The Impact of Catfish Imports on the U.S. Wholesale and Farm Sectors

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The primary objective of this study was to assess the impact of catfish imports and tariffs on the U.S. catfish industry, with particular focus on the U.S. International Trade Commission ruling on Vietnam in 2003. Given the importance of Vietnam to the U.S. catfish market, it was assumed that catfish import prices would increase by 35 percent if the maximum tariff was imposed on catfish from Vietnam. With the tariff, domestic catfish prices at the wholesale level would increase by \$0.06 per lb, and farm prices by \$0.03 per lb. Processor sales would increase by 1.66 percent. Total welfare at the wholesale level would increase from \$69.2 million to \$71.7 million, an increase of about 3.63 percent, and processor and farm revenue would increase by 4.4 percent and 5.8 percent, respectively. These results represent the greatest possible benefit and suggest modest gains for the U.S. catfish industry.

Key Words: catfish imports, simultaneous equations, supply, demand, tariffs

During the 1970s and 1980s, seafood imports accounted for about half of all seafood products consumed in the United States. Since that time, imports have been steadily increasing, accounting for an increasing share of U.S. seafood consumption. Within the last decade, seafood imports have increased to over three-quarters of total U.S. supply. In contrast, import competition is a relatively new phenomenon for the U.S. catfish industry (see Figure 1). Prior to 1999, catfish imports accounted for less than 1 percent of total catfish sales in the United States. However, imports as a percentage of total U.S. sales increased from 3 percent in 2004 to over 25 percent in late 2006 and early 2007 (Hanson and Sites 2009, Muhammad and Jones 2009).

Catfish is imported mainly in the form of frozen fillets (Quagrainie and Engle 2002). Upon arrival, it is sold to U.S. wholesalers and competes directly with domestic catfish products at the retail level (Kinnucan et al. 1988). Since 2003, the primary exporters of catfish to the United States have been China and Vietnam. In 2006, the United States imported 19,843 tons of catfish from Vietnam. The second leading supplier, China, exported 8,545 tons to the United States that year. In years prior, Brazil was the leading supplier; however, imports from Brazil have been negligible in recent years (National Marine Fisheries Service 2009).

In 2002, Catfish Farmers of America, a trade association of farmers and processors, filed a petition with the U.S. International Trade Commission (USITC) alleging that Vietnamese companies were dumping catfish products into the United States. Vietnam was found guilty by the USITC, and the Department of Commerce recommended imposing tariffs up to 64 percent on catfish and catfish-like species coming from specific Vietnamese companies (USITC 2003). Given the USITC ruling on Vietnam, the following questions arise: What is the impact of catfish import prices on the domestic industry? And to what degree do

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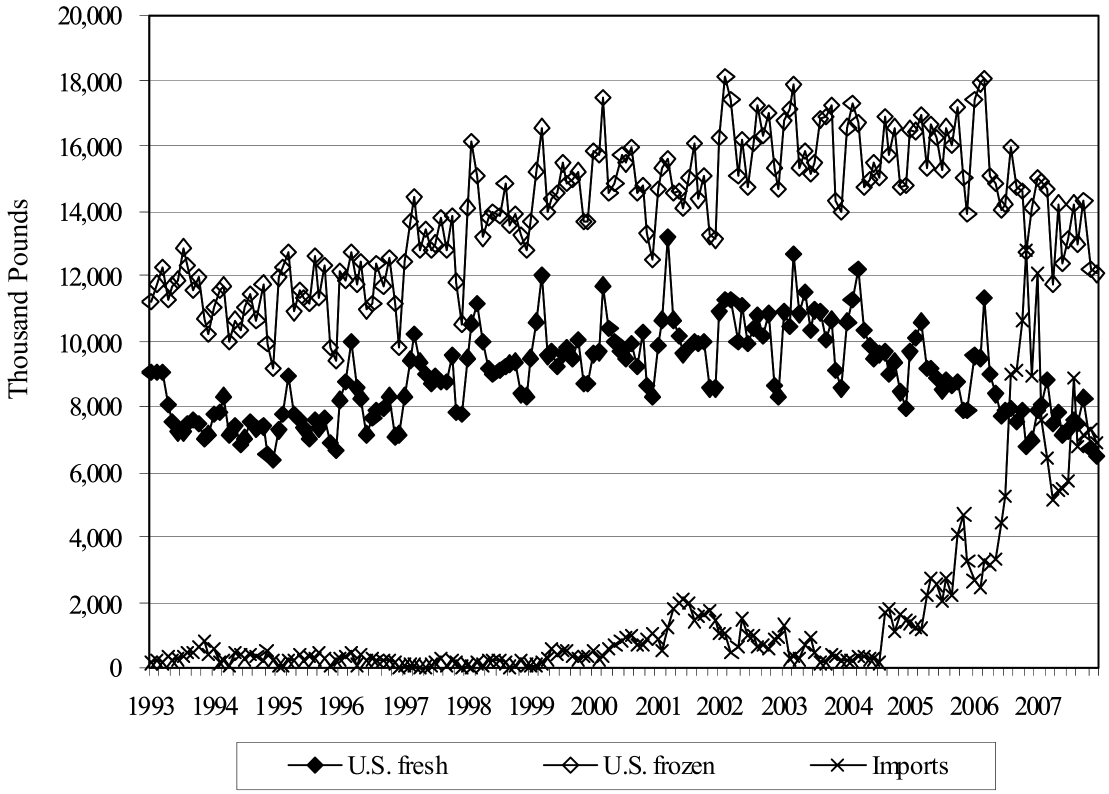

Figure 1. U.S. Catfish Sales and Imports: January 1993 through December 2007

import tariffs benefit domestic processors and farmers?

The primary objective of this study is to assess the impact of catfish imports and import tariffs on the U.S. catfish industry, with particular focus on the USITC ruling on Vietnam. Specifically, we estimate a simultaneous system of supply and demand equations at the wholesale (processor) and farm level for the U.S. catfish industry, accounting for such factors as resource and feed prices, import prices, and other relevant supply and demand determinants; and second, the supply and demand estimates are used to simulate the effects of the USITC ruling on domestic sales, prices, revenue, and welfare at the wholesale and farm level.

Given that the surge in catfish imports is fairly recent, few studies have investigated the relationship between imports and the domestic industry. Exceptions include Quagrainie and Engle (2002), Kinnucan (2003), Muhammad and Jones (2009), and Norman-López and Asche (2008). However, no study to date has analyzed this relationship in a multimarket simultaneous equation framework. Also, past studies focused mainly on the U.S. wholesale market and did not consider how imports affect the U.S. market at the farm level.

The remainder of the paper is organized as follows. An overview of the USITC ruling on Vietnam is presented in the next section as well as a review of the relevant literature. Then we present the empirical model. In the fourth section, the empirical results are given and the results of the policy analysis are reported. A brief summary and conclusion close the paper.

Background

USITC Ruling on Vietnam

The U.S. catfish industry has faced significant competition in recent years, particularly from Vietnam. In fact, the controversy with Vietnam did not begin with the antidumping petition mentioned in the previous section. In May 2002, section 10806 of the 2002 Farm Security and Rural Investment Act (the 2002 Farm Bill) specified that the term "catfish" may be applied only to fish classified within the Ictaluridae family. This meant that catfish-like species from Vietnam that belong to the Pangasiidae family could not be identified as "catfish" but as basa and tra. However, this did not slow the growth in imports of channel catfish and catfish-like products from Vietnam.

The United States has anti-dumping laws to protect domestic industries from products being imported at less than fair market value. The Tariff Act of 1930 states that U.S. industries can petition the government for protection and compensation when countries are found to be dumping (USITC 2003). Stoler (2003) notes that in the antidumping agreement of the 1994 General Agreement on Tariffs and Trade, the non-market provision allows for discriminatory treatment in cases where countries have a complete or substantially complete government monopoly over international trade and where domestic prices are fixed by the state. This provision proved particularly important in the petition against Vietnam because the U.S. Department of Commerce determined that Vietnam was a non-market economy justifying antidumping and countervailing duty proceedings (Brambilla, Porto, and Tarozzi 2009).

In June 2002, Catfish Farmers of America filed a petition with the USITC alleging that Vietnamese companies were dumping catfish into the United States. In August 2002, the USITC determined that there was reasonable indication that the U.S. catfish industry was threatened with material injury by reason of imports of certain frozen fish fillets from Vietnam. In June 2003, the U.S. Department of Commerce issued its final determination, concluding that Vietnamese producers sold frozen catfish fillets at less than fair market value and recommending margins ranging from 36.84 percent to 63.88 percent to be targeted to specific Vietnamese companies. In August 2003, the antidumping duty order was issued against frozen tra and basa fillets from Vietnam as well (Federal Register 2003). In January 2009, the U.S. Department of Commerce found that a revocation of the order would likely lead to prolonged or recurring incidents of dumping. Consequently, import duties on catfish products from Vietnam remain in effect (Martin 2009).

Literature Review

The literature reviewed in this section is twofold. First, we review studies that investigate the impact of catfish imports on the domestic industry. These include Ligeon, Jolly, and Jackson (1996), Quagrainie and Engle (2002), and Muhammad and Jones (2009). Second are studies that investigate the effects of trade protection on the seafood sector, with special emphasis on import duties. These include Kinnucan (2003), Kinnucan and Myrland (2006), and Torbjørn (2009).

Ligeon, Jolly, and Jackson (1996) analyzed how catfish imports affect U.S. producers, domestic prices, and import prices. They examined the possible threat posed to the U.S. catfish industry by the North American Free Trade Agreement (NAFTA). Their study showed that if domestic prices fell relative to import prices, the quantity of imported catfish would decline. Additionally, their results showed that an increase in imports from NAFTA countries would not have a significant effect on the domestic industry due to the small level of catfish imports at that time.

More recent studies have found a more significant relationship between domestic and imported catfish. Quagrainie and Engle (2002) indicate that the driving force behind the increase in imports in recent years is the relatively high price of domestic fillets. They note that as long as wholesalers and retailers do not see any reason for paying a higher premium for U.S. catfish, they will continue to purchase lower-priced imports. Their results show that there is a positive price transmission between domestic and imported frozen fillets. Muhammad and Jones (2009) used a dynamic Rotterdam model to estimate the demand for disaggregated catfish products in the United States. Their results show a significant competitive relationship between imported catfish and domestic frozen fillets.

Kinnucan (2003) examined the effects of targeted tariffs (tariffs targeted to companies within a specific country) on the U.S. catfish industry. He applied a targeted tariff of \$0.50 per lb to Vietnamese catfish to determine if the U.S. catfish industry benefited from this form of protection. His results show that the tariff causes a

\$0.17 per lb rise in U.S wholesale prices in the short run, and a \$0.11 per lb rise in the long run. He suggests that a better way of dealing with increased imports is through marketing and promotion where foreign countries could then invest in the domestic catfish market. Kinnucan and Myrland (2006) found that imposing safeguard tariffs on imported fish does more to punish producers in the exporting country than to reward producers in the importing country. In evaluating the salmon agreement between Norway and the European Union (EU), Torbjørn (2009) also found that exporting countries are punished by these safeguard tariffs but the net-welfare gain for an importing country may be minimal or even negative. His analysis concluded that the net effect of this agreement was negative for the EU due to the moderate gains realized by EU producers relative to significantly greater losses realized by buyers/consumers.

Model of the U.S. Catfish Industry

Following Crutchfield (1985), Traesupap, Matsuda, and Shima (1999), and Marsh (2003, 2007), a multi-level market model is developed to assess the impacts of catfish import prices on domestic catfish demand and supply at the wholesale and farm level. The structural model for the U.S. catfish industry is expressed in linear form as follows (time subscripts are omitted):

(1)
$$QW_D = \alpha_0 + \alpha_L QW_{D(-1)} + \alpha_1 PW + \alpha_2 PR + \alpha_3 PMC + \alpha_4 PMT + \alpha_5 PE + \sum_{i=1}^{3} \alpha_{Di} D_i + \varepsilon$$

(2)
$$QW_S = \beta_0 + \beta_L QW_{S(-1)} + \beta_1 PW + \beta_2 PF + \beta_3 PE + \beta_4 t + \sum_{i=1}^{3} \beta_{Di} D_i + \nu$$

(3)
$$PF = \phi_0 + \phi_1 PW + \phi_2 PFD_{(-24)} + \phi_3 PE + \phi_4 t + \omega$$

(4)
$$QW_D = QW_S = QW.$$

Descriptions of variables are in Table 1, along with their unit of measure and descriptive statistics. Equation (1) is catfish demand at the wholesale level where wholesale demand (QW_D) is a function of processor prices (PW), catfish import prices (PMC), and tilapia import prices (PMT). Imported catfish and tilapia are substitutes for domestic catfish. Since demand at this level is derived demand (i.e., processed catfish is resold at retail), wholesale-level demand is also a function of catfish prices at the retail level (PR). We also include energy prices (PE) in equation (1) due to fuel and utilities being inputs for wholesale distributors and retailers. The quantity lagged one period ($QW_{D(-1)}$) is also included as an independent variable to account for dynamic behavior and non-instantaneous adjustments in equilibria. To account for seasonal variation in wholesale demand, quarterly dummy variables are added to the model where D_i equals unity in quarter i and zero otherwise.[1]

Catfish supply at the wholesale level (QW_S), equation (2), is also a function of processor prices, and is also determined by the price of catfish at the farm level (PF) and energy prices. Live catfish from farmers and energy are inputs for U.S. processors. To account for technological change in catfish processing, as well as other trending factors, a trend term (t) is added to the wholesale supply equation. Similar to wholesale demand, a lag term is added to account for dynamic behavior, and quarterly dummy variables are added to account for seasonal variation in wholesale supply.

The estimation of farm supply proved difficult in preliminary analysis; this may be due to the dynamic nature of catfish supply making it difficulty to obtain true farm supply determinants. Instead of estimating farm supply and demand directly, we imposed the market-clearing condition at the farm level to derive a farm price equation as specified by equation (3).[2] The price of catfish at the farm level is a function of processor prices and energy prices, as well as a trend term to account for technological change in farm production. Since feed is an important input in farm production, farm prices are also a function of catfish feed prices (PFD). Note that feed prices are lagged 24 months to account for the time required

[1] Although the data used to estimate the model are monthly, the seasonality in catfish demand and supply was best explained by quarterly dummy variables. Monthly seasonal estimates were mostly insignificant in preliminary results.

[2] Let demand at the farm level be defined as $QF_D = f(QF_{D(-1)}\ PF, PW, PE)$ and farm-level supply as $QF_S = f(QF_{S(-1)}\ PF, PE, PFD_{(-24)}, t)$. Given the market-clearing condition $QF_D = QF_S = QF$, a farm price equation can be defined as $PF = f(PW, PE, PFD_{(-24)}, t)$.

Table 1. Description of Model Variables and Statistics

Symbol	Description	Unit of Measure	Mean	Std. Dev.	Minimum	Maximum
QW	Processor quantity	1,000 lbs	23,583.16	2,977.40	16,018.00	30,485.00
PW	Processor price	$/lb	2.30	0.14	2.02	2.59
PF	Farm price	$/lb	0.72	0.08	0.53	0.96
PR	Seafood retail price index	Index	160.42	11.55	136.60	183.70
PMC	Catfish import price	$/lb	1.37	0.25	0.89	2.20
PMT	Tilapia import price	$/lb	1.14	0.20	0.75	1.59
PE	Energy price index	Index	1.39	0.47	0.85	2.71
PFD	Catfish feed price	$/lb	0.11	0.01	0.09	0.16
t	Trend		1.02	0.45	0.25	1.79
SEASONAL DUMMY VARIABLES						
*D*1	First quarter		0.25	0.44	-	1.00
*D*2	Second quarter		0.25	0.44	-	1.00
*D*3	Third quarter		0.25	0.44	-	1.00

to raise catfish from fingerling to food-size. Lastly, equation (4) is the market-clearing condition at the wholesale level. ε, ν, and ω are random error terms.

Given the wholesale market-clearing condition, equations (1)–(3) form a system of three equations with three endogenous variables: *QW*, *PW*, and *PF*. To obtain the equilibrium values, the system is restated as follows:

(5) $$QW = \alpha_0^* + \alpha_1 PW$$

(6) $$QW = \beta_0^* + \beta_1 PW + \beta_2 PF$$

(7) $$PF = \phi_0^* + \phi_1 PW \; .$$

The intercept terms α_0^*, β_0^*, and ϕ_0^* are linear combinations of the exogenous variables, where

$$\alpha_0^* = \alpha_0 + \alpha_L QW_{(-1)} + \alpha_2 PR + \alpha_3 PMC + \alpha_4 PMT + \alpha_5 PE + \sum_{i=1}^{3} \alpha_{Di} D_i$$

$$\beta_0^* = \beta_0 + \beta_L QW_{(-1)} + \beta_3 PE + \beta_4 t + \sum_{i=1}^{3} \beta_{Di} D_i$$

$$\phi_0^* = \phi_0 + \phi_2 PFD_{(-24)} + \phi_3 PE + \phi_4 t \; .$$

Setting equation (5) equal to (6) yields

(8) $$PW = \frac{\beta_0^* - \alpha_0^*}{\alpha_1 - \beta_1} + \frac{\beta_2}{\alpha_1 - \beta_1} PF \; .$$

Substituting equation (7) into equation (8), the wholesale price at market clearing is

(9) $$PW^* = \frac{\dfrac{\beta_0^* - \alpha_0^*}{\alpha_1 - \beta_1} + \dfrac{\beta_2}{\alpha_1 - \beta_1}\phi_0^*}{1 - \dfrac{\beta_2}{\alpha_1 - \beta_1}\phi_1} = \frac{\beta_0^* - \alpha_0^* + \beta_2 \phi_0^*}{(\alpha_1 - \beta_1) - \beta_2 \phi_1} \; .$$

Given PW^*, the wholesale quantity and farm price at market clearing are

(10) $$QW^* = \alpha_0^* + \alpha_1 PW^*$$

(11) $$PF^* = \phi_0^* + \phi_1 PW^* \; .$$

From equations (9)–(11), it can easily be shown that import prices affect the equilibrium values of *QW*, *PW*, and *PF* since all are either directly or indirectly determined by the value of α_0^*.

Empirical Results

The wholesale demand and supply, and the farm price equations, are estimated simultaneously using the three-stage least squares procedure in TSP, version 5.0. Monthly data are used in estimating the model, and the time period for the data is from January 1993 to December 2007. Domestic catfish quantities and prices were provided by the National Agricultural Statistics Service. Import prices were provided by the National Marine Fisheries Service. An energy price index is used as a proxy for energy cost, and a retail seafood price index is used as a proxy for catfish prices at the retail level.[3] Both indexes were provided by the Bureau of Labor Statistics.

Quagrainie and Engle (2002) indicate that there is a positive price transmission between the price of domestic frozen fillets and the price of imported fillets. Therefore, catfish import prices may not be exogenous in the system. To account for this endogeneity, catfish import prices were regressed on the exogenous variables to obtain the fitted values. The predicted value of import prices was then used as an instrument for import prices when estimating the model.

Estimation results are reported in Table 2. Most estimates are significant at the 0.05 level and consistent with economic theory. The R^2 for each equation (0.74, 0.69, and 0.85) indicates a relatively good fit. Greene (2008, p. 646) notes that the Durbin-Watson test for autocorrelation is invalid when there is a lagged dependent variable in the equation. However, the Durbin-h test can still be used in this instance. Given the lag dependent variables in equations (1) and (2), the Durbin-h statistics are reported for these equations. Autocorrelation is present if the absolute value of the Durbin-h statistic is greater than 1.645 (Johnston 1984, p. 318). The Durbin-h statistics for the wholesale demand equation (-1.492) and supply equation (-0.855) indicate that the errors are not serially correlated. The Durbin-Watson statistic for the farm price equation indicates that autocorrelation could be a problem for this equation, but given that equation (3) does not include a lag dependent variable, the least squares estimates are still unbiased and consistent (Green 1997, p. 586).

The effect of wholesale price (*PW*) on the quantity demanded at the wholesale level (-9,001.09) is negative, as expected, and statistically significant at the 0.01 level. This indicates that a one-dollar increase in the wholesale price would cause quantity demand at the wholesale level to decrease by about 9 million pounds. This is quite considerable given average monthly sales of 23.58 million pounds. Note that the average processor price is $2.30 per lb and ranged from as low as $2.02 per lb to as high as $2.59 per lb during the data period. Clearly, a one-dollar price increase would be quite significant, which explains the relatively large estimate. The estimate for the retail seafood price index (*PR*) (50.74) is positive as expected since an increase in demand at the retail level should cause demand at the wholesale level to also increase. The price estimates for imported catfish and tilapia (1,956.70 and 1,457.86) are both positive and significant, indicating that these products are substitutes for domestic catfish. Although it has the expected negative sign, the energy price index is insignificant.

The significance and magnitude of the quarterly dummy variables suggests that catfish demand at the wholesale level is highly seasonal. The relatively large estimate for *D*1 (3,559.15) is likely due to Lent, as this Catholic tradition encourages the consumption of non-meat products and takes place during the first quarter. The estimates for the second and third quarter are 1,153.99 and 1,613.95, respectively, and reflect that during the spring and summer months more fish is consumed relative to the fourth quarter, where catfish consumption tends to decrease during the holiday season.

The significance of the lagged term ($QW_{D(-1)}$) indicates that the responsiveness of quantity demanded is not instantaneous. An interpretation of this estimate is that the quantity demanded in the previous month explains 38.1 percent of the quantity demand in the current month or that the initial responsiveness of quantity demanded is about 62 percent. This is due to adjustment costs incurred by wholesalers, retailers, and other buyers when responding to changes in the market.

Consistent with theory, the impact of the processor price (*PW*) on quantity supplied at the wholesale level is positive, and given that live catfish from the farm is an input for processors, the relationship between the farm price (*PF*) and

[3] The retail seafood price index was used because monthly catfish prices at the retail level were not readily available. Additionally, retail catfish prices are likely endogenous and dependent upon determining factors at the farm and wholesale level. To account for this endogeneity, the seafood price index could be considered as an instrument for retail catfish prices.

Table 2. Three-Stage Least Squares Estimates

WHOLESALE DEMAND (QW_D)	Estimate	Standard Error	t-statistic
constant	22,330.500	4323.220	5.17
QW_D (-1)	0.381	0.065	5.85
PW	-9,001.090	1680.070	-5.36
PR	50.742	15.414	3.29
PMC^p	1,956.700	719.273	2.72
PMT	1,457.860	631.240	2.31
PE	-732.792	488.880	-1.50
*D*1	3,559.150	342.975	10.38
*D*2	1,153.990	398.694	2.89
*D*3	1,613.950	341.919	4.72
WHOLESALE SUPPLY (QW_S)			
constant	10,878.800	5767.720	1.89
QW_S (-1)	0.420	0.062	6.73
PW	6,228.020	4259.160	1.46
PF	-17,560.800	6375.240	-2.75
PE	-1,942.420	721.905	-2.69
t	2,364.750	692.925	3.41
*D*1	3,656.560	351.784	10.39
*D*2	766.721	388.691	1.97
*D*3	1,396.640	342.501	4.08
FARM PRICE (*PF*)			
constant	-0.448	0.079	-5.66
PW	0.474	0.042	11.31
PE	0.029	0.019	1.54
PFD (-24)	0.789	0.227	3.47
t	-0.054	0.019	-2.79

Notes: Wholesale demand: R^2 = 0.741; Durbin-w = 2.157; Durbin-h = -1.492. Wholesale supply: R^2 = 0.685; Durbin-w = 2.096; Durbin-h = -0.855. Farm price: R^2 = 0.846; Durbin-w = 1.233.

quantity supplied is negative. The estimate for the processor price (6,228.02) is not significant (although not highly insignificant), but the farm price estimate (-17,560.80) is significant and indicates that wholesale supply is highly sensitive to changes in farm prices. While this estimate is relatively large, the average farm price is about $0.72 per lb. Thus, a one-dollar increase in farm prices is quite large. The estimate for the energy price index (-1,942.42) is significant and negative, which is to be expected since energy is an input for processors. The estimate for the lagged term ($QW_{S(-1)}$) suggests that the quantity supplied in the previous month explains about 42 percent of the quantity supplied in the current month. Similar to wholesale demand, wholesale supply is also seasonal, where the dummy variable estimates are significant and similar in magnitude when compared to the demand seasonality estimates.

The variables in the farm price equation are significant mostly at the 5 percent level, and all have the expected signs according to economic theory. The wholesale price (*PW*) is significant and positive, and reflects the price transmission from the wholesale to the farm level. This estimate indicates that for every dollar increase in the processor price, about \$0.47 is passed through to the farm price. The feed price estimate (0.789) is significant and theoretically consistent. Since feed prices are supply-decreasing, higher feed prices should result in higher farm prices. This estimate indicates that a dollar increase in feed prices would cause farm prices to increase by \$0.79, which is quite significant given that the average farm price is \$0.72. This is to be expected since feed expenses are about 50 percent of the total production cost. Additionally, mean feed prices are only \$0.11 per lb, so a one-dollar increase would be quite substantial.

If the model estimates are reliable, the equilibrium values of *QW*, *PW*, and *PF* should be fairly close to the mean values when the model is evaluated using the mean exogenous variables reported in Table 1. The equilibrium values are calculated using equations (9)–(11), and the intercept terms are derived using the mean values of the exogenous variables. The resulting equilibrium wholesale price and quantity are \$2.30 and 23.69 million pounds, respectively. This is exactly identical to the mean wholesale price for the data period and very close to the mean quantity, which is 23.58 million pounds. The equilibrium farm price (\$0.72) is also identical to the mean value for the data period (see Table 1).

The model estimates are used to derive the short- and long-run demand and supply elasticities. The presence of lagged dependent variables in equations (1) and (2) allows for deriving the long-run relationships. Since $QW = QW_{(-1)}$ in the long run, the long-run effects are obtained from equation (1) by dividing each estimate by $1 - \alpha_L$. For equation (2), each estimate is divided by $1 - \beta_L$. For instance, the effect of own-price on quantity demanded ($\partial QW_D / \partial PW$) is α_1 in the short run and $\alpha_1 / (1 - \alpha_L)$ in the long run.

Mean-based demand and supply elasticities are reported in Table 3. Of the wholesale demand determinants, the wholesale price has the largest effect on demand where the percentage responsiveness of wholesale demand to percentage changes in own-price is -0.88 in the short run and -1.42 in the long run. These estimates are comparable to past studies. Zidack, Kinnucan, and Hatch (1992) found an own-price elasticity of -1.01, Kinnucan and Miao (1999), -0.71, and Kinnucan and Thomas (1997), -0.87. Muhammad and Jones (2009) also found similar elasticities where their own-price elasticity for frozen catfish fillets was -0.85 in the short run and -1.31 in the long run. Norman-López and Asche (2008) estimated long-run own-price elasticities for fresh and frozen catfish of -1.03 and -0.77, respectively.

Of particular importance is the impact of catfish import prices on the domestic quantity as well as the impact of import prices on domestic wholesale and farm prices. In the short run, a percentage increase in catfish import prices causes a 0.11 percent increase in quantity demanded (0.18 percent in the long run). Since U.S. catfish imports in significant quantities are relatively recent, past studies have found the relationship between import prices and domestic demand to be insignificant. For instance, see Zidack, Kinnucan, and Hatch (1992). More recent studies have found the relationship to be positive and significant. For instance, the results of Muhammad and Jones (2009) indicate that the percentage responsiveness of U.S. frozen fillets to import prices is 0.52 assuming a market share for imports of about 5 percent. Using a greater market share of about 20 percent which is more consistent with current imports, the responsiveness is 0.14.

The responsiveness of market-clearing prices to changes in import prices is also reported in Table 3. In terms of units, a one-dollar increase in import prices causes the equilibrium wholesale price to increase by \$0.28 per lb and the farm price to increase by \$0.13 per lb. In terms of percentage, import prices cause the wholesale price to increase by 0.17 percent and the farm price to increase by 0.26 percent. These estimates do not significantly differ in the long run, given that the estimates for the leg-dependent variables are fairly close in value.[4]

Policy Analysis

On June 17, 2003, it was determined that Vietnamese producers and exporters made sales to the U.S. market at less than fair market value. There

[4] From equations (9) and (11), the impact of the import price on the wholesale price is $\partial PW / \partial PMC = -\alpha_4 / (\alpha_1 - \beta_1 - \beta_2 \varphi_1)$, and the impact on the farm price is $\partial PF / \partial PMC = (\partial PF / \partial PW) \partial PW / \partial PMC = -\alpha_4 \varphi_1 / (\alpha_1 - \beta_1 - \beta_2 \varphi_1)$. Given that the estimates of α_L and β_L are close in value, dividing the α terms by $1 - \alpha_L$ and the β terms by $1 - \beta_L$ will not significantly change the value of $\partial PW / \partial PMC$ and $\partial PF / \partial PMC$.

Table 3. Short-Run and Long-Run Elasticities

	Short-Run Elasticities		Long-Run Elasticities	
WHOLESALE DEMAND	Estimate	t-statistic	Estimate	t-statistic
Own-price	-0.88	-5.36	-1.42	-7.22
Retail fish index price	0.35	3.29	0.56	3.56
Imported catfish price	0.11	2.72	0.18	2.92
Imported tilapia price	0.07	2.31	0.11	2.43
WHOLESALE SUPPLY				
Own-price	0.61	1.46	1.05	1.46
Farm price	-0.53	-2.75	-0.92	-2.85
Energy price index	-0.11	-2.69	-0.20	-2.73
IMPORT PRICE				
$\Delta PW^* / \Delta PMC^p$	0.28	4.35	0.29	4.26
$\Delta PF^* / \Delta PMC^p$	0.13	3.57	0.14	3.49
$\% \Delta PW^* / \% \Delta PMC^p$	0.17	4.35	0.17	4.26
$\% \Delta PF^* / \% \Delta PMC^p$	0.26	3.57	0.26	3.57

were four mandatory respondents to the questionnaire in this investigation: Agifish, Cataco, Nam Viet, and Vinh Hoan. Using these four companies, tariffs were determined ranging from 36.84 percent to 52.9 percent. Vietnamese companies that voluntarily responded to the questionnaire received a tariff margin of 44.66 percent, which was based on a weighted average margin of the mandatory respondents. Imports from all other Vietnamese producers and exporters were subject to the highest tariffs margin of 63.88 percent (U.S. Department of Commerce 2003).

For the analysis, we assume the highest possible tariff margin and that the tariff is fully passed through to import prices. Given that Vietnam accounts for over half of U.S. catfish imports, import prices would increase by about 35 percent if all imports from Vietnam were assessed a tariff of 63.88 percent. The effect of the actual tariffs on import prices is probably much smaller; however, as the results will show, even with the highest possible margin and largest import price increase, the benefit to the U.S. catfish industry is still relatively modest.

The results of the policy analysis are presented in Table 4 and Figure 2. The baseline values (reference point) are derived from the equilibrium using the mean values of the exogenous variables and are as follows: wholesale quantity 23.69 million pounds, wholesale price $2.30 per lb, farm price $0.72 per lb, consumer or buyer surplus $31.18 million, processor surplus $38.03 million, processor revenue $54.48 million, and farm revenue $33.95 million. Consumer and producer surplus respectively represent the welfare for wholesalers and processors, shown graphically by area (b, d) and area (a) in Figure 2.

The equilibrium farm quantity is needed to calculate farm revenue, but our model does not allow for obtaining farm quantities. However, throughout the data period, processor sales as a percentage of farm sales have consistently been around 50 percent. Total processor sales, and processor sales as a share of farm sales since January 1993, are presented in Figure 3. The figure shows that processor sales as a share of farm sales have always been between 40 percent and 60 percent. Thus, farm revenue was calculated with the assumption that

Table 4. Impact of the Tariff on the U.S. Catfish Industry

	Baseline (equilibrium)	With Tariff	Difference	% change
Wholesale quantity (1,000 lb)	23,693.52	24,086.46	392.94	1.66
Wholesale price ($/lb)	2.30	2.36	0.06	2.65
Farm price ($/lb)	0.72	0.75	0.03	4.02
WELFARE				
Consumer surplus ($1,000)	31,184.16	32,227.08	1,042.92	3.34
Processor surplus ($1,000)	38,033.90	39,503.68	1,469.78	3.86
Total ($1,000)	69,218.06	71,730.76	2,512.70	3.63
REVENUE				
Processor ($1,000)	54,484.17	56,852.82	2,368.65	4.35
Farm ($1,000)	33,953.96	35,905.67	1,951.71	5.75

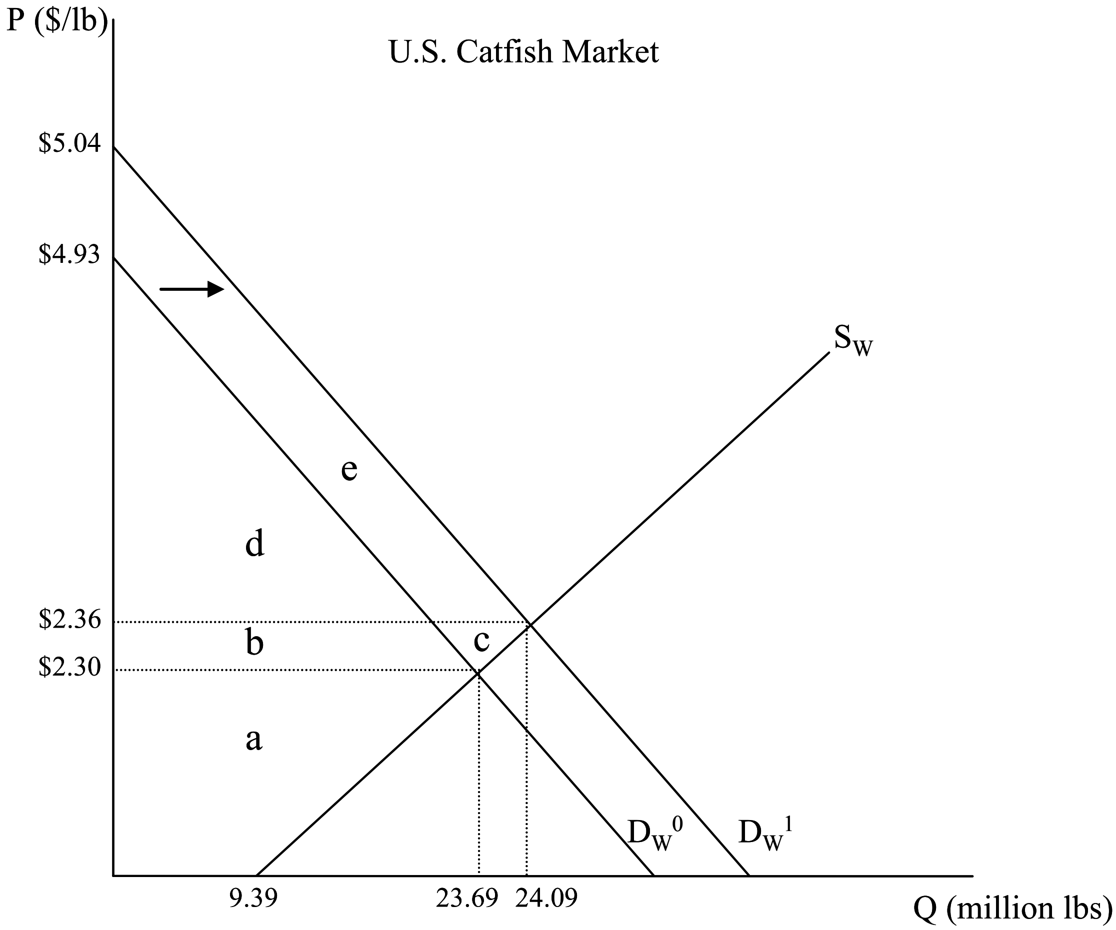

Figure 2. Impact of the Tariff on the Wholesale Sector

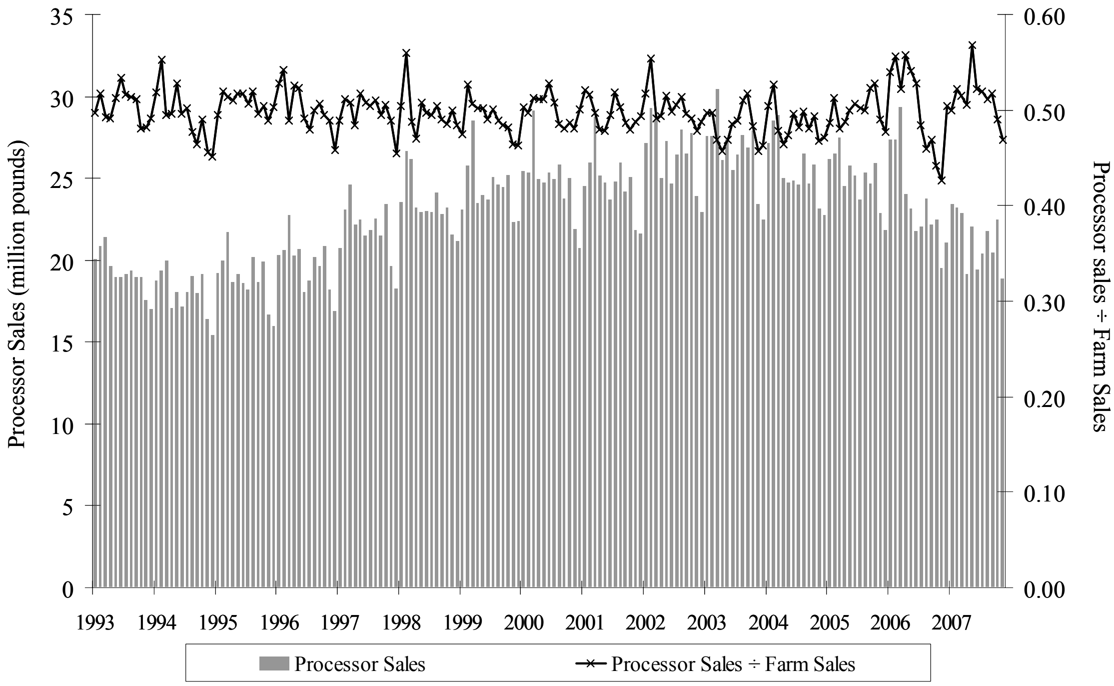

Figure 3. Processor Sales Relative to Farm Sales: January 1993 through December 2007

farm sales are twice the equilibrium quantity at the wholesale level.

Given the tariff or 35 percent import price increase, the quantity sold at the wholesale level increases to 24.09 million pounds, a difference of about 393,000 pounds or 1.66 percent, and the wholesale price and farm price increase by $0.06 per lb and $0.03 per lb, respectively. Buyer surplus and producer surplus increase by 3.34 percent and 3.86 percent, respectively. The increase in producer surplus is shown by area (b, c) in Figure 2. Buyer surplus decreases by area (b), but increases by area (e). Processor revenue increases by $2.37 million (4.35 percent), and farm revenue increases by $1.95 million (5.75 percent).

The results show that U.S. processors and farmers are marginally better off with the tariff. The increase in welfare for wholesalers (buyers) [area (e) – area (b)] represents the welfare gain in the domestic market but does not account for the welfare loss in the import market. If this welfare loss due to higher import prices exceeds the welfare gain in the domestic market, then wholesalers will be worse off with the tariff. These results represent the highest possible benefit to the domestic industry. If the average tariff is smaller, or if the tariff is not fully passed through to import prices, which may be the case with targeted tariffs (Kinnucan 2003), the benefit to U.S. processors and farmers could be even smaller.

Conclusion

The goal of this research was to determine how the U.S. catfish industry benefited from tariffs imposed on catfish-like species from Vietnam. Given the importance of Vietnam to the U.S. import market, it was assumed that catfish import prices would increase by 35 percent given a tariff on Vietnamese catfish. A multi-market supply and demand model was estimated and used to determine how price and quantity, consumer and producer welfare, and revenue at the wholesale and farm levels respond to changes in catfish import prices.

We assumed the maximum possible tariff on catfish imports, which resulted in the domestic price of wholesale catfish increasing by $0.07 per lb, and processor sales increasing by 1.33 percent. The benefit to U.S. farmers was a price increase of \$0.03 per lb. Total welfare in the wholesale market increased from \$69.2 million to \$71.7 million, an increase of about 3.63 percent. The benefit in terms of revenue (sales) for processors and farmers was an increase of 4.35 percent in processor revenue and 5.75 percent in farm revenue. These results represented the greatest possible benefit to the U.S. catfish industry using our model. The probable benefit to the U.S. catfish industry could be smaller if import prices are not fully responsive to tariffs.

These results support the findings of Quagrainie and Engle (2002), and Kinnucan (2003). Both studies indicate that import tariffs would be of small benefit to the domestic industry, particularly given the relative inexpensiveness of catfish imports, and the likelihood that targeted tariffs may not result in higher import prices in the domestic market. Note that the average import price for the data period was \$1.37 per lb. Domestic frozen fillets are about \$2.60 per lb. With a 35 percent price increase, imports are still significantly cheaper on average.

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Appendix

A reviewer suggested that we also consider other functional forms when estimating the model, particularly a nonlinear functional form. The model as specified by equations (1)–(4) was re-estimated assuming a constant elasticity functional form. We compare the resulting elasticities in Table A1.

In comparing the short- and long-run elasticities derived from each model, the results show no statistical difference between the two functional forms. This was also true when comparing the responsiveness of the wholesale and farm price to changes in the import price.

Table A1. Statistical Comparison of Elasticity Estimates across Model Functional Forms

SHORT-RUN ELASTICITIES	Linear Model		Constant Elasticity Model		Difference		Difference P-Value
Demand							
Own-price	-0.877	(0.164)	-0.596	(0.142)	-0.281	(0.217)	[.195]
Retail fish index price	0.345	(0.105)	0.344	(0.091)	0.001	(0.139)	[.995]
Imported catfish price	0.114	(0.042)	0.088	(0.038)	0.026	(0.056)	[.650]
Imported tilapia price	0.071	(0.031)	0.036	(0.028)	0.035	(0.042)	[.406]
Supply							
Own-price	0.607	(0.415)	0.605	(0.340)	0.001	(0.536)	[.998]
Farm price	-0.533	(0.193)	-0.407	(0.160)	-0.126	(0.251)	[.615]
Energy price index	-0.115	(0.043)	-0.101	(0.035)	-0.014	(0.055)	[.803]
LONG-RUN ELASTICITIES							
Demand							
Own-price	-1.418	(0.196)	-1.247	(0.232)	-0.171	(0.304)	[.574]
Retail fish index price	0.558	(0.157)	0.720	(0.174)	-0.162	(0.234)	[.489]
Imported catfish price	0.184	(0.063)	0.185	(0.074)	-0.001	(0.097)	[.995]
Imported tilapia price	0.114	(0.047)	0.075	(0.058)	0.039	(0.075)	[.602]
Supply							
Own-price	1.046	(0.716)	1.337	(0.754)	-0.290	(1.040)	[.780]
Farm price	-0.919	(0.323)	-0.898	(0.344)	-0.021	(0.471)	[.965]
Energy price index	-0.197	(0.072)	-0.223	(0.076)	0.025	(0.105)	[.811]
Import Price Elasticities							
$\%\Delta PW^{*}/\%\Delta PMC^{p}$	0.169	(0.039)	0.147	(0.043)	0.023	(0.058)	[.697]
$\%\Delta PF^{*}/\%\Delta PMC^{p}$	0.258	(0.072)	0.216	(0.071)	0.042	(0.101)	[.680]

Note: Asymptotic standard errors are in parentheses.