THE IMPLICIT PRICES OF FINFISH AND SHELLFISH ATTRIBUTES AND RETAIL PROMOTION STRATEGIES: HEDONIC ANALYSIS OF WEEKLY SCANNER DATA IN THE U.S.

By

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To my family

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Using retail-level grocery store scanner data in the U.S., this study aims to estimate the implicit prices of a suite of promotional, situational, labeling and other product attributes within the frozen finfish and shellfish market.

Past research has shown that "product specific" attributes (e.g., size, product form, quality and species) and "situational" attributes (e.g., natural disasters, health concerns, branding, country of origin and production method) affect the value of seafood products. Recently, various "labeling" attributes (such as certifications) have been developed to market products that are more sustainable, and at least one published study has shown these labels have received higher prices at the retail level. Few studies have assessed the implied value of labels or marketing activities which do not require third-party certification.

ACNielsen's Scantrack data was used to estimate price premiums and discounts for promotional, situational and labeling attributes as well as product specific attributes for seafood (i.e., fish and shellfish, marine and freshwater). In particular, this study will use data on frozen unbreaded fish and shellfish products (exclusive of crabs, oysters and shrimp) sold weekly in the U.S. from June 2007 through May 2010. Observations related to products (i.e., defined at the

UPC level) that were not sold in at least one-third of the weeks or species groups that were not at least 1% of the volume of products sold were deleted.

In the U.S. finfish dataset, 11 groups of fish species had some products labeled as “wild.” Of those species, 14% of the weekly observations were products with “wild” on the label and the wild label was found to command price premiums of 5.9% to 43.7%, depending on the species. In the shellfish dataset, nearly one-third of the weekly observations were products labeled as “imported” and the imported label was found to increase price 5.9% in the case of one species (lobster) but decrease price for four other species groups from 11.0% to 34.1%, depending on the species. Across both product types (i.e., unbreaded frozen fish and shellfish), promotional activities resulted in products being sold at a discount from 15.2% to 29.7%, when 100% of sales were promotional. The retail prices for only two species groups (scallop and lobster) declined after the Deepwater Horizon oil spill, which occurred in late April 2010, while the prices for 10 others increased, but only marginally (i.e., from 3.1% to 9.6%). Lastly, products sold under a retailers’ own label (grocery store brand) were found to reduce the price of shellfish products by an average of $3.37/lb. but increase the price of finfish products by an average of $0.37/lb.; only the latter result concurs with previous US market studies. Collectively, it is concluded that interaction terms are necessary to properly model the seafood market using hedonic analysis, as the implicit prices of attributes must be estimated while controlling for species.

CHAPTER 1
INTRODUCTION

The Seafood Industry

Nature provides an extensive selection of marine animals for harvest and consumption. Between the year 2000 and 2009 total consumption of "seafood" products in the United States (U.S.) has fluctuated around 20 billion pounds per year (See Figure 1-1; NOAA, 2010, Table 895)). The 2007 per capita consumption of red meat (primarily beef, pork and lamb), poultry (primarily chicken and turkey) and fish combined was 200.4 pounds. About half (55%) was red meat, 36.7% was poultry and 8.2% was fish (AMI, 2009). While the consumption of red meat and poultry is relatively high, the number of species is very small compared to seafood (finfish and shellfish, marine and freshwater). In addition, raw red meat and poultry products are differentiated at the retail level by different cuts; most of the differentiation with respect to raw seafood is with the species. Species of fish and shellfish, especially when considered within broad species groups (e.g., salmon, tuna, cod or shrimp), have distinctly different attributes including taste, texture, color, and ease of preparation. While these differences exist within the other types of animal-based proteins, the differences are arguably greater among seafood products.

The seafood industry in particular is reliant on a large suite of species, many of which consumers can identify (at least at the broad level such as salmon, shrimp, or catfish). That said; many "species" that consumers could name are likely groups of similar species. For example, the generic terms "cod" or "whitefish" could be cod, pollock, hoki or catfish. Processing procedures such as breading can also disguise species. In fact, a large number of breaded fish products are sold as simply "fish." In contrast, some consumers are willing to pay price premiums for consumption of a specific species of fish, especially when it is sold in unprocessed form. Costly processing procedures such as smoking also result in more expensive (valuable) products.

Whereas other protein sources are farmed, and therefore available on consistent bases, many seafood products are wild-caught such that supply is dependent on the cyclical behavior of natural processes including seasonal migrations and spawning. Because some products are only available during certain times of the year, extensive regulations have been placed on the harvesting of particular products. This has an added effect on promotional behaviors of retail outlets. Commercial harvest periods are relatively known, so retailers can anticipate supply and demand based on these seasons.

Much research and analysis has been performed to understand what drives prices and promotional behaviors of various products within this industry. We know from past research that consumers place value on a variety of seafood product attributes and qualities including species, product form, processing, size, region and product grade/quality (Roheim et al., 2007 and Gardiner, 2007; McConnell and Strand, 2000). Situational determinants which have been found to influence consumers' purchasing behavior typically involve health concerns (Leek and Maddock, 2000). However, situational determinants involve all those situations that change a consumers' perception about a particular product; which can include exogenous events, placing a product "on sale" or placing it in a different location in the store. The recent Deepwater Horizon oil spill in the Gulf of Mexico is an example of such a situational determinant. Holiday traditions, such as turkey on Thanksgiving, are also situational determinants which may influence consumers' decisions.

Different types of labeling on food products have been shown to affect consumers purchasing behavior (e.g., Carew, 2012; Roheim et al., 2011). Some labels, such as country of origin or nutritional information, are mandated by governments. Others provide location of production or harvest. Furthermore, some labels symbolize a product as being certified organic or sustainable in production. In the seafood industry, the mislabeling of products has been of growing concern to consumers. A 2010 study found consumers were willing to pay an average premium of $0.83 to $3.18 for grouper entrees at restaurants with a product integrity label (Ropicki, Larkin and Adams, 2010).

The use of certifications and eco-labeling within the seafood industry has developed widely within the last ten years. The theory that the market will reward products with these labels is highly supported by environmental groups. Many producers are considering adopting the labeling process with the thought it may hold a high return on investment. Policy makers question if the labels reflect tangible and measureable improvements in the environment, if not the level of the fish stocks directly (Roheim et al., 2011).

While the effectiveness of eco-labeling in changing consumers' perception is still a topic of research and debate, recent research has determined that such labels have resulted in higher retail prices. It must be noted that this study was in a limited market and for a single species, partially due to the limited markets in general for environmentally-certified seafood (Roheim et al., 2011). Regardless of the underlying environmental effects of labels, there is no doubt that marketing efforts will continue. As such, research will continue to attempt to measure consumer preferences both before and after products have been introduced to the market. Before discussing the particular approach adopted in this study, some background and previous literature are reviewed in the following section.

Background and Previous Studies

The majority of past research on the value of seafood attributes has used the "stated preference" methodology meaning that buyers were asked in surveys about their preferences for different attributes (characteristics) of seafood products. This methodology is necessary if new attributes are being considered such as new product forms or processing techniques are being considered. This is because there would be no existing data with which to estimate the value that consumers place on such attributes; we simply must ask buyers how they feel about the proposed attributes and what they might be willing to pay (or the discount they would be willing to accept) for a positive (negative) change in existing products. Whether or not consumers actually follow through with their statements and reveal these preferences when the new products are available in the market place is not known. This is a common criticism of these types of studies, that is, that the results are based on the "stated" preferences of buyers rather than "revealed" preferences that are based on historic market data, and is a general concern regarding the ability to obtained unbiased information through surveys.

Researchers often have no choice but to use a stated preference approach if they are investigating new products or attributes, which is the essence of traditional marketing. Luckily, there is a vast amount of literature on how to address several types of biases in stated preference studies. However, in cases where data are available, employing the revealed preference approach is preferred. Fortunately, technological advances, such as the UPC label on packaging, have allowed for improved detail in the tracking of products sold at the retail level; these data are typically referred to as "scanner data" to reflect the fact that information is collected at the point of sale. The companies which collect these data, such as ACNielsen, typically provide an analysis of this data to clients for a substantial cost. Recently these companies have been making the raw data available for purchase. The availability of these raw data has enabled researchers to conduct revealed preference studies. Much interest lies in the results from this type of empirical analysis in part because they can verify or dismiss results from stated preference studies.

Using the reported sales price with the corresponding attributes of the products sold, the implicit (or implied) prices of various product attributes can be calculated (McConnell and Strand, 2000). This theory, which is referred to generically as "hedonic analysis" and is discussed further in the following section, has not been limited to the seafood market. Recent hedonic price studies of other food types include eggs (Chang, Lusk and Norwood, 2010), wine (Carew and Florkowski, 2010), and chicken (Ahmad and Anders, 2012). Table 1-1 includes a summary of selected recent hedonic analyses of food products that have used scanner data.

This increase in hedonic analysis is in part due to the availability of retail scanner data. More studies have been able to use hedonic analysis to calculate the revealed preferences of consumers. Scanner data provide a level of detail in retail market sales that cannot be found in other data sources, such as government provided data. It is this level of detail that makes hedonic analysis of retail food sales possible. The data simply contains an abundance of product attribute information embedded within the UPC of each observation (Roheim et al., 2007; 2010). Auction and home sales data have been popular sources of data used in hedonic analysis in the past.

While the theory of hedonic analysis is widely accepted, guidance on the application is much less clear, especially with respect to the "correct" functional form. Both linear and log-linear functional forms have been used in published literature. Ahmad and Anders (2012) defend the use of the log-linear form as follows:

> Mutually advantageous exchanges of attributes by consumers may not be possible, resulting in marginal utilities that may not be proportional in equilibrium. We therefore would expect the hedonic price function to be convex in equilibrium and a nonlinear functional form to be the appropriate specification. (p. 120).

The log-linear functional form may also be more popular due to the interpretation of parameter estimates percentage (relative) changes rather than currency (absolute) changes.

The published hedonic literature, especially those using scanner data, does not provide much advice with respect to regression techniques or econometric problems such as autocorrelation, heteroscedasticity and multicollinearity. Some models are developed as more broad market analysis tools, using Ordinary Least Squares (OLS) regression and accept the fact that better models could be developed.

Roheim et al. (2007) accepts multicollinearity as an issue, and suggests developing individual models for each product group (such as species of fish) to reduce this problem. This is, in fact, the approach used in Roheim et al. (2011) to determine the price premium associated with eco-labeled Alaskan Pollock sold in the London market. While this study was narrowly focused, it was the first to show empirically that consumers pay a price premium (14%) for a seafood product bearing the eco-label.

In reference to Steiner (2004), Ahmad and Anders employed the used of interaction terms to "avoid equivalency in the implicit price effects across dummy variables"(Ahmad and Anders, 2012, p. 120). Advantages of this approach would suggest, for example in this study, that the implicit price effect of breading a shrimp is different than breading any other species of seafood.

Attributes that have been shown to affect the price of seafood include flavor and texture (Kinnucan and Wessels, 1997), product quality (McConnell and Strand, 2000), form, brand, species, size and processing (Roheim et al., 2007). A 2006 study by Leek and Maddock investigated the roles that intangible attributes such as availability, environment and other situational determinants play in consumers' consumption patterns.

Hedonic Methodology

This study employs techniques accepted in the literature to understand promotional, labeling and situational effects on the seafood industry. This study will implement the hedonic theory developed by Rosen (1974). The basis of the hedonic model is the assumption that a product is composed of a variety of specific attributes or characteristics with which the consumer identifies. It has been widely used in implicit price estimation models for a variety of market goods.

The hedonic model attempts to estimate the value or shadow price that is contributed by each individual attribute of the product. A firm or consumer may estimate the total price of a product by totaling all of the attributes corresponding shadow prices. The hedonic model takes the market prices of various goods and disaggregates the total value (price) into its component parts, mostly through the use of dummy variables. In this study, the use of retail scanner data supplies the market prices of the various goods.

The shadow prices are obtained from the coefficients. In a linear model, a negative parameter estimate for an attribute means that the attribute reduced the overall price of the good. Conversely, a positive parameter estimate means that the attribute increased the overall price of the good. Ultimately, consumer preferences (i.e., willingness to pay or less for a good depending on whether the attribute is present or absent, respectively) are extracted for each characteristic of the product being modeled.

Generally, first degree hedonic models – models that regress price on the attributes of the product(s) – ignore production and demand effects on the price of a good; however, changes in production and demand can be picked up through the use of seasonal attributes within hedonic modeling. A 1999 hedonic analysis of the apple market found price premiums associated with the summer and fall marketing seasons, and that the cyclical nature of apple prices closely followed the marketing seasons (Carew, 2000).

A criticism of Rosen’s hedonic theory is the assumption that a zero income elasticity of demand exists for each attribute. Murray (1983) claims this is missing from empirical implementations of Rosen's model when demand estimates are included, and that real world demands for attributes do have income effects, just like for the product overall. If so, the income effects will bias the demand parameter estimates.

This study hypothesizes that $P=f(X, Y)$, where P is the price of a seafood product, X is a vector of promotional, labeling and situational variables and Y is a vector of product attributes. In an attempt to model products closer to the natural animal form (least processing), this analysis is conducted with two categories of ACNielsen retail scanner data: frozen unbreaded fish and frozen unbreaded remaining (shellfish). These categories were selected since unbreaded products have less processing in general than their breaded counterparts and therefore should be more comparable at the species level. The unbreaded product categories also contain a much larger collection of identifiable shellfish and finfish species and forms (e.g., a large portion of the breaded fish category contains products labeled as simply "fish"). In 2010, the unbreaded products also account for the largest proportion of sales in the seafood market (see Figure 1-2).

Objective

The objective of this paper is to determine the implicit price of a suite of promotional, labeling and situational variables that have yet to be investigated with seafood using a hedonic model of retail sales in the U.S. This study will estimate pricing models for unbreaded frozen fish and shellfish. Comparisons of promotional behaviors, labeling practices and other hypothesized pricing effects will be made between the shellfish and finfish markets in the United States. Specifically, we investigate the price changes associated with different species of fish and shellfish during promotions, labeled as imported or wild, and sold after the Deepwater Horizon Gulf Oil Spill.

Overview of Study

Promotional price changes are examined for different species of shellfish and finfish. The implicit prices for labeling finfish "wild" and shellfish "imported" is investigated. The effect on retail price of seafood after the Deepwater Horizon oil spill in the Gulf of Mexico occurred is studied. The Data chapter will describe how the data were organized by ACNielsen, how the data were prepared for analysis, data manipulation and the creation of variables used in the final models. The Empirical Analysis chapter will describe model specification, estimation, and results for both the shellfish and finfish data. The Summary and Conclusions chapter will discuss the results and conclusions. Key results are further examined and suggestions for future applications of hedonic analysis using scanner data are made.

Table 1-1. Summary of selected recent studies involving hedonic modeling of food products using scanner data

Authors	*Product*	*Method*	*Key Findings*
Roheim, Gardiner and Asche (2007)	Frozen fish	Two UK markets; regression analysis of general frozen fish product attributes.	Regions, species, brands, product form, package size and processing all have significant effects on price.
Roheim, Asche and Santos (2011)	Alaskan Pollock	One UK market semi-log regression analysis of product attributes, including labeling.	Labeling, branding, processing and form all have significant effects on price. Marine Stewardship Council label on Pollock demands an average 14.2% price premium.
Ahmad and Anders (2012)	Frozen Chicken and Seafood	Two product genera (chicken/seafood) semi-log regression analysis of attributes, including interaction terms.	Species, brand, size, form and processing all have significant effects on price. Interaction terms are necessary to identify multi-dimensions of an attribute.
Carew and Florkowski (2010)	Burgundy Wine	Two product (red/white wine) semi-log regression analysis of wine attributes, including origin of production labeling. Includes quantity in the model.	Origin of production labeling, alcohol content, vintage labeling and time all have an effect on wine prices. Negative relationship between quantity sold and price confirmed.
Chang, Lusk and Norwood (2010)	Retail Eggs	Two market semi-log regression analysis of product attributes, including labeling.	Regions, production method, color, size, package, brands and seasonality have significant effects on price.

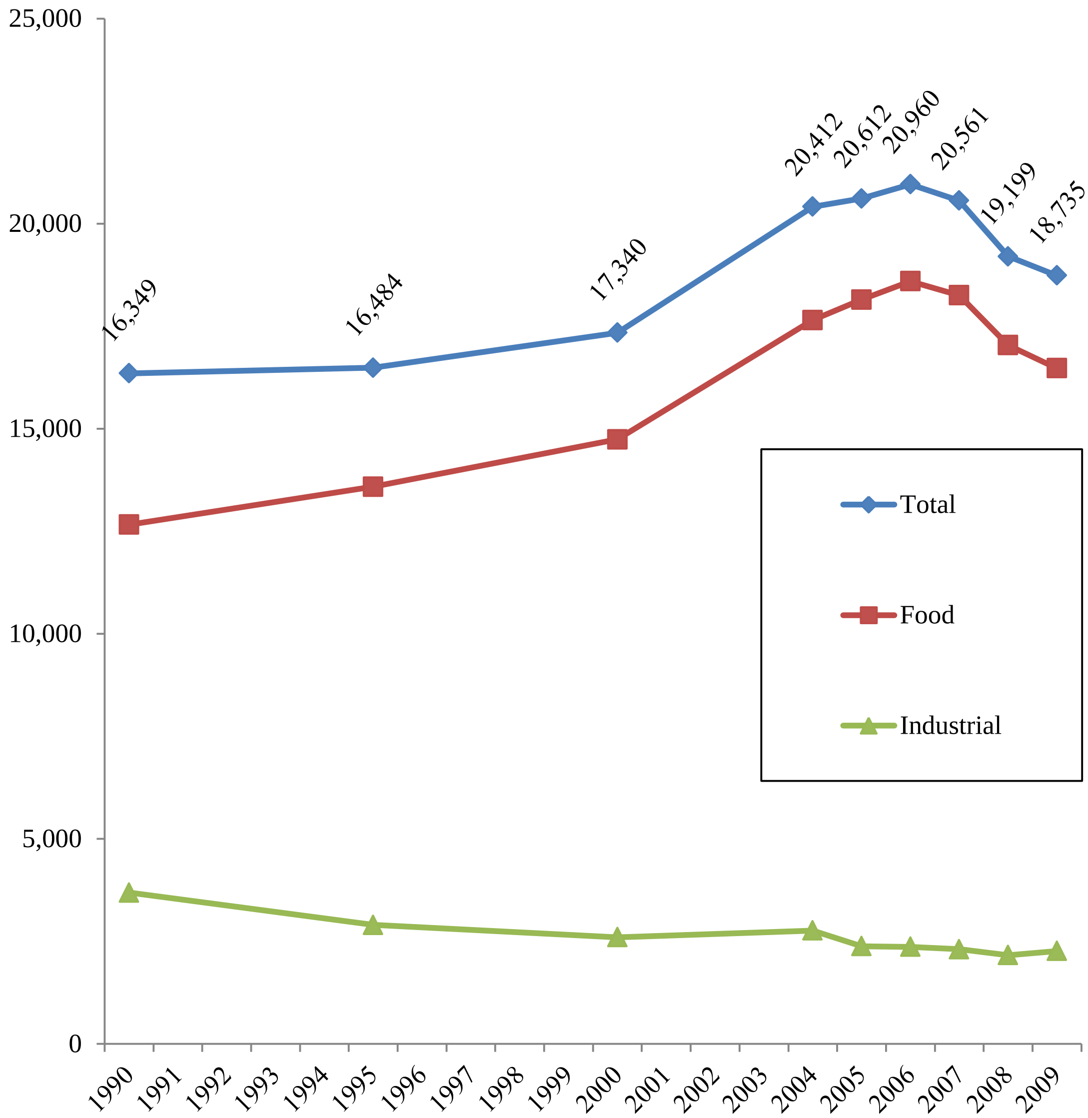

Figure 1-1. Live weight of total fisheries products sold in the U.S. annually (mil lbs), 1990-2009, by use (Source: NOAA, 2010, Table 895)

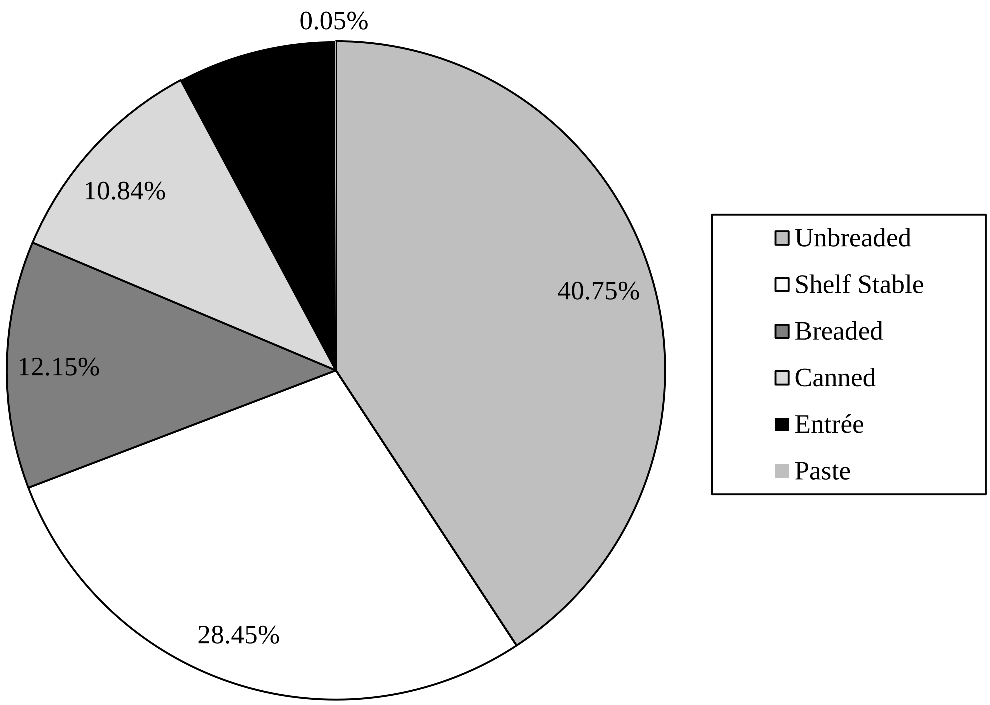

Figure 1-2. Seafood market share by product category form in 2010 (Source: ACNielsen Scantrack)

CHAPTER 2
DATA

Overview

Table 2-1 provides a summary of the variables provided in the original datasets. By using nine variables provided in the original national datasets, more than 30 variables are created for use in the models (i.e., finfish and shellfish). For example, qualitative variables are coded into categories using dummy variables. Average market price is calculated using sales and volume figures and adjusted for general inflation. This chapter first discussion the source of the data and how the original data were organized; the data were provided in very large datasets that were not in the format necessary to estimate basic hedonic models as intended. Then the use of existing variables to create distinct measures of additional attributes is discussed. Lastly, the empirical models are specified and discussed.

Source of Data

The data was purchased from ACNielsen. ACNielsen is a global marketing research firm that is most known for the creation of Nielsen ratings, which measure television, radio and newspaper audiences. Another popular market research tool provided by ACNielsen is the Homescan program in which household retail purchases are tracked by members of a sample group. The data used in this study are ACNielsen Scantrack data. Product sales are recorded by the register scanners at retail outlets and stored by ACNielsen. The data were acquired from three types of retail outlets: (1) 2 million dollar grocery stores, (2) FDM, and (3) drug stores. This research used the data from the first category (grocery store chains in the U.S.), which for seafood products is sufficient.

Table 2-2 provides a list of the store chains included in ACNielsen Scantrack data. Some of the stores included sell seafood products branded by their own private label. The private label brands are known collectively as control brands by ACNielsen. These data track products by UPC (Universal Product Code). It was discovered during this study that the number included in the dataset is technically an EAN (International Article Number), which is a superset of UPC. EAN codes add an additional digit to the string of numbers, and indicate the country which the company selling the product is based. The code is referred to as a UPC in this study because that is a term most people are familiar with.

Data Description

Regional Aggregation

The 53 cities ("markets") included in the data are: Albany, Atlanta, Baltimore, Birmingham, Boston, Buffalo/Rochester, Charlotte, Chicago, Cincinnati, Cleveland, Columbus, Dallas, Denver, Des Moines, Detroit, Grand Rapids, Hartford/New Haven, Houston, Indianapolis, Jacksonville, Kansas City, Las Vegas, Little Rock, Los Angeles, Louisville, Memphis, Miami, Milwaukee, Minneapolis, Nashville, New Orleans/Mobile, New York, Oklahoma City/Tulsa, Omaha, Orlando, Philadelphia, Phoenix, Pittsburgh, Portland, Raleigh/Durham, Richmond/Norfolk, Sacramento, Salt Lake City/Boise, San Antonio, San Diego, San Francisco, Seattle, St. Louis, Syracuse, Tampa, Total U.S., Washington D.C., and West Texas.

Item and Brand Aggregation

ACNielsen provided data aggregated by either "item" or "brand." If "item" is chosen the data contain individual entries (rows) for the various products (e.g., UPC) sold under the same brand name for a given product category. The brand "ctl br" is the value of this variable for products which are branded by the store which is selling them. For example, Publix, Winn-Dixie and Kroger all sell a frozen salmon fillet branded as a Publix, Winn-Dixie or Kroger product, respectively. Typically, these "private" brands are less costly than national "name" brands. In the item aggregation, the products may vary by species, size of package, or the form the fish is sold, each having its own UPC. These individual product sales are then aggregated from all the retail outlets in a given market. It was verified that each item was aggregated per market by performing a frequency procedure on the UPC variable. Each UPC had a frequency of one for each week of data.

If "brand" aggregation is chosen, the data contain only one entry (row) for all of the various products (UPCs) sold under the same brand name for a given product category. For example, the various species, package sizes, and forms of fish sold under brand "ctl br" will be aggregated to one entry (row). This option reduces the richness of the data, and is not suitable for this study. However, this choice of aggregation may be suitable for studies which are interested in examining brands.

Monthly and Weekly Aggregation

The data for years 2006 and 2007 are aggregated on a monthly basis. The data for years 2008, 2009 and 2010 are aggregated weekly. The weekly data begins with the week ending June 17, 2007 and ends with the week ending June 12, 2010. In order to provide greater accuracy pertaining to the assignment of the situational determinants variables, only data in weekly format are used (i.e., the dataset contains 156 weeks of data).

Product Categories

The ACNielsen retail scanner dataset from the grocery stores is composed of 19 product categories as shown in Table 2.

In 2010, the dataset included sales totaling 3.6 billion dollars. Shelf-stable tuna is the largest product category by sales, accounting for 28% of the market share. The two product categories included in this analysis are Frozen Unbreaded Fish and Frozen Unbreaded Remaining. These product categories account for 12.3% and 1.8% of the market share, respectively. Figure 2 illustrates that in the aggregate, the Unbreaded Seafood product category has the largest market share in 2010.

As previously explained, this study is interested in two of these categories: frozen unbreaded fish and frozen unbreaded remaining. The unbreaded remaining category contains shellfish such as clams, oysters and lobsters. This category also includes a variety of other product types which do not fit in any of the other 19 categories, such as escargot and frogs, which were removed from the dataset. Although a separate category exists for crabs, a small percentage of the unbreaded remaining category included crab products. Upon investigation, these products were found to be crab and fish products combined (processed products), such as "salmon pinwheels," which were also removed from the dataset.

Data Manipulation

In order to estimate a hedonic equation, the datasets had to be merged and transposed. The format and content of the original datasets are summarized in Table 3. First, the quantitative sales data that are available for each product are the sum of sales in each market in each week. The "sales" figures include the total dollar value and total number of units sold with and without associated promotional activities and the total dollar value and number of units sold (i.e., six spreadsheets for each year, each containing one of these measures of sales). Each spreadsheet contains variables that describe the product (discussed below) and 52 variables (columns) that are the sales figures for each week. "Promotional activities" are defined to include those with any advertisement, coupon, and product display and/or a price reduction of at least 5 percent below the suggested retail price by the producer; in other words, "promotional sales" include any promotional activities and not solely those associated with the concept of putting a good on sale at lower price. In addition, there is also a "rank #" variable (column) that indicates how each product ranked in terms of total sales dollars for the year. After removing products with no sales during that year, the maximum value of the rank # variable is the total number of products (UPCs) sold that year in that product category.

Each week of sales information was originally a separate variable. This information had to be associated with the week in which the data were collected (as is, the time information is embedded in the file and column titles). This was accomplished by transposing the column headings (i.e., week ending MM/DD/YY) into variable name WEEK with values ranging from 1 to 52 in each year. Once the sheets were merged, this variable contained values from 1-156 to represent the continuous measurement of sales across three years. All of the remaining variables (those that describe the product) had to be duplicated for each new weekly observation row. This was accomplished in SAS using the transpose procedure on the WEEK variables and selecting the option "group analysis by" on the remaining product attribute variables.

The variables provided by ACNielsen which include product attribute information are: Brand Description, Form, Product, Size and Type. Brand Description includes both "high" and "low" level company names. For some of the products, the values for both these variables are the same. However, if the brand name seen on the packaging is a subsidiary of a larger corporation, the larger corporation name will be listed under the "high" level brand description variable. The Form variable describes the physical state, or cut, of the seafood product (e.g. fillet, whole fish, piece and steak). The Product variable is the "broad" species of fish or shellfish. Additional species information, such as Pacific Tuna or Chilean Sea Bass, is included under Type. Size is a numerical variable representing the weight in ounces of the product, or the "count" of products in the package. Products sold with "count" as the units for package sizes were removed from the analysis since they could not be converted to pounds for comparison with other products. The Type variable provides information regarding to a variety of product labels, which may reveal origin and processing information.

A data input error was discovered in the finfish dataset by examining outliers. Three products with a package size of two ounces were removed from the dataset. One of the three was found for sale on an online retailers' website and discovered to actually be a two count package. The other two, due to such an absurdly large price per pound, were assumed to be two count packages as well. It should be noted that the USDA measures a serving size of fish to three ounces, which supports this data error deletion.

To reduce the amount of "noise" in the data, products that did not sell for at least one-third of the time frame modeled (i.e., 52 weeks) were removed from the dataset. This method has been previously suggested and applied by Roheim et al. (2007). Weeks with no sales information are indicated by a zero. After merging the sales sheets, the data for each year, and each product category (unbreaded fish and unbreaded remaining), two datasets were created: the "finfish" dataset and the "shellfish" dataset.

Variables Created for Analysis

Each observation in the datasets contain qualitative variables that include the UPC, brand, product (species), form, size description and type; and quantitative variables on week, year, rank, size, dollars (sales), units (packages), promotional dollars (sales), and promotional units (packages). As explained earlier, for a sale to qualify as promotional, it must either be recorded during a time of advertisement, with or without a price adjustment; or sold at an adjusted price (> 5%) without advertisement.

Through calculations made with dollars, units, promotional dollars, promotional units and size variables, the dependent variable "adjusted weighted price per pound" is determined. Price is weighted by the proportion of sales made under promotion. The price per pound is adjusted for inflation using the Consumer Price Index, base 2007. The dependent variable has a mean value of $8.83 per pound for shellfish and $6.27 per pound for finfish. The maximum adjusted weighted price per pound is $86 for shellfish and $148 for finfish. For a complete explanation on the development of the dependent variable, see Appendix A.

Species group variables (e.g., salmon, tuna) were created from the product description on the dataset and are included in the models to correct for price influences hypothesized due to the distinct characteristics of species. Preliminary regression analysis revealed that removing the species groups has a dramatic negative effect on the explanatory power of the models. To further reduce noise in the data, and following previous studies using scanner data, the species grouping variable is limited to the inclusion of groupings which account for at least 1% of the market. Many of the species with less than 1% market share are accounted for as a subgroup within a more dominant species group and, thus, were retained. After these changes to the datasets, the finfish dataset contained 89,101 observations and the shellfish dataset contained 38,999 observations. The species variables in the shellfish dataset from the "remaining unbreaded" file are: SCAL, SQU, LOB, MUSS, CRAW, CLA and OCT which identifies the product as being a scallop, squid, lobster, mussel, crawfish, clam or octopus, respectively. Shrimp were not included in this dataset, as ACNielsen provides all frozen unbreaded shrimp sales in a separate dataset. It should be noted that oysters were among the species dropped as the market share was less than 1%. The species variables in the finfish dataset from the "unbreaded fish" file are: COD, SAL, TIL, CAT, WHIT, FLOU, POLL, PER, TUN, MAHI, SWOR, HADD, OR, HAL, SOL, SMEL and GROU which identify the product as being a cod, salmon, tilapia, catfish, whiting, founder, pollock, perch, tuna, mahi-mahi (aka dolphin or dorado), swordfish, haddock, orange roughy, halibut, sole, smelt or grouper, respectively.

The variable for the proportion of sales made under promotion, PRO, is a continuous number between 0 and 1. It is calculated using packages sold, to determine the proportion of packages sold under promotion each week. A comparative chart of the 3-year average PRO variable is interesting (Figure 2-1). In the shellfish market, Christmas is the time of heaviest average proportion of promotional behavior. In the finfish market, Lent is the time of heaviest proportion of promotional behavior. Shellfish promotion in February peaks prior to finfish, which may be due to promotions encompassing Valentines' Day when entrees that include lobster and other high end shellfish are popular. Dummy variables are created to capture these peaks to understand price influences during these times of promotional behavior change. This promotional variable is also interacted with the species group variables to test if promotional behavior varies by products of different species groups.

The model time event variables are: OS, HOL_1, and HOL_2, which represent the sales made during the weeks following the Deepwater Horizon Oil Spill (which occurred in the Gulf of Mexico on April 20, 2010 and lasted into July 2010, past when this dataset stops), two weeks in February (capturing the onset of the Lent season and Valentines' Day sales collectively), and the two weeks prior to Christmas, respectively. The Oil Spill variable is interacted with the various species group variables to test if the oil spill affected species groups differently.

The brand variables, NB and SB, identify products which are branded by name brand companies and private label companies, respectively. The inclusion of SB can be used to test whether US retailers own brand sell at a 10-40% discount to national name brands, which was found by Halstead and Ward (1995). Roheim (2007) reports the opposite effect for the British own-label brands.

The ACNielsen provided variable Type, which the special attribute labeling variables are created from. The values of the variable, Type, reveal information pertaining to location of catch, imported or wild labeling, or additional information specific to the species. The finfish model has a higher percentage of products without special attribute labeling (50%) than the shellfish model (25%). A value of "regular" means that these products do not reveal any special attributes on the labeling. The variable REGTYPE identifies all products which do not reveal any special attributes on the labeling, in both the shellfish and finfish models.

In the shellfish model, the variable SHEL indicates products which are identified as being in the "shell" or on the "half-shell." The variable BAY indicates products labeled as "bay." It should be noted that BAY is exclusive to the scallop products, and is necessary in the model to distinguish between higher valued sea scallops. The variable IMP is created to identify shellfish products that are labeled as imported. In the shellfish model, 35.6% products were imported during the three year time horizon covered in this analysis. This variable is also interacted with the species group variables to test if the imported label affected species groups differently. An analysis of the UPC's including the country code (EAN's) found that approximately 10% of the companies selling the products were registered in foreign countries. This indicates that many of the products imported are actually sold by U.S. companies.

In the finfish model, ALAS, PAC, ATL, BN, and SM are created to identify products labeled Alaskan, Pacific, Atlantic, boneless or smoked, respectively. Unfortunately, the finfish data do not contain information on whether the product was imported. The finfish data do, however, include products labeled as "wild." Approximately 7% of the finfish model contains products with this label. The variable WILD is created to identify products with this label. It is interacted with the species group variables to test if the wild label affected species groups differently.

The size variable, SIZE, was created for those products that were identified as being measured in ounces. The size variable has a mean of 21 ounces for both shellfish and finfish. About one sixth of both markets are comprised of products with a size of ten ounces or less. This is important because these smaller package sizes in general yield a higher price per pound, which was determined by examining at products with an adjusted weighted price per pound outside two standard deviations from the mean. For finfish these products cost greater than \$19.47 adjusted weighted price per pound, for shellfish these products cost greater than \$26.39 adjusted weighted price per pound. In the finfish market 92 percent of these outlier products are less than or equal to 10 ounces and in the shellfish market 85 percent of these outlier products are less than or equal to 10 ounces. Controlling for this through the use of a dummy variable was explored in previous models, and these smaller package sizes were found to have a significant increase in the price per pound of the products. However, in the final model this variable was dropped due to the fact that determining the relationship between size and price is not part of the research question. Also, removing this variable improved the ease of interpretation. These outlier products are retained in the dataset and do not disrupt the explanatory power of the models.

Table 2-1. Variables provided by ACNielsen

Variable	*Description*
Weekly Data by Year and Product (i.e., UPC):	
No Promo Sales Units	Number of units sold (1) without advertisements, coupons, or displays, or (2) without price discount of at least 5%.
No Promo Sales Dollars	Total dollar sales (1) without advertisements, coupons, or displays, or (2) without price discount of at least 5%.
Any Promo Sales Unit	Number of units sold (1) with advertisements, coupons, or displays, or (2) with price discount of at least 5%.
Any Promo Sales Dollars	Total dollar sales (1) with advertisements, coupons, or displays, or (2) with price discount of at least 5%.
Unit Volume	Total units sold (No Promo Sales Units plus Any Promo Sales Units).
Sales Dollar	Total dollar sales (No Promo Sales Dollars plus Any Promo Sales Dollars).
Description of Products:	
Universal Product Code	A maximum of 12 digit number, determined to be the EAN code but without the verification digit
Brand Description	The product brand name. All private label store brands are identified with the value “ctl br.” Table 2-2 provides a list of all the grocery store food chains included in ACNielsen Scantrack data.
BE High Description	The international, parent company of a particular brand.
BE Low Description	The national (United States) company of a particular brand.
Form	The form of the product, for example, fillet, steak, whole.
Product	Fish group or species of the product, for example, Tilapia, Crab, and Crawfish.
Style	Attribute of product, specific to breaded and canned categories. For example, crunchy, crispy.
Size	Numerical value for size of package (units) and reported in either ounces or counts.
Size Description	Type of size count. Either ounces or count (data reported based on counts were not used).
Type	Attribute labeling of the product. For example, Smoked, Boneless, Skinless, Wild, Alaskan, Atlantic. A value of “regular” is interpreted as having no attribute labeling.

Table 2-2. List of grocery food chains covered by ACNielsen store level data

Grocery Food Chains	
KROGER	FRYS
FOOD LION	PRICE CHOPPER
PUBLIX	SWEETBAY
SAFEWAY	LOWES
ALBERTSONS (SV)	MARSH
WINN DIXIE	KING SOOPER
SAVE A LOT CORPORA	SCHNUCK MARKETS IN
PIGGLY WIGGLY CARO	FOOD CITY KVAT
STOP & SHOP	FRESH BRANDS/PIGGL
VONS	PICK N SAVE (CORP
HEB	A&P
RALPHS GROCERY	BASHAS
HOUCHENS/SAVE-A-LO	HOMELAND
ALBERTSONS (Cerb)	DILLON/GERBES/SAV
BI LO	RALEYS FOOD & DRUG
GIANT EAGLE INC	CUB FOODS
SHOP RITE/WAKEFERN	DOMINICKS
HYVEE	SUPER FRESH
INGLES	TOPS
SHAWS SUPERMARKETS	QUALITY
MEIJER	PIGGLY WIGGLY/STOR
GIANT (MD)	WEGMANS
JEWEL OSCO	LUCKY STORES
HARRIS TEETER INC	HARVEYS SUPERMARKE
HANNAFORD/SHOP N S	PIGGLY WIGGLY
STATER BROS MARKET	BRUNOS/FOOD MAX/FO
BROOKSHIRE	SHOPPERS FOOD/METR
WEIS	WALDBAUM INC
GIANT (CARLISLE)	TOM THUMB
FOOD 4 LESS	BASHAS FOOD CITY
PATHMARK	DEMOULAS/MARKET BA
SAVE MART	NASH-FINCH/ECONO/S
SMITHS	BIG Y
FOOD EMPORIUM	STRACK & VAN TIL
LOWES/PAY N SAVE	RAINBOW (ROUNDY'S)
PRICE CHOPPER	JAY C STORE/FOOD P
P & C	UKROPS
NIEMANN FOODS/COUN	SUPERIOR SUPER WAR
HARPS	COPPS CO

Table 2-2. Continued

Grocery Food Chains	
FIESTA MART INC	KINGS
KING KULLEN	SUPER ONE
RANDALLS	QUALITY MARKETS
FARM FRESH	FAMILY FARE
SUPER S/MEGA	G&W FOODS/FARMERS
UNITED	HARVEST FOODS
COUNTRY MART	E W JAMES & SONS S
FOOD MAXX STORES	DAVIDS
BUEHLER FOODS INC	NOB HILL
SOUTHERN FAMILY MA	DIERBERGS
BIG M	BOYERS IGA INC
REDNERS	CARNIVAL FOOD STOR
CITY MARKET	BILO
GENUARDI/MAD GROCE	MORGANS HOLIDAY MA
GRISTEDES	KNOWLANS SUPERMKTS
COBORNS/CASH WISE	ROSAUERS
GREERS/FOOD TIGER	MINYARD
SENTRY/SUPER SAVER	MARTINS
SAVE A LOT FOODS	LUNDS INC
G U MARKETS	MARVINS IGA INC
PRICE RITE	BEL AIR MARKETS
GLENS MARKETS INC	PIONEER/MET FD/ASSOC
RAMEY SUPER MARKET	LAWRENCE IGA
TOP FOOD/HAGGENS	ACME MARKETS
ROUSES	FRED MEYER INC
HARDINGS	SHOP N SAVE (SUPER
MARKET BASKET/LUCK	RAYS FOOD PLACE
FULMER SUPERMARKET	

Note: These grocery food chains are the source of the data collected as ACNielsen Scantrack data, if the store has sales greater than 2 million annually. Some of the retailers listed sell store brand products, known collectively in this data set as the control brand (ACNielsen Brand variable value “ctl br”).

Table 2-3. Total U.S. seafood sales and market share at grocery stores that exceeded $2 million in 2010 by category

Product Category	*2010 Sales ($)*
SEAFOOD-TUNA-SHELF STABLE	1,031,047,472
SEAFOOD - SHRIMP - UNBREADED - FROZEN	925,556,370
SEAFOOD-FISH-UNBREADED-FROZEN	445,362,426
SEAFOOD - FISH - BREADED - FROZEN	339,261,224
ENTREES - SEAFOOD - 1 FOOD - FROZEN	235,815,831
SEAFOOD - SALMON - CANNED	130,154,630
SEAFOOD - SHRIMP - BREADED - FROZEN	94,843,782
SEAFOOD - SARDINES - CANNED	83,868,140
SEAFOOD-REMAINING-UNBREADED-FROZEN	65,458,664
SEAFOOD - REMAINING - CANNED	49,592,763
ENTREES - SEAFOOD - 2 FOOD - FROZEN	45,439,902
SEAFOOD-CRAB-UNBREADED-FROZEN	40,815,006
SEAFOOD-CLAMS-CANNED	40,032,917
SEAFOOD - OYSTERS - CANNED	32,183,084
SEAFOOD-CRAB-CANNED	24,240,632
SEAFOOD - SHRIMP - CANNED	17,189,272
SEAFOOD - ANCHOVIES	15,706,391
SEAFOOD-REMAINING-BREADED-FROZEN	6,184,956
ANCHOVY PASTE	1,950,890
Total	3,624,704,352

Source: A.C. Neilson, New York City, NY.

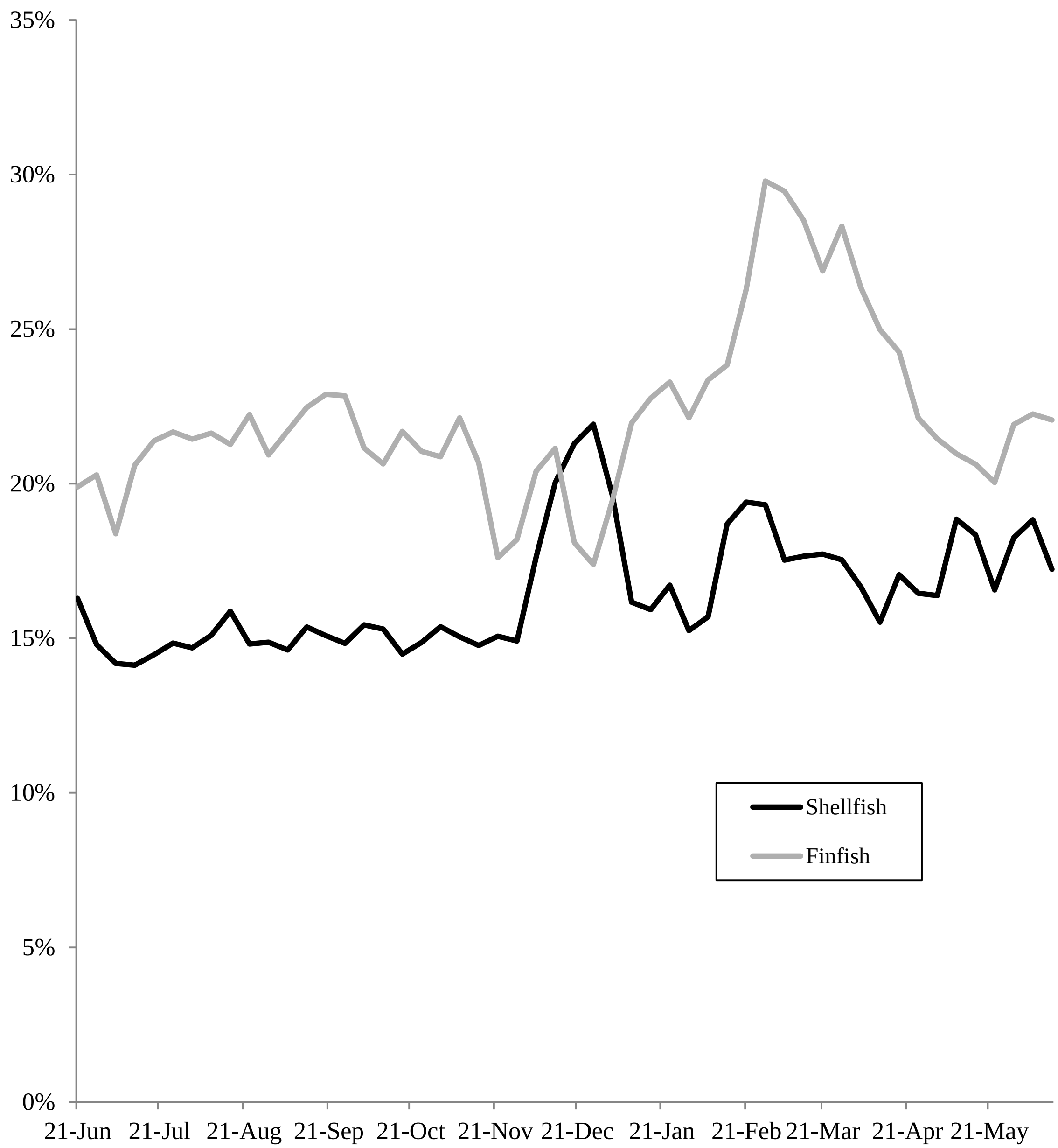

Figure 2-1. Proportion of promotional sales for shellfish and finfish by week, 3-year average

CHAPTER 3
EMPIRICAL ANALYSIS

Overview

Implicit price estimation and model specification methods are discussed. Results are reported for both finfish and shellfish models. Comparisons between the implicit prices of intangible attributes are discussed. Interaction terms are used to further understand the effects of promotional, labeling and situational attributes at the individual product species group level. Because these results are specific to shellfish and finfish, the results are reported separately.

Estimation and Model Specification

Hedonic regression analysis is used to calculate the implicit prices of product, promotional, situational and labeling attributes. An individual model is created for finfish and shellfish due to different values on certain variables. For example, in the shellfish model, the type variable contains information that identifies a product as imported. This variable does not contain this information in the finfish model, so combining these data would implicitly assume that all of the finfish were domestically produced. This would be an incorrect assumption and result in misspecification of the model.

Initially, regression analysis was performed in SAS using the PROC REG procedure. Both heteroscedasticity and autocorrelation were identified as issues with the Ordinary Least Squares (OLS) regression, which assumes the estimates are BLUE; BLUE refers to the best, linear, unbiased estimators. Homoscedasticity is an assumption of the OLS regression that the variances remain consistent across all values of a variable. By looking at the plots of the residuals, it was determined that this implied assumption was incorrect since the residual variances appeared to be correlated with the SIZE variable (i.e., the size of the package in ounces). This may be due to inconsistencies in product (species) size offerings as well as increased price variability in smaller package sizes. For example, the smaller package size has high "adjusted weighted price per pound" variability because many different products are offered at that size package (e.g., smaller packages had a higher share of expensive processed products, such as smoked product).

Autocorrelation was also detected as an issue with the OLS regression. The Durbin-Watson (DW) statistic in both the finfish and shellfish models indicated significantly high positive autocorrelation (DW=0.15). As a result, models were estimated that corrected for either[1] autocorrelation or heteroscedasticity. It was determined that the model correcting for autocorrelation was superior because the problem existed in all the variables, whereas heteroscedasticity was only an issue with the size variable. Correcting for autocorrelation increased the explanatory power of the model by increasing the number of significant parameter estimates.

The following equation is the shellfish model:

$$P_{it} = \beta_0 + \beta_1(D_{SQU}) + \beta_2(D_{LOB}) + \beta_3(D_{MUSS}) + \beta_4(D_{CRAW}) + \beta_5(D_{CLA}) + \beta_6(D_{OCT}) + \beta_7(\mathrm{PRO})(D_{SCAL}) + \beta_8(\mathrm{PRO})(D_{SQU}) + \beta_9(\mathrm{PRO})(D_{LOB}) + \beta_{10}(\mathrm{PRO})(D_{MUSS}) + \beta_{11}(\mathrm{PRO})(D_{CRAW}) + \beta_{12}(\mathrm{PRO})(D_{CLA}) + \beta_{13}(\mathrm{PRO})(D_{OCT}) + \beta_{14}(D_{OS})(D_{SCAL}) + \beta_{15}(D_{OS})(D_{SQU}) + \beta_{16}(D_{OS})(D_{LOB}) + \beta_{17}(D_{OS})(D_{MUSS}) + \beta_{18}(D_{OS})(D_{CRAW}) + \beta_{19}(D_{OS})(D_{CLA}) + \beta_{20}(D_{OS})(D_{OCT}) + \beta_{21}(D_{IMP})(D_{SCAL}) + \beta_{22}(D_{IMP})(D_{SQU}) + \beta_{23}(D_{IMP})(D_{LOB}) + \beta_{24}(D_{IMP})(D_{MUSS}) + \beta_{25}(D_{IMP})(D_{CLA}) + \beta_{26}(D_{IMP})(D_{OCT}) + \beta_{27}(D_{HOL\_1}) + \beta_{28}(D_{HOL\_2}) + \beta_{29}(D_{SB}) + \beta_{30}(D_{BAY}) + \beta_{31}(D_{SHEL}) + \beta_{32}(\mathrm{SIZE}) + \beta_{33}(D_{PIEC}) + \varepsilon_{it}$$

The following equation is the finfish model:

$$P_{it} = \beta_0 + \beta_1(D_{SAL}) + \beta_2(D_{TIL}) + \beta_3(D_{CAT}) + \beta_4(D_{WHIT}) + \beta_5(D_{FLOU}) + \beta_6(D_{POLL}) + \beta_7(D_{PER}) + \beta_8(D_{TUN}) + \beta_9(D_{MAHI}) + \beta_{10}(D_{SWOR}) + \beta_{11}(D_{HADD}) + \beta_{12}(D_{OR}) + \beta_{13}(D_{HAL}) + \beta_{14}(D_{SOL}) + \beta_{15}(D_{SMEL}) + \beta_{16}(D_{GROU}) + \beta_{17}(\mathrm{PRO})(D_{COD}) + \beta_{18}(\mathrm{PRO})(D_{SAL}) + \beta_{19}(\mathrm{PRO})(D_{TIL}) + \beta_{20}(\mathrm{PRO})(D_{CAT}) + \beta_{21}(\mathrm{PRO})(D_{WHIT}) + \beta_{22}(\mathrm{PRO})(D_{FLOU}) + \beta_{23}(\mathrm{PRO})(D_{POLL}) + \beta_{24}(\mathrm{PRO})(D_{PER}) + \beta_{25}(\mathrm{PRO})(D_{TUN}) + \beta_{26}(\mathrm{PRO})(D_{MAHI}) + \beta_{27}(\mathrm{PRO})(D_{SWOR}) + \beta_{28}(\mathrm{PRO})(D_{HADD}) + \beta_{29}(\mathrm{PRO})(D_{OR}) + \beta_{30}(\mathrm{PRO})(D_{HAL}) +$$

[1] GARCH parameter estimates, which correct for both heteroscedasticity and autocorrelation simultaneously, were examined. However, these estimates were not used because this procedure is commonly used in forecasting and "forced" all parameter estimates to be significant. The resulting suspiciously high r-square value was a concern (0.9950).

$\beta_{31}(\text{PRO})(D_{SOL}) + \beta_{32}(\text{PRO})(D_{SMEL}) + \beta_{33}(\text{PRO})(D_{GROU}) + \beta_{34}(D_{OS})(D_{COD}) + \beta_{35}(D_{OS})(D_{SAL}) + \beta_{36}(D_{OS})(D_{TIL}) + \beta_{37}(D_{OS})(D_{CAT}) + \beta_{38}(D_{OS})(D_{WHIT}) + \beta_{39}(D_{OS})(D_{FLOU}) + \beta_{40}(D_{OS})(D_{POLL}) + \beta_{41}(D_{OS})(D_{PER}) + \beta_{42}(D_{OS})(D_{TUN}) + \beta_{43}(D_{OS})(D_{MAHI}) + \beta_{44}(D_{OS})(D_{SWOR}) + \beta_{45}(D_{OS})(D_{HADD}) + \beta_{46}(D_{OS})(D_{OR}) + \beta_{47}(D_{OS})(D_{HAL}) + \beta_{48}(D_{OS})(D_{SOL}) + \beta_{49}(D_{OS})(D_{SMEL}) + \beta_{50}(D_{OS})(D_{GROU}) + \beta_{51}(D_W)(D_{COD}) + \beta_{52}(D_W)(D_{SAL}) + \beta_{53}(D_W)(D_{FLOU}) + \beta_{54}(D_W)(D_{POLL}) + \beta_{55}(D_W)(D_{PER}) + \beta_{56}(D_W)(D_{TUN}) + \beta_{57}(D_W)(D_{MAHI}) + \beta_{58}(D_W)(D_{SWOR}) + \beta_{59}(D_W)(D_{OR}) + \beta_{60}(D_W)(D_{HAL}) + \beta_{61}(D_W)(D_{SOL}) + \beta_{62}(D_{HOL\_1}) + \beta_{63}(D_{HOL\_2}) + \beta_{64}(D_{SB}) + \beta_{65}(D_{ALAS}) + \beta_{66}(D_{PAC}) + \beta_{67}(D_{ATL}) + \beta_{68}(D_{BN}) + \beta_{69}(D_{SM}) + \beta_{70}(\text{SIZE}) + \beta_{71}(D_{PIEC}) + \beta_{72}(D_{STEA}) + \beta_{73}(D_{WHOL}) + \beta_{74}(D_{REMF}) + \varepsilon_{it}$

Previous studies have examined the possibility of a non-linear relationship between price and package size. While this study does not claim that a linear relationship is the best fit, the models performed well (as will be discussed below) and interpretation of the coefficients is straight-forward. The base product (β_0 or INT) in the finfish model is a whole, name brand cod product lacking any special attribute labeling and not sold under promotion or during any of the situational influence time-periods. The base product parameter estimate (the intercept) is interpreted as a product with a package size equal to zero. The base product in the shellfish model is a whole, name brand scallop lacking any special attributes and labeling and not sold under promotion or during and of the "situational influence" time-periods. The base product parameter estimate (the intercept) is interpreted as a product with a package size equal to zero. The base product parameter can be adjusted to reflect a product of different package sizes by summing with the product of the SIZE parameter estimate and the number of ounces in a package (Appendix A).

The explicit models specified above were estimated using PROC AUTOREG in SAS and results for the shellfish and finfish models are shown in Tables 3-1 and 3-3, respectively. More detailed results for each model are discussed in turn.

Shellfish Results

The shellfish model is composed of 38,999 observations with a r-square value of 0.7884. The r-square value indicates that 79 percent of the variation in price is explained by the independent variables. Twenty-seven of the thirty-four variables are significant at the 90% level of confidence or greater.

The intercept value is 11.44 in the shellfish model. This is the predicted price, without adjusting for size, for the base product cod. The predicted price, without adjusting for size, for the other species groups can be determined by taking the sum of the intercept value and the corresponding species group parameter estimate. The predicted price used in determining the magnitude of price effects is adjusted for a package size of 16 oz., which equates to a discount of $1.26 for the shellfish products. This eases interpretation as price is reported in dollars per pound. The magnitude of the promotional, situational and labeling interaction term parameter estimates is calculated in relation to the predicted price for each species group. Table 3-1 contains a summary of the model results and Table 3-2 contains the resulting predicted prices and magnitudes of change for key variables in the shellfish model.

Premiums for Species

With the exception of crawfish, all of the species group variables have parameter estimates significant at the 99% level. Crawfish is significant at the 95% level. The predicted price for SCAL, SQU, LOB, CRAW, MUSS, CLAM and OCT are $10.18, $5.76, $22.02, $9.52, $4.91, $6.71 and $3.36, respectively. These predicted prices are a national average of what may be seen when visiting the frozen food aisle of a grocery store. Lobster is the most highly valued species; with a predicted price more than double that of scallops. Scallops and crawfish both have a predicted price around $10. The variable BAY is accounting for scallops labeled as “bay” scallops. Therefore, the predicted price for SCAL is assumed to be for higher valued sea scallops. Squid, octopus and mussels are species with the lower predicted prices, which is what we would expect to find. These results increase ones confidence in the model.

Implied Value of Promotional Activities

The proportion of promotional sales variable, PRO, has a negative influence on price for all species groups. All of the parameter estimates are significant at the 99% level. The magnitude of promotional price change with respect to the species group predicted value for SCAL, SQU, LOB, CRAW, MUSS, CLA and OCT are -21%, -16%, -27%, -15%, -16%, -18% and -30%, respectively (Figure 3-1). The results are interesting in that the marginal change of price for products sold 100% under promotion does not correlate with the product market share or underlying predicted price. For example, both lobster and octopus have the highest promotional price cuts near 30%, yet lobsters are highly valued while octopus is of low value. Octopus products hold the smallest market share, so large price cuts may be explained by producers trying to increase market share. Many of the weekly observations had PRO values < 1. This is explained by retailers and producers implementing different promotional and non-promotional strategies in different stores or regions during the same time period.

Price Effects from the Deepwater Horizon Oil Spill

The oil spill variable, OS, had both a positive and negative influence on price, depending on the underlying species group. Three of the seven parameter estimates are significant. The magnitude of price change after the oil spill with respect to the species group predicted value for SCAL, LOB and MUSS are -3.9%, -3.7% and 7.3%, respectively (Figure 3-2). These results only cover six weeks following the start of the oil spill, so these price changes are initial reactions to the news. Clams, squid, crawfish, and octopus did not have a significant price change. These four species groups are either (1) not saltwater shellfish or (2) species of lesser value. The two species with price cuts, both scallops and lobsters, are highly valued saltwater species and consumers may have started slowing their purchasing of the more expensive saltwater seafood species. Another thought is that these products, being of higher value, may have larger margins from which to make a price cut. The producers of the lesser valued products may not have had the room in their margins to make a 4% price cut, and may have looked towards other methods of increasing demand (e.g., promotion). Mussels are the species group of shellfish with the highest share of imported products (70%), which are mainly from New Zealand. The price may have been increased on mussel products because consumers were aware that they were coming from waters other than the Gulf of Mexico, and were willing to pay a higher price.

Relative Value of Imported Shellfish

The imported species labeling variable has both a positive and negative influence on price. Five of the six parameter estimates are significant. The magnitude of price change for labeling the product imported with respect to the species group predicted value for SCAL, SQU, LOB, MUSS and CLA are -11%, -34%, 6%, -15% and -14%, respectively (Figure 3-3). Lobsters were the only species with a positive effect for labeling seafood products as imported. This may be a result of the different types of lobsters harvested outside of U.S. waters. Domestically produced lobsters may be less valued in the U.S. market. Imported squid is approximately one-third cheaper than squid products not labeled as imported. Foreign production and processing of this species must be considerably cheaper for a discount of this magnitude to show up in the retail price. The remaining three significant changes are scallops, mussels and clams. These products are all between 10-15% cheaper when labeled as imported, which may be impacting the sales of domestically produced or processed products. Crawfish are not sold as imported and octopus labeled as imported was not significantly different than octopus without the label.

Other Implied Prices for Shellfish

The parameter estimate for HOL_1, which covers the two weeks in mid-February, is not significant. This means that on average, the price of products sold during this time were not significantly different than the price of products sold during other times of the year. Interaction terms between this holiday variable and species may reveal more about shellfish pricing during this time of the year.

The parameter estimate for HOL_2, which covers the two weeks leading up to Christmas, is also not significant in the shellfish model. This variable covered the time period of highest promotion for the shellfish model.

The branding variable, SB, has a negative influence on price. Products sold under the store brand label were on average $3.37 cheaper than the name brand products. Store brand products are generally thought to be cheaper in price, so this result supports our hypothesis and what was previously discovered in the literature pertaining to fish. Store brand products' market share is 8%. Additionally, not all species groups are sold as store brand products. Scallop, squid, lobster and mussel account for 69%, 4%, 24%, and 3% of the store brand products' market share (Table 3-3, Figure 3-4 and Figure 3-5).

The other labeling variables, BAY and SHEL have the following significant parameter estimates: -2.33 and -1.63. BAY is specific to scallop products, being those with the label "bay", and are typically cheaper than sea scallops. The result confirms this hypothesis. SHEL is hypothesized to be negative. According to Ahmad and Anders (2012), product forms and processes which add convenience to the consumer have a positive influence on price. Therefore, products lacking convenience, and requiring additional processing prior to consumption, are expected to have less value. The result confirms this hypothesis.

The size variable has a negative influence. The parameter estimates is -0.079 in the shellfish model. For every ounce of package size, the average price per pound decreases by

$0.08. This has been called the "family pack" discount in the literature, as well as in the market place. Consumers expect to pay less per pound if the purchase is made in bulk.

The product form variables in the shellfish model are either WHOL (base) or PIEC. As expected, consumers on average pay more for product forms which are more convenient and/or ready for consumption (Ahmad and Anders, 2012). The parameter estimates for PIEC is 1.395, supporting this claim.

Finfish Results

The finfish model is composed of 89,101 observations with a r-square value of 0.6470. The r-square value indicates that 65% of the variation in price is explained by the independent variables included in the model. Sixty-one of the seventy-five variable parameter estimates are significant at the 90% level. Table 3-4 contains a summary of the model results and Table 3-5 contains the resulting predicted prices and magnitudes of change for key variables in the finfish model.

The intercept value in the finfish model is 8.208. As in the shellfish results, the magnitude of the promotional, situational and labeling interaction term parameter estimates is calculated in relation to the predicted price for each species group. The predicted price used in determining the magnitude of price effects is adjusted for a package size of 16 oz., which equates to a discount of $0.88 for the finfish products.

Premiums for Species

All of the species group variables have parameter estimates significant at the 99% level besides grouper and tuna. Grouper and tuna are significant at the 90% level. The predicted prices for COD, SAL, TIL, CAT, WHIT, FLOU, POLL, PER, TUN, MAHI, SWOR, HADD, OR, HAL, SOL, SMEL and GROU are $7.33, $8.78, $5.46, $4.80, $3.90, $5.93, $4.42, $6.24, $7.64, $6.86, $8.01, $6.22, $10.20, $12.95, $5.92, $3.58 and $6.91, respectively. The results are what one might expect to find, with catfish, whiting, Pollock and smelt being the less valued species; and cod, salmon, tuna, swordfish, orange roughy, halibut and grouper as the more valued species. Halibut is the most valued species. As in the shellfish premiums for species, these results provide for more confidence in the model.

Implied Value of Promotional Activities

The proportion of promotional sales variable, PRO, has a negative influence on price for all species groups. All of the parameter estimates are significant. The magnitude of promotional price change with respect to the species group predicted value for COD, SAL, TIL, CAT, WHIT, FLOU, POLL, PER, TUN, MAHI, SWOR, HADD, OR, HAL, SOL, SMEL and GROU are -20%, -20%, -22%, -18%, -12%, -21%, -18%, -21%, -25%, -28%, -24%, -19%, -21%, -17%, -17%, -14% and -29%, respectively (Figure 3-6). A surprising similarity to the results from the shellfish model is the species with the highest promotional cut is the species with the lowest market share (Grouper = -30%). Again, the producers of these products may be trying to increase their market share by making large price cuts. The lowest promotional price cuts are made by species with lower predicted prices. These products may not have the room in their margins to make large price cuts. One difference from the shellfish model is the higher valued species as a group only made price cuts between -17 and -22%. Overall, finfish promotional price cuts range from -12% to -30% and shellfish promotional price cuts range from -15% to -30%. The inclusion of interaction terms between species and promotional price change is necessary to understanding how promotions change between products.

Price Effects from the Deepwater Horizon Oil Spill

The oil spill variable, OS, had a generally positive influence on price. Nine of the seventeen parameter estimates were statistically significant. The magnitude of the price change after the oil spill with respect to the species group predicted premiums for SAL, TIL, CAT, FLOU, SWOR, HADD, OR, HAL and SOL of 3%, 4%, 4%, 4%, 3%, 7%, 5%, 7% and 10%, respectively (Figure 3-7).

It was hypothesized that Gulf species would experience a price cut, in order to increase demand of a product consumers may be concerned with eating. However, the results show that for Gulf species, the price did not change significantly. All of the species with significant price changes are either fresh water, or not harvested in the Gulf. The producers which rely of the Gulf of Mexico for harvest were possibly stockpiling their catch, due to the uncertainty of future harvest. Because this data only covers six weeks into the spill, a price adjustment direction may not have been determined at that time. If supply was going to get low, prices should increase *ceterus paribus*. What is interesting is that producers of products not related to the Gulf of Mexico made increasing price adjustment rather soon after the news of the oil spill.

Relative Value of Wild Labeled Finfish

The wild species labeling variable has a generally positive correlation with retail price. Eight of the seventeen parameter estimates were statistically significant. The magnitude of price change for describing the product as "wild" with respect to the species group predicted values for COD, SAL, PERC, MAHI, SWOR, OR, HAL and SOL were found to be higher by 10%, 10%, 41%, 44%, 32%, 44%, 6% and 33%, respectively (Figure 3-8). Interestingly, many of these species such as swordfish and orange roughy are only harvested in the wild. These results show that consumers may not be aware of the production methods currently available for a particular species, and pay a higher price for the label, regardless that alternatives without the label are also harvested wild. The perch, mahi-mahi, swordfish, orange roughy and sole results are surprising; these products received nearly a 50% premium for including the "wild" descriptor on the packaging. Flounder, Pollock and tuna labeled "wild" were not significantly different (on a statistical basis) than non-wild labeled products. Catfish, tilapia, whiting, haddock, smelt and grouper did not have the wild label on any products.

Other Implied Prices for Finfish

The parameter estimate for HOL_1, which covers the two weeks in mid-February, is -0.029 (approximately -$0.03 per pound) and statistically significant. This means that on average, products sold during this time were about three cents cheaper than during other times of the year. While this result is rather small, it was statistically different than the prices during other times of the year. It was hypothesized that products are cheaper during this time of year because it is the onset of Lent, a holiday in which fish is a popular substitute for red meat. The promotional chart (Figure 2-1) supports the claim that this is an important time in fish marketing. This variable may be better explained by interaction terms between this holiday and the species that was beyond the scope of work for this study.

The parameter estimate for HOL_2, which covers the two weeks leading up to Christmas, was not statistically significant in the finfish model. As reasoned with the shellfish model, price changes during this time may be better explained by examining interaction terms between the holiday variable and species that were beyond this study.

The branding variable, SB, indicated that store brands were positively correlated with price per pound. Products sold under the store brand label were, on average, $0.37 more expensive than name brand products. This is not what we would expect to find, and is different than what is reported in the literature (Roheim et al., 2007). Store-branding is associated with higher valued species in the finfish market, for example, catfish products make up 11% of name brand products and 4% of store brand products (Table 3-6, Figure 3-9 and Figure 3-10). Interaction terms could be used to pull apart and better estimate the correlations between branding and price.

The other labeling variables, “Pacific” (PAC), “Atlantic” (ATL), “boneless” (BN) and “smoked” (SM) have the following statistically significant correlations with price paid per pound: -$1.31, $0.99, -$0.48 and $8.99, respectively. The parameter estimate for “Alaska” (ALAS) is not statistically significant. Atlantic labeled products are of higher value than non-labeled products. It is hypothesized that any additional information on the label should increase the price; otherwise producers would leave that information off of the label. This is not true in the case of Pacific labeled products, which received a lower value than non-labeled products. Smoking fish products increased the retail price considerably, which likely reflects that fact that smoking fish is a timely process and alters the flavor distinctively. This research indicated that consumers want this attribute and paid a considerable premium for fish products that are smoked.

The size variable has a negative correlation with price per pound for the primary frozen unbreaded fish and shellfish products sold in the U.S. market. For every ounce of package size, the price of the product decreases by six cents (i.e., $0.055), on average, which supports the strategy of discounted bulk sales.

The product form variables are more extensive in the finfish model than the shellfish. As expected, consumers on average pay more for product forms which are more processed and contain less waste. The parameter estimates for PIEC, WHOL and REMFORM indicated the following prices changes: $0.76, -$0.96 and -$3.45 per pound, respectively. The parameter estimate for STEA (products in the form of “steaks”) was not significantly different from the base of FILL (products in the form of “fillets”). Products that contain a variety of parts ground together (e.g., burgers and loafs) sold at a considerable price discount.

Table 3-1. Shellfish variable means and hedonic model results

			Model results			
Variable	Description	Mean	PE	SE	*t*-Value	*p*-Value
DV	Price adjusted by CPI (base 2007), $/lb.	8.825				
INT	Intercept		11.437***	0.293	38.98	<.0001
Shellfish Species Group						
SCAL	= 1 if Scallop; = 0 otherwise	0.272	BASE			
SQU	= 1 if Squid; = 0 otherwise	0.218	-4.420***	0.273	-16.18	<.0001
LOB	= 1 if Lobster; = 0 otherwise	0.156	11.840***	0.313	37.84	<.0001
CRAW	= 1 if Crawfish; = 0 otherwise	0.139	-0.661**	0.313	-2.11	0.0346
MUSS	= 1 if Mussel; = 0 otherwise	0.109	-5.270***	0.361	-14.60	<.0001
CLAM	= 1 if Clam; = 0 otherwise	0.077	-3.472***	0.381	-9.12	<.0001
OCT	= 1 if Octopus; = 0 otherwise	0.028	-6.816***	0.543	-12.56	<.0001
Promotional Interaction Variables (PRO = Promotional Units Sold/Total Units Sold; = 0 otherwise)						
PRO_SCAL	= PRO * Scallop	0.054	-2.118***	0.041	-52.31	<.0001
PRO_SQU	= PRO * Squid	0.012	-0.939***	0.075	-12.58	<.0001
PRO_LOB	= PRO * Lobster	0.018	-6.030***	0.063	-95.56	<.0001
PRO_CRAW	= PRO * Crawfish	0.007	-1.447***	0.113	-12.79	<.0001
PRO_MUSS	= PRO * Mussel	0.009	-0.776***	0.099	-7.82	<.0001
PRO_CLAM	= PRO * Clam	0.006	-1.213***	0.113	-10.69	<.0001
PRO_OCT	= PRO * Octopus	0.002	-0.999***	0.221	-4.52	<.0001
Oil Spill Interaction Variables (OS = 1 if sold after 4/20/10; = 0 otherwise)						
OS_SCAL	= OS * Scallop	0.012	-0.397***	0.102	-3.92	<.0001
OS_SQU	= OS * Squid	0.010	-0.139	0.108	-1.29	0.1980
OS_LOB	= OS * Lobster	0.007	-0.817***	0.137	-5.97	<.0001
OS_CRAW	= OS * Crawfish	0.005	0.302	0.196	1.54	0.1236
OS_MUSS	= OS * Mussel	0.005	0.358**	0.169	2.12	0.0337
OS_CLAM	= OS * Clam	0.004	0.191	0.198	0.96	0.3347
OS_OCT	= OS * Octopus	0.001	0.435	0.328	1.32	0.1852
Import Label Interaction Variables (IMP = 1 if label contains "Import"; = 0 otherwise)						
IMP_SCAL	= IMP * Scallop	0.080	-1.124***	0.243	-4.62	<.0001
IMP_SQU	= IMP * Squid	0.078	-1.961***	0.264	-7.43	<.0001

Table 3-1. Continued

			Model results			
Variable	Description	Mean	PE	SE	*t*-Value	*p*-Value
IMP_LOB	= IMP * Lobster	0.067	1.306***	0.314	4.16	<.0001
IMP_MUSS	= IMP * Mussel	0.076	-0.752**	0.343	-2.19	0.0284
IMP_CLAM	= IMP * Clam	0.041	-0.941**	0.414	-2.27	0.0231
IMP_OCT	= IMP * Octopus	0.014	-0.002	0.672	0.00	0.9973
Time Event Variables						
HOL_1	= 1 for 2 weeks in mid-February; = 0 otherwise	0.038	-0.003	0.028	-0.12	0.906
HOL_2	= 1 for 2 weeks before Christmas; = 0 otherwise	0.038	-0.013	0.028	-0.45	0.6542
Branding Variables						
NB	= 1 if national retail brand; = 0 otherwise	0.924	BASE			
SB	= 1 if private label brand; = 0 otherwise	0.076	-3.372***	0.561	-6.01	<.0001
Labeling Variables						
REGTYPE	= 1 if no attribute labeling; = 0 otherwise	0.269	BASE			
BAY	= 1 if label contains “bay”; = 0 otherwise	0.078	-2.333***	0.265	-8.81	<.0001
SHEL	= 1 if label contains “shell”; = 0 otherwise		-1.634***	0.286	-5.72	<.0001
Package Size Variable						
SIZE	Size of package, ounces	21.191	-0.079***	0.004	-18.30	<.0001
Product Form Variables						
WHOL	= 1 if whole; = 0 otherwise	0.553	BASE			
PIEC	= 1 if piece, ring, claw, chunk, cut; = 0 otherwise	0.447	1.395***	0.163	8.55	<.0001
Model Statistics						
Observations	38,999					
Total R-Square	0.7884					
Pr > ChiSq	<0.0001					
Durbin-Watson	1.9994					

Note: Level of Significance = 99%***, 95%**, 90%*. Intercept = price of the “base” product of whole scallop, not imported, not on promotion, not sold after the Oil Spill or during the two holiday periods. In addition, the base product has no attribute labeling and is sold under a national retail brand. The package size is 0 oz.

Table 3-2. Shellfish predicted price and interaction effects

Species	Predicted price	Percent change of predicted price for promotional, situational and labeling attribute effects		
		PRO	OS	IMP
SCALL	$10.18	-20.81%	-3.90%	-11.04%
SQU	$5.76	-16.31%	NS	-34.05%
LOB	$22.02	-27.39%	-3.71%	5.93%
CRAW	$9.52	-15.20%	NS	Not imported
MUSS	$4.91	-15.80%	7.29%	-15.32%
CLAM	$6.71	-18.08%	NS	-14.03%
OCT	$3.36	-29.69%	NS	NS

Note: Predicted prices adjusted for size (16 oz.) NS = Parameter not significant ($p > 0.10$).

Table 3-3. Frequencies of name brand and store brand shellfish products by species group

Species	Name brand frequency	Store brand frequency	Name brand percentage	Store brand percentage	Difference in percentage
SCAL	11648	2808	23.7	69.2	45.5
SQU	11440	156	23.3	3.9	-19.4
LOB	7332	988	14.9	24.4	9.4
CRAW	7384	-	15.0	-	-15.0
MUSS	5720	104	11.6	2.6	-9.1
CLAM	4108	-	8.4	-	-8.4
OCT	1508	-	3.1	-	-3.1
SUM	49140	4056	100	100	0.0

Note: Crawfish, Clam and Octopus product not sold under store branding.

Table 3-4. Finfish variable means and hedonic model results

Variable	Description	Mean	Model Results			
			PE	SE	*t*-Value	*p*-Value
DV	Price adjusted by CPI (base 2007), $/lb.	6.267				
INT	Intercept		8.208***	0.124	66.43	<.0001
Fish Species Group						
COD	=1 if Cod; = 0 otherwise	0.073	BASE			
SAL	=1 if Salmon; = 0 otherwise	0.171	1.442***	0.124	11.62	<.0001
TIL	=1 if Tilapia; = 0 otherwise	0.137	-1.875***	0.122	-15.35	<.0001
CAT	=1 if Catfish; = 0 otherwise	0.094	-2.529***	0.134	-18.90	<.0001
WHIT	=1 if Whiting; = 0 otherwise	0.076	-3.432***	0.133	-25.76	<.0001
FLOU	=1 if Flounder; = 0 otherwise	0.072	-1.407***	0.130	-10.86	<.0001
POLL	=1 if Pollock; = 0 otherwise	0.069	-2.917***	0.140	-20.92	<.0001
PER	=1 if Perch; = 0 otherwise	0.057	-1.097***	0.136	-8.04	<.0001
TUN	=1 if Tuna; = 0 otherwise	0.042	0.310*	0.185	1.67	0.0948
MAHI	=1 if Mahi-Mahi; = 0 otherwise	0.038	-0.470***	0.168	-2.79	0.0052
SWOR	=1 if Swordfish; = 0 otherwise	0.038	0.674***	0.220	3.07	0.0022
HADD	=1 if Haddock; = 0 otherwise	0.031	-1.117***	0.154	-7.26	<.0001
OR	=1 if Orange Roughy; = 0 otherwise	0.029	2.862***	0.163	17.53	<.0001
HAL	=1 if Halibut; = 0 otherwise	0.027	5.612***	0.198	28.33	<.0001
SOL	=1 if Sole; = 0 otherwise	0.021	-1.410***	0.194	-7.27	<.0001
SMEL	=1 if Smelt; = 0 otherwise	0.013	-3.751***	0.325	-11.55	<.0001
GROU	=1 if Grouper; = 0 otherwise	0.012	-0.425*	0.224	-1.90	0.0576
Promotional Interaction Variables (PRO=Promotional Units Sold/Total Units Sold; = 0 otherwise)						
PRO_COD	= PRO * Cod	0.020	-1.490***	0.030	-50.44	<.0001
PRO_SAL	= PRO * Salmon	0.045	-1.731***	0.020	-88.69	<.0001
PRO_TIL	= PRO * Tilapia	0.040	-1.194***	0.020	-60.93	<.0001
PRO_CAT	= PRO * Catfish	0.016	-0.888***	0.029	-30.39	<.0001
PRO_WHIT	= PRO * Whiting	0.013	-0.454***	0.032	-14.15	<.0001
PRO_FLOU	= PRO * Flounder	0.017	-1.258***	0.029	-42.93	<.0001
PRO_POLL	= PRO * Pollock	0.013	-0.781***	0.035	-22.54	<.0001
PRO_PERC	= PRO * Perch	0.014	-1.329***	0.033	-39.78	<.0001

Table 3-4. Continued

Variable	Description	Mean	Model Results PE	SE	*t*-Value	*p*-Value
PRO_TUN	= PRO * Tuna	0.010	-1.892***	0.037	-51.13	<.0001
PRO_MAHI	= PRO * Mahi-Mahi	0.009	-1.907***	0.040	-47.95	<.0001
PRO_SWOR	= PRO * Swordfish	0.008	-1.936***	0.043	-45.45	<.0001
PRO_HADD	= PRO * Haddock	0.007	-1.195***	0.041	-28.94	<.0001
PRO_OR	= PRO * Orange Roughy	0.007	-2.179***	0.050	-43.31	<.0001
PRO_HAL	= PRO * Halibut	0.007	-2.194***	0.049	-44.40	<.0001
PRO_SOL	= PRO * Sole	0.005	-1.006***	0.063	-16.08	<.0001
PRO_SMEL	= PRO * Smelt	0.001	-0.509***	0.105	-4.85	<.0001
PRO_GROU	= PRO * Grouper	0.004	-2.023***	0.067	-30.12	<.0001
Oil Spill Interaction Variables (OS = 1 if sold after 4/20/10; = 0 otherwise)						
OS_COD	= OS * Cod	0.003	0.131	0.082	1.60	0.1104
OS_SAL	= OS * Salmon	0.007	0.272***	0.053	5.15	<.0001
OS_TIL	= OS * Tilapia	0.006	0.229***	0.058	3.94	<.0001
OS_CAT	= OS * Catfish	0.004	0.168**	0.072	2.33	0.0197
OS_WHIT	= OS * Whiting	0.003	-0.059	0.075	-0.78	0.4375
OS_FLOU	= OS * Flounder	0.003	0.256***	0.081	3.16	0.0016
OS_POLL	= OS * Pollock	0.003	0.008	0.085	0.09	0.9266
OS_PERC	= OS * Perch	0.003	0.121	0.095	1.27	0.2025
OS_TUN	= OS * Tuna	0.002	0.109	0.112	0.97	0.3297
OS_MAHI	= OS * Mahi-Mahi	0.002	0.010	0.121	0.08	0.9344
OS_SWOR	= OS * Swordfish	0.002	0.256**	0.127	2.02	0.0438
OS_HADD	= OS * Haddock	0.001	0.426***	0.126	3.39	0.0007
OS_OR	= OS * Orange Roughy	0.001	0.533***	0.149	3.57	0.0004
OS_HAL	= OS * Halibut	0.001	0.853***	0.136	6.29	<.0001
OS_SOL	= OS * Sole	0.001	0.567***	0.178	3.19	0.0014
OS_SMEL	= OS * Smelt	0.001	0.233	0.178	1.31	0.1916
OS_GROU	= OS * Grouper	0.001	0.262	0.210	1.25	0.2124
Wild Label Interaction Variables (WILD = 1 if label contains "Wild"; = 0 otherwise)						
W_COD	= WILD * Cod	0.012	0.763***	0.218	3.50	0.0005

Table 3-4. Continued

Variable	Description	Mean	Model Results PE	SE	*t*-Value	*p*-Value
W_SAL	= WILD * Salmon	0.039	0.910***	0.149	6.10	<.0001
W_FLOU	= WILD * Flounder	0.005	0.149	0.302	0.49	0.6215
W_POLL	= WILD * Pollock	0.001	-0.165	0.605	-0.27	0.7855
W_PERC	= WILD * Perch	0.001	2.637***	0.523	5.05	<.0001
W_TUN	= WILD * Tuna	0.006	-0.017	0.314	-0.05	0.9569
W_MAHI	= WILD * Mahi-Mahi	0.004	3.000***	0.361	8.32	<.0001
W_SWOR	= WILD * Swordfish	0.003	2.536***	0.419	6.05	<.0001
W_OR	= WILD * Orange Roughy	0.001	4.493***	0.509	8.82	<.0001
W_HAL	= WILD * Halibut	0.005	0.763**	0.341	2.24	0.0254
W_SOL	= WILD * Sole	0.003	1.943***	0.428	4.54	<.0001
Time Event Variables						
HOL_1	= 1 for 2 weeks in mid-February; = 0 otherwise	0.038	-0.029***	0.011	-2.79	0.0053
HOL_2	= 1 for 2 weeks before Christmas; = 0 otherwise	0.038	0.003	0.011	0.26	0.7963
Branding Variables						
NB	= 1 if name brand; = 0 otherwise	0.796	BASE			
SB	= 1 if private label brands; = 0 otherwise	0.204	0.370**	0.147	2.52	0.0116
Labeling Variables						
REGTYPE	= 1 if no attribute labeling; =0 otherwise	0.496	BASE			
ALAS	= 1 if labeled as Alaskan; = 0 otherwise	0.066	-0.038	0.125	-0.30	0.7614
PAC	= 1 if labeled as Pacific; = 0 otherwise	0.051	-1.310***	0.123	-10.63	<.0001
ATL	= 1 if labeled as Atlantic; = 0 otherwise	0.024	0.995***	0.176	5.64	<.0001
BN	= 1 if labeled as Boneless; = 0 otherwise	0.264	-0.482***	0.065	-7.40	<.0001
SM	= 1 if labeled as Smoked; = 0 otherwise	0.024	8.987***	0.160	56.11	<.0001
Package Size						
SIZE	Size of package in ounces	20.855	-0.055***	0.002	-34.83	<.0001
Product Form						
FIL	= 1 if Fillet; = 0 otherwise	0.774	BASE			

Table 3-4. Continued

			Model Results			
Variable	Description	Mean	PE	SE	*t*-Value	*p*-Value
PIEC	=1 if Piece, Strip, Nugget; = 0 otherwise	0.118	0.764***	0.086	8.85	<.0001
STEA	=1 if Steak; = 0 otherwise	0.081	0.054	0.155	0.35	0.7253
WHOL	=1 if Whole; = 0 otherwise	0.037	-0.962***	0.160	-6.02	<.0001
REMF	= 1 if Ground, Loaf, Burger; = 0 otherwise	0.017	-3.450***	0.193	-17.86	<.0001
Model Statistics						
Observations	89,101					
Total R-Square	0.6470					
Pr > ChiSq	<0.0001					
Durbin-Watson	1.9955					

Note: Level of Significance = 99%***, 95%**, 90%*. Intercept = price of the "base" product of fillet cod, not labeled wild, not on promotion, not sold after the Oil Spill or during the two holiday periods. In addition, the base product has no attribute/origin labeling and is sold under a national retail brand. The package size is 0 oz.

Table 3-5. Finfish predicted price and interaction effects

		Percent change of predicted price for promotional, situational and labeling attribute effects		
Species	Predicted Price	PRO	OS	WILD
COD	$7.33	-20.32%	NS	10.40%
SAL	$8.78	-19.72%	3.10%	10.37%
TIL	$5.46	-21.88%	4.20%	No Wild
CAT	$4.80	-18.49%	3.50%	No Wild
WHIT	$3.90	-11.65%	NS	No Wild
FLOU	$5.93	-21.23%	4.33%	NS
POLL	$4.42	-17.69%	NS	NS
PER	$6.24	-21.31%	NS	40.66%
TUN	$7.64	-24.75%	NS	NS
MAHI	$6.86	-27.78%	NS	43.71%
SWOR	$8.01	-24.18%	3.20%	31.67%
HADD	$6.22	-19.22%	6.85%	No Wild
OR	$10.20	-21.37%	5.22%	44.07%
HAL	$12.95	-16.95%	6.59%	5.90%
SOL	$5.92	-16.98%	9.57%	32.81%
SMEL	$3.58	-14.21%	NS	No Wild
GROU	$6.91	-29.28%	NS	No Wild

Note: Predicted prices adjusted for size (16 oz.) NS = Parameter not significant ($p > 0.10$).

Table 3-6. Frequencies of name brand and store brand finfish products by species group

Species	Name brand frequency	Store brand frequency	Name brand percentage	Store brand percentage	Difference in percentage
COD	5876	2028	6.8	9.22	2.4
SAL	14612	3848	17.0	17.49	0.5
TIL	13260	1560	15.4	7.09	-8.3
CAT	9308	884	10.8	4.02	-6.8
WHIT	7072	1144	8.2	5.20	-3.0
FLOU	6292	1456	7.3	6.62	-0.7
POLL	6708	728	7.8	3.31	-4.5
PERC	4472	1716	5.2	7.80	2.6
TUN	3068	1508	3.6	6.86	3.3
MAHI	3172	936	3.7	4.26	0.6
SWOR	2496	1560	2.9	7.09	4.2
HADD	2288	1040	2.7	4.73	2.1
OR	2340	780	2.7	3.55	0.8
HAL	1248	1664	1.5	7.57	6.1
SOL	1508	728	1.8	3.31	1.6
SMEL	1404	-	1.6	-	-1.6
GROU	832	416	1.0	1.89	0.9
SUM	85956	21996	100.0	100.0	0.0

Note: Smelt product not sold under store branding.

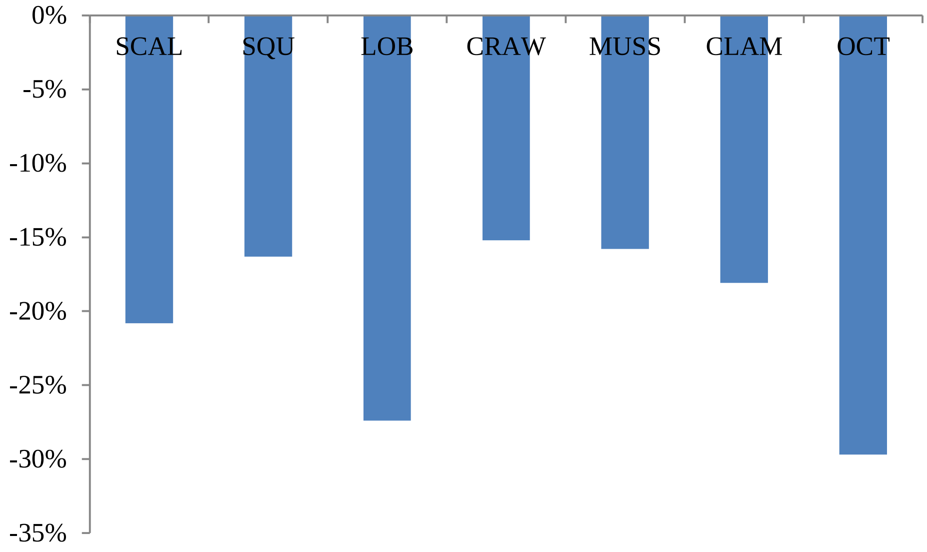

Figure 3-1. Percent change of predicted price for promotional sales by shellfish species group

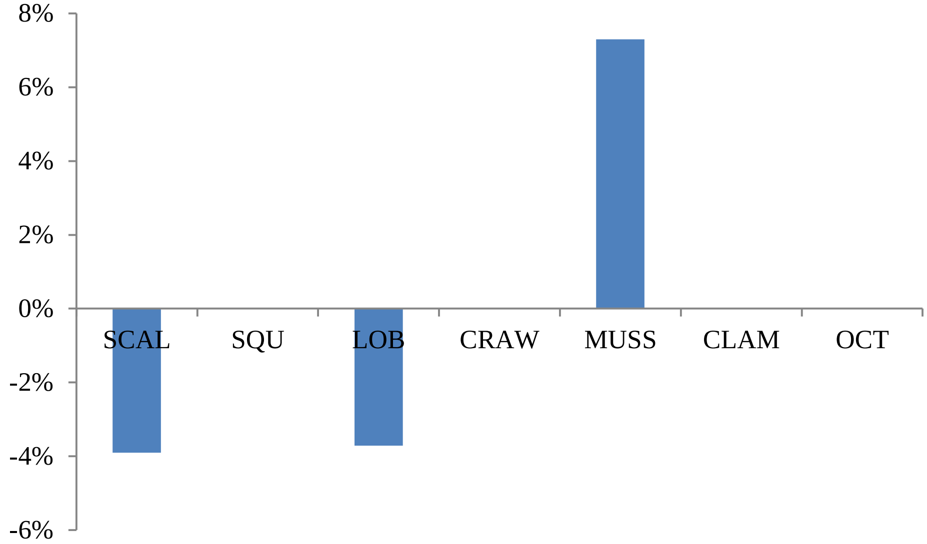

Figure 3-2. Percent change of predicted price after the Gulf of Mexico oil spill by shellfish species group

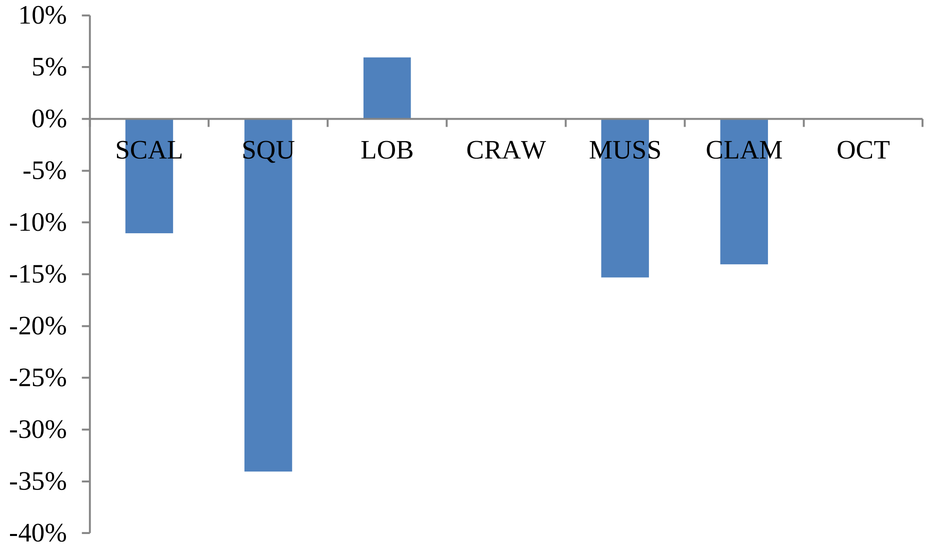

Figure 3-3. Percent change of predicted price for import labeling by shellfish species group

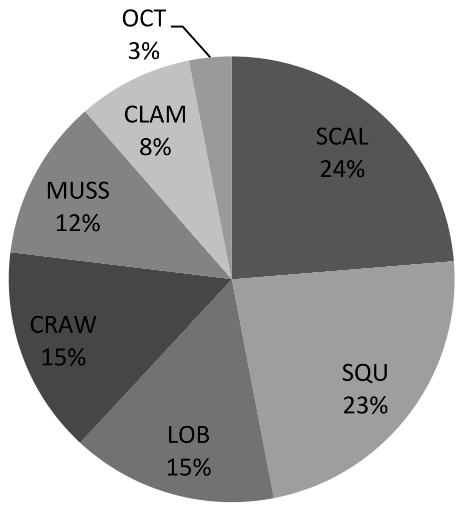

Figure 3-4. Shellfish name brand products' market share by species group

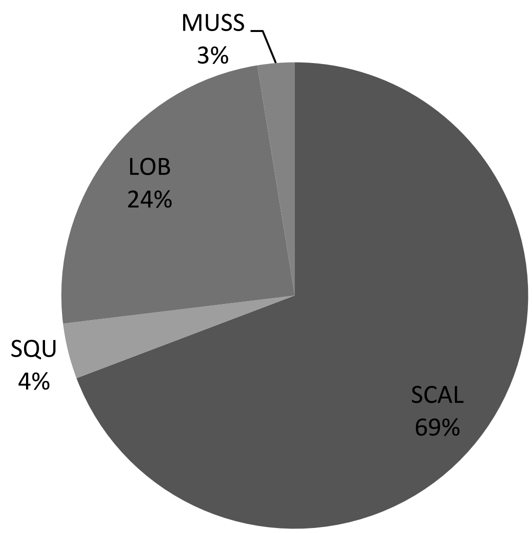

Figure 3-5. Shellfish store brand products’ market share by species group

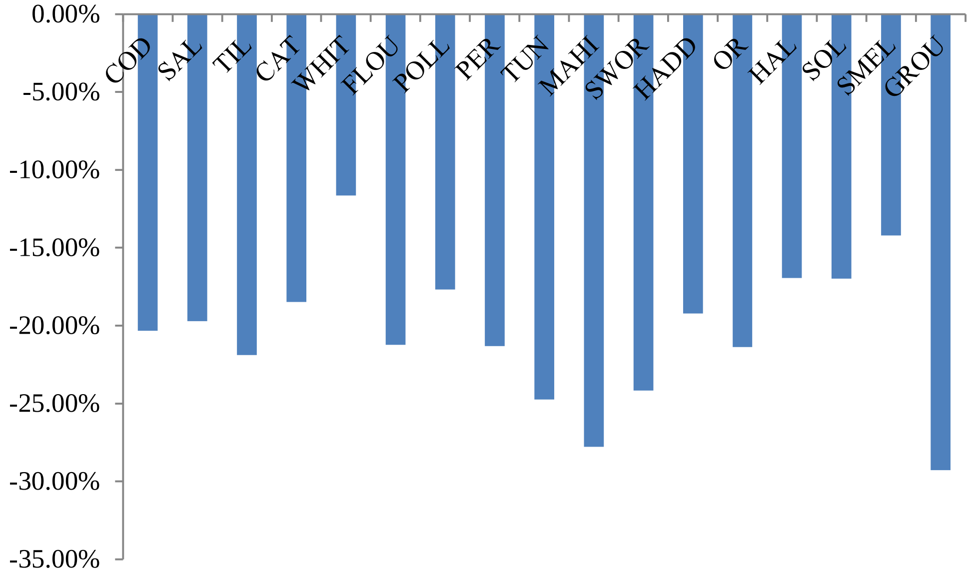

Figure 3-6. Percent change of predicted price for promotional sales by finfish species group

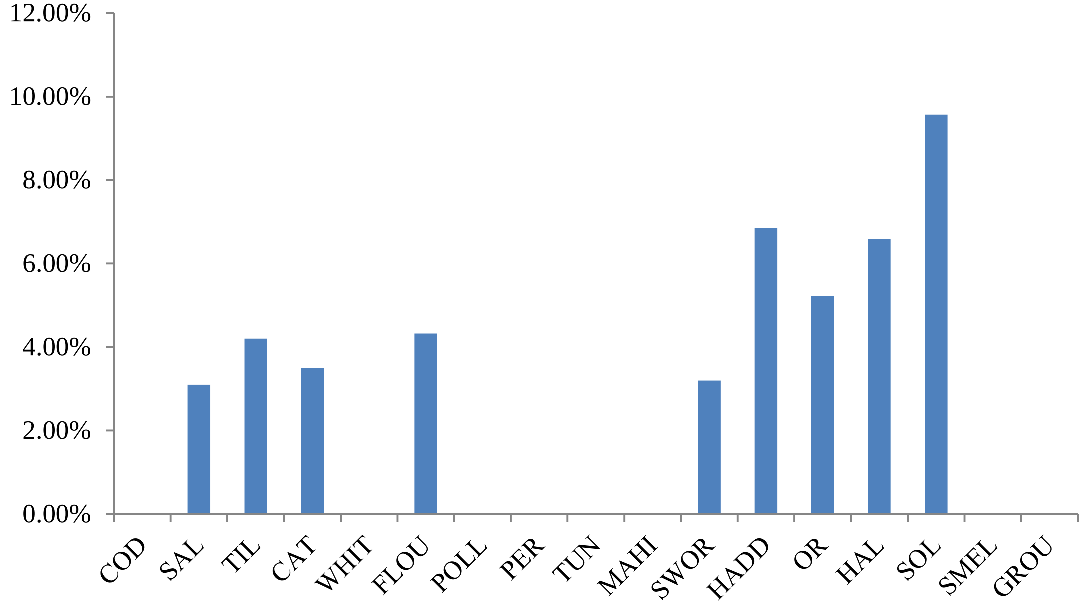

Figure 3-7. Percent change of predicted price after the Gulf of Mexico oil spill by finfish species group

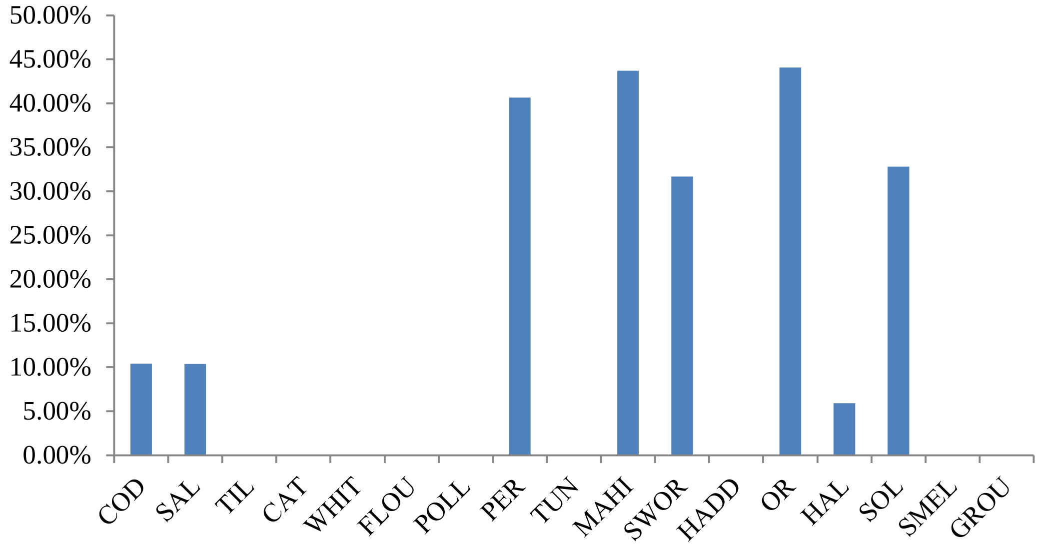

Figure 3-8. Percent change of predicted price for wild labeling by finfish species group

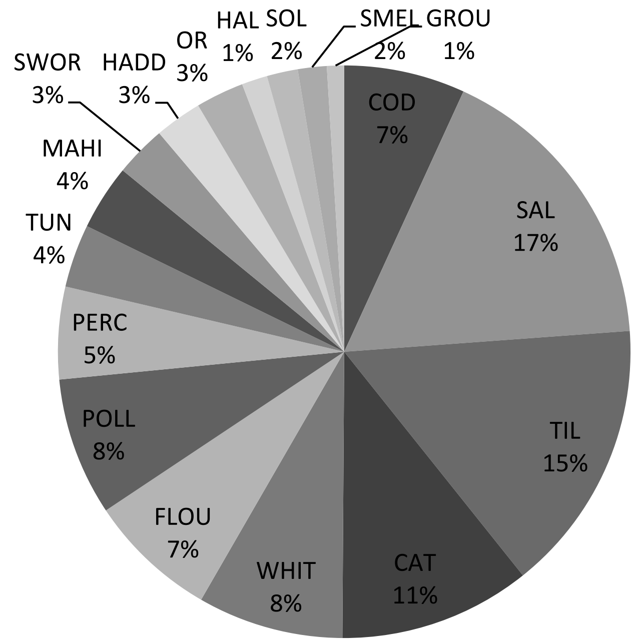

Figure 3-9. Finfish name brand products' market share by species group

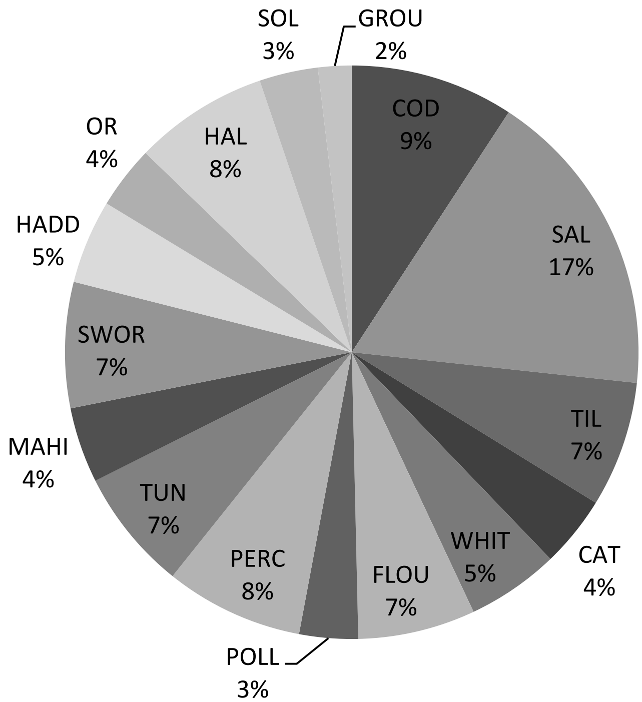

Figure 3-10. Finfish store brand products' market share by species group

CHAPTER 4
CONCLUSIONS

Summary of the Study

The objective of this paper was to use ACNielsen Scantrack data to estimate price premiums and discounts associated with frozen finfish and shellfish products at the retail level in the U.S. Consumers revealed preferences for product attributes were determined using weekly sales data aggregated by UPC for each type of product (finfish or shellfish, exclusive of oysters, shrimp and crab). Additionally, the use of interaction terms between attributes and species of shellfish and finfish was tested as necessary to understand the additional dimensions of a product attribute. It was determined that interaction terms were needed to fully understand an attributes contribution to the overall price of the product. Both product and situational attributes were explored, specifically price effects of promotion, labeling (as “wild” finfish or “imported” shellfish) and the 2010 oil spill that occurred in the Gulf of Mexico.

Summary of the Results

The promotional, labeling and time-event attributes varied significantly between shellfish and finfish, as well as species within each product category. The holiday variables were not significant in the shellfish model. The mid-February variable that captures Valentine’s Day and the onset of Lent was significant in the finfish model, but has a rather small parameter estimate (-$0.03/lb.). Private label brands are significantly cheaper in the shellfish model and significantly more expensive in the finfish model, reducing price by $3.37 per pound and increasing price by $0.37 per pound, respectively. Consumers pay $1.63/lb. less for a shellfish product which contains the shell. Products which are prepared and closer to cook-ready fetch a higher price. Whole fish products are $0.96/lb. cheaper than fillet products, on average. Highly processed fish products (e.g. ground, burger, loaf) sell at a price discount of $3.45. The negative relationship between package size and price per pound is confirmed. For every ounce of package size, shellfish products average price per pound decrease by $0.08 and finfish products average price per pound decrease by $0.06.

Findings

By examining the promotional variable (PRO) estimates and descriptive statistics, it is determined that the finfish market is more heavily involved in promotional behavior than the shellfish market. Both shellfish and finfish adjusted weighted price per pound decreases as proportion of promotional sales increases. This finding supports that promotional activities for these products are as traditionally assumed (i.e., that the products went "on sale," meaning they sold for a lower price), and promotional activities on average are those that involve price discounts. A higher percentage of finfish products are sold under promotion than shellfish products.

Following the Deepwater Horizon Oil Spill, the finfish and shellfish markets reacted differently. Only the shellfish market exhibited a statistically significant price decrease for any species, scallops and lobsters, which were also the two most expensive species groups. This price decrease may be explained by scallop and lobster retailers and producers attempting to increase demand for seafood during a time in which its safety in question. Mussels exhibited a large increase in price. A large proportion (~75%) of mussels are labeled "imported." This is higher than any other species group. This price increase may be explained by the foreign producers believing that their product is more valuable because it comes from waters not associated with the spill. In the finfish market, it was observed that species which are not harvested in the Gulf of Mexico increased in price following the oil spill. Salmon, tilapia, catfish, flounder, swordfish, haddock, orange roughy, halibut and sole all exhibited price increases following the oil spill

These data only encompass six weeks of sales, covering the initial reaction of the market to the oil spill. Some may debate that the oil spill had just started during this time period, and all the products on the shelf had more than likely been harvested prior to this disaster. However, such an event acts as a reminder to consumers of past disasters, and revives past questioning of seafood's safety. For example, the Exxon Valdez disaster happened more than 20 years ago, but consumers may begin to question Alaskan seafood once again because they are reminded of safety concerns due to the new oil spill far from the Alaskan fisheries. According to a review in the *Journal of Environmental Health Perspectives*, NOAA initiated the first fisheries closures on May 2nd and expanded closures to nearly 84 thousand square miles by the beginning of July (Gohlke et al., 2011). The data end prior to the reopening of closed areas (i.e., June 23rd). Alternatively, the lack of a statistically significant price decrease for Gulf-sourced species (e.g., grouper) may also be due to the aggregation of all regional markets, or that there simply was not an effect.

Finfish products with the descriptor "wild" on the packaging received a price premium in comparison to products without this descriptor. The price premium varied based on the species. The magnitude of this price premium varied from as much as 44% on orange roughy to 6% for halibut. This evidence could be used to support a movement by the industry to adopt a regulatory body which ensures products are being labeled correctly. These results dismiss the need for paying the high cost associated with eco-labeling certification program such as the Marine Stewardship Council (MSC). Although this variable encompasses products not eco-label certified, the results show that the wild label fetches a price premium in excess of the MSC label (Roheim et al., 2011). It should also be noted that the products were not examined to determine if the wild labeled product was also MSC certified.

The majority of imported products in the shellfish market were sold at a price discount. The only product that sold at a premium in the U.S. market during the study period when labeled "imported" was lobster. Scallops, squid, mussels, and clams were all sold at a price discount with "imported" on the packaging.

These models serve as an overall representation of the United States market for selected frozen and unbreaded shellfish and finfish. Specific regional models are necessary to reveal intricacies unable to be detected by these general models. The Simpson Paradox is a phenomenon which "occurs when a relationship that exists for all subgroups of a population disappears when the data are aggregated for the whole population" (Klass, 2008). Breaking this data apart and analyzing specific subgroups of interest could yield more explanatory results.

Key Results and Implications

Intangible attributes such as promotional behavior, the Gulf Oil Spill and various labeling practices were found to have statistically significant correlation with (and relative magnitude of), the price consumers paid for some seafood products in the United States. It was determined that interaction terms were necessary to understand the multiple dimensions of these attributes, as suggested by Ahmad and Anderson (2012).

Natural disasters, as well as disasters which are caused by man are highly unpredictable. The effects such disasters have on our natural resources are hard to assess, as are the total costs. By using interaction terms, this study is able to detect changes in the average market price of seafood products by species after the Gulf oil spill occurred. Since the oil spill, the tsunami and nuclear disaster in Japan has increased concern over highly migratory species in the Pacific Ocean. Using the methodology presented in this thesis and more current data, a similar study to assess changes in the average market price for highly migratory species in the Pacific Ocean could be developed.

As expected in the US market, the store brand shellfish products are cheaper than name brand products. Store brand products in the finfish model were of higher value than name brand finfish products, selling for an average of $0.37 more than name brand products. This store brand price premium is opposite the general consumer perception and findings from the US market (Halstead and Ward, 1995). However, British retailers' own-label products were found to demand a price premium in the UK market (Roheim et al., 2007). In both the finfish and shellfish markets, the market share of name brand and store brand products by species group indicate lesser valued species groups are less present under the store brand.

The general consumer perception for imported products is that they are cheaper than domestically produced alternatives. This is proven to be untrue by the shellfish model. For example, imported lobsters fetched a higher price than domestically harvested lobsters. This may be due to the species of lobster imported. Domestically produced lobster may be of less value to U.S. consumers than the imported species.

Labeling finfish as wild increases the value in a number of species, by a margin of nearly 50% in some cases. For example, the 14% price premium of Marine Stewardship Council Alaskan Pollock sold in London, as determined by Roheim et al. (2010). The discovery of such a high premium may influence the industry to adopt a wild certification program, or improve self-regulation. Many of the species with price premiums for wild labeling did not have a farmed fish option. Consumers may not be aware of the different production methods based on fish species.

Future Work

This preliminary analysis of using "scanner" data to examine the implicit prices of seafood product attributes has revealed much about the potential and limitations of future revealed preference work. Additional analyses that could be conducted to improve the analyses presented here include:

- Expand on the situational variables to better capture or expand on the points of interest in time. Dummy variables could be assigned to the exact weeks Lent occurs over the three year period rather than just capturing the onset. Thanksgiving is a time of low finfish promotions. It may be of interest to explore price changes of species groups during this time.
- The Oil Spill coefficient can be expanded on and better understood by focusing on subsets of the national data, i.e. using regional data. Within these subset models, it may be of more value to examine only those species harvested in the Gulf of Mexico.

Due to the richness of the entire dataset, several other avenues of research are likely to provide additional information on seafood marketing in the U.S. including the following:

- While choosing to examine a large, nationwide dataset is an ideal starting point for market analysis, restricted sample models could be used to reveal the market intricacies which are unable to be detected at such a large scale. Future work should explore the possibility of the Simpson paradox existing in relation to specific markets (either by Census region or major market areas for example) within the United States. For example, the possibility exists that the price effects from the oil spill estimated in this model are conservative, as the data encompasses areas which may not have been concerned or were not aware (particularly at that point in time). Examining a similar model using only regions around the Gulf of Mexico may yield different results. Promotional behaviors may also vary based on the possibilities of recreational harvesting seasons; regions of which a specific species is unable to be harvested by the consumer (e.g., halibut in Florida) may exhibit different promotional behaviors than regions which harvest is possible.

- Estimation and model specification techniques as used by the Roheim et al. (2011) study of Alaskan Pollock may be applied to the examination of two species within two markets of the United States. The ability to estimate "locally" produced species may be possible through restricting the two included species to those which are commonly harvested in such areas. For example, models which estimate the implicit prices for Pacific Salmon and Atlantic Grouper could be compared between the Jacksonville, FL and Seattle, WA markets.
- To examine the value of alternative product forms for a given species, data could be pooled across the 19 files to allow for estimation of implicit prices related to more highly processed products.

APPENDIX
DEVELOPMENT OF THE DEPENDENT VARIABLE

Non promotional price per package:

(PRICE) = (non-promotional sales (USD$))/ (non-promotional units (packages))

Promotional price per package:

(P_PRICE) = (promotional sales (USD$))/ (promotional units (packages))

Pounds per package:

(PACKLBS) = (SIZE/16)

Proportion of promotional sales:

(PRO) = (promotional units sold)/ (total units sold)

Weighted price:

(WPRICE) = (P_PRICE * PRO) + (PRICE * (1-PRO))

The Consumer Price Index variable is assigned to each observation using a time series identification variable. The time series identification variable is calculated with YEAR and WEEK. For example, if YEAR = 3 and Week = 52 then TSID = 156. The value for the Consumer Price Index when TSID = 1 is 202.416.

Consumer Price Index base 2007 adjustment variable:

(CPIBASE7) = (CPI/202.416)

Adjusted weighted price using Consumer Price Index base 2007:

(ADJ_WPRICE) = (WPRICE/CPIBASE7)

Adjusted weighted price per pound:

(ADJ_WPRICE_LB) = (ADJ_WPRICE/PACKLBS)

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BIOGRAPHICAL SKETCH

Glen Gold was a University of Florida master's student in the Department of Food and Resource Economics. A native Floridian, his interest in fisheries began when he was a child. Fishing, boating and enjoying the outdoors were common weekend activities for Glen growing up. He has experienced the detrimental effects of natural resource overuse first-hand, when the neighborhood lake was dry for several years due to over pumping of the aquifer. After completing a number of data analysis and econometrics courses, Glen was offered the opportunity to work with real market data as a research intern with the Institute of Food and Agricultural Sciences. This summer internship developed into a Graduate Research Assistant position during his last year of studies. Glen also worked at Santa Fe College as a Graduate Assistant in the Student Life Business Office. He completed his bachelor's degree with honors in spring of 2011 and his master's degree in summer of 2012.