An Almost Ideal Demand Analysis for Seafood in Texas

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Abstract

Despite the human nutritional benefits of seafood such as shrimp, per capita consumption has been declining since 2004. A few studies have been conducted, but the literature is still limited. Indeed, studies that have analyzed the market demand for seafood and shrimp in the United States don't furnish empirical estimates of the consumer behavior of this market. This void in literature is evident, as recent works have either used aggregated data on seafood or disaggregated shrimp data but focusing on shrimp imports.

This paper uses the Almost Ideal Demand System (AIDS) to estimate the demand for shrimp in Texas, using AC Nielsen Scanner consumption panel data collected from four metropolitan areas: Dallas, Houston, San Antonio, and West Texas. The data ranges from 2006 to 2010. The demand for shrimp is estimated in a system of demand equations for ten fish species. The availability of data on these various kinds of fish enables the assumption of separability of seafood from other food products.

The results suggest that all the fish species considered are normal goods and that shrimp demand is price sensitive with an uncompensated own price elasticity of -1.53 and an income elasticity of 0.98. This is partly attributed to the fact that consumers view other fish types as substitutes for shrimp. This result also means that changes is price for shrimp will hurt shrimp consumers more than consumers of other food products which are less price elastic.

Key Words: Shrimp, Almost Ideal Demand System, elasticities, metropolitan areas.

This paper uses the Almost Ideal Demand System to estimate the demand for seafood in Texas using AC Scanner consumption data from four metropolitan areas: Dallas, Houston, San Antonia and West Texas. The demand for seafood is estimated in a system of demand equations with ten fish species: shrimp, catfish, crawfish, codfish, Flounder, Pollock, Salmon, Scallop, Tilapia and whiting. A test for the restrictions of homogeneity, symmetry and adding up in the linear expenditure, Rotterdam model, LA/AIDS and Full AIDs does not hold. The results obtained with the Full AIDSs model suggest that all the fish species in the system are normal and that shrimp is highly price responsive with an uncompensated own price elasticity of -1.53 and an income elasticity of 0.98.

***Key words**:* LES Rotterdam, LA-AIDs, Full AIDs

I. **Introduction**

Despite the human nutrition benefits, the per capita consumption of sea foods (finfish and shellfish) in the USA has been declining since 2004[1]. The consumption has fallen gradually from 16.6 pounds per person in 2004 to 14.6 pounds person in 2014. Compared to other food products, seafood consumption claims for a small share. Therefore, further reduction in the consumption level is likely to hurt the industry. For example, it has been estimated that in 2013, average per capita consumption of seafood is 53.3 pounds of beef, about 57.7 pounds of chicken, 600 pounds of dairy products, 480 pounds of vegetables, over 250 pounds of fruits, and about 175 pounds of flour and cereals (National Marine Fisheries Service Statistics, 2014).

USA seafood supplies are from both domestic production and imports. The imported sea foods account for over 90% of the sea foods consumed in the USA. About 84% of Sea foods are imported in either fresh or frozen forms, about 12 % are canned and about 2% are cured. Among the imported fresh seafood shrimp accounts for 33% by weight followed by fresh water fillets and steaks, salmon, tuna, ground fish (cod, haddock and hakes), crabs and crabmeat, frozen fish blocks used to make fish, squid, and lobster. Among the imported canned seafood, canned tuna accounts for over 50%. About 75% of the seafood imported by the USA in 2014 were supplied

[1]For example a study conducted by Samya et al., 2013 reveals that shrimp is highly nutritious and healthy. This is due to its lower atherogenic (0.36) and thrombogenic (0.29) indices that make it a cardio protective food. In spite of its relatively lower lipid content (less than 1%), the daily value of 100g of shrimp for an adult human is 75% for eicosapentanoic acid and docosahexanoic acid, 70% for essential amino acids (methionine, tryptophan and lysine) and 35% for proteins.

Finfish is a bony fish, such as a salmon, or a cartilaginous fish, such as a shark. Shellfish include two groups: crustaceans and mollusks. Crustaceans include lobsters, crabs, crawfish, prawns and shrimp. Mollusks include octopus, squids, abalones, clams, mussels, oysters, and scallop among others.

by China, Canada, Thailand, Vietnam, Indonesia, and Chile (National Marine Fisheries Services, 2014).

The local seafood supply comes from the wild and domestic sources. The wild sources include the commercial fisheries while the domestic sources include aquaculture production and recreational fisheries. In 2014, commercial fisheries contributed about 9.5 billion pounds of seafood in 2014 while the estimated recreationally harvested catch is about 186 million pounds. The catch from the fish farms is estimated at 662 million pounds in 2013 (National Marine Fisheries Service, 2014). The top seafood products consumed in the USA in 2014 are shrimp, Salmon, Tuna, Tilapia, Alaska Pollock, Pangasius (Basa or Swai), Cod, Catfish, Crab, Clams with reported consumption of 4.0, 2.3, 2.3, 1.4, 0.98, 0.69, 0.65, 0.52, 0.51 and 0.34 pounds per person, respectively (National Marine Fisheries Services, 2014). This qualifies shrimp to be the most important seafood consumed in the USA.

The change in the market demand for shrimp in particular has been attributed to the decline in the amount of fish caught from commercial fisheries such as the Gulf of Mexico since 2008. This decline in local shrimp harvesting has been partly due to unstable fuel prices and the decline in shrimp prices. Shrimp price fluctuations resulted from the influx of shrimp imports from Brazil, Ecuador, India, Thailand, Vietnam and China (Keithly. et al., 2008). Nevertheless, USA shrimp imports have also declined from 2008 to 2012. The fall in shrimp imports followed the investigation results of 2005 by US Trade Commission regarding the petitions filed by the US Shrimp industry (2003). As a result, a countervailing duty was imposed on specific warm water shrimp imports from Brazil, Ecuador, India, Thailand, Vietnam and China. The reduced shrimp harvests coupled with the reduced shrimp imports have resulted into reduced supply of shrimp to the USA shrimp consumers.

A few studies have been conducted on seafood but most of these studies have treated sea foods as a single commodity (Wang, 2014; Asche, 1991; Barton and Betterdorf, 1989; Dey, 2000). The problem with these kinds of studies is that it is not possible to estimate short-term responses of specie-specific markets to price and non-price factors (Johnson, 2007). This has been a consequence of the difficulties associated with clearly categorizing fish into clear component commodities.[2] More recent works have evolved into more disaggregated analyses (Pawan, 2008; Keithly et al., 2008; Zhou, 2008; Jack and Lavergne, 2007; Tabarestani, 2013).

Pawan (2008) determines the impact of increasing shrimp import base on the Gulf of Mexico dockside shrimp price associated with increased cultured shrimp activities and concomitant increased exports to the U.S market. The analysis involved import demand equations for three countries that account for most of shrimp imports: United States of America, Japan and European Union. The export supply equations were developed for the three major warm-water shrimp producing regions –Asia, South America, and Central America in addition to an inverse demand equation associated with U.S Gulf of Mexico shrimp production. Their results reveal that the increased cultured production from the three regions has had a significant impact on the Gulf of Mexico dockside price. More specifically, the results show that the Gulf of Mexico dockside price is expected to decline by approximately 3.5% for every 10% increase in Asian production of cultured shrimp. The results also show that a 10% increase in South

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[2] Fish can be categorized based on so many aspects (specie, method of production, market destination etc.). For example, sea foods are classified as fish and shellfish. Yet, different species of sea food are normally caught from different environment (i.e., farmed fish versus non-farmed fish).The non-farmed fish can also be classified into deep sea or coastal water fish. In addition fish preferences vary across categories of consumers and fish is also differentiated according to market destinations. Although effects of all these factors/variations would be important to understand in assessing market sensitivity to changes in the sector, disaggregated data to this detail has not always been available (Johnson, 2007).

American cultured shrimp production leads to a 2.2% decline in the dockside price. A similar effect was found with Central American Cultured shrimp.

Tabarestani (2013) estimates the effect of US. Shrimp imports on the Gulf of Mexico dock side price using a source differentiated mixed demand model. The analysis considers China, Ecuador, India, Indonesia, Mexico, Thailand, Vietnam, and a final category which includes all other exporting countries. The result of this analysis reveal that all own-price elasticities of regular demand are negative, implying an inverse relation between the quantity of imports from a selected country and its price of imports. Cross price elasticities of regular demand are positive which means that the price of a selected country's shrimp products have a direct effect on the quantity of other country's shrimp exports. The income elasticities for inverse demand represent the gulf dockside price sensitivities relative to a change in U.S expenditures on shrimp. These results mean that if U.S. expenditure on shrimp products increases by 1%, the gulf large, medium, and small size shrimp prices will increase by 0.12%, 0.15%, and 0.19%, respectively.

Zhou, (2008) estimates demand for shrimp in the United States using an Almost Ideal Demand System. The paper estimates the demand for shrimp together with beef, pork, and chicken to predict supply strategies, consumer preferences and policy making. Their results had insignificant slope coefficients and inappropriate signs which do not comply with microeconomic theory. The authors attribute the anomaly in their results to heteroscedasticity and autocorrelation in the data used. An additional source of problem with their results is that estimating the demand for shrimp together with beef, pork and chicken would not allow the assumption of separability since beef, pork, chicken and shrimp are more likely not to be separable group of foods.

To the best our knowledge, the existing literature does not provide information on the seafood/ shrimp consumer behavior in the face of price variations. Therefore, this study contributes to the current literature through providing estimates of demand elasticities for seafood including shrimp, catfish, crawfish, codfish, flounder, Pollock, salmon, scallop, tilapia, and whiting. The measurement of income and price elasticities is important for the design of many policies. Determination of indirect taxes and subsidies for taxable commodities and services is one of their useful application. By using AC Nielsen scanner consumption data from four metropolitan areas in Texas: Houston, Dallas, San Antonio and West Texas, this paper provides i) estimates of the expenditure elasticity of demand for each of the fish species, the compensated and uncompensated demand elasticities. ii) Estimate the impact of location (demographics) on the demand for fish in Texas by considering four metropolitan areas: Houston, Dallas, San Antonio, and West Texas.

I. Review of Related Literature

Earlier demand models often used a single –equation approach. The problem with such estimations is that they do not conform to demand theory. With a single –equation approach to demand estimation, the demand cannot be estimated to empirically conform to the properties of a true demand function such as homogeneity of degree zero, symmetry and adding up. In addition, econometrically single –equation demand estimation are not efficient since they do not make use of the possible correlation between errors from different equations for a given observation

(Greene, 2012, Pg.295). Consequently, more recent empirical researches are more focused on system specifications. Such systems were pioneered by Stone's Linear Expenditure System (1954). Subsequent models include: the Rotterdam demand model by Theil (1965), the S-branch demand model by Brown and Heien (1972), the translog demand model by Christensen et al. (1975) and the Almost Ideal demand system (AIDS) model by Deaton and Muellbauer (1980). Recent modifications of the Almost Ideal Demand System include the Liner Approximation (LA-AIDS) and the quadratic Almost Ideal Demand model (QUAIDs).

The Linear Expenditure System (LES) is derived from maximization of a utility function of the form $V(q) = \pi(q_k - \gamma_k)^{\beta_k}$ (1) subject to a budget constraint $\varphi(x, p) = (x - \sum p_k \gamma_k) / \pi p_k^{\beta k}$ (2) which yields the linear expenditure: $p_i q_i = p_i \gamma_i + \beta_i (x - \sum p_k \gamma_k)$ (3) where $\sum p_k \gamma_k$ are the minimum required quantities or subsistence quantities and $(x - \sum p_k \gamma_k)$ is total outlay divided in a constant pattern between commodities. p_i is the price of the i^{th} good. The advantage of using this demand system is the small number of parameters to be estimated given by 2n where n is the number of parameters to be estimated. However, this is only because of the restrictive nature of the demand system. For example, this system assumes that inferiority can only occur for goods with β_i negative but this violates the assumption of concavity. If this violation is allowed, then goods end up having positive price elasticities. Also, if concavity is to hold, no two goods can be complements, that is, all goods must be substitutes for every other good. This model also has a property of approximate proportionality between price and expenditure elasticities. These restrictions, limit the linear expenditure system models' application to only situations where these limitations do not cause serious issues.

The Rotterdam model proposed by Theil (1965) and Barten (1966) can be derived from budget shares.

$w_i d\log q_i = b_i d\log \overline{X} + \sum_{j=1}^{n} c_{ij} d\log p_j$ (4) Where $b_i = w_i e_i$ and $c_{ij} = w_i \eta_{ij}^{*}$. w_i Is a budget share for good *i*, e_i is the income elasticity and η_{ij}^{*} is the compensated cross price elasticity between good i and goods j. The Rotterdam model has ability to model the whole substitution matrix. This model also allows for demand restrictions to be imposed while estimating the parameter estimates.

The translog model is one of the most popular flexible functional forms for estimating demand systems. The basic method followed in generating these flexible functional forms is the approximation of the direct utility function, the indirect utility function or the cost function by some specific functional form that has enough parameters to be regarded as a reasonable approximation to whatever the true unknown function may be.

Deaton and Muellbauer (1980) suggest the Almost Ideal Demand system as a more flexible model as it gives arbitrary first-order approximation to any demand system; it satisfies the axioms of choice exactly; it aggregates perfectly over consumers without invoking parallel linear Engel curves; it has a functional form which is consistent with known household –budget data; it is simple to estimate, essentially avoiding the need for non-linear estimation and; it can be used to test the restrictions of homogeneity and symmetry through linear restrictions on fixed parameters (Deaton and Muellbauer, 1992. pg.73) Thus modelling the AIDs has attracted great attention. However, Olorunfemi (2012) notes that the linearity of budget shares in the logarithm of consumption expenditure makes it a very restrictive model. He also argues that the AIDs model is locally flexible as it does not put a priori restrictions on the possible elasticities at any point. Consequently, this local inflexibility often exhibits small regular region, consistent with microeconomic theory. As a result, more flexible functional forms with larger regular regions have been developed. Such models include the Quadratic AIDs model (QUAIDS)

II. Conceptual Framework

The analysis in this paper uses the Almost Ideal Demand system of Deaton and Muellbauer (1980a, b). The model is derived from a specific class of preferences known as the Price Independent Generalized Logarithmic preferences (PIGLOG). These preferences are represented through a cost (expenditure) function which defines the minimum expenditure necessary to attain a specific utility level at given prices. The expenditure function is of the form:

$$\ln e(p,u) = a(p) + ub(p) \quad (5)$$

Where: $a(p) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j$ (6)

$$b(p) = \beta_0 \underset{i=1}{\overset{n}{\pi}} p_i^{\beta_i} \quad (7)$$

The utility in the expenditure function is a function of expenditure and prices:

$$u = \frac{\ln x - \ln P}{\beta_0 \underset{i=1}{\overset{n}{\pi}} p_i^{\beta_i}} \quad (8)$$

Where $\ln P = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2}\sum \gamma_{ij} \ln P_i \ln p_j$ (9)

The derivative of an expenditure function with respect to any price yields a demand function and after all the substitutions, the Almost Ideal Demand Estimation becomes:

$$w_i = \alpha_i + \sum \gamma_{ij} \ln p_j + \beta_i \ln\left(\frac{x}{p}\right) \quad (10)$$

Where X is total expenditure on the group of goods being analyzed, P_j is the price of the j^{th} good within the group, w_i is the share of total expenditure allocated to the i^{th} good and P is the price index for the group which is defined as

$$\ln P = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln P_i \ln p_j \quad (11)$$

Modifications of this model include the Linear Approximate AIDs (LA-AIDs model) and the Quadratic form of the AIDs model. Greene and Alston (1990) note that the price index of the full AIDs model is often difficult to estimate and it is common to use Stone's price index (P^*) instead of P. $\ln P^* = \sum_k w_k \ln p_k$ (12). The Model that uses stones' index is called the linear approximate AIDS[3].

III. Data

The AC Nielsen Scanner data used in this analysis contains ten fish species: Shrimp, Catfish, Crawfish, codfish, flounder, Pollock, salmon, scallop, tilapia, and whiting. The total sales for each fish species are an aggregate value for the different products under each fish species. A total of 260 four weeks aggregate observations for consumer purchases and value of fish species from 2006 to 2010 are used in this analysis. The data is for four metropolitan areas: Houston, Dallas, San Antonio and West Texas.

The summary statistics of the variables used in this analysis is provided in table 1. These statistics show that on average, salmon is the most expensive fish species selling for \$8.65/lb, followed scallop, selling at \$8.03/lb. Whiting is the least expensive fish selling for \$1.92/lb,

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[3] Green and Alston (1990) Argues that is prices are highly collinear, P may be approximately proportional to P^* (see Green and Alston for more details)

followed by pollock selling for $2.55/lb. In terms of budget share, on average, shrimp has the highest share of the budget with 78% of the budget being allocated to shrimp consumption. On average, codfish, flounder, pollock, scallop and whiting have the smallest budget share of 1%.

Table 1. Descriptive/summary statistics of variables used in the Econometric Analysis

Fish specie	No. of Obs.	Price ($/lb) $[p_i]$	Log price $[\ln p_i]$	Expenditure $[p_i * q_i]$	Expenditure Share $[w_i]$
Shrimp	260	5.86 *(0.68)*	1.76 *(0.11)*	793602.00 *(521896.98)*	0.78 *(0.12)*
Catfish	260	3.09 *(0.85)*	1.10 *(0.25)*	16499.81 *(16882.21)*	0.02 *(0.01)*
Crawfish	260	8.11 *(0.76)*	2.09 *(0.10)*	32450.39 *(33973.47)*	0.03 *(0.02)*
Codfish	260	6.80 *(1.69)*	1.89 *(0.24)*	12120.87 *(8236.54)*	0.01 *(0.01)*
Flounder	260	4.30 *(1.16)*	1.42 *(0.27)*	8677.30 *(7745.39)*	0.01 *(0.01)*
Pollock	260	2.55 *(0.39)*	0.92 *(0.16)*	6439.41 *(5197.03)*	0.01 *(0.01)*
Salmon	260	8.65 *(2.63)*	2.11 *(0.31)*	49622.24 *(41713.25)*	0.05 *(0.03)*
Scallop	260	8.03 *(1.41)*	2.06 *(0.21)*	12563.51 *(10898.57)*	0.01 *(0.01)*
Tilapia	260	4.09 *(1.07)*	1.38 *(0.23)*	78058.44 *(68249.25)*	0.08 *(0.07)*
Whiting	260	1.92 *(0.32)*	0.64 *(0.17)*	9507.27 *(6150.19)*	0.01 *(0.01)*
		Mean Values of other Explanatory Variables			
Variables			*Units*	*Mean*	
Expenditures (X)			$	1019541.23 *(642115.57)*	
Dummy Variable for Dallas				0.25	
Dummy Variable for Houston				0.25	
Dummy Variable for San Antonio				0.25	
Dummy Variable for West Texas				0.25	

Note: Values in parentheses are standard deviations.

Empirical Application:

Demand systems are consistent with the assumptions of utility maximization if they satisfy the homogeneity, and symmetry restrictions. The test for the appropriateness of the model for the analysis in this paper is based on the results of the test for restrictions of the various demand systems as listed in table 2. Unfortunately, the restrictions do not hold in any of the four models tested.

Table 2: Test for Demand restrictions in the Linear Expenditure, Rotterdam Model Liner Approximate AIDs and the Full AIDs Model

Model	***Restriction tested***	***Restriction***	***Statistic***	***Pr>ChiSq.***	***Conclusion***
Linear Expenditure	*Adding-up*	$\sum b_i = 1$	*398.75*	*<0.0001*	*Reject Ho.*
Rotterdam Model	*Symmetry Homogeneity*	$C_{ij} = C_{ji}$,	*263.48*	*<0.0001*	*Reject Ho.*
LA-AIDs	*Homogeneity Adding up symmetry*	$\sum c_{ij} = 0$ $\sum a_i = 1$		*<0.0001*	*Reject Ho.*
Full AIDs	*Homogeneity Add-up symmetry*	$\sum c_{ij} = 0$ $C_{ij} = C_{ji}$ $\sum b_i = 1$,	*1357.1*	*<0.0001*	*Reject Ho.*

For this data set, the restrictions do not hold in any of the four models tested. Attfield (1985) notes that the failure for the restrictions to hold may be attributed to the endogeneity of prices and expenditure in demand systems.

The expenditure, compensated and uncompensated price elasticities of the AIDs model are estimated using the expressions given in table 3.

Table 3: Expenditure, uncompensated and compensated elasticities of the AIDs model

Elasticity	***Estimation***
Expenditure Elasticity	$e_i = \frac{\beta_i}{w_i} + 1$
Uncompensated price elasticity	$\eta_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{\beta_i \alpha_j}{w_i} - \frac{\beta_i}{w_i} \sum_k \gamma_{kj} \ln P_k$
Compensated price elasticities	$\eta^*_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{\beta_i \alpha_j}{w_i} - \frac{\beta_i}{w_i} \sum_k \gamma_{kj} \ln P_k + \frac{\beta_i}{w_i} + 1$

Note: compensated elasticities are calculated using the Slutsky: $\eta^*_{ij} = \eta_{ij} + w_j e_i$

The first of the estimated demand equation in the AIDs system is specified as.

$$w_i = \alpha_i + \sum \gamma_{ij} \ln p_j + \beta_i \ln\left(\frac{x}{p}\right) \text{(from 10)}$$

Where $\ln P = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln P_i \ln p_j$. Fish species 1, 2,3,4,5,6,7,8,9,10 are shrimp, catfish, Crawfish, codfish, flounder, Pollock, salmon, scallop, tilapia, and whiting respectively.

IV. Results and Discussion

This section is organized as follows: The first section presents the parameter estimates of the AIDS model, the second section presents the compensated and uncompensated elasticities calculated using the Full AIDs model. Finally, results comparing the elasticities estimated using the different estimation procedures are presented.

Table 4: Parameter estimates of the FULL AIDS model:

Fish	α_i	γ_{i1}	γ_{i2}	γ_{i3}	γ_{i4}	γ_{i5}	γ_{i6}	γ_{i7}	γ_{i8}	γ_{i9}	γ_{i10}	β_i
Shrimp	1.0121a	-0.4171a	0.0530a	0.0332a	0.0342a	0.0067b	0.0220a	0.0695a	0.0159a	0.1641a	0.0192a	-0.0115
(w1)	(0.1181)	(0.0519)	(0.0061)	(0.0096)	(0.0035)	(0.0033)	(0.0022)	(0.0137)	(0.0043)	(0.0281)	(0.0024)	(0.0099)
Catfish	-0.0059		-0.0084a	0.0050c	0.0009	0.0023b	-0.0067a	-0.0190a	0.0032c	-0.0192a	-0.0116a	-0.0003
(w2)	(0.0125)		(0.0024)	(0.0026)	(0.0012)	(0.0011)	(0.0009)	(0.0022)	(0.0016)	(0.0031)	(0.0009)	(0.0011)
Crawfish	-0.0965a			-0.0244a	-0.0124a	0.0031	-0.0015	0.0197a	-0.0015	-0.0280a	0.0068a	0.0105a
(w3)	(0.0179)			(0.0069)	(0.0025)	(0.0020)	(0.0020)	(0.0036)	(0.0027)	(0.0044)	(0.0022)	(0.0015)
Codfish	-0.0047				0.0047a	0.0020b	-0.0024b	-0.0081a	-0.0037a	-0.0098a	-0.0054a	0.0012b
(w4)	(0.0068)				(0.0018)	(0.0010)	(0.0010)	(0.0016)	(0.0014)	(0.0017)	(0.0010)	(0.0006)
Flounder	-0.0525a					0.0047a	-0.0100a	-0.0069a	0.0072a	-0.0038b	-0.0052a	0.0039a
(w5)	(0.0064)					(0.0011)	(0.0008)	(0.0013)	(0.0011)	(0.0016)	(0.0008)	(0.0005)
Pollock	0.0500a						0.0001	0.0063a	-0.0003	-0.0053a	-0.0023	-0.0046a
(w6)	0.0051						(0.0014)	(0.0010)	(0.0010)	(0.0011)	(0.0012)	(0.0004)
Salmon	0.0013							-0.0112b	-0.0099a	-0.0466a	0.0062a	0.0023
(w7)	0.0277							(0.0051)	(0.0018)	(0.0063)	(0.0011)	(0.0024)
Scallop	-0.0144c								-0.0001	-0.0105a	-0.0004	0.0026a
(w8)	0.0086								(0.0023)	(0.0022)	(0.0011)	(0.0007)
Tilapia	0.0427									-0.0349b	-0.0061a	0.0022
(w9)	0.0705									(0.0173)	(0.0012)	(0.0059)
Whiting	0.0680a										-0.0019	-0.0063a
(w10)	0.0059										(0.0017)	(0.0004)

Note a, b and c denote significance level at 1%, 5% and 10% respectively. Values in parentheses are standard errors.

The parameter estimates of the Full AIDs model are presented in table 4. The parameter estimates were estimated from a system of share equations with the restrictions of symmetry, Homogeneity and adding up imposed. 51 out of the 65 AIDs model parameter estimates are statistically significant. The own price coefficient of shrimp in the shrimp equation of -0.4171 means that a one percent increase in the price of shrimp reduces the allocated budget share for shrimp by 0.41 dollars. In the catfish equation, the coefficient estimate of -0.0084 means that a one percent increase in the price of catfish causes a reduction in the budget share for cat fish by 0.0084 dollars. For codfish and flounder fish, and one percent increase in the price increases the expenditure share 0.0047 dollars.

Tables 5 and 6 present the results of expenditure, the uncompensated, and compensated price elasticities. The expenditure elasticities are all positive and statistically significant at 1 % level of significance, indicating that all fish species are normal goods. These elasticities also reveal that consumers in these four metropolitan areas consider crawfish, codfish, flounder, salmon, scallop, and tilapia as luxury products; while shrimp, catfish, Pollock, and whiting are necessity foods. Among the luxury fish, flounder has the largest expenditure elasticity of 1.5073. This elasticity means that a one percent increase in the income of Texans, increases their flounder fish consumption by 1.51%. Among the necessary fish species whiting is the least affected by income changes with an expenditure elasticity of 0.4305.

Table 5 shows the uncompensated price elasticities. All uncompensated own price elasticities have the expected negative signs and are statistically significant at the one percent level of significance. Fish species with absolute own price elasticities greater that unity are more price responsive while those with own price elasticities less than one are less price responsive. These elasticities in table 5 show that craw fish is the most price elastic fish species in that a 1 percent increase in the price of crawfish reduces its demand by 1.87%. This is followed by shrimp for which demand falls by 1.53%. For crawfish, shrimp, catfish, tilapia, salmon whiting, and scallop, the demand is elastic while codfish, flounder and Pollock have inelastic demands. A policy implication for these results is that any price policy aiming at increasing the price of the fish species with the elastic demands will hurt consumers of those species, as they will be forced to cut down on consumption of those products.

Table 6 shows the compensated price elasticities. All the compensated Own price elasticities have the expected negative signs, which confirms the inverse relationship between demands and prices. The compensated price elasticities are smaller than the uncompensated price elasticities in magnitude as would be expected due to the income effect. Here, crawfish, catfish, tilapia, salmon, and whiting are highly price responsive with compensated own price elasticities of -1.835, -1.438, -1.370, -1.186, and -1.104, respectively.

Table 5: Uncompensated Elasticities of the Full Aids Model.

Fish	*Expenditure Elasticity*	*1)*	*2)*	*3)*	*4)*	*5)*	*6)*	*7)*	*8)*	*9)*	*10)*
Shrimp	0.9852a	**-1.5227a**	0.0685a	0.0413a	0.0440a	0.0080b	0.0293a	0.0896a	0.0192a	0.2117a	0.0259a
	(0.0127)	**(0.0644)**	(0.0078)	(0.0118)	(0.0044)	(0.0041)	(0.0028)	(0.0175)	(0.0054)	(0.0360)	(0.0030)
Catfish	0.9849a	3.0390a	**-1.4548a**	0.2843b	0.0508	0.1308b	-0.3815a	-1.0812a	0.1826b	-1.0920a	-0.9929a
	(0.0602)	(0.3322)	**(0.1338)**	(0.1448)	(0.0688)	(0.0601)	(0.0490)	(0.1281)	(0.0882)	(0.1772)	(0.0525)
Crawfish	1.3931a	0.8774a	0.1794b	**-1.8719a**	-0.4634a	0.1297c	-0.0794	0.7277a	-0.0476	-1.0650a	0.2198a
	(0.0550)	(0.3255)	(0.0945)	**(0.2551)**	(0.0930)	(0.0744)	(0.0764)	(0.1315)	(0.1017)	(0.1564)	(0.0810)
Codfish	1.0939a	2.6484a	0.0694	-0.9842a	**-0.6245a**	0.1628b	-0.1993b	-0.6476a	-0.2964a	-0.7857a	-0.4368a
	(0.0451)	(0.2583)	(0.0964)	(0.1993)	**(0.1407)**	(0.0771)	(0.0809)	(0.1271)	(0.1075)	(0.1336)	(0.0841)
Flounder	1.5073a	0.4057	0.2918b	0.4515c	0.2617b	**-0.3664b**	-1.3412a	-0.9150a	0.9509a	-0.5176b	-0.7288a
	(0.0678)	(0.3912)	(0.1377)	(0.2612)	(0.1262)	**(0.1443)**	(0.1039)	(0.1720)	(0.1477)	(0.2092)	(0.1092)
Pollock	0.4305a	3.2379a	-0.8142a	-0.2365	-0.2990b	-1.2531a	**-0.9511a**	0.7895a	-0.0450	-0.6226a	-0.2365
	(0.0440)	(0.2484)	(0.1056)	(0.2520)	(0.1244)	(0.0975)	**(0.1679)**	(0.1238)	(0.1255)	(0.1266)	(0.1448)
Salmon	1.0477a	1.4111a	-0.3981a	0.4171a	-0.1692a	-0.1413a	0.1296a	**-1.2356a**	-0.2053a	-0.9794a	0.1253a
	(0.0492)	(0.2705)	(0.0467)	(0.0737)	(0.0332)	(0.0274)	(0.0209)	**(0.1067)**	(0.0378)	(0.1323)	(0.0221)
Scallop	1.2190a	1.0548a	0.2620b	-0.1016	-0.3095a	0.6052a	-0.0365	-0.8216a	**-1.0065a**	-0.8789a	0.0134
	(0.0595)	(0.3326)	(0.1283)	(0.2264)	(0.1116)	(0.0936)	(0.0847)	(0.1507)	**(0.1869)**	(0.1806)	(0.0910)
Tilapia	1.0282a	2.0816a	-0.2466a	-0.3572a	-0.1255a	-0.0473b	-0.0696a	-0.5996a	-0.1338a	**-1.4498a**	-0.0805a
	(0.0756)	(0.3541)	(0.0399)	(0.0541)	(0.0215)	(0.0206)	(0.0132)	(0.0815)	(0.0280)	**(0.2222)**	(0.0141)
Whiting	0.4813a	2.0600a	-0.9496a	0.5093a	-0.4431a	-0.4513a	-0.1588	0.5187a	0.0219	-0.4756a	**-1.1097a**
	(0.0320)	(0.1767)	(0.0757)	(0.1785)	(0.0866)	(0.0686)	(0.0969)	(0.0875)	(0.0903)	(0.0904)	**(0.1457)**

Note a, b, and c denote levels of significance at 1%, 5% and 10%, respectively. Values in parentheses are standard errors.

The uncompensated and compensated cross price elasticities are the off-diagonal values of the price elasticity matrix presented in tables 5 and 6. The main diagonal elements are the own price elasticities. The interpretations of substitution among fish products are based on the compensated elasticity matrix given in table 6. From the shrimp equation elasticities, the results show that shrimp has no complements, all other fish are substitutes (weak substitutes). From the catfish equation, catfish has four complements: pollock, salmon, tilapia and whiting. Among these, salmon is the strongest complement with an elasticity of -1.0342, followed by tilapia with an elasticity of 1.0153. Among all these fish species, tilapia has the largest number of complements (8); with the exception of shrimp, all other fish are complements for tilapia.

Table 7 presents the expenditure elasticities, uncompensated and compensated own price elasticities calculated using the Linear Expenditure , Rotterdam, LA/AIDs and full AIDs demand systems. Columns (1), (4), (7), and (10) are the expenditure elasticities for the LES, Rotterdam, LA/AIDs and Full AIDs model respectively. Columns (2), (5), (8), (11) contain the uncompensated elasticities for the LES, Rotterdam, LA-AIDs and Full AIDs, respectively, and columns (3), (6), (9), (12) contain the compensated own price elasticities for the LES, Rotterdam, LA-AIDs and Full AIDs model, respectively. The purpose of this table is compare the estimates of elasticities calculated with the different approaches since the test for restrictions did not support any of the models. A comparison of the expenditure elasticities given in columns (1), (4), (7), and (10) shows that expenditure elasticity estimates of the Linear expenditure system and the Rotterdam system are quite similar but different from the results under the LA-AIDs and Full AIDs.

Table 6: Compensated Elasticities of the Full AIDs Model.

Fish	*Expenditure Elasticity*	*1)*	*2)*	*3)*	*4)*	*5)*	*6)*	*7)*	*8)*	*9)*	*10)*
Shrimp	0.9852a	**-0.7565a**	0.0857a	0.0677a	0.0563a	0.0155a	0.0373a	0.1366a	0.0310a	0.2884a	0.0379a
(w1)	0.0127	**0.0658**	0.0078	0.0118	0.0044	0.0041	0.0028	0.0173	0.0054	0.0359	0.0029
Catfish	0.9849a	3.8049a	**-1.4375a**	0.3107b	0.0631	0.1384c	-0.3735a	-1.0342a	0.1944b	-1.0153a	-0.6509a
(w2)	0.0602	0.3448	**0.1338**	0.1445	0.0688	0.0600	0.0490	0.1270	0.0882	0.1767	0.0524
Crawfish	1.3931a	1.9608a	0.2039b	**-1.8346a**	-0.4459a	0.1404c	-0.0681	0.7942a	-0.0308	-0.9565a	0.2367a
(w3)	0.0550	0.3409	0.0945	**0.2548**	0.0930	0.0744	0.0764	0.1304	0.1017	(0.1560)	0.0808
Codfish	1.0939a	3.2402a	0.0827	-0.9638a	**-0.6108a**	0.1686b	-0.1931b	-0.6113a	-0.2872a	-0.7265a	-0.4276a
(w4)	0.0451	0.2711	0.0964	0.1991	**0.1408**	0.0771	0.0808	0.1263	0.1074	0.1333	0.0839
Flounder	1.5073a	1.5779a	0.3182b	0.4919c	0.2806	**-0.3549b**	-1.3289a	-0.8431a	0.9690a	-0.4002c	-0.7105a
(w5)	0.0678	0.4117	0.1377	0.2609	0.1262	**0.1443**	0.1038	0.1706	0.1476	0.2089	0.1090
Pollock	0.4305a	3.1968a	-0.8154c	-0.2379	-0.2997b	-1.2535a	**-0.9476a**	0.7870a	-0.0456	-0.6232a	-0.2371
(w6)	0.0440	0.2642	0.1057	0.2518	0.1245	0.0976	**0.1679**	0.1229	0.1255	0.1266	0.1446
Salmon	1.0477a	2.2258a	-0.3797a	0.4451a	-0.1351a	0.8572a	0.1382a	**-1.1856a**	-0.1927a	-0.8978	0.1380a
(w7)	0.0492	0.2820	0.0466	0.0733	0.0331	0.0273	0.0209	**0.1057**	0.0378	0.1317	0.0221
Scallop	1.2190a	1.9523a	0.2822b	-0.0707	-0.2951a	0.6142a	-0.0271	-0.7665	**-0.9918a**	-0.7890a	0.0274
(w8)	0.0595	0.3499	0.1284	0.2261	0.1116	0.0936	0.0847	0.1496	**0.1867**	0.1804	0.0909
Tilapia	1.0282a	2.8812a	-0.2286a	-0.3296a	-0.1127a	-0.0395c	-0.0612a	-0.5505a	-0.1214	**-1.3697a**	-0.0680a
(w9)	0.0756	0.3585	0.0398	0.0537	0.0214	0.0205	0.0132	0.0807	0.0279	**0.2215**	0.0141
Whiting	0.4813a	2.4343a	-0.9411	0.5222a	-0.4371a	-0.4476a	-0.1549	0.5416a	0.0277	-0.4382	**-1.1038**
(w10)	0.0320	0.1885	0.0758	0.1785	0.0866	0.0686	0.0969	0.0869	0.0903	0.0902	**0.1455**

Note a, b, and c denote levels of significance at 1%, 5% and 10%, respectively. Values in parentheses are standard errors.

Table 7: A comparison with other demand system estimations: The LES, Rotterdam Model and LA-AIDS

Commodity	Liner Expenditure System			Rotterdam Demand System			Liner-Approximation of the Almost Ideal Demand System			Full-Almost Ideal Demand System		
Fish	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
Shrimp	1.0674a	-1.0693a	-0.2393a	1.0781a	-1.1365a	-0.2982a	0.9750a	-1.5189a	-0.5440a	0.9852a	-1.5227a	-0.7565a
	(0.0104)	(0.0130)	(0.0082)	(0.0113)	(0.0356)	(0.0368)	(0.0129)	(0.0637)	(0.0653)	(0.0127)	(0.0644)	(0.0658)
Catfish	0.6620a	-0.8697a	-0.8581a	0.6702a	-0.9001a	-0.8883a	1.0089a	-1.4894a	-0.4805a	0.9849a	-1.4548a	-1.4375a
	(0.0636)	(0.0962)	(0.0753)	(0.0854)	(0.1619)	(0.1620)	(0.0618)	(0.1331)	(0.1481)	(0.0602)	(0.1338)	(0.1338)
Crawfish	1.1488a	-14955a	-1.4647a	0.9298a	-1.3288a	-1.3039a	1.3940a	-1.8477a	-0.4537a	1.3931a	-1.8719a	-1.8346a
	(0.0800)	(0.0986)	(0.0973)	(0.0840)	(0.3274)	(0.3267)	(0.0554)	(0.2556)	(0.2504)	(0.0550)	(0.2551)	(0.2548)
Codfish	0.6365a	-0.8371a	-0.8292a	0.8664a	-1.1163a	-1.1055a	1.1185a	-0.5993a	0.5193a	1.0939a	-0.6245a	-0.6108a
	(0.0356)	(0.0448)	(0.0446)	(0.0900)	(0.2303)	(0.2304)	(0.0457)	(0.1431)	(0.1550)	(0.0451)	(0.1407)	(0.1408)
Flounder	0.8839a	-1.1608a	-1.1541a	1.0027a	-0.1836	-0.1760	1.5198a	-0.2913b	1.2285a	1.5073a	-0.3664a	-0.3549b
	(0.0541)	(0.0438)	(0.0437)	(0.1361)	(0.2799)	(0.2801)	(0.0692)	(0.1435)	(0.1577)	(0.0678)	(0.1443)	(0.1443)
Pollock	0.2795a	-0.3671a	-0.3648a	0.4235a	-0.4084	-0.4050	0.4901a	-1.0264a	-0.5362a	0.4305a	-0.9511a	-0.9476a
	(0.0283)	(0.0347)	(0.0345)	(0.1164)	(0.2959)	(0.2959)	(0.4901)	(0.1625)	(0.1605)	(0.0440)	(0.1679)	(0.1679)
Salmon	0.7538a	-0.9900a	-0.9541a	0.7468a	-0.9315a	-0.8959a	1.0590a	-1.2113a	-0.1524	1.0477a	-1.2356a	-1.1856a
	(0.0528)	(0.0545)	(0.0532)	(0.0727)	0.1408)	(0.1397)	(0.0501)	(0.1056)	(0.0958)	(0.0492)	(0.1067)	(0.1057)
Scallop	0.8117a	-1.0682a	-0.0585a	1.0012a	-1.4500a	-1.4380a	1.2045a	-1.0346a	0.1699	1.2190a	-1.0065a	-0.9918a
	(0.0542)	(0.0916)	(0.0912)	(0.1028)	(0.2046)	(0.2045)	(0.0600)	(0.1811)	(0.1767)	(0.0595)	(0.1869)	(0.1867)
Tilapia	0.8017a	-1.0551a	-0.9927a	0.6687a	-0.6180a	-0.5660a	1.1027a	-1.4838a	-0.4522b	1.0280a	-1.4498a	-1.3697a
	(0.0512)	(0.0675)	(0.0654)	(0.0573)	(0.1127)	(0.1121)	(0.0768)	(0.2199)	(0.2198)	(0.0756)	(0.2222)	(0.2215)
Whiting	0.1985a	-0.2611a	-0.2587a	0.3487a	0.2722	0.2764	0.5207a	-1.1641a	-0.6434a	0.4813a	-1.1097	-1.1038a
	(0.0299)	(0.0387)	(0.0384)	(0.0808)	0.4459	(0.4458)	(0.0264)	(0.1281)	(0.1204)	(0.0320)	(0.1457)	(0.1455)

Note a, b, and c denote levels of significance at 1%, 5% and 10%, respectively. Values in parentheses are standard errors. Columns (1), (4), (7), and (10) are the expenditure elasticities for the LES, Rotterdam, LA/AIDs and Full AIDs model, respectively. Columns (2), (5), (8), (11) contain the uncompensated elasticities for the LES, Rotterdam, LA/AIDs and Full AIDs respectively and columns (3), (6), (9), (12) contain the compensated own price elasticities for the LES, Rotterdam, LQA/AIDs and Full AIDs model, respectively.

Under the Linear expenditure system, all fish are normal goods but shrimp and craw fish are luxury goods. With the Rotterdam model, all fish are normal goods but shrimp, Flounder, and scallop are luxury. With the LA-AIDs all fish are normal goods but catfish, crawfish, codfish, flounder, salmon, scallop, and tilapia are luxury. The full AIDS also reports all fish as being normal goods but crawfish, codfish, Flounder, salmon scallop and tilapia are a luxury.

V. Conclusion

Based on the results obtained in this analysis, shrimp is highly price sensitive. This is partly attributed to the finding that consumers view other fish as substitutes for shrimp. Therefore policies causing shrimp price alterations are likely to be more welfare distorting since shrimp is more price sensitive than any other seafood studied. It has also been established that all fish products are normal at least in the range of the data analyzed.

Further research could investigate the estimation of elasticities while accounting for the endogeneity of prices and expenditure since it is highly probable the SUR estimation might suffer from simultaneity bias. The panel data used in this analysis was collected from four metropolitan areas in Texas: Dallas, Houston, San Antonio and West Texas, and investigation of the difference in price responses across these different metropolitan areas would give beneficial information and guide policy makers to develop appropriate policies that can accommodate the variations in the different areas of the state.

Simultaneous equation bias is a possibility in the estimation of demand systems. It has been argued by many authors (for example: Dhar et.al. (2003), Walter (1986)) that prices and expenditures in demand systems are endogenous. The price endogeneity is as a result of the possibility that purchase decisions are based on the decisions of suppliers. The expenditure endogeneity is mainly a problem in household level analyses where the analyses do not cover all the products and services that a household purchases. Since this paper is working with aggregate data, it has been assumed that issues of endogeneity with expenditure do not arise.

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Annexes:

Annex1: Regression Coefficients for the simple Rotterdam model estimation (no restrictions)

Fish Type	β_i	c_{i1}	c_{i2}	c_{i3}	c_{i4}	c_{i5}	c_{i6}	c_{i7}	c_{i8}	c_{i9}	c_{i10}	R^2
Shrimp	0.851*** (0.010)	-0.290*** (0.051)	0.037* (0.021)	0.036 (0.047)	0.092** (0.029)	0.066*** (0.024)	0.051* (0.030)	-0.029 (0.028)	-0.004 (0.021)	0.101*** (0.029)	-0.097** (0.037)	0.9765
Catfish	0.0092*** (0.002)	0.012*** (0.008)	-0.023*** (0.003)	0.008 (0.007)	-0.015*** (0.005)	-0.007* (0.004)	0.0003 (0.005)	-0097** (0.004)	0.005* (0.003)	-0.020*** (0.005)	0.006 (0.006)	0.4417
Crawfish	0.023*** (0.003)	0.034*** (0.012)	0.009* (0.005)	-0.036*** (0.011)	-0.029*** (0.007)	0.003 (0.006)	-0.010 (0.007)	0.045*** (0.007)	0007 (0.005)	-0.012* (0.007)	0.026*** (0.0088)	0.4973
Codfish	0.010*** (0.0010)	0.021*** (0.005)	-0.003 (0.002)	-0.008* (0.005)	-0.020*** (0.003)	-0.002 (0.002)	0.001 (0.003)	0.001 (0.003)	-0.002 (0.002)	-0.003 (0.003)	0.004 (0.004)	0.4611
Flounder	0.007*** (0.001)	0.007 (0.004)	-0.0003 (0.002)	-0.007* (0.004)	-0.002 (0.003)	-0.005** (0.002)	-0.004 (0.003)	-0.003 (0.002)	0.001 (0.002)we	0.007*** 0.003)	0.004* (0.003)	0.3308
Pollock	0.003*** (0.001)	0.009** (0.005)	-0.007*** (0.002)	-0.007* (0.004)	-0.001 (0.003)	-0.018*** (0.002)	-0.006** (0.003)	0.008*** (0.003)	0.002 (0.002)	-0.008*** (0.003)	-0.007** (0.003)	0.5794
Salmon	0.035*** (0.004)	0.049*** (0.019)	0.009 (0.008)	0.003 (0.018)	-0.038*** (0.011)	-0.005 (0.009)	-0.022** (0.011)	-0.021** (0.010)	0.006 (0.008)	-0.028** (0.011)	0.026* (0.014)	0.3968
Scallop	0.013*** (0.002)	0.034*** (0.006)	-0.004 (0.003)	-0.012** (0.006)	0.006* (0.004)	0.005* (0.003)	0.001 (0.004)	-0.007** (0.003)	-0.018*** (0.003)	0.004 (0.004)	0.008* (0.004)	0.4389
Tilapia	0.045*** (0.005)	0.136*** (0.025)	-0.012 (0.011)	0.025 (0.023)	-0.004 (0.015)	-0.035*** (0.012)	-0.013 (0.015)	0.018 (0.014)	0.006 0.010	-0.037** (0.015)	0.051*** (0.019)	0.4754
Whiting	0.004*** (0.001)	0.006 (0.005)	-0.010*** (0.002)	-0.006 (0.004)	0.001 (0.003)	-0.014*** (0.002)	-0.005* (0.003)	0.006** (0.003)	0.001 (0.002)	-0.004 (0.003)	-0.014*** (0.003)	0.5518

Note: values in parentheses are standard errors. ***, **, and * denote level of significance at the 1%, 5% and 10%.

Annex 2: Rotterdam Estimates given Symmetry and Homogeneity

Fish Type	β_i	c_{i1}	c_{i2}	c_{i3}	c_{i4}	c_{i5}	c_{i6}	c_{i7}	c_{i8}	c_{i9}	c_{i10}
Shrimp	0.833*** (0.009)	**-0.310*** (0.034)**	0.043*** (0.006)	0.027*** (0.010)	0.030*** (0.005)	0.012** (0.005)	0.025*** (0.004)	0.042*** (0.013)	0.020*** (0.005)	0.118*** (0.016)	-0.007 (0.007)
Catfish	0.012*** (0.002)	0.043*** (0.006)	**-0.017*** (0.003)**	0.006* (0.003)	-0.005** (0.002)	0.000 (0.002)	-0.003* (0.002)	-0.007** (0.003)	-0.002 (0.002)	-0.016*** (0.004)	0.001 (0.003)
Crawfish	0.025*** (0.003)	0.027*** (0.010)	0.006* (0.003)	**-0.044*** (0.008)**	-0.010*** (0.003)	-0.004 (0.003)	-0.004 (0.003)	0.029 (0.005)	-0.003 (0.003)	-0.010* (0.005)	0.012** (0.005)
Codfish	0.011*** (0.001)	0.030*** (0.030)	-0.005** (0.002)	-0.010*** (0.003)	**-0.012*** (0.003)**	0.002 (0.002)	0.003 (0.002)	-0.005 (0.003)	-0.002 (0.002)	-0.004 (0.003)	0.003 (0.003)
Flounder	0.008*** (0.001)	0.012** (0.005)	0.000 (0.002)	-0.004 (0.003)	0.002 (0.002)	**-0.001 (0.003)**	-0.008*** (0.002)	-0.007*** (0.003)	0.002 (0.002)	0.005* (0.003)	-0.002 (0.003)
Pollock	0.004*** (0.001)	0.025*** (0.004)	-0.003* (0.002)	-0.004 (0.003)	0.003 (0.002)	-0.008*** (0.002)	**-0.009*** (0.003)**	0.007*** (0.002)	0.003* (0.002)	-0.011*** (0.003)	-0.002 (0.003)
Salmon	0.036*** (0.004)	0.042*** (0.013)	-0.007** (0.003)	0.029*** (0.005)	-0.005* (0.003)	-0.007*** (0.003)	0.007*** (0.002)	**-0.043*** (0.007)**	-0.005* (0.003)	-0.016*** (0.006)	0.007* (0.004)
Scallop	0.012*** (0.001)	0.020*** (0.005)	-0.002 (0.002)	-0.003 (0.003)	-0.002 (0.002)	0.002 (0.002)	0.003* (0.002)	-0.005* (0.003)	**-0.017*** (0.002)**	0.002 (0.003)	0.001 (0.003)
Tilapia	0.055*** (0.005)	0.118*** (0.016)	-0.016*** (0.004)	-0.010* (0.005)	-0.004 (0.003)	0.005* (0.003)	-0.011*** (0.003)	-0.016*** (0.006)	0.002 (0.003)	**-0.070*** (0.011)**	0.001 (0.005)
Whiting	0.003 (0.002)	-0.007 (0.007)	0.001 (0.003)	0.012** (0.005)	0.003 (0.003)	-0.002 (0.003)	-0.002 (0.003)	0.007* (0.004)	0.001 (0.003)	0.001 (0.005)	**-0.014** (0.006)**

Note: values in parentheses are standard errors. ***, **, and * denote level of significance at the 1%, 5% and 10%.