the case of the breaded shrimp. This will lead to a narrowing in the processor margins as shifts in supply are observed. It is suspected that economies of scale exist over certain range in the shrimp processing industry, and that a processor faces significant level of fixed investment costs and a substantial level of variable costs as well. The processor margins are narrowing over time because not only are the retail changes associated with changes in the volume of output charged exclusively to the processors, the change in the level of marginal cost for marketing services are charged to them as well. That is, processor prices will decline more than retail prices when output is expanded and will increase more than retail prices when output is reduced. This is evident in the decline in wholesale prices as the total output expanded between 1973 and 1996. The result is a narrowing in processor margins.

In conclusion, the estimated model suggests that all market levels will be affected by changes in policy measures. For example, the impacts of the shrimp imports on the wholesale sector are larger than on the retail or the ex-vessel sectors. Therefore, a policy of increased trade restrictions would then decrease the available supplies, cause prices to rise, ultimately increase wholesale processor margins.

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Table 1: Estimated Structural Equation Coefficients for the United States Shrimp Processing Industry (1973-1996).

Variable	Retail	Peeled	Headless	Breaded	Canned	Ex-Vessel	Markup
Intercept	-255.83 (421.66)	7.5526 (0.703)	7.4733 (0.934)	11.0904 (1.021)	7.3744 (0.516)	4.9062 (0.634)	-0.4892 (0.171)
$P_{proc,t}$	-63.17 (11.90)						
$Y_{disp,t}$	0.0172 (0.013)						
$MeatP_t$	223.91 (107.36)						
$FishPPI_t$	253.83 (95.14)						
$ChickP_t$	-108.22 (374.01)						
$DOM_{qp,t}$		-0.0113 (0.008)					
$INV_{qp,t-1}$		0.00428 (0.032)				-0.0207 (0.011)	
$IMP_{qp,t}$		-0.0041 (0.002)				-0.0005 (0.001)	
D_{83}		-1.3985 (0.493)					
$DOM_{qh,t}$			-0.0007 (0.007)				
$INV_{qh,t-1}$			0.0236 (0.019)			0.0057 (0.009)	
$IMP_{qh,t}$			-0.0080 (0.002)			-0.0033 (0.001)	
$DOM_{qb,t}$				-0.0625 (0.008)			
$INV_{qb,t-1}$				0.1116 (0.087)			
$IMP_{qb,t}$				0.1537 (0.219)			
$DOM_{qc,t}$					0.0095 (0.192)		
$IMP_{qc,t}$					-0.0310 (0.0163)		
$LAND_t$						-0.0046 (0.002)	
$DOM_{pp,t}$							0.1966 (0.039)
$DOM_{ph,t}$							0.5821 (0.071)
$DOM_{pb,t}$							0.4101 (0.034)
$DOM_{pc,t}$							-0.0047 (0.022)
$P_{raw,t}$							-0.2320 (0.141)

System R-Square is 0.9635
System Mean square Error=2.036 with 134 d.f.
Standard Errors are in parenthesis

Table 2: Reduced Form Estimates for the U.S. Southeast Region Shrimp Industry Model (1973-1996).

Variables	$Q_{dd,t}$	$DOM_{pp,t}$	$DOM_{ph,t}$	$DOM_{pb,t}$	$DOM_{pc,t}$	$P_{raw,t}$	$P_{proc,t}$
Intercept	-806.8329	7.5526	7.4734	11.0904	7.3754	4.9062	8.7230
$Y_{disp,t}$	0.0173						
$MeatP_t$	223.9132						
$FishPPI_t$	253.8374						
$ChickP_t$	-108.2226						
$DOM_{qp,t}$	0.1414	-0.0114					-0.0022
$INV_{qp,t-1}$	-0.3567	0.0043				-0.0207	0.0056
$IMP_{qp,t}$	0.0447	-0.0041				-0.0005	-0.0007
$D83$	17.3767	-1.3986					-0.2751
$DOM_{qh,t}$	0.0270		-0.0007				-0.0004
$INV_{qh,t-1}$	-0.7860		0.0237			0.0058	0.0124
$IMP_{qh,t}$	0.2496		-0.0081			-0.0033	-0.0039
$DOM_{qb,t}$	1.6198			-0.0625			-0.0256
$INV_{qb,t-1}$	-2.8925			0.1116			0.0458
$IMP_{qb,t}$	-3.9841			0.1538			0.0631
$DOM_{qc,t}$	0.0028				0.0095		-0.00004
$IMP_{qc,t}$	-0.0092				-0.0310		0.0001
$Land_t$	-0.0671					-0.0046	0.0010
$AdjR^2$	0.99	0.81	0.64	0.77	0.26	0.527	0.850
DW	2.392	2.346	1.749	2.262	1.866	1.968	2.241