Has Country of Origin Labeling Influenced Salmon Consumption?

Shawn Wozniak
Department of Agribusiness, Applied Economics & Agriscience Education
N.C. A&T State University
A–18 C.H. Moore Agricultural Research Station
1601 E. Market St., Greensboro, NC 27411
Phone: (301) 525-7480
E-mail: swozniak@ncat.edu

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N.C. A&T State University
swozniak@ncat.edu

Abstract

Country-of-Origin Labeling (COOL) legislation for fish and shellfish was passed as part of the Farm Security and Rural Investment Act of 2002. Farm-raised and wild-caught seafood items caught after December 4, 2004, began COOL in April 4, 2005. COOL requires retailers to display the country of origin on seafood. Using a nonlinear AIDS model the demand for 3 salmon products was estimate--precooked, uncooked fresh, and uncooked frozen. COOL had no significant impact on consumer demand for the three products. The 3 salmon products were all found to be inelastic, but uncooked fresh was found to be more price sensitive than precooked and uncooked frozen salmon.

Introduction

The 2002 Farm Bill intended that grocery stores identify certain commodities—beef, pork, lamb, fish and shellfish, fruits and vegetables, and peanuts—by country of origin. This provision also proposed that an initial voluntary program be followed by a mandatory program by September 30, 2004. The Farm Security and Rural Investment Act of 2002 (2002 Farm Bill) and the 2002 Supplemental Appropriations Act (Appropriations Act) were designed to amend the Agricultural Marketing Act of 1946 (Act) to require retailers to notify their customers of the country of origin of covered commodities beginning September 30, 2004.

The law required the Department of Agriculture (USDA) to issue regulations to implement a mandatory country of origin labeling (COOL) program not later than September 30, 2004. For much of the 2002 Farm Bill the final ruling was tied up in negotiations. As a result, COOL was implemented only for fish and shellfish. Farm-raised and wild-caught seafood items caught after December 4, 2004, began COOL in April 4, 2005. The Senate decided to delay the COOL rule, and as a result, the final ruling on the other commodities was not made. However, the 2008 Farm Bill also requires that COOL be reinstated.

The 2008 Farm Bill adapted the same laws and same commodities considered in the 2002 Farm Bill with minor expansions. Notable inclusions, not considered in the previous Farm Bill were goat meat, poultry, and macadamia nuts. On January 15, 2009 the USDA

Agricultural Marketing Service published a final rule for all covered commodities combined (74FR2658) which became effective on March 16, 2009 (USDA, AMS, 2009).

COOL mandates that retailers distinguish between wild-caught and farm-raised seafood in addition to the country labeling. Record-keeping under COOL is extensive for all involved in the production, processing, transport and sale of fish. Under COOL, "fish farmers" must keep records of hatchings, brood stocks, receiving records, purchase records, and more (USDA-AMS "Farm Raised Fish" 2009). Slaughterers, processers and distributors must also keep records related to receiving, purchase, quality control, and more. Commercial fishermen must keep similar records as fish farmers, as well as site maps and their U.S. flagged vessel ID (USDA-AMS "Wild Fish" 2009). The USDA Agricultural Marketing Service has a list of required documentation under COOL.

Economic theory suggests that COOL can confer both costs and benefits to buyers and sellers. When markets are performing as expected, COOL does not change consumer's willingness to purchase the product because sellers will voluntarily provide labels if consumers are willing to pay for their costs, causing COOL to be reflected in the consumer demand. Since COOL was implemented only for seafood in April 2005, it is the only commodity for which data reflecting consumer response to its implementation is available. The objective of this paper is to evaluate the influence of COOL on consumer demand for 3 groups of salmon products.

The next section presents an overview of the salmon industry. The section after that describes connection between the Tariff Act of 1930 and COOL. Next is a description of how the data was compiled. This is followed by a description of the nonlinear almost ideal demand system model. This is followed by the empirical results and discussion. Summary and concluding remarks close the paper.

Salmon Industry Overview

Salmon is the fourth most traded fishery product in the world, representing 11 percent of trade value. Growth in salmon trade is driven by increased aquaculture in the Americas and Europe (FAO 2009). Aquaculture has increased demand and consumption worldwide for salmon since the 1980s due to a steady availability throughout the year (FAO 2009). Farmed salmon has increased in market share relative to wild-caught salmon and the decreasing price (FAO 2007). The average world price for salmon fell from $6.10/kilogram to $3.20/kg from 1988 to 2004. Salmon is one of the top 5 species groups for aquaculture in the world. 55.6 percent of the world's farmed salmon comes from Western Europe, mainly in the north (FAO 2007). It has eclipsed shrimp as the top aquaculture species group produced in Latin America and the Caribbean (FAO 2009). Norway is the largest producer of farmed salmon, with 33 percent of the world's production, followed by Chile with 31 percent (FAO 2009).

The United States farm-level sales from aquaculture totaled over $672 million (NASS 2005). Salmon aquaculture represents only 6.1 percent of commercial aquaculture for food fish production in the U.S., totaling over $41 million in farm-level sales. Farm-raised salmon sold for an average of $1.81 per pound at the farm-level (NASS 2007). Domestic production of salmon filets and steaks is second to Alaskan pollock, with almost 71 million pounds produced (NMFS 2008).

The United States is third in per capita consumption of seafood, behind Japan and China. The United States per capita consumption of seafood products was 16 pounds in 2008, and increase from 15.2 pounds in 1998 (NFI 2009) with per capita consumption of all fillets and steaks growing from 3 pounds in 1996 to a record 5.2 pounds in 2006, before dropping to 4.8 pounds in 2008.

Salmon was third among per capita seafood consumption in the United States in 2008 with 1.84 pounds per person, trailing shrimp which ha with 4.10 pounds per person and canned tuna was next with 2.80 pounds. This is a decrease from 2.36 pounds/person in 2007, but an increase from 1.58 pounds in 1998. Salmon is ranked first among finish, with 36.5 percent dollar share of supermarket finfish sales (Seafood Business 2009).

Most fresh or frozen Pacific salmon sold in the U.S. is caught wild. Alaska, Washington, Oregon, California, and freshwater introductions of Chinook and Coho to Michigan are the states where wild Pacific salmon are caught. Alaska leads all states with over 290,000 tonnes in 2008, down from 390,000 tonnes in 2007 (NMFS 2009). Washington is second with 7,000 tonnes, down from 11,800 tonnes in 2006.

Imports of fresh or frozen Pacific salmon varieties have decreased since the start of the study period, from just over 16,000 tonnes in 1998 to 5,400 in 2008. Pacific salmon landings have fluctuated wildly. They decreased from 370,500 tonnes in 1998 to as low as 41,900 tonnes in 2004 before increasing again to almost 299,000 in 2008. At the same time, exports have been steadily increasing, going from 60,800 in 1998 to 111,000 in 2008.

The U.S. has imported a limited and decreasing amount of wild Atlantic salmon in recent years, dropping from 566 tonnes in 1999 to 54 tonnes in 2008 (USITC 2009). Imports of Atlantic salmon have grown from 48,000 tonnes in 1998 to almost 83,000 tonnes in 2008. The trade deficit in Atlantic salmon has grown from $462 million in 1998 to over $1.3 billion in 2008 (NMFS 2009). Atlantic salmon is primarily imported as farmed salmon from countries such as Norway and Chile. Overfishing has reduced their numbers drastically, and the U.S Fisheries and Wildlife Service has listed them as endangered in many rivers in Maine since 2000 (USFWS 2009).

The Nexus between the Tariff Act of 1930 and COOL

COOL requires suppliers and retailers to incur the costs for labeling, record-keeping and operations. A 2003 USDA AMS report estimated these costs could be anywhere from $582 million to $3.9 billion for a procedure that does not alter the composition of the actual product (Federal Register 2003). Advocates claimed consumers would benefit from this knowledge. Opponents argued the labeling was trade restricting and designed to imply foreign products’ inferiority to U.S. products, and that government oversight at the retail level would be expensive (Becker 2001). They also pointed to possible higher food prices through increased costs incurred because of new labor, and the increased paperwork and materials needed to convey COOL information to consumers.

Section 304 of the Tariff Act of 1930, as amended (19 U.S.C. 1304), generally provides that every article of foreign origin imported into the United States shall be marked to indicate to the ultimate purchaser in the United States the country of origin of the article. Generally, the country of origin of a good is the country in which the good is wholly manufactured, produced or grown. Further work or material added to an article in another country must effect a "substantial transformation" to render such other country the country of origin. Country of origin means that the labels on the imported products must have the following form "Product of Z", where Z is the name of the name of the country of origin. Imported bulk products, such as carcasses, carcass parts, or large containers of meat, fish or poultry parts destined for U.S. plants for further processing also must bear country-of-origin marks. The Tariff Act expressly states that "ultimate purchaser" must be aware of its country of origin.

The U.S. Customs Service administers and enforces the Tariff Act. They define the "ultimate purchaser" as the last U.S. person who will receive the article in the form in which it was imported. For items imported as retail-ready packages, the U.S. consumer is the ultimate purchaser. However, items imported in bulk and destined for transformation by a processor or manufacturer, will be considered ultimately purchased by the processor or manufacturer. As a result, the Tariff Act does not, in all cases, ensure that the final consumer is aware of the country of origin.

Also, section 304 of the Tariff Act requires that, if products are sold loosely at random weight from a container in a supermarket, their "immediate containers" have country-of-origin labels. However, the loosely sold products themselves are not required to be marked to indicate their origin. Only if those products are wrapped in cellophane or otherwise packaged, is the label required.

The U.S Department of Agriculture, Agriculture Marketing Service (AMS) administers COOL. COOL supplements the Tariff Act by providing additional information about country of origin to the final consumer. It requires retailers to inform consumers of the country of origin at the final point of sale for farm-raised fish and shellfish; and wild fish and shellfish. Country of origin labeling rules outlines the requirements for labeling and recordkeeping for retailers and suppliers. The rule prescribes specific criteria that must be met for a commodity to bear a "United States Country of Origin" declaration. The rule also contains provisions for labeling covered commodities of foreign origin. It provides explicit information on what must be labeled, as well as the distinction between exclusive U.S. origin products and foreign products. It also provides information on the food service establishments that are exemptions from the COOL requirements, as well as the types of processed food items that are not covered by the legislation.

Products not covered under COOL are those that undergo some form of transformation which alters the character of the commodity so as to render the commodity different from the original material used in the transformation (U.S. Customs and Border Protection 2008). Breading, smoking, and curing are examples of transformation done to commodities that preclude them from being considered under COOL.

Data

The data consist of U.S random weight purchases of salmon from 1998-2006, using the Neilsen Homescan panel dataset. Salmon was divided into three mutually exclusive categories based on the type of preparation and the method of purchase—pre-cooked refrigerated, uncooked fresh or chilled, and uncooked frozen. These three preparations were sold at four locations within the store, a clerk-attended counter, a self-serve refrigerated cooler, and a self-serve frozen cooler. Fresh and frozen salmon can be sold as steaks, fillets or whole, while pre-cooked salmon is often sold smoked or as lox/gravlax. Steaks are recommended to be no less than 2.5 ounces (0.16 pound), while there are no specifications for fillet size.

Panel sizes for the Nielsen data has increased from 1998 to 2006 by nearly 9,000 households participated. Data was available from 1998 to 2006, when Nielsen ceased to differentiate random weight seafood purchases. The dataset included 63,284 different purchases of random weight salmon. To avoid excessive missing data and to obtain a uniform time series, household purchases were aggregated weekly, obtaining a total quantity purchased for each week and an average unit weekly purchase price for each category of salmon. Partial weeks 0 and 53 were dropped from the observations, and COOL implementation was established week 15 of 2005, the first full week after April 4. The Nielsen data did not contain country-of-origin information after April 4, 2005, so a dummy variable took the value 1 during week 15 of 2005 and after. Figure 1 shows the weekly share of expenditure for precooked, uncooked fresh and uncooked frozen salmon from 1998-2006. Table 1 shows the descriptive statistics of the three salmon categories.

Model

The system estimated is conditional on total salmon expenditure. There is a two stage budgeting scenario; U.S demand for salmon and U.S. demand for a variety of salmon products. In the first scenario, I maintain that U.S. consumers allocate total expenditure among groups of goods, and that those preferences are blockwise or weakly separable (Barten 1977; Seale 1992). Having allocated expenditure on all goods, which includes salmon, U.S. consumers further allocate salmon expenditure among cooked, uncooked fresh and uncooked frozen salmon. As such, all three categories can be evaluated as a system.

The nonlinear Almost Ideal Demand System (AIDS) model of Deaton and Muellbauer (1980) was employed to analyze demand changes in salmon after the implementation of COOL. The AIDS model gives the share equations in a three good system as

$$w_{it} = \alpha_i + \sum_j \gamma_{ij} \ln p_{ij} + \beta_i \ln(X / P) + e_{it}, \qquad \textbf{(1)}$$

where w_i is the share associated with i salmon category, p_i is the price of good i, X is the total expenditure on salmon, α_i, γ_i, and β_i are parameters, e is an error term, and P is the translog price index defined by

$$\ln P = \alpha_0 + \sum_{i=1} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1} \sum_{j=1} \gamma_{ij} \ln p_i \ln p_j \qquad \textbf{(2)}$$

Consistency with utility maximization requires that the parameters satisfy the following restrictions on the nonlinear AIDS model:

$$\sum_i \alpha_i = 1; \sum_i \beta_i = 0; \sum_i \gamma_{ij} = 0, \ \forall \ i; \qquad \textbf{(3)}$$

where homogeneity is satisfied if and only if, for all i $\sum_j \gamma_{ij} = 0; \forall j$ and symmetry is satisfied if $\gamma_{ij} = \gamma_{ji}$, $\forall$ i and j. Homogeneity and symmetry were imposed in the model. In this analysis I tested for the effect of structural stability since the implementation of country of origin labeling. Given the above cross equation restrictions, if structural change exist it will likely be a system-wide phenomenon, affecting all equations simultaneously. This involved specifying and estimating an augmented equation. Following Moschini and Meilke (1989) and (Klonaris (2001) the augmented equation is expressed as

$$w_{it} = \alpha_i + \phi_i c_t + \sum_j (\gamma_{ij} + \delta_{ij} c) \ln p_j + (\beta_i + \delta_i c) \ln(X / P) + e_{it}, \qquad \textbf{(4)}$$

Again, consistency with utility maximization requires the additional parametric restrictions of homogeneity, adding up and symmetry:

$$\sum_i \phi_i = 0; \sum_i \delta_{ij} = 0; \sum_i \delta_i = 0 \ \forall \ i; \ \delta_{ij} = \delta_{ji}, \ \forall \ i. \qquad \textbf{(5)}$$

The stability tests that $\phi = 0$ and $\delta = 0$ are tests for no structural change. Because the COOL implementation period is clearly defined, the time path c_t is approximated by a vector whose elements are 0 prior to the implementation of COOL and 1 thereafter, thus allowing for the implementation of the Chow test for structural change. I argue that the effect of the legislation may occur over an extended period since some retailers may choose to begin preparation for, and adoption of, the law prior to it taking effect, while others will not adopt the law until after it takes full effect. Also, information to consumers is not perfect and as the law takes effect it is expected that more and more consumers will become aware of it and respond accordingly. Hence, the first breakpoint for the structural change process may take place prior to the law as well as it could take place well after the law was implemented. I chose breakpoints at 8 week intervals, beginning 24 weeks prior to the implementation of COOL and ending 24 weeks after its implementation.

Preliminary tests of the data indicated first order autocorrelation in the means and variances of uncooked fresh and uncooked frozen salmon. As a result, the final model is expressed as the first difference of the logs as:

$$\Delta w_{it} = \alpha_i + \phi_i \Delta c_t + \sum_j (\gamma_{ij} + \delta_{ij} c) \Delta \ln p_j + (\beta_i + \delta_i c) \Delta \ln(X / P) + e_{it},$$

where Δ is the first difference operator.

Own-price, cross-price, and expenditure elasticities, η are calculated for each product-specific demand following Chalfant (1987).

$$\eta_{i,j} = \frac{\left(\gamma_{ij} - \beta_i \left[w_j - \beta_j \ln \frac{x}{p} \right]\right)}{w_i} - \varphi_{i,j}, \qquad \textbf{(6)}$$

where $\varphi_{i,j} = 1$ if i=j, =0 otherwise. (Own and cross-price elasticities of demand) and,

(6) $\eta_i = 1 + \frac{\beta_i}{w_i}$, the expenditure elasticity (7)

Empirical Results and Discussion

The parameter estimates from the iterative seemingly unrelated regression AIDS model for salmon products are presented in table 2. Homogeneity, symmetry and adding up restrictions consistent with the theoretical properties of demand systems are imposed. Singularity is avoided by dropping the uncooked frozen salmon equation and recovering it at the end from the adding up conditions.

Price-effect parameters relating to precooked refrigerated salmon and uncooked fresh salmon are statistically significant at the 1-percent level. Expenditure effect parameters are not statistically significant for precooked refrigerated salmon and uncooked fresh salmon. COOL had no statistically significant effect on precooked and uncooked salmon consumption.

The Marshallian (uncompensated) and expenditure elasticities at the variable means are presented in table 3. The price-elasticity estimates are conditional on expenditures for salmon products being constant. Consistent with demand theory, own-price elasticity coefficients are all negative and statistically significant. The own-price elasticities for precooked salmon, uncooked fresh, and uncooked frozen are -0.540, -0.934, and -0.641, respectively. Though they were all found to be inelastic, uncooked fresh which could be considered the higher quality product (Muhammad, Jones and Hahn 2007, Smith et al. 1968 and Wheeler et al 1990) was found to be more price sensitive than precooked and uncooked frozen salmon.

The cross-price elasticities express competitive relationships between and among products. The cross-price elasticities between uncooked fresh salmon and the other 2 salmon products are negative, suggesting complementarity. Complementarity relationships, though not normal and expected, have been found within and between meats (Yang and Koo, 1994; Wahl, Hayes, and Williams, 1991 and Hayes, Wahl and Williams, 1990). However, complementarity within product demand may occur when both products are jointly demanded to satisfy different market segments (Hahn, et al. 1990). This may be the case for the salmon products where one product may be used to satisfy the fresh or chilled market while the other is used to satisfy the processed market. Positive cross-price elasticities between precooked and uncooked frozen suggest that they substitute for each other in the salmon complex.

All expenditure elasticities are positive and statistically significant, suggesting normal goods. The expenditure elasticities for precooked salmon, uncooked fresh and uncooked frozen salmon were 0.936, 0.997, and 1.079, respectively. Interestingly, all the salmon products were found to show near unitary response to expenditure.

Table 4 shows the results of the Chow tests for structural breaks. Chow tests were conducted at 8 week interval 24 weeks prior to, and 24 weeks after COOL went into effect. The results show that the Chow tests were statistically insignificant for all of the potential break points, suggesting that the events surrounding COOL did not affect the consumer demand structure for salmon.

Summary and Conclusions

A full information maximum likelihood nonlinear AIDS 3-equation model was specified to estimate consumer demand for salmon and to ascertain if there are any sign of structural instability since country of origin labeling was implemented.

Estimated parameters and coefficients were consistent with demand theory. Own price elasticities suggest that higher quality uncooked fresh salmon was more sensitive to price changes than precooked or uncooked frozen salmon the period of study. Expenditure elasticities were positive and all statistically significant, suggesting normal goods. Uncooked fresh salmon was found to be expenditure elastic, while precooked and uncooked frozen salmon were found to be expenditure inelastic.

The paper also evaluated the impact of COOL on the consumption of salmon. The findings suggest that COOL had no significant effect on precooked and uncooked consumption. A comprehensive evaluation of structural stability for the system-wide model was done using a series of Chow tests to check for structural change in some or all of the parameters of a model 24 weeks prior to, and 24 weeks after, COOL suggests stable consumer demands. This implies that COOL has not significantly affected the way consumers purchase salmon products. This is consistent with the findings of Jones, Somwaru, Whitaker (2009) who found no structural change in trade of fish since the implementation of COOL.

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Table 1. Descriptive Statistics on U.S. Random Weight Consumption of Salmon

Variable	Mean	Std Dev	Minimum	Maximum
Precooked				
Share(% expenditure)	3.7	2.6	0.1	18.8
Price ($ per lb)	9.65	3.95	0.98	30.51
Quantity (lbs)	4.21	2.96	0.14	17.13
Uncooked Fresh				
Share(% expenditure)	90.3	4.5	55.8	97.8
Price ($ per lb)	5.68	1.00	4.15	9.51
Quantity (lbs)	176.30	63.97	30.63	385.15
Uncooked Frozen				
Share(% expenditure)	6.1	3.7	0.4	43.2
Price ($ per lb)	4.65	1.24	0.97	9.07
Quantity (lbs)	14.28	10.12	0.55	142.05

Table 2. Parameter estimates from the nonlinear almost ideal demand system salmon products

Parameter[a]	Parameter estimate	Standard Error	t-value
Intercepts			
α_1	0.0159	0.0292	0.55
α_2	0.0169	0.0552	0.31
α_3	0.9672	0.0532	18.18***
Price effects			
γ_{11}	0.0168	0.0031	5.38***
$\gamma_{12} = \gamma_{21}$	-0.0261	0.0045	-5.86***
$\gamma_{13} = \gamma_{11-}\gamma_{12}$	0.0093	0.0038	2.42***
γ_{22}	0.0572	0.0115	4.99***
$\gamma_{23} = \gamma_{12} - \gamma_{22}$	-0.0311	0.0099	-3.14***
γ_{33}	0.0219	0.0098	2.23**
Expenditure effects			
β_1	-0.0023	0.0042	-0.56
β_2	-0.0024	0.0080	-0.30
COOL effects			
ϕ_1	0.0004	0.0039	0.11
ϕ_2	0.0003	0.0064	0.04
DW_1= 1.81			
DW_2= 1.70			

Parameter subscripts denote: 1=Precooked; 2=Uncooked Fresh; 3=Uncooked Frozen
**Significance level < 0.05
***Significance level < 0.01

Table 3. Estimated Marshallian Price and Income Elasticities for Salmon

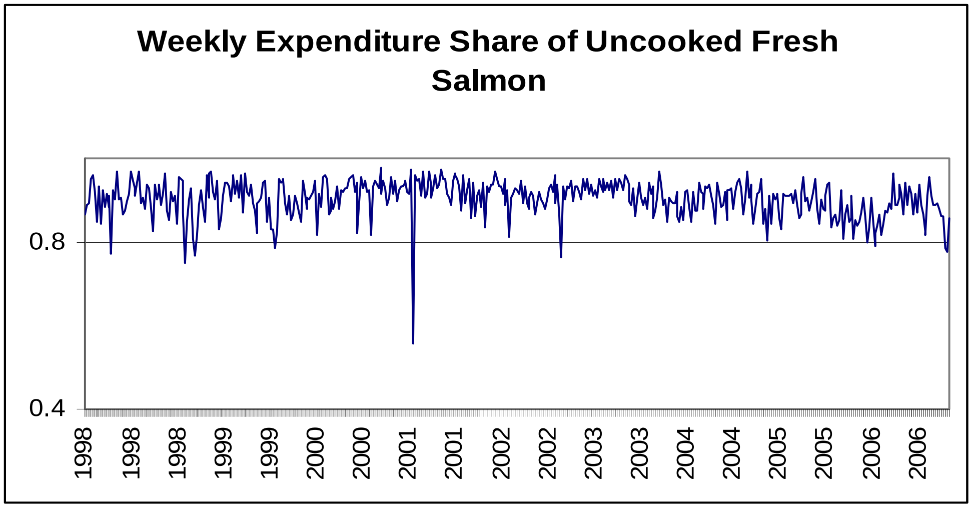
	Precooked	Uncooked Fresh	Uncooked Frozen	Expenditure Elasticity
Precooked	**-0.540**	-0.651	0.254	0.9362
	(0.086)***	(-0.184)***	(0.103)***	(0.115)***
Uncooked Fresh	-0.029	**-0.934**	-0.034	0.9973
	(0.005)***	**(0.019)***	(0.012)***	(0.009)**
Uncooked Frozen	0.149	-0.586	**-0.641**	1.0785
	(0.066)**	(0.256)**	**(0.162)***	(0.1271)**

[a]Asymptotic standard errors are in parentheses
**Significance level = 0.05
***Significance level = 0.01

Table 4. Chow test for Structural Change

Break Point	**Year Month**	**Den DF**	**F -Value**	**Pr > F**
354	2004/43	418	0.47	0.9382
362	2004/51	418	0.51	0.9158
370	2005/7	418	0.69	0.7764
378	2005/15	418	0.9	0.5514
386	2005/23	418	0.85	0.6056
394	2005/31	418	0.85	0.6103
402	2005/39	418	1.01	0.4418

Figure 1.


Weekly Expenditure Share of Uncooked Fresh Salmon
0.8
0.4
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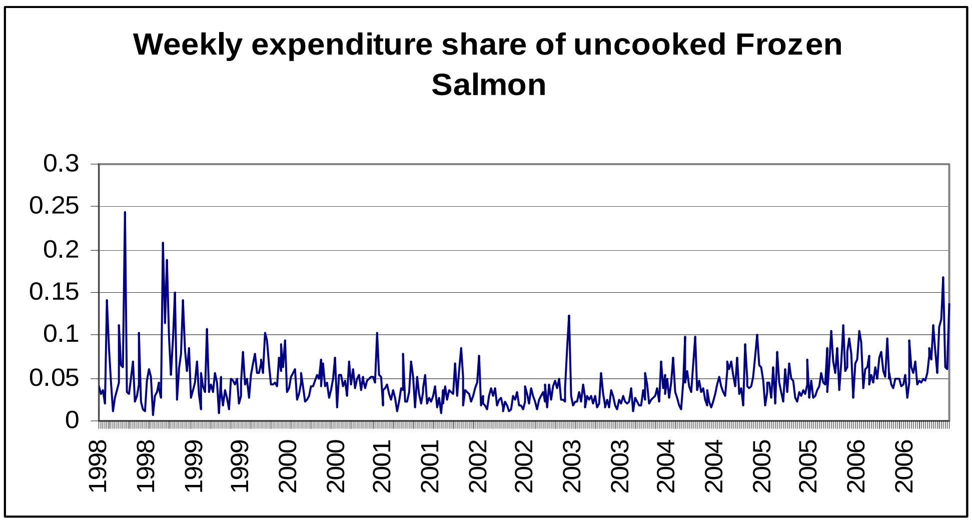
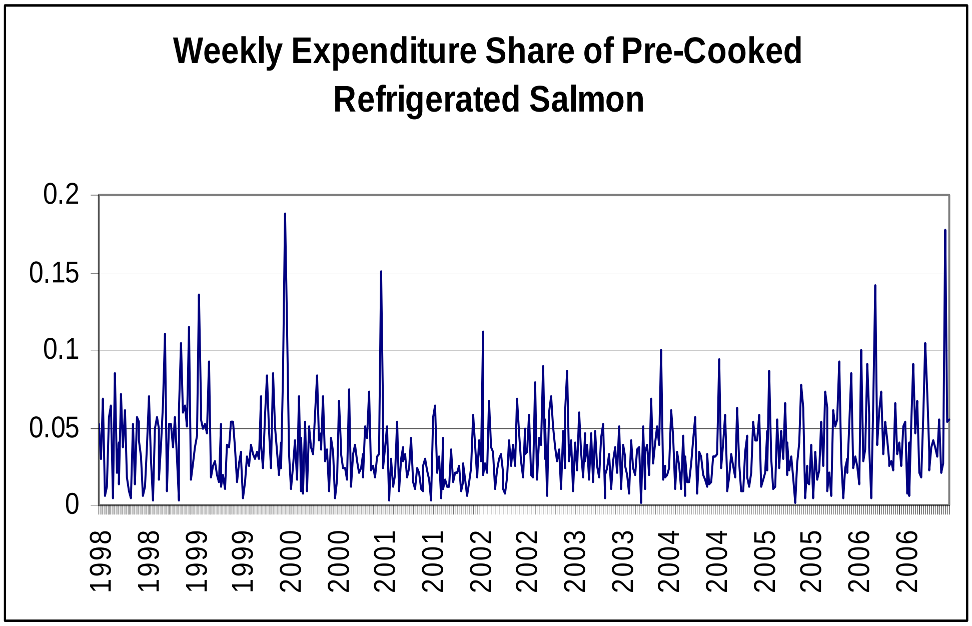
2006
2006


Weekly expenditure share of uncooked Frozen Salmon
0.3
0.25
0.2
0.15
0.1
0.05
0
1998
1998
1999
1999
2000
2000
2001
2001
2002
2002
2003
2003
2004
2004
2005
2005
2006
2006


Weekly Expenditure Share of Pre-Cooked Refrigerated Salmon
0.2
0.15
0.1
0.05
0
1998
1998
1999
1999
2000
2000
2001
2001
2002
2002
2003
2003
2004
2004
2005
2005
2006
2006