Demand for Meat and Fish Products in Korea

Jione Jung

Graduate Student
Department of Food and Resource Economics
University of Florida
Gainesville, FL 32611
e-mail:jionej@ufl.edu

Won W. Koo

Professor
Department of Agribusiness and Applied Economics
North Dakota State University
Fargo, ND 58105
e-mail:wkoo@ndsuext.nodak.edu

Selected Paper
Annual Meeting of American Agricultural Economics Association
Long Beach, California
July 28-31, 2002

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Abstract

The Korean livestock industry is currently facing the critical challenge of the market liberalization trend under the World Trade Organization. This study analyzes the consumption behavior of meat and fish products in Korea, by estimating the Linear Approximate Almost Ideal Demand System (LA/AIDS).

The empirical results indicate that beef imports in Korea would increase in the future under trade liberalization. If cheap and better quality imported beef are introduced to Korean consumers, Hanwoo (Korean domestic cattle) beef would not maintain its market share.

Key words: Meat, fish, trade liberalization, per capita consumption, demand, separability, and price elasticity.

DEMAND FOR MEAT AND FISH PRODUCTS IN KOREA

Food consumption in Korea has changed due mainly to increased per capita income over the last two decades. Consumption patterns are shifting toward eating more meat (beef, pork, and chicken), vegetables, and fruits rather than cereals. Meat consumption has increased eight fold, from 165 thousand metric tons to 1,339 thousand metric tons over the 1970-97 period. Pork consumption increased faster than consumption of beef and chicken during this time period.

Fish products are important sources of protein in the Korean diet, and their consumption is large compared to meat products. Per capita consumption of fish products was 34.1 kg in 1997, while per capita consumption of beef, pork, and chicken combined was 25.3 kg. However, consumption of fish products has declined slightly for the 1980-98 period.

The Korean meat industry is currently facing a challenge from trade liberalization under the World Trade Organization (WTO). Imports of frozen pork and chicken were liberalized on July 1, 1997, and the Korean beef market was liberalized on January 1, 2001. The Korean fish industry is also undergoing trade liberalization. From the Asia-Pacific Economic Cooperation (APEC) agreement in 1997, nine fish commodities were liberalized in 1999, and all tariffs in fishery sector will be eliminated by 2007.

The objective of this study is to estimate consumers' behavior in the consumption of meat and fish products in Korea. Special attention is given to fish product consumption as a meat substitute because fish products are important sources of protein in Korea.

The study estimated the meat demand system in Korea using the Linear Approximate Almost Ideal Demand System (LA/AIDS). The F and Likelihood Ratio (LR) tests were used to test separability between meat and fish products. A model specification test developed by Alston and Chalfant (1993) was used to determine an appropriate demand system for Korean meat and fish products. The Hausman endogeneity test was conducted to check the endogeneity of the expenditure term.

Past studies assumed that fish products are separable from meat products, when they estimate the demand for meat products in Korea. Koo, Yang, and Lee estimated Korean meat demand, using a general switching AIDS, to evaluate structural changes in meat consumption in Korea. Kim and Sa investigated model specifications for the Korean meat demand system using the procedure developed by Alston and Chalfant. Shin analyzed the impact of beef trade liberalization in Korea and suggested that if the quality of Hanwoo beef were similar to high-quality imported beef, Hanwoo beef would lose its price competitiveness. Quality differentiation would induce consumers to pay more for Hanwoo beef than for imported beef.

Korean Meat and Fish Industries

The demand for meat products has increased from 0.4 million metric tons in 1980 to 1.3 million metric tons in1996, along with the growth in national income. Per capita consumption was 1.2 kg for beef, 2.6 kg for pork, and 1.4 kg for chicken in 1970 and increased to 7.9 kg for beef, 15.3 kg for pork, and 6.1 kg for chicken in 1997.

Among meat products, beef is the preferred meat in Korea, but pork has become more popular since it is less expensive. People in high-income groups tend to eat more beef, while low-income consumers generally choose less expensive pork. Pork consumption could decrease in the future as income increases, while beef consumption could increase.

Hanwoo (Korean domestic cattle) beef production does not meet the increasing trend of beef consumption. As a result, beef imports increased from 7 thousand metric tons in 1988 to

134 thousand metric tons in 1997. The price of Hanwoo beef is generally higher than that of imported beef. In 1997, the price of Hanwoo beef was 13,822 Won/kg, while the price of imported beef was 5,748 Won/kg.

The major exporting countries of beef to Korea are the United States and Australia. U.S. exports of beef increased from 42 thousand metric tons in 1993 to 83 thousand metric tons in 1997, while other country exports remained the same or increased slightly. Korea’s imports of other meat products, mainly pork and chicken, have been sporadic and small in quantity.

The Korean meat industry is currently facing a market liberalization trend as a result of bilateral and multilateral trade negotiations. Korea’s meat imports could increase due to commitments under the Uruguay Round of the GATT, completed in 1993. Imports of frozen pork and chicken were liberalized on July 1, 1997 and beef imports were liberalized by January 1, 2001.

Unlike meat consumption in Korea, fish consumption has decreased about 23 percent for the 1980-98 period. Per capita consumption of fish was 34.1 kg in 1997, which is about 29 percent higher than the total per capita meat consumption. The Korean fish industry is also undergoing a trade liberalization process. As a member of the Asia-Pacific Economic Cooperation (APEC), Korea is responsible for the early voluntary sectoral liberalization in its fishery sector. From the APEC agreement in 1997, nine fish commodities were liberalized in 1999, and by 2007 all tariffs in the fishery sector should be eliminated.

Empirical Model and Estimation Procedure

Meat and fish products are important sources of protein in the Korean diet, and the aggregate consumption of these products increased with increased per capita income over the

1970-98 period. Meat consumption, however, increased faster than fish consumption for the period. Meat is divided into beef, pork, and chicken. Beef is further divided into beef produced in Korea (Hanwoo beef) and imported beef. Since Korea does not import pork and chicken regularly, imported pork and chicken are not considered in this study. Fish and other seafood are categorized into three groups of products: (1) fish, which includes cod, flounder, pollack, corvinias, anchovy, mackerel, saury, and tuna; (2) crustaceans, which include shrimp and crab; and (3) mollusks, which include abalone, oyster, shell, clam, squid, and octopus.

Quarterly time series data for 1980-98 are used to estimate a theoretical demand model for the Korean meat and fish industries. Quantities of meat consumed and prices were obtained from the National Livestock Cooperative Federation in Korea. Consumption and price data for fish products came from the "Monthly Statistics on Cooperative Sales of Fishery Products" published by the National Fishery Cooperative Federation of Korea. The consumer price index, disposable income, and population are from the Korean Statistical Information System (KOSIS) published by the National Statistical Office (NSO). The sample statistics for meat and fish product expenditure share for Korea from 1980 to 1998 are summarized in Table 1.

<u>Separability Between Meat and Fish Products</u>

A concern is separability between meat and fish products in the two-stage budgeting procedure. If they are separable, it is more efficient to estimate the demand for meat products separately from the demand for fish products. On the other hand, if they are not separable, they should be estimated in one demand system. Consequently, a separability test for Korea's demand for meat and fish products (Eales and Wesells) is conducted for the specification of the demand model. Table 2 reports separability tests between meat and fish products. Both the F and LR tests reject the separability between meat and fish products. The empirical model specified for this study, therefore, includes both meat and fish products.

<u>Almost Ideal Demand System (AIDS) and Rotterdam Model</u>

Two different demand systems (AIDS and Rotterdam model) are considered to estimate meat and fish product demand in Korea. Assuming that meat and fish products are not separable, the Rotterdam model developed by Theil and Barten is specified for the Korean meat and fish industry as follows:

(1) $$\bar{w}_i \Delta \log q_i = \sum_{j=1}^{n} \gamma_{ij} \Delta \log p_j + \beta_i DQ, \qquad i = 1,2,\ldots,n,$$

where i and j are indexes for goods, q_i is the quantity demanded of the i^{th} good, and p_j is the price of j^{th} good within the group. $\bar{w}_i$ is the average of $w_{i,t}$ and $w_{i,t-1}$, budget shares of i^{th} good on time t and t-1. Δ denotes the first-difference operator ($\Delta \log q_i = \log q_{i,t} - \log q_{i,t-1}$). DQ represents the real income term.

The theoretical restrictions of adding-up, homogeneity, and symmetry are satisfied by the following parametric restrictions on the Rotterdam model.

(2) Adding-up: $$\sum_{i=1}^{n} \gamma_{ij} = 0, \qquad \sum_{i=1}^{n} \beta_i = 1.$$

Homogeneity: $$\sum_{j=1}^{n} \gamma_{ij} = 0.$$

Symmetry: $$\gamma_{ij} = \gamma_{ji}.$$

The AIDS developed by Deaton and Muellbauer is specified as

(3) $$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \log p_j + \beta_i \log(E / P)\,, \qquad i = 1,2,\ldots,n\,,$$

where w_i is the budget share of the i^{th} good, E is the total expenditure on the group of goods, and $\log P$ is the price index for the group defined as

(4) $$\log P = a_i + b_i \log p_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} c_{ij} \log p_i \log p_j\ .$$

This price index makes the system nonlinear. To make the model linear in parameters, Deaton and Muellbauer suggested using Stone’s price index defined as

(5) $$\log P^* = \sum_{i=1}^{n} w_{i,t} \log p_{i,t}\ .$$

The model which uses Stone’s price index is the *Linear Approximate* AIDS (LA/AIDS) as follows

(6) $$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \log p_j + \beta_i \log(E / P^*)\,, \qquad i = 1,2,\ldots,n\,.$$

However, using Stone's price index causes a simultaneity problem since the dependent variable w_i appears on the right-hand side of the LA/AIDS. To avoid the simultaneity problem, the lagged share has been used for P^*, as $\log P^* = \sum_i^n w_{i,t-1} \log p_{i,t}$ (Eales and Unnevehr). Equation (6) implies that the budget shares of various commodities are linearly related to the logarithm of the real total expenditure and relative prices.

The general demand restrictions of adding-up, homogeneity, and symmetry are satisfied by the following parametric restrictions on the AIDS.

(7) Adding-up: $\sum_{i=1}^{n} \alpha_i = 1, \quad \sum_{i=1}^{n} \gamma_{ij} = 0, \quad \sum_{i=1}^{n} \beta_i = 0.$

Homogeneity: $\sum_{j=1}^{n} \gamma_{ij} = 0.$

Symmetry: $\gamma_{ij} = \gamma_{ji}.$

A test procedure developed by Alston and Chalfant (1993) is used to choose between the AIDS and the Rotterdam model. The right-hand side of a first-differentiated version of the LA/AIDS is virtually identical to that of the Rotterdam model, even though the dependent variables differ. In several studies, the LA/AIDS has been estimated in the first-differentiated form (e.g., Deaton and Muellbauer, Eales and Unnevehr, Moschini and Meilke, Alston and Chalfant). In the first-differentiated form, the LA/AIDS becomes

$$\Delta w_i = \sum_{j=1}^{n} \gamma_{ij} \Delta \log p_j + \beta_i \Delta \log(E / P^*) . \tag{8}$$

The first-differentiated Stone's index, $\Delta \log P^*$ may be decomposed into three components:

(9) $$\Delta \log P^* = \sum_{j=1}^{n} w_j \cdot \Delta \log p_j + \sum_{j=1}^{n} \Delta w_j \cdot \log p_j - \sum_{j=1}^{n} \Delta w_j \cdot \Delta \log p_j \ .$$

The second and third term are likely to be quite small since, in the context of time-series data, shares usually do not change much from one observation to the next (Alston and Chalfant). Substituting the first term of $\Delta \log P^*$ from Equation (9) into the first-differentiated LA/AIDS in Equation (8) yields

(10) $$\Delta w_i \approx \sum_{j=1}^{n} \gamma_{ij} \Delta \log p_j + \beta_i [\Delta \log X - \sum_{j=1}^{n} w_j \Delta \log p_j] \ .$$

Equation (10) is similar to the Rotterdam model. Any difference is in the specification of the income term. Theil and Clements (1987) refer to *DQ* in Equation (1) as *a finite change version of the Divisia volume index* (Alston and Chalfant). It is approximately equal to

(11) $$DQ^* = \Delta \log X - \Delta \log P^\circ \ ,$$

where $\Delta \log P^\circ = \sum_{j=1}^{n} \overline{w}_j \cdot \Delta \log p_j$, which is similar to the first-differentiated Stone's price index in Equation (9). Substituting *DQ** for *DQ*, the Rotterdam model is re-specified as follows

(12) $$\overline{w}_i \Delta \log q_i = \sum_{j=1}^{n} \gamma_{ij} \Delta \log p_j + \beta_i DQ^*$$

$$= \sum_{j=1}^{n} \gamma_{ij} \Delta \log p_j + \beta_i [\Delta \log X - \sum_{j=1}^{n} \overline{w}_j \cdot \Delta \log p_j].$$

On the right-hand side, the real income terms in the first-differentiated LA/AIDS in Equation (10) differs from the Rotterdam model. The differences is the use of $\overline{w}_j$ instead of w_j in the Rotterdam model in Equation (12).

Equation (10) and (12) can be combined as

(13) $$(1-\phi)\Delta \overline{w}_i \log(q_i) + \phi \Delta w_i = \sum_{j=1}^{n} \gamma_{ij} \Delta \log(p_j) + \beta_i DQ^*, \qquad i = 1,2,\ldots,n.$$

Equation (13) is a linear combination of the LA/AIDS and the Rotterdam model. If $\phi = 0$, Equation (13) reduces to the Rotterdam model; if $\phi = 1$, Equation (13) reduces to the first-differentiated LA/AIDS. A test of the hypothesis that $\phi = 0$ can be interpreted as a test of the hypothesis that the Rotterdam model is the correct specification.

The LA/AIDS can be tested directly as well. In the alternative compound model,

(14) $$(1-\lambda)\Delta w_i + \lambda \Delta \overline{w}_i \log(q_i) = \sum_{j=1}^{n} \gamma_{ij} \Delta \log(p_j) + \beta_i \Delta \log(X / P^*)$$

$\lambda = 0$ implies that the LA/AIDS is correct while λ near 1 is evidence against the LA/AIDS in the direction of the Rotterdam model.

Both Equation (13) and Equation (14) were estimated for the Korean meat and fish products. In Equation (13), the estimated value of ϕ is 1.2193, with a standard error of 0.0829. The p-value of ϕ is 0.0001. In Equation (14), the estimated value of λ is 0.0221, with a standard error of 0.0097. The p-value of λ is 0.0237. The p-value of ϕ is less than that of λ in the test, indicating that the LA/AIDS fits better for the Korean meat and fish industry than the Rotterdam model.

Endogeneity of the Expenditure Variable

One concern is whether the expenditure variable in the model is exogenous. If the expenditure variable is exogenous, the seemingly unrelated regression (SUR) estimator is efficient for estimating parameters of the model by enforcing homogeneity and symmetric restrictions in estimation. The adding-up condition is imposed by dropping one equation in the system. When the expenditure variable in the model is endogenous, it is correlated with the random error term, so the SUR estimator is no longer an unbiased estimator (Edgerton). In this case, the three-stage least squares (3SLS) estimator is consistent for estimating the demand system. To test endogeneity of the expenditure variable, the Hausman test suggested by LaFrance was used.

The Hausman test statistic is

(15) $$m = T(\hat{\theta}^* - \hat{\theta})'[Var(\hat{\theta}^*) - Var(\hat{\theta})]^{-1}(\hat{\theta}^* - \hat{\theta}),$$

which has a chi-square distribution with degrees of freedom equal to the number of unknown parameters in θ. If m is larger than the critical value, then the null hypothesis of exogeneity is rejected.

In this study, θ is the seemingly unrelated regressions (SUR) estimator, and θ^* is the three-stage least squares (3SLS) estimator. Under the exogeneity assumption of the expenditure variable of the demand system, the SUR estimator is consistent and asymptotically efficient. If the expenditure variable is endogenous, the SUR estimator is no longer consistent or efficient, whereas the 3SLS estimator is inefficient but consistent.

The calculated values of the chi-square for all meat and fish products in the system are larger than the critical value of chi-square with 9 degrees of freedom at the 5 percent significance level. Thus, the null hypothesis that the expenditure variable is exogenous is rejected (Table 3). The result indicates that the expenditure variable in the LA/AIDS should be endogenous.

Therefore, the 3SLS estimator is used to estimate the LA/AIDS for meat and fish products in Korea. The instruments employed in the estimation are the first lags of all prices and expenditure variables, disposable income, and the consumer price index (Eales, Durham, and Wessells).

Estimation Results

Table 4 presents the 3SLS estimates of the LA/AIDS for meat and fish products in Korea using quarterly data from 1980 to 1998. The system weighted R^2 is 0.788, indicating that independent variables in the LA/AIDS explain 78.8 percent of the data variation. Prices of Hanwoo beef, pork, chicken, and fish exhibit significant effects in their corresponding equations but those of other products (imported beef, crustacean, and mollusk) are not significant. The expenditure variable is significant in the equations for imported beef, pork, and fish; but not in the share equations of Hanwoo beef, chicken, and crustacean.

In the case of the imported beef, parameters of pork and chicken prices are significant at the 5 percent level, indicating that consumption of imported beef is sensitive to the prices of pork and chicken. However, the consumption of Hanwoo beef is not sensitive to the prices of other meats.

Most of seasonal dummy variables of meat (except pork) and fish products are significant at the 5 percent level. The consumption of Hanwoo beef and imported beef increases in the spring and fall, and decreases during the winter. Pork consumption increases in the winter, but the increase is not statistically significant. The seasonality of chicken is significant at the 5 percent level, especially during the summer and fall. Fish consumption is greatest in winter.

Elasticities of Price and Expenditure

Parameter estimates of the LA/AIDS are used to calculate the price and expenditure elasticities. Price elasticity is calculated in two ways; uncompensated elasticity that contains both price and income effects, and compensated elasticity which includes only price effects.

Uncompensated and compensated price elasticities of the LA/AIDS are calculated with the following equations, respectively:

(16) $$e_{ij} = -\delta_{ij} + \frac{\hat{\gamma}_{ij}}{\overline{w}_i} - \hat{\beta}_i\left(\frac{\overline{w}_j}{\overline{w}_i}\right),$$

(17) $$e_{ij}{*} = e_{ij} + \overline{w}_j + \hat{\beta}_i\left(\frac{\overline{w}_j}{\overline{w}_i}\right) = -\delta_{ij} + \frac{\hat{\gamma}_{ij}}{\overline{w}_i} + \overline{w}_j, \qquad i, j = 1,2,\ldots,n,$$

where $\delta = 1$ for $i = j$ and $\delta = 0$ otherwise. $\overline{w}_i$ is the average expenditure share. $\hat{\beta}_i$ and $\hat{\gamma}_{ij}$ are parameter estimates. The variances of uncompensated and compensated price elasticities are calculated by applying the variance operator as

(18) $$Var(e_{ij}) = \frac{1}{\overline{w}_i^2}Var(\hat{\gamma}_{ij}) + \frac{\overline{w}_j^2}{\overline{w}_i^2}Var(\hat{\beta}_i) - 2\left(\frac{\overline{w}_j}{\overline{w}_i^2}\right)Cov(\hat{\gamma},\hat{\beta}),$$

(19) $$Var(e_{ij}*) = \frac{1}{\overline{w}_i^2}Var(\hat{\gamma}_{ij}).$$

The estimated variances are used to evaluate the statistical significance of the elasticities. The expenditure elasticity can be computed as

(20) $$\eta_i = 1 + \frac{\hat{\beta}_i}{\overline{w}_i}.$$

The variance of expenditure elasticity is

(21) $$Var(\eta_i) = \frac{1}{\overline{w}_i^2}Var(\hat{\beta}_i).$$

Table 5 shows the calculated uncompensated elasticities at the sample mean. The uncompensated own price elasticities of individual meat and fish products show a negative sign. Own-price elasticities of all meat and fish are significant at the 5 percent level. The uncompensated own-price elasticities of Hanwoo and imported beef are -1.1515 and -0.8987, respectively, indicating that beef consumption is sensitive to prices. Chicken is the most price inelastic, implying that chicken consumption is not sensitive to its price. The price elasticities of fish products range between -0.6952 and -0.8620. Expenditure elasticities for all meats are positive and statistically significant at the 5 percent significance level, implying that they are normal goods. The expenditure elasticity for imported beef is the most elastic, indicating that Korea would increase imports of beef as the country increases its expenditure for meat and fish products.

The compensated elasticities, which compensate for the income effect, are shown in Table 6. The compensated price elasticities are very similar to the uncompensated elasticities in terms of magnitude and statistical significance. Own-price elasticities of individual meat and fish products carry a negative sign. Cross-price elasticities show competitive or complementary relations among products. Positive cross-price elasticity indicates that products are substitute, while negative cross-price elasticity means that products are complements. Hanwoo beef has the competitive relationship with pork, as indicated by the positive sign and significance at the 95 percent confidence level. Hanwoo beef also has a competitive relationship with all other meat and fish products.

Cross-price elasticity of imported beef with respect to Hanwoo beef (ε_{IH} = 0.8098) is greater than that of Hanwoo beef with respect to imported beef (ε_{HI} = 0.2180). This implies that the price of imported beef does not have an influence on the consumption of Hanwoo beef, while the price of Hanwoo beef affects the consumption of imported beef. This is because consumers in Korea prefer Hanwoo beef to imported beef.

There are substitute or competitive relationships between fish products, but they are not elastic, implying that the consumption of a fish product is not sensitive to prices of other fish products. Meat has a substitute relationship with most of fish products and is statistically significant at the 5 percent significance level, indicating that the consumption of meat products is influenced by prices of fish products. However, fish products do not have a good substitute relationship with meat products, indicating that the consumption of fish is not generally sensitive to prices of meat products.

In the case of Hanwoo beef, the own-price elasticity is larger than the expenditure elasticity in terms of absolute value (ε_H =-1.1515 > η_H =1.1463), while the opposite is true for imported beef (ε_I =-0.8987 < η_I =2.2622). If price and income (expenditure for meat and fish products) change at the same time, Hanwoo beef consumption would be more affected by price than income. However, the consumption of imported beef is more sensitive to income than price of imported beef. Consumers buy imported beef when they cannot afford Hanwoo beef. This is the reason why consumers are sensitive to prices of Hanwoo beef than imported beef. Imported beef is generally consumed by a consumer group with lower income, while Hanwoo beef is consumed by a higher income group.

Summary and Conclusions

The LA/AIDS was estimated using quarterly data for the 1980-98 period. To evaluate seasonal effects on meat and fish product consumption with quarterly data, seasonal dummy variables were included in each equation. The consumption of Hanwoo beef and imported beef increases in the spring and fall and decreases during the winter. Pork consumption increases in the winter, but it is not statistically significant. Chicken consumption increases during the summer and fall. The consumption of fish products is the greatest in winter.

Uncompensated and compensated elasticities were calculated from estimated parameters of the LA/AIDS. The uncompensated and compensated price elasticities were similar in terms of magnitude and statistical significance. All own-price elasticities are negative and statistically significant. The own- price elasticity of Hanwoo beef is most elastic, followed by imported beef, mollusks, fish, pork, crustaceans, and chicken.

Expenditure elasticities for all meats are positive and significant at the 5 percent significance level. The expenditure elasticity for imported beef is the most elastic, implying that Korea will increase beef imports as the country increases its expenditure for meat and fish products.

Because of trade liberalization, meat imports in Korea will increase in the future. If per capita income continues to increase, beef imports would also increase since Korean consumers prefer beef to other meat, and Hanwoo beef is more expensive than imported beef. The price of Hanwoo beef is generally two times higher than that of imported beef. Consumers in Korea are willing to pay a premium for Hanwoo beef because they prefer Hanwoo beef to imported beef. However, if cheap and better quality imported beef were introduced to Korean consumers, Hanwoo beef would not be able to maintain market share in Korea.

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Table 1. Summary Statistics for Meat and Fish Products Expenditure Shares of Korea: 1980-98

	Hanwoo	I-Beef	Pork	Chicken	Fish	Crust.	Mollusk.
Mean	0.264	0.065	0.362	0.072	0.162	0.015	0.060
St. Dv.	0.055	0.049	0.035	0.013	0.035	0.007	0.018
Min	0.168	0.000	0.270	0.049	0.093	0.005	0.028
Max	0.424	0.158	0.450	0.097	0.244	0.033	0.110

Table 2. F- and LR Tests for Separability

Separability	Calculated Value	DF*		Critical Value (α =.05)
		DF1	DF2	
F				
Meat vs. Fish Products	11.050	3	63	3.15
Likelihood Ratio				
Meat vs. Fish Products	1649.384	10		18.307

* DF denotes Degree of Freedom.

Table 3. Endogeneity Test of the Expenditure Variable

	Calculated Test Statistics	DF*	Critical Value (α = 0.05)
Hanwoo Beef	1821.224	9	16.919
Imported Beef	34.603	9	16.919
Pork	126.967	9	16.919
Chicken	2078.976	9	16.919
Fish	83.557	9	16.919
Crustacean	261.119	9	16.919
System	4406.447	54	72.136

* DF denotes Degree of Freedom.

Table 4. Parameter Estimates of the LA/AIDS using Quarterly Data

	Hanwoo	I-Beef	Pork	Chicken	Fish	Crust.	Mollusk
Hanwoo	-0.0295 (-0.630)						
I-Beef	0.0385 (1.537)	0.0133 (0.686)					
Pork	-0.0065 (-0.288)	-0.0362 (-2.623)*	0.1178 (6.304)*				
Chicken	-0.0094 (-1.506)	-0.0098 (-2.298)*	-0.0279 (-6.896)*	0.0485 (10.210)*			
Fish	0.0103 (0.532)	-0.0098 (-0.846)	-0.0258 (-2.303)*	0.0017 (0.444)	0.0034 (0.250)		
Crust.	0.0112 (2.871)*	-0.0058 (-2.242)*	-0.0061 (-2.604)*	0.0009 (0.488)	-0.0017 (-0.713)	0.0031 (2.304)*	
Mollusk	-0.0146 (-1.111)	0.0098 (1.199)	-0.0153 (-1.847)	-0.0040 (-1.925)*	0.0218 (3.187)*	-0.0016 (-1.183)	0.0039
Exp.	0.0380 (0.896)	0.0884 (3.067)*	0.0696 (2.505)*	0.0013 (1.720)	-0.1313 (-5.201)*	0.0066 (1.427)	-0.0725
Spring	0.0487 (3.431)*	0.0105 (1.245)	0.0033 (0.349)	0.0030 (1.601)	-0.0359 (-5.016)*	-0.0124 (-10.584)*	
Summer	0.0261 (1.852)	0.0118 (1.424)	0.0157 (1.690)	0.0200 (11.387)*	-0.0538 (-7.882)*	0.0063 (5.730)*	
Fall	0.0463 (3.579)*	0.0179 (2.292)*	0.0024 (0.268)	0.0215 (13.208)*	-0.0552 (-8.800)*	-0.0050 (-4.843)*	
System	Weighted R^2 = .788						

* Denotes significance at the 5 percent level, and t-ratios are in the parentheses.

Table 5. Uncompensated Elasticities of Korean Meat and Fish Products: 1980-98

	HAN	IB	PK	CH	FS	CR	MO	EXP
HAN	-1.1515*	0.1378	-0.0778	-0.0463	0.0164	0.0416	-0.0649	1.1463*
	(0.1867)	(0.0922)	(0.0975)	(0.0253)	(0.0908)	(0.0152)	(0.0532)	(0.1632)
IB	0.2216	-0.8987*	-0.9713	-0.2277	-0.3416	-0.0959	0.0638	2.2622*
	(0.3980)	(0.2611)	(0.2301)	(0.0626)	(0.2087)	(0.0376)	(0.1217)	(0.4115)
PK	-0.0684	-0.1140	-0.7424*	-0.0911	-0.1025	-0.0187	-0.0542	1.1933*
	(0.0671)	(0.0365)	(0.0546)	(0.0122)	(0.0392)	(0.0066)	(0.0244)	(0.0772)
CH	-0.1387	-0.1406	-0.4054	-0.3078*	0.0209	0.0125	-0.0586	1.0179*
	(0.0984)	(0.0576)	(0.0620)	(0.0666)	(0.0644)	(0.0261)	(0.0311)	(0.1045)
FS	0.2780	-0.0036	0.1345	0.0678	-0.8474*	-0.0026	0.1857	0.1794
	(0.1221)	(0.0682)	(0.0830)	(0.0251)	(0.1048)	(0.0153)	(0.0440)	(0.1578)
CR	0.9480	-0.6288	-0.8412	0.0427	-0.2772	-0.6952*	-0.1971	1.6552*
	(0.4272)	(0.2458)	(0.2385)	(0.1790)	(0.2876)	(0.1360)	(0.1390)	(0.4590)
MO	0.0708	0.2474	0.1792	0.0174	0.5571	-0.0142	-0.8620	-0.2077

*Denotes significance at the 5 percent level, and standard errors are in parentheses.

Table 6. Compensated Elasticities of Korean Meat and Fish Products: 1980-98

	HAN	IB	PK	CH	FS	CR	MO
HAN	-0.8535*	0.2180*	0.3349*	0.0339	0.1998*	0.0530*	0.0039
	(0.1801)	(0.0963)	(0.0874)	(0.0240)	(0.0748)	(0.0150)	(0.0505)
IB	0.8098	-0.7403*	-0.1569	-0.0693	0.0204	-0.0733	0.1996
	(0.3577)	(0.2766)	(0.1971)	(0.0606)	(0.1650)	(0.0371)	(0.1164)
PK	0.2419	-0.0305	-0.3128*	-0.0076	0.0885*	-0.0068	0.0174
	(0.0631)	(0.0383)	(0.0519)	(0.0112)	(0.0311)	(0.0065)	(0.0231)
CH	0.1260	-0.0693	-0.0389	-0.2365*	0.1837*	0.0227	0.0024
	(0.0890)	(0.0606)	(0.0578)	(0.0679)	(0.0535)	(0.0259)	(0.0299)
FS	0.3246	0.0089	0.1991	0.0804	-0.8187*	-0.0008	0.1964*
	(0.1215)	(0.0722)	(0.0699)	(0.0234)	(0.0853)	(0.0151)	(0.0428)
CR	1.3784	-0.5129	-0.2453	0.1586	-0.0124	-0.6786*	-0.0978
	(0.3896)	(0.2600)	(0.2324)	(0.1814)	(0.2417)	(0.1353)	(0.1334)
MO	0.0168	0.2328	0.1044	0.0029	0.5239	-0.0163	-0.8745

*Denotes significance at the 5 percent level, and standard errors are in parentheses.