WHAT IS THE FUTURE OF BRAND NAME BEEF?
A PRICE ANALYSIS OF BRANDING INCENTIVES AND OTHER ATTRIBUTES FOR RETAIL BEEF USING SALES SCANNER DATA

by

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Abstract

It is clear that consumers rely on certain experience and credence attributes when purchasing beef products from the retail meat case. It is essential for all beef industry sectors to recognize the complexity of consumers buying behavior. The objective of this research is to determine if there are incentives to brand beef products and to determine what types of brands entertain price premiums as well as what levels these premiums exists.

Retail scanner data, collected from 2004 through March 2009, was used for the evaluation of branded beef and also to determine what other product attributes benefit with a premium to six specific cuts of beef. Hedonic models were estimated using Ordinary Least Squares regressions to determine which variables affected the overall price per pound of each of the six cuts of beef chosen to analyze.

Results indicate that there is an incentive to brand beef products at the retail level. Local, regional, national, and store brands all garnered premiums across the six models for the beef cuts, steak, roast, ground, strip, cube, and ribs in relation to products with no brand. Other variables that garnered premiums across all models include organic, Prime quality grade, and Kosher and Kosher-Glatt religious labels. Steak exhibited the highest mean price per pound followed by cube, roast, strip, ribs and ground. In all of the models estimated explaining price variation, there were few coefficients that were statistically insignificant.

Additional modeling was done to determine if outlier observations were influencing the regression results. The sensitivity analyses resulted in small changes in parameter estimates indicating the identified influential observations did not have undue impact on the parameter estimates.

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CHAPTER 1 - Introduction

Today's consumers demonstrate a desire for beef products with specific attributes that satisfy their palate for beef along with the emotional factors attached to these products that affect their overall consumption of beef. Patterns in behavior have shown that consumers are concerned with, not only, price and taste, but recently emerging is their demand for certain attributes that are not considered experience attributes. These external factors or credence characteristics can include attributes that pertain to animal welfare, organic vs. nonorganic, and religious practices. Branding beef has created niche markets that attract consumers that are willing to pay a price premium for products that carry certain desirable attributes. As producers discover more about branding beef, questions arise regarding the incentives to brand. The main objective of this research is to determine what types of brands entertain price premiums and at what levels these premiums exist. The resulting analysis will help the industry better position beef products in the retail market to enhance consumer loyalty.

1.1 Background

As Barkema (1993) points out in the article "Reaching Consumers in the Twenty-First Century: The Short Way Around the Barn," consumers are becoming more discriminating in their food purchasing decisions. The consumer's view on the meat industry has changed over the last ten years due to a variety of issues including food safety, animal welfare, and health consciousness. Barkema discusses the increase in nutritional concern and also the fact that technology has enabled the food industry to provide more niche markets. Innovative products are geared toward consumers who spend less time in the kitchen. Brands can be considered a tool for consumers to reduce the chance of making a disappointing purchase (Ward, Lusk, and

Dutton, 2008a). If a purchase of a branded product brings satisfaction to a consumer they will associate the particular brand with consistent quality and will more than likely purchase the brand again.

It is beneficial to examine the impact of consumer purchasing behavior in order for the beef industry sectors to better serve the consumer's needs and, in return, increase marketability and profitability. Also, providing the customer with a desirable product can be profitable for producers. Retail scanner data is an innovative data collection process that offers accurate volume weighted pricing data which reveals what consumers are purchasing and how much they are spending in the store on beef. National Cattlemen's Beef Association along with other industry leaders regularly conducts thorough market research, especially in the grocery retail meat case. Specifically, Sealed Air's Cryovac Food Packaging, The Beef Checkoff, and the National Pork Board have conducted National Meat Case Studies in 2002, 2004, and 2007. The 2007 National Meat Case Study results "not only provide a benchmark for changes that have occurred, but can also be used to aid development of new marketing applications for incremental fresh meat growth" (Sealed Air Corporation Cryovac Division, The Beef Checkoff, and National Pork Board Retail Marketing, 2007). Findings reflected the current economic conditions, as well as the growth in the natural and organic markets. Behind chicken, ground beef had the highest number of packages with a natural claim associated with it (Sealed Air Corporation Cryovac Division, The Beef Checkoff, and National Pork Board Retail Marketing, 2007). One of the most significant results of this study showed that the majority of beef was branded for the first time since the National Meat Case Studies conducted market research. Beef exhibited the greatest reallocation of branding in 2007 with the most significant shifts in store brands relative to no brand and supplier brand products.

Today's consumer has a variety of choices in the retail beef case and some would argue that there are too many options; therefore, causing the consumer to be confused. The amount of branded beef products being offered has seen a steady incline in the past few years and continues to try to capture consumer loyalty. Branding beef "puts emphasis on the development of new and different product attributes, rather than emphasizing traditional product values" (Outlaw, Anderson, and Padberg, 1997, p. 42). Actual sales scanner data not only address what products are being purchased and at what volume, but they also provide detailed information about the characteristics that different beef products possess.

1.2 Objectives

This study will provide information for all industry sectors as to how the consumer is purchasing beef and also what is constituted as a discount or a premium to the individual price of certain beef cuts. More specific information about the data will be presented in Chapter 3. The main objectives for this research will be addressed thoroughly in the paper and more specifically in the results chapter. Through a contract with the National Cattlemen's Beef Association, the FreshLook Marketing Group and Meat Solutions, LLC. has provided data for the evaluation of the effects that multiple product attributes have on the price of six chosen cuts of beef. Objectives for this research will focus on the importance of branding beef. Specific objectives include:

- Determine if branding beef is considered a sales incentive for producers, processors, breed associations, etc. by estimating whether a premium or a discount is exhibited for branded products relative to unbranded products available in the market.

- Analyze if local, regional, national, and store brands garner different price premiums for individual beef cuts and if there is any comparison in brand premiums across various beef product cuts. Are there particular brand categories (local, regional, national, store) that provide evidence as to what types of brands consumers prefer?
- Estimate what other product attributes, such as an organic claim or a certain quality grade, affect the individual retail price for steaks, roasts, strips, cubes, ground beef, and ribs.
- Determine if there is a certain brand category that is consistent across the beef cut categories which has the highest premium amount. If so, does this imply that producers should consider certain target markets based upon brand demand?

1.3 Thesis Organization

The presentation of the thesis research is organized into seven chapters. Chapter 2 discusses previous literature related to this thesis and is divided into several key sections including scanner data research, previous hedonic modeling, and several papers looking at branding beef as well as the importance of other product attributes and labeling. Chapter 3 will discuss the source of the data. Also to be achieved in this section will be the comparison between the FreshLook Marketing Group data and the Livestock Marketing Information Center data, as well as, the Bureau of Labor Statistics data. Chapter 4 will present the theoretical model developed for this research. The theory section will explain the framework behind the estimated models. Chapter 4 will also empirically examine the theoretical models and define the variables used for estimation. The functional form of the models will be explained as well as the expected signs of the independent variables. The OLS procedure will be mentioned and will include the reasons for using this estimation method. Chapter 5 will concentrate on the results of the OLS regression analysis. It will be separated into the results for the six different beef cuts used for evaluation. There is also a section that will compare and contrast the individual models. The last section will briefly present the results of a log-linear model as an alternative to the linear regression presented in the earlier sections of Chapter 5. Chapter 6 will present influence diagnostics regression results and will compare the results to the linear regression and parameter estimations discussed in Chapter 5. In closing, Chapter 7 will summarize the models and results. The conclusion will specifically address the implications of the results and suggest further research.

CHAPTER 2 - Literature Review

Extensive research has been done to analyze price determinants of fresh meat products. A range of studies has focused on product attributes, labeling and branding information, willingness to pay, and hedonic pricing of fresh beef. Consumer surveys have been used as well as pricing models and tenderness evaluation methods to assess the current situation in the beef retail market. As the economy struggles to regain strength, it is important to assess consumers' purchasing behaviors in order to makes improvements or changes to the products being supplied.

2.1 Branding Beef

Important for assessing product attributes is the understanding of branding incentives and recognizing that different brand categories offer a variety of quality and price. "Assessing the Competitive Interaction between Private Labels and National Brands," by Cotterill, Putisis, and Dahr (2000) analyzes the price differentiation between private labels and national brands. The empirical framework is developed using the "LA/AIDS functional form" to derive the demand side specifications to assess the competitive interaction between private labels and national brands. The data used in the empirical estimation is from Information Resources, Inc. This data includes food products from 59 geographical markets. Used from 1991 to 1992 were 125 categories with average coverage of 54 cities in a typical category. A three-stage least squares method was used to model the interaction between national brands and private labels. The results are presented in two sections. The first section is the pooled cross-category results which suggest that the differences in prices between national brands and private labels narrows in grocery markets focused primarily on local products. Another important finding worth noting is in categories where private label share is high, price is very important as opposed to categories where private label share is low, price is not an important strategic component. Intracategory results also show that when national brands display advertisements private label share of the market is lower. This result suggests that retailers can use price as a "strategic weapon" where extensive advertisement of national brands is present. Overall the results concur that the higher the price of either national brands or private label the less share of the market they will have.

"Economics of Food Labeling," by Golan, Kuchler, and Mitchell (2000) looks at the government involvement in food labeling. The paper presents three case studies where labeling decisions involved federal intervention and two examples where federal intervention has been proposed. It was found that the implementation of mandatory food labeling alleviates problems with asymmetric information and increases information for consumers. In order to enhance customer knowledge about a product, the product's desirable attributes are positioned on the label to entice consumers. Product attributes consist of credence attributes, search attributes, and experience attributes. The article presents a cost-benefit analysis where firms will include more desirable attributes as long as profit exceeds cost. Although producers may want to hide negative attributes, the article presents that this is difficult because of consumer skepticism, warranties, and firm competition. The government also regulates what information must be included on labels for consumer safety purposes. One example of labeling presented in the paper is organic labeling. There is an increase in demand for organic foods which can be translated into a higher price for organic products. Because organic products are credence goods the only way for the consumer to know the product is organic is by the labeling. Government intervention is important in establishing regulations for organic production in order to maintain consistent national organic standards. Another example presented in the paper provides information on biotech food labeling and the government interaction associated. A cost-benefit analysis is considered when looking at mandatory labeling. If the government established labeling requirements, the effectiveness of addressing problems such as externality issues is debatable. Overall, the paper presents examples in attempt to explain the proposed theories. It is important to note that the authors are looking at the establishment of successful mandatory labeling. They conclude that labeling could be a suitable policy tool when consumers prefer different products, when information is clear and to the point, when information aids the consumer in avoiding risk is important, when consumers bear the cost and benefits of consumption, when quality standards, testing services, and enforcement mechanisms can be implemented, and when no political compromise exists on the appropriate regulation response.

"Willingness-to-pay for fresh brand name beef," by Froehlich, Carlberg, and Ward (2009) analyzes consumers' willingness to pay in a specific Canadian location and also evaluates the aspects that affect willingness to pay for fresh brand name beef. This study was developed because of the small amount of branded fresh beef products in the Canadian market. The method used in this research was the Becker-DeGroot-Marschak (BDM) experimental auction technique. Hypothetical brands were developed that illustrated that each different brand had a specific attribute associated with it. One developed brand guaranteed tenderness; another was a local brand; one was a natural beef brand; and the final brand was an Angus brand. The experimental auctions mentioned above took place in June and July of 2006. Participants included 274 individuals; approximately 39 per store. Seven stores from two of the major grocery store chains were used for the survey sites. Participants in the survey were given brief information about each brand before they submitted bids for the most they were willing to pay for each. The theory in this paper begins with basic utility equations for a customer's decision to purchase or not to purchase a branded steak product. Utility is subject to a budget constraint to form the indirect utility equations. From these assumptions the demand function is derived. The tobit and the double hurdle models are used for the econometric analysis of results. The study finds that consumers are willing to pay more for steaks with the characteristics that each of the hypothetical brands represented. The econometric models show that factors, such as how often the customer consumes beef and their brand preference, can positively affect the consumer's willingness to pay. There was significant preference shown by the survey participants for branded product and the logo variable was the only variable significant across all brand names. This result suggests the positive impact that developing a good brand and logo has for marketing a new beef product to Canadian consumers. The less knowledgeable a consumer is regarding steak quality the more likely they will purchase a product with a brand that reveals high steak quality. It is important to note that the sample size was small in this case but can still be useful to the Canadian beef industry for members interested in branding fresh beef products.

"Economic Value of a Beef Tenderness-Based Fed Cattle Valuation System," by Schroeder, Riley, and Frasier (2008) analyzes the current pricing systems that do not include a tenderness measurement in the valuation procedure and discusses how a tenderness measurement could change assessments of valuation in fed cattle. Other objectives include designing an alternative pricing/valuation system and illustrate how tenderness valuation would enhance the consistency between the value of fed cattle and meat quality compared to current price grids. Willingness to pay analysis was used for this study because it is the most straight forward method to determine what consumers are looking for in a food product. Twelve previous studies evaluating willingness to pay for tender steaks that had a total of 29 different premium estimates were analyzed by comparing the adjusted means or by running regressions to compare willingness to pay estimates to factors in this study. The most important results found overall were that consumers on average are willing to pay more for a tender steak than a tough steak. This result was statistically significant however; there was a considerable amount of variation between the studies. One result worth noting is that the price premium was significantly higher for the studies that were hypothetical compared to the studies that used binding contracts, meaning the customer would pay the price premium they revealed in the survey. For this research paper, only the binding contract studies will be used to analyze the factors that affect the consumers' willingness-to-pay premiums. Regression results show that consumers' are more likely to pay a higher premium for a tender steak if they have experienced the product's tenderness. If a consumer is told that a product is tender results show they will pay a premium of $1.12/lb more than if they are not told the product is tender. This result led to a further study of whether labeling a product tender increases the retail price. Retail prices were collected from 20 grocery stores located in Colorado, Kansas, and Nebraska on 112 rib eye and strip loin steak products. The products in the sample had a national brand, a store brand, a co-brand, or neither a national or a store brand. One-third of the steak products had a natural claim on the label and 41 percent had the tender terminology on the label. Because of the wide range of the use of the word "tender" on the labeling of the products a category was added for evaluation called tender premium which included premium products that increased the likelihood of being a tender product. A frequency distribution showed that the prices ranged from $4.99/lb to $19.99/lb with the average steak price being $11.39/lb. From the sample taken, a regression model including factors, such as tender and brand, related to price was derived. Results of this regression reported that the model explained 53 percent of steak price variation. An important result to mention is that national branded products had a price premium of $1.30/lb as shown in Table 2.1.

Table 2.1 Schroeder, Riley, Frasier (2008) Regression Estimates of Ribeye and Strip Loin Steak Prices

Variable	Coefficient Estimate
Brand and/or Quality Grade on Label	
National (0,1)	1.30
Store Brand (0,1)	0.31
Angus (0,1)	-0.19
Choice (0,1)	0.38
Select (0,1)	1.70
Natural (0,1)	1.49
TenderPrem (0,1)	1.82

This result was marginally statistically significant. Store brands showed no significant increase in price related with it compared to products that were not branded. Natural steaks were priced at a premium of $1.49/lb over steaks that did not exhibit a natural claim. A premium for exhibiting the term "tender" on the label showed no statistically significant results. A tender premium product with a tenderness claim on the label did however have an increase in price of $1.82/lb over the products that did not make this claim on the label. The authors suggest that the reason the term "tender" did not prove to have a premium associated with it is because there is no standard benchmark for consumers to use when deciding whether the tenderness claim is true. The paper also analyzes introducing a tenderness valuation grid which would increase direct price incentives to producers that produce tender beef.

"National Meat Case Study 2004: Product labeling information, branding, and packaging trends," by Reicks et al. (2004), was conducted in order to provide information about products available to consumers in the fresh meat case and to also analyze trends in retail meat case. Scanner data from 104 main supermarket chains located in large metropolitan areas within 29 states were used in this study to collect information on packaging materials, product labeling, and branding. The products in which the data was collected on included: whole muscle beef products, ground beef, veal, pork, chicken, lamb and turkey. Packaging and labeling information that was collected for each stock keeping unit (SKU) included: the name of the cut, the species type, boneless or bone-in product, whether the product was enhanced or value-added, case-ready, fixed or net weights, irradiation, how the package is displayed, how the cooking and nutritional information is labeled, how many cuts are in each package, the average weight of each package, package type, tray color and type, and the product brand name. The least squares mean differences regression method was used to analyze the information collected. The majority of products used the traditional polyvinyl chloride (PVC) overwrap packaging. Out of all the sample species whole muscle beef products used this traditional packaging more than any other species. Out of the products that used a tray for packaging white, yellow, and black were the most common tray colors. Styrofoam trays were used the most across all species. The presence of case ready products in the 2004 meat case was approximately 60 percent of all packages. Chicken and turkey products had the highest amount of case ready products and whole muscle beef products had the least amount. The frequency of products carrying a national brand was approximately 50 percent. Approximately 12 percent of products were store branded and approximately 38 percent of products had no brand at all. Ground beef and whole muscle beef were the least likely to have a national brand as opposed to chicken and turkey which were most likely to have a national brand. Over 50 percent of whole muscle beef and over 70 percent of ground beef products were not branded as of the 2004 study. Products with the highest frequency of cooking instructions found on the packaging were pork and turkey products with ground beef products being the least likely to provide cooking instructions. Turkey and chicken most commonly displayed nutritional information on the product labeling. Lamb, whole muscle beef, and veal were the least likely to display nutritional information compared to all other species. Approximately 22 percent of all products in the 2004 meat case were enhanced with pork products being most likely enhanced compared to all other products. Only approximately 6 percent of products were value-added with turkey products exceeding all other products. More than 60 percent of all products were most frequently boneless. Overall, results from this study can be utilized to improve communication between producers, processors, retailers and the end consumer.

The former examination of branding initiatives is useful to compare the parameter estimations found using the scanner data for this research. It is necessary to look at the implications of the branding of retail products and to determine if the previous research compares or contrasts to the results found in Chapter 5. It is beneficial to also look at the labeling of products that are branded because product labels relay specific information regarding the particular brand being offered. Most of the past research relates to this study by assessing the valuation of branding in the national beef retail sector as well as other attributes that affect the price through either a discount or a premium. The more that is known about consumer purchasing behaviors the better producers and retailers can develop and provide a more desired and profitable branded product. Further evaluation of previous results examined in conjunction with the estimation results presented in this study will be discussed in Chapter 5 when the results are presented.

2.2 Scanner Data Research

Since 1979, scanner data has been readily available in a dependable and steady manner to track consumer purchases. These data are useful in economic research to provide results for advancements in management decisions at the retail level (Capps, 1989) and ultimately for the producers who provide the raw product. Capps (1989) points out that although there are other methods of examining consumer demand, scanner data provides relatively cheap and detailed method for analysis, unlike expensive consumer survey studies.

The Capps study is centered on point-of-sale purchases and utilizes more than 1,600 universal product codes (UPCs) for steak, ground beef, roast beef, chicken, pork chops, ham, and pork loin. A double logarithmic functional form is used for estimating demand models. The model exhibited a high weighted R Square 0.89. The own-price elasticities for the dependent variables were all significant and negative with the exception of ground beef and ham products. Capps also found that the cross price elasticities align with economic theory in that most of them are positive and statistically significant. He found that in particular, roast beef, ground beef, and steak were substitutes. When looking at the results for the seasonality variables, Capps found that higher amounts of steak and pork chops were purchased between the months of March through May and June and August when compared to the base period used consisting of months September through November. Roast beef and ground beef purchases were highest during December through February. Ground beef was also highest between March through May and June through August. As for the analysis of advertising, increases in advertising space in weekly publications showed an increase in the purchases made in all the commodities with the exception of pork. Overall, the scanner data used produced significant results and goes to show that if managed properly, scanner data is an asset at the retail level for demand analysis (Capps, 1989).

Cotterill (1994) also discusses the opportunities associated with the use of scanner data and provides background information as to how scanner data are collected. "Because there are real economies of scale and scope in data processing no individual retailer has sufficient incentive to process scanner data into a usable format for manufacturers" (Cotterill, 1994, p. 125). The main third party processor of scanner data, Information Resources, Inc. (IRI), is what

Cotterill focuses on for this particular paper being discussed. He provides several examples using IRI scan data including an in depth look at brand level analysis for soft drinks. Cotterill makes clear that deeper analysis with this particular retail scanner data will enhance the understanding of the price spread from farm to retail.

Similar to Coterrill's viewpoint, Kinoshita et al. (2001) uses retail scanner data to examine the demand of Japanese dairy products at the retail level. A price-cost margin ratio is developed to specifically look at reconstituted milk products. The scanner data observations consist of a collection period of one year from the third largest national supermarket chain in Japan. Utility functions and demand equations were constructed and the price-cost margin ratio was estimated using the Seemingly Unrelated Regression (SUR) method. Results implied that "own-price elasticity of demand for fluid milk products is much more elastic than findings in previous studies using market-level data" (Kinoshita et al, 2001, p. 523). However, the estimates support the beliefs of the Japanese retailers and also specify that customers are twice as price responsive in their buying behavior toward reconstituted milk products than for fresh milk products.

Rojas, Andino, and Purcell (2008) examined sources of scanner data and their reliability. They argue that retailers are more responsive to changes in wholesale beef prices when using Economic Research Service (ERS) data rather than what previous Bureau of Labor Statistics (BLS) data has found. The study uses monthly price data that includes beef price information for the farm, wholesale, and retail sectors. In particular, the ERS data are quantity-weighted monthly price per pound data from 2001-2005. One observation found when comparing BLS and ERS scanner data prices is that "on average, BLS prices are 16% higher than the ERS prices" (Rojas, Andino, Purcell, 2008, p. 4-5). A Cointegration approach was used to analyze

BLS retail prices and ERS retail prices both in relation to wholesale and farm prices in order to determine the effects that BLS scanner price data for beef products has in comparison to the new quantity weighted scanner data from ERS. Results indicated that the ERS scanner data illustrates that retailers are more responsive to a decrease (increase) in wholesale prices which is opposite to what the BLS price data found for beef price spreads. Although the results found in this study are economically beneficial, the ERS data does not provide a good representation of total supermarkets and only account for approximately 20 percent of all U.S. supermarket sales in the U.S. that have sales in the amount of $2 million or more (Rojas, Andino, Purcell, 2008).

The previous research that utilized scanner data resources discusses the reliability and accuracy of retail scanner price data in the analysis of consumer purchasing behavior. Seasonality patterns can be tracked for different products and provide information as to what products are frequently purchased during a certain time of year. Past literature presents opportunities to further develop the use of scanner data. In this study, the retail data provided will offer a larger market share and be able to evaluate the pricing data by brand category which has not previously been examined in great detail.

2.3 Hedonic Modeling

One commonly used method of examining scanner data is through hedonic modeling, which is used in this study. There is broad range of research that takes a closer look at the hedonic approach of analysis. One important study completed was by Kelvin J. Lancaster who began to build the foundation for hedonic modeling. The study, “A New Approach to Consumer Theory,” discusses the importance of knowing consumer response to new products and different levels of quality (Lancaster, 1966). Prior to hedonic modeling, goods were considered simply items consumers’ desire and before quality attributes were considered, only quantitative valuation methods of individual goods were considered. The basic derivation for the new approach is that whether it is a single good or a combination of goods, consumption of these inputs will occur and create a compilation of attributes (Lancaster, 1966). It is assumed that consumers will want to maximize utility subject to a budget constraint. Also presented by Lancaster is the introduction of a new commodity. This concept was rather difficult to apply the traditional approach before hedonic modeling (Lancaster, 1966). New products are introduced all the time and often present a new set of quality attributes that vary from products already present in the market. This is an important topic to mention in relation to the beef retail industry with the introduction of new brands occurring more frequently. It is beneficial to point out the attribute diversity across each branded product as reiterated by Lancaster's assumption that goods have a set amount of multiple characteristics in which consumers use to decide their preferences as opposed to the goods themselves.

Specific information of interest is valuation of product attributes and branding fresh beef products. "Characteristics and hedonic pricing of differentiated beef demands," by Hahn and Mathews (2007) analyzes the shift in taste for beef products by specifically looking at hedonic characteristics. The model used in this research allowed characteristics to be "priced." The first modeling structure estimates the changes in quantity demanded for meat products. Beef is divided into three quality categories by using the demand for characteristics. The USDA quality grading system is used to divide Choice beef, Select beef, and Cull beef. The hedonic framework illustrates the price premium for Choice beef as compared to Select beef. Also recorded in the data analyses are the seasonal and annual demand shifts over the years 1988-2004. Results found that from the 1980's, total beef demand has been fairly stable except for small adjustments in seasonality. Beef demand shifted away from Choice to Select products in the early years of the study and then shifted back towards Choice in the latter years of the study.

"Implicit Value of Retail Beef Product Attributes," by Ward, Lusk, and Dutton (2008b) seeks to analyze the value that consumers place on different fresh beef attributes. The data were collected from 66 random stores from Oklahoma City, Ok, Tulsa, Ok, and Denver, Co. Stores were divided into 4 groups including: specialty stores, conventional supermarket stores, discount stores, and warehouse club stores. Price and product attributes were recorded for each product. There were 462 packages of ground beef, 175 roasts, and 749 steaks obtained for the study. A hedonic pricing model was used to find the value of the beef attributes from the retail sector. Results are presented with two models for each beef type to represent nominal prices in one model and a log transformation of dependent variable prices. Models were estimated using Proc Mixed in SAS. The area in which the sample was from, played a significant role on the price of each product. The cut or product name significantly affected beef prices in the retail sector. Packaging was more consistent for ground beef as opposed to steaks and roasts.

Table 2.2 Ward, Lusk, and Dutton (2008b) Linear Hedonic Parameter Estimate Results

Variable		Ground Products	Roast/Steak Products
Brand ($/lb)			
	Special	0.94	6.20
	Program/Breed	0.39	1.04
	Store	0.22	0.00
	Other	1.26	1.09
	None/Generic	Base	Base
USDA Grade			
	USDA Standard	n/a	-0.53
	USDA Select	n/a	-0.23
	USDA Choice	n/a	0.70
	USDA Prime	n/a	1.37
	None Indicated	n/a	Base

Table 2.2 illustrates that branded ground and steak/roast products garner a premium when compared to generic products. The brand variables in the linear model are statistically significant. All the data used to formulate these conclusions were observed from the meat case and not from actual purchase data.

"Hedonic Retail Beef and Pork Product Prices" by Parcell and Schroeder (2007) is perhaps one of the closest studies to the research presented in this paper. It is also the most recent study addressing how retail beef and pork product attributes affect their prices. Purchase prices are used to construct the hedonic modeling framework in order to examine brand loyalty. Parcell and Schroeder (2007) used data from the Meat Panel Diary (MPD) that was collected from roughly 2,000 surveyed households twice per month. Packaging information such as weight, dollars spent, and brand was recorded and aggregated into ground, roasts, and steaks for beef products. Pork included cuts such as chops, ribs, and hams. A composite retail price was included as an independent variable as well as the percent leanness for the ground beef products. After running an initial OLS regression, most of the statistically significant parameter estimates exhibited the expected signs. When looking specifically at the results, Table 2.3 shows the brand coefficients for the beef model ground, roasts, and steaks that are considered branded products. The parameter estimates for roasts and steaks illustrate a premium of \$0.34/lb and \$0.76-\$1.26/lb respectively.

Table 2.3 Parcell and Schroeder (2007) Hedonic Model Results

Variable	Ground Beef	Roast	Steak Low Quality	Steak Medium Quality	Steak High Quality
Quality Grade ($/lb) (Default = nongraded)					
Prime	n/a	n/a	1.405	0.268	2.459
Choice	n/a	n/a	0.0048	0.067	-0.823
Select	n/a	n/a	-0.572	-0.038	0.253
Brand (Default = store brand)	-0.019	0.338	0.758	1.26	1.22
Average Retail Price ($/lb)					
	1.70	2.02	2.87	3.65	4.17

Overall the premium amounts for branded pork and beef products vary across cuts and it is clear that there are brands that demand a premium and there are also brands that cater to consumers who are more price-sensitive.

Hedonic modeling has been used for a wide array of retail products in order to capture the value placed on quality attributes. The previous research that used hedonic modeling offers insight to the estimation process and provides comparable results. The results and implications from historical research looking at beef demand can be compared to the research presented in this study in order to determine any similarities among the different studies. It is beneficial to capture any consistencies among findings that can strengthen information about the premiums and discounts found for the various product attributes. Both the Ward, Lusk, and Dutton study (2008b) and the Parcell and Schroeder (2007) study capture similar premiums for branded steak and roast products but differ on ground products. Ward, Lusk, and Dutton found a premium for branded ground products ranging from $0.94/lb to $1.26/lb relative to generic or unbranded beef. Parcell and Schroeder (2007) found that ground beef was slightly discounted in comparison to store branded products. Chapter 5 will present the results found in this study and will compare them to several of these prior studies.

CHAPTER 3 - Overview of Data Set

This chapter will discuss in detail the data set used for this research. The structure of the data set will be addressed and also information regarding data collection will be examined. In comparison, the Bureau of Labor Statistics (BLS) and the Livestock Marketing Information Center (LMIC) have collected data for similar beef cuts. Section 3.2 will discuss the similarities and differences between the monthly volume weighted average prices calculated by BLS and LMIC and the data used in this study for ground beef, ribs, roasts, and steaks.

3.1 Data Sources

The data used in this study was provided through The Beef Checkoff. It was collected by the FreshLook Marketing Group on a weekly basis for the years 2004 through March of 2009. FreshLook Marketing collects meat department InfoScan data from more than 14,000 stores nationwide (Shepard, 2009-2010). There are approximately 175 retail market areas covered and approximately 68 percent of all U.S. grocery all categories volume (ACV) captured (Shepard, 2009-2010). All categories volume is related to all supermarket categories sold. FreshLook Marketing receives meat department sales data from U.S. stores that collectively represents 68 percent of total annual U.S. grocery store sales dollar volume. Table 3.1 shows the percentage of ACV as well as specific analysis of the percentage of meat departments covered by FreshLook Marketing in relation to the total United States.

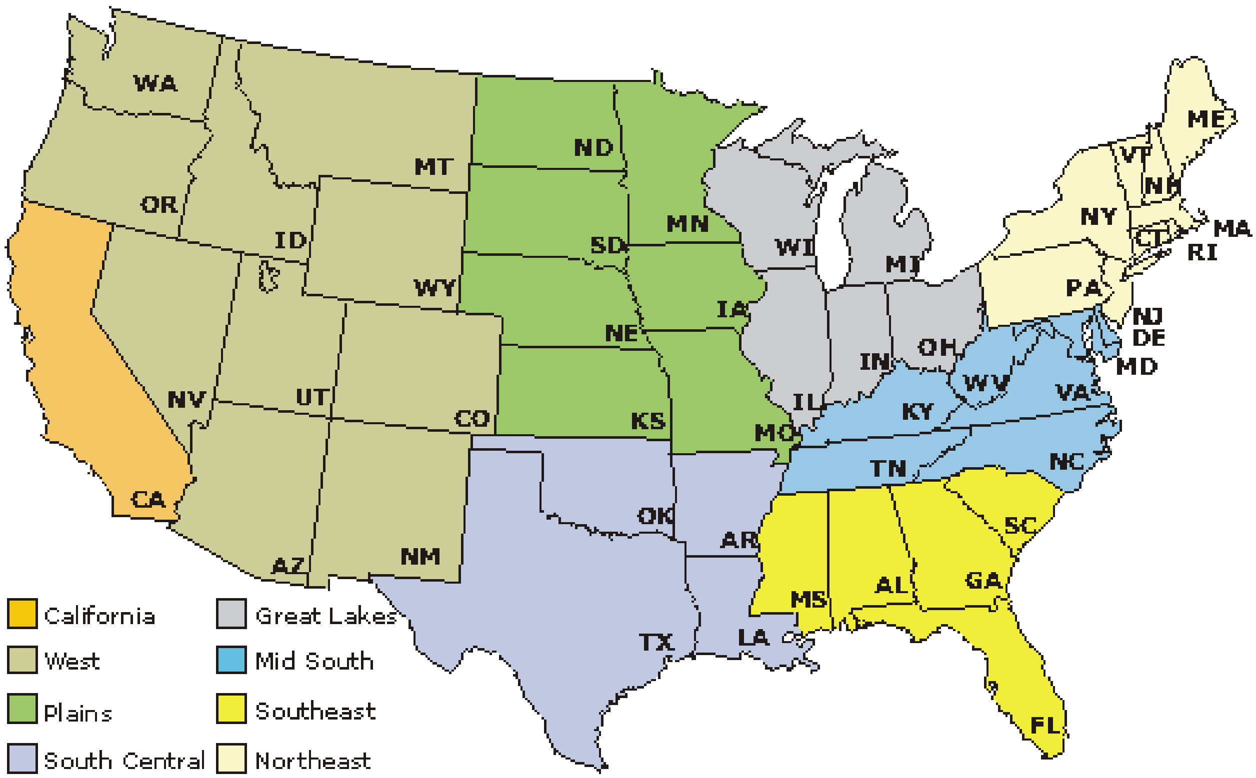
Table 3.1 All Categories Volume Divided By Region

Region	% of U.S. ACV	Meat Analysis ACV Coverage
California	12.3	76.6%
Great Lakes	15.4	55.3%
Midsouth	11.9	71.7%
Northeast	20.4	72.4%
Plains	6.3	24.4%
South Central	9.8	63.4%
Southeast	13.2	78.6%
West	10.8	81.3%
TOTAL U.S.	100.0	**68.1%**

Source: Meat Solutions, LLC.

The eight regions shown above in Table 3.1 are further broken down into states per region in Figure 3.1. Retail grocery stores are carefully monitored to insure that the data collected is accurate. There is an item count process to monitor the items available at each chain store each week. Approximately 3,500 System 2's and Price Look-Up codes should be available. System 2 is the structure currently in place for U.P.C. bar codes used for scanning variable measure products (Shepard, 2009-2010). The majority of variable measure meat products at the retail level are priced and sold by the pound, however, some meat products are priced and sold by the package or item (Shepard, 2009-2010). Price Look Up (PLU) codes are used to identify products that are not packaged (American Lamb Board et al., 2007). This primarily pertains to produce products such as apples and oranges.

Figure 3.1 Scan Data Market Regions by State



Source: Meat Solutions, LLC.

The raw data is collected from each retail store at the point of sale and sent to Information Resources, Inc. for the initial aggregation process. Information Resources, Inc. is the leading enterprise providing marketing material solutions and services to companies and catering to clients in the retail industry who want to improve their performance in the marketplace (Information Resources, Inc., 2010). They provide the retail tracking information to FreshLook Marketing where the data is further categorized and sent to clients and data service companies. This particular data set was provided through The Beef Check Off and Meat Solutions, LLC. Meat Solutions receives the data from FreshLook marketing and creates the VMMeat® database. The VMMeat ® database "is an extended information repository based on industry standards" including but not limited to USDA standards, URMIS Standards, and certification organizations (Shepard, 2009-2010). This database is specifically important for this research because the structure allows for unique identification and tracking of brands. It provides interpretation of the FreshLook data by certain brand characteristics in order to differentiate brands. The VMMEAT® database is based on a five-tiered hierarchy system starting with the class (in this case the class is strictly beef) followed by processed type, product type, category, and sub-category (Shepard, 2009-2010).

There are 494,139 weekly records categorized by brand name contained in the data set. In addition to the five tiers in the hierarchy system, additional category information is included in order to enhance the analysis. The product's form, such as steak or roast, is recorded for each weekly total for the specific brand. In addition to product form, bone state, breed claim, brand, quality grade, organic label, and religious label were recorded and used in econometric analysis completed in this research. Further discussion regarding modeling and variables chosen for estimation will be presented in Chapter 4.

3.2 Data Comparison

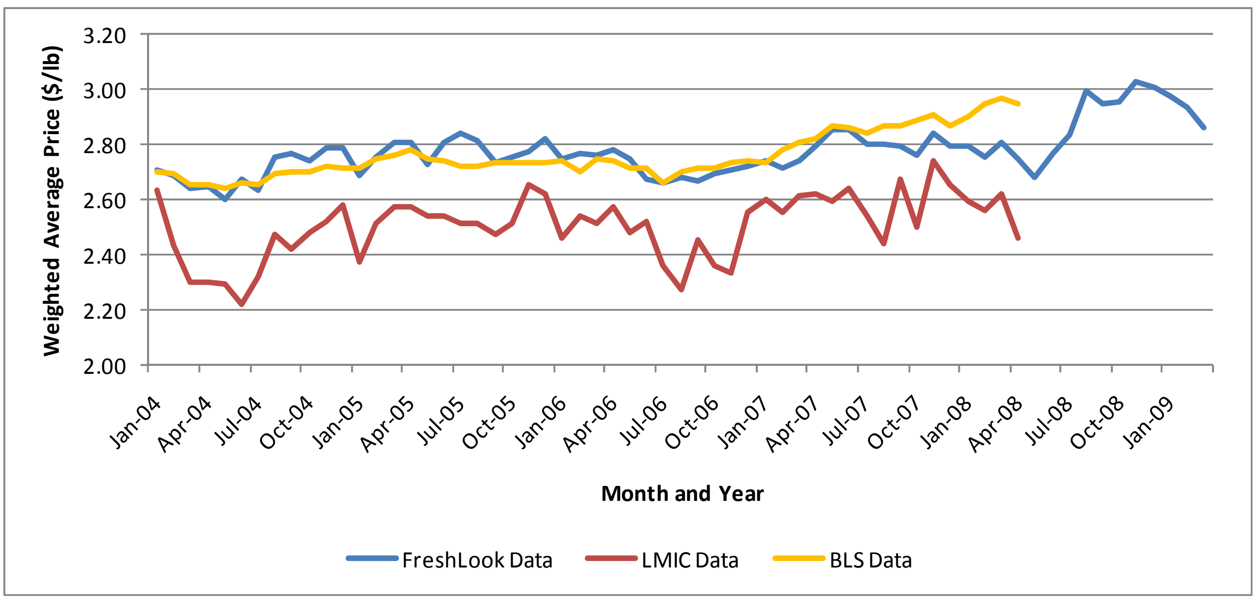
FreshLook Marketing data efficiently captures fresh meat and produce retail industry sales and is one of the leading providers of highly accurate scanner data. There are however several other sources of retail scanner data. Comparison among the BLS, LMIC-ERS, and Freshlook data is of importance in this study to determine the correlation between the reporting methods. The correlation component is valuable in verifying that the FreshLook data is an effective and consistent reporting method for scanner data observations. The LMIC database is comprised of the data that the USDA Economic Research Service has developed. LMIC updates and oversees the database with ERS funding. The observations collected are from approximately

20 percent of U.S. supermarket sales (Livestock Marketing Information Center, 2009). The LMIC data set contains monthly average retail prices for specific cuts of red meat and poultry, specifically beef cuts which are used in this comparison. Only random-weight products that are specie-specific and sold in a traditional supermarket meat department are included in the data base. A unique attribute that the LMIC database contains is the adjustment for featured prices. Featured prices take into account price discounts through retailer advertisements. After accounting for featured price discounts the database consists of dollar sales, price per pound, and volume sold for each product. Observations are also then classified into their respective cut and category. The ERS collected monthly retail meat price data under mandatory price reporting from January 2004 through April of 2008.

The ERS and BLS collect similar scanner data information however BLS price data tends to be higher on average than the ERS observations collected. One reason for this, which is considered a weakness, is BLS prices better measure the prices that consumers observe rather than the prices they actually pay. BLS data is considered a "snapshot" of prices once a month from the stores being sampled and they do not collect the volume of meat sold (Livestock Marketing Information Center, 2009). BLS selects certain stores and products through statistical sampling methods as opposed to scanner data which collects participating store observations on a voluntary basis (Hahn, Perry, and Southard, 2009). There are also fewer categories of beef products categorized with BLS data compared to scanner data.

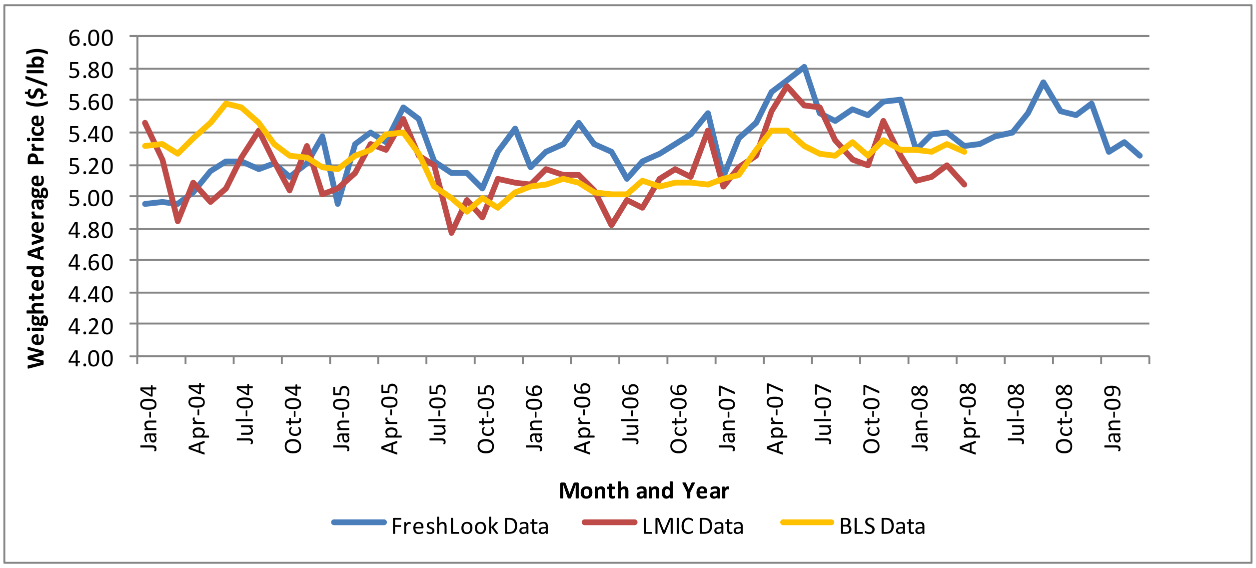
The FreshLook data available for this study ranges from January 2004 through March 2009. To compare the three sources of data we can observe monthly weighted average prices from each source by individual beef cuts. Ground beef, steak, and roast monthly weighted average prices are present in all three data sources as shown in Figures 3.2. – 3.4. Due to the fact that the BLS data categorizes fewer cuts of meat than the scanner data sets, there is no BLS price information for ribs, strips, and cubed beef products. The LMIC-ERS data determined meat categories based on the Uniform Retail Meat Identity Standards (URMIS) codes and consequently offer more categories than the BLS reporting. The LMIC-ERS data offers comparable categories to the FreshLook data for ground beef, steak, roast, and ribs. The FreshLook data is the only data set that includes the monthly weighted average prices for strip and cubed beef, therefore there is no comparison data shown in Figures 3.6 and 3.7.

Figure 3.2 Monthly Weighted Average Ground Beef Prices Comparing Freshlook, LMIC-ERS, and BLS Data Sources



As seen in the above graph, the FreshLook and BLS monthly weighted price trends are closely related. The LMIC price data is slightly lower however; the price spread only varies by $1.00/lb ranging from $2.00/lb to approximately $3.00/lb.

Figure 3.3 Monthly Weighted Average Steak Prices Comparing Freshlook, LMIC-ERS, and BLS Data Sources



The monthly weighted average price data for steak products exhibits the closest price relationship between the different data sets out of all the beef products analyzed. The rigidity of the trend line could be explained by the seasonality patterns of grilling steaks in the warmer months of the year.

Figure 3.4 Monthly Weighted Average Roast Prices Comparing Freshlook, LMIC-ERS, and BLS Data Sources

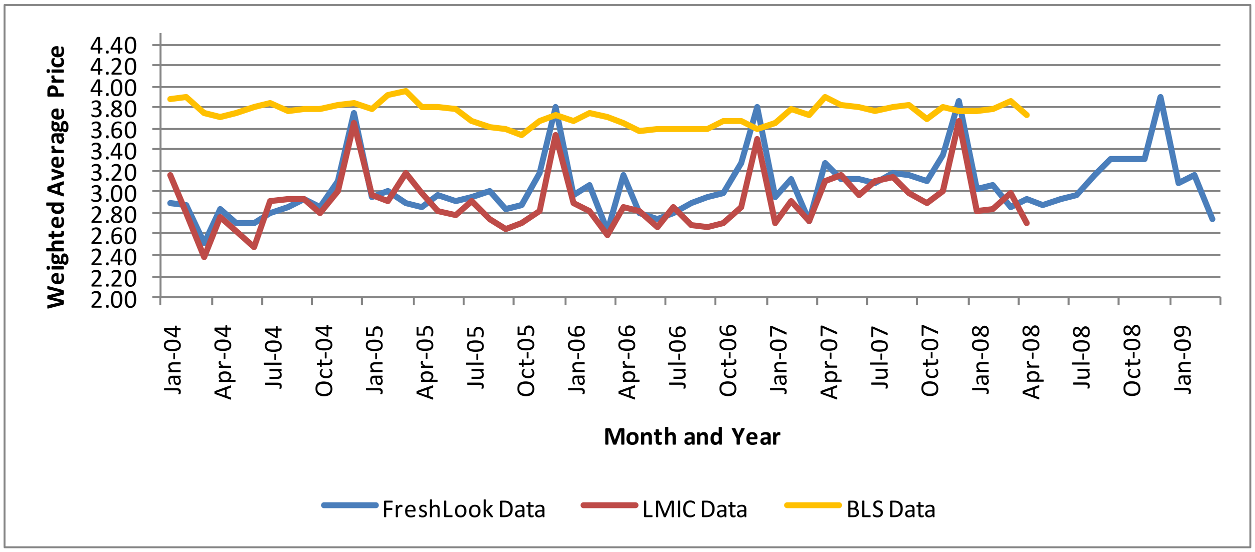
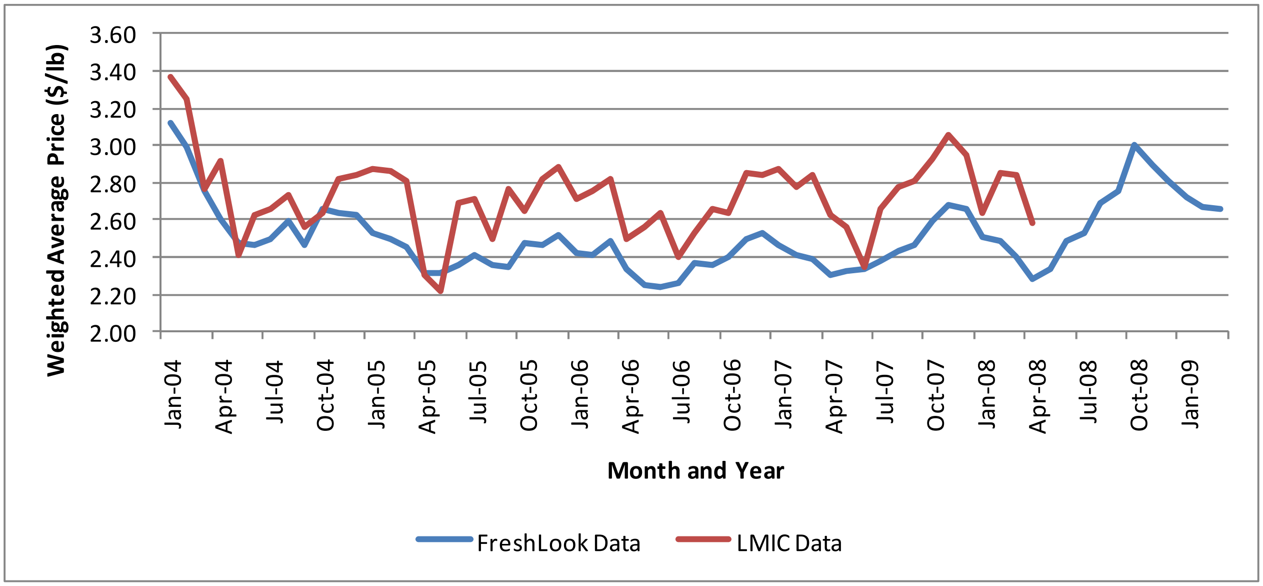


Figure 3.4 exemplifies seasonal pricing patterns for roast products. LMIC and FreshLook pricing data follow a very similar pattern, where as the BLS weighted averages appear higher. This observation complies with the LMIC information that BLS prices are typically overstated because the volume of beef products sold are not recorded.

For beef rib products, only LMIC and FreshLook have monthly weighted average prices available. Figure 3.5 represents the correlation of the average prices for beef ribs between FreshLook and LMIC. The monthly weighted averages range from \$2.22/lb to \$3.37/lb.

Figure 3.5 Monthly Weighted Average Beef Rib Prices Comparing Freshlook and LMIC-ERS Data Sources



For beef strip and cube products only FreshLook monthly weighted averages are available. Figures 3.6 and 3.7 exhibit the price trends for the two products. Beef products that are in the form of strips show an increasing average price from 2004 through 2008.

Figure 3.6 Monthly Weighted Average Strip Product Prices from the FreshLook Data

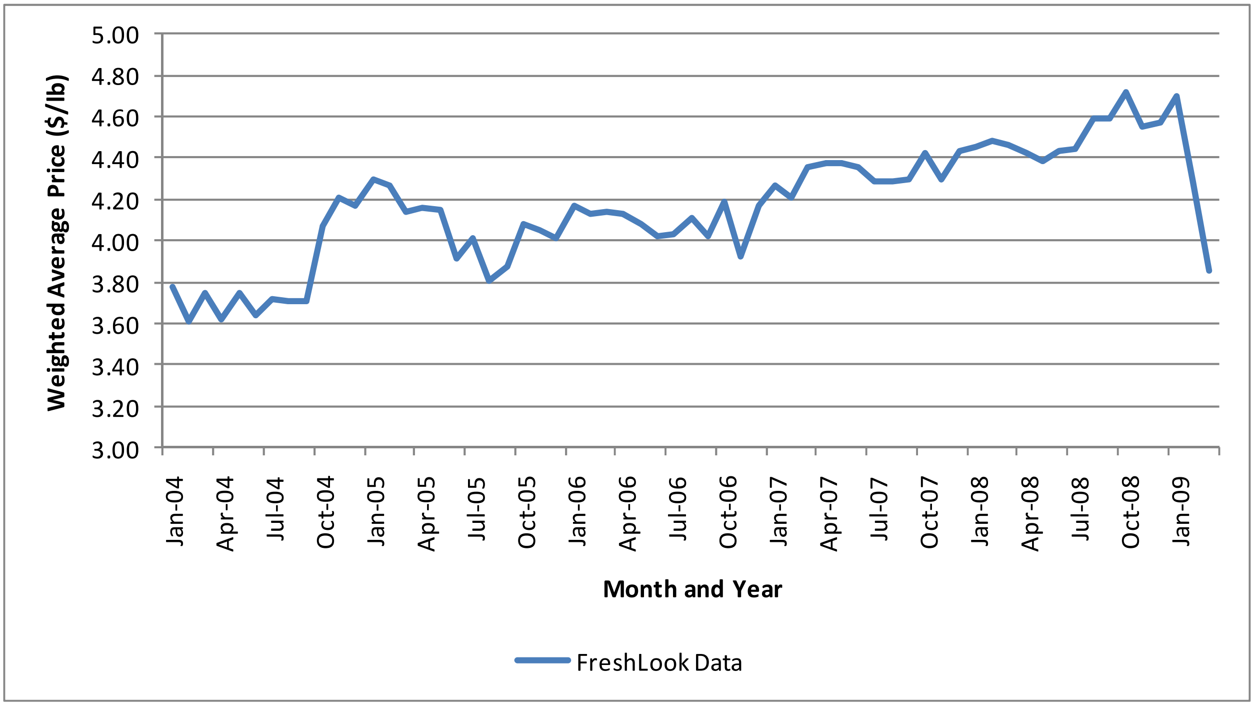
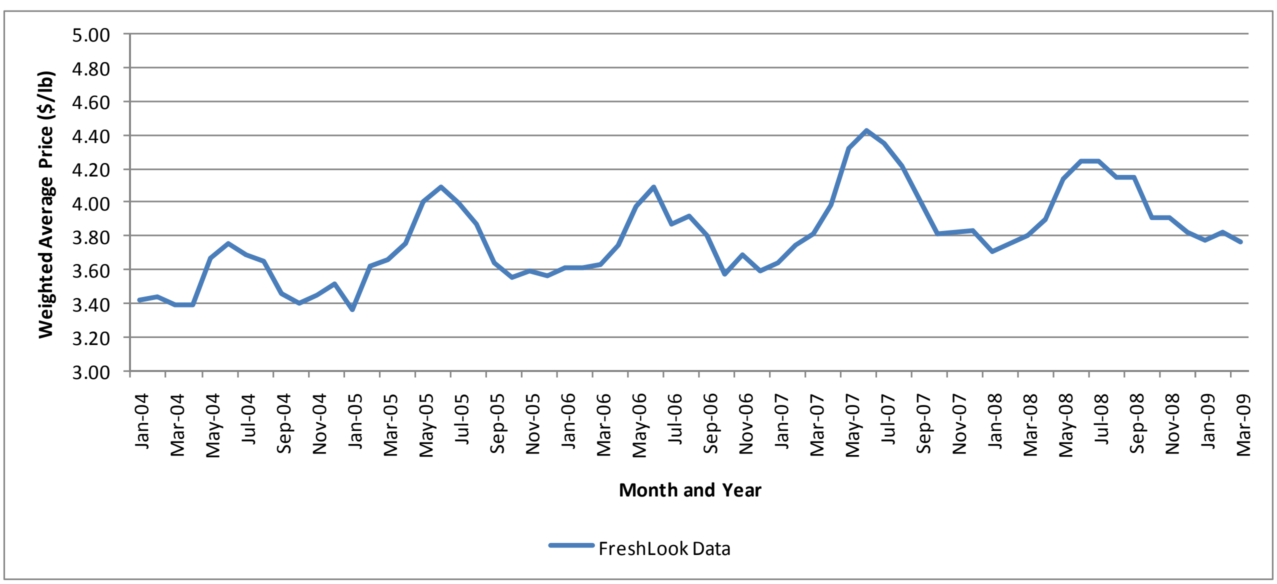


Figure 3.7 Monthly Weighted Average Cubed Product Prices from the FreshLook Data



The monthly weighted average price data for cubed beef products show seasonal spikes in price during the summer months. This could be because of the increase in consumers grilling products, such as shish kabobs, in the summer time.

Overall the cut categories available for comparison provide valuable information in understanding how the FreshLook data relates to other market collections. By comparing the data used in this study to external data sets, we can better determine the validity of the FreshLook data used for analysis. The LMIC-ERS and Freshlook data follow similar patterns for steaks, roasts, and ribs. This is to be expected because both data sets are scanner data observations as opposed to the BLS data which is known for being a “snapshot” of observable prices that are typically higher. The only category in which the FreshLook data compares more to the BLS data is for ground beef. One explanation for this could be related to the method of aggregation for the categorization of ground beef between the FreshLook data and the LMIC-ERS data. For example, there could be different forms of ground beef such as hamburger patties, included in the FreshLook data that may exhibit a higher price that could affect the overall monthly weighted average price when compared to the LMIC-ERS data. Any variation between the LMIC-ERS data and the FreshLook data could be a result of the differentiation in recording the featured discount prices due to advertising events.

CHAPTER 4 - Model Specification

This chapter will discuss the development of the theoretical model and explain in detail the model specifications including the definitions of variables used. As seen in previous literature, hedonic modeling can help to identify the marginal value of individual product attributes. Section 4.1 will discuss the framework of the hedonic model used in this study. Sections 4.2 and 4.3 will illustrate the specific model applied to the retail beef scanner data. Section 4.4 will define the specific variables for each model and will also discuss the expected signs on coefficients for the individual variables.

4.1 Theoretical Framework

The notion that one can receive utility from one or more product attributes was developed by Lancaster (1966). Further work has also been completed by Rosen (1974) who defines hedonic prices as "the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them" (Rosen, 1974, p. 34). Given this definition and the framework formulized by previous research, the conceptual framework is developed as:

$$z = (z_1, z_2, \ldots\ldots, z_n). \qquad (1)$$

The above illustrates that there is a set of *nth* characteristics represented by a vector, *z*. Prices can be related to the characteristics or attributes as seen in the function below:

$$p(z) = p(z_1, z_2, \ldots\ldots, z_n), \qquad (2)$$

where it is assumed that each product has a market price, *p*, and the summation of product attributes can be expressed by *z* (Rosen, 1974). Therefore, following Rosen, utility is given as follows:

$$U(x, z_1, z_2, \ldots, z_n), \quad (3)$$

where the utility is maximized subject to a budget constraint when a product is purchased with the desired bundle of *z* and *x* is all other consumption goods.

A linear theoretical model can be formulated for estimation. Commonly used to estimate hedonic models are Ordinary Least Squares (OLS) regressions. The conceptual price function used for linear regression analysis is:

$$PLB_t = \sum_{n=1}^{N} (\beta_n * z_{nt}) + \varepsilon_t, \quad (4)$$

where PLB_t is the price per pound for each beef retail product for a certain time period, *t*. Beta, β, is the coefficient for the vector *z*, z_{nt} is a vector for the bundle of product attributes, and ε_t is the error term.

4.2 Model Specification

Based on the framework presented above, a standard conceptual model can be derived to explain variation in the dependent variables included across six different beef products. There are six dependent price variables that will be modeled using the Ordinary Least Squares regression method. Steak, roast, ground, strip, cube, and rib were developed to categorize the beef retail cuts included in this data set. The price per pound of each of these categories will be the dependent variables estimated.

There are independent variables that are common across all six models that will be illustrated in the conceptual model below. There are also independent variables that are unique for each retail beef cut category that will be further discussed in Section 4.4. The following function represents a general conceptual framework:

PLB = f(Brand, Breed Claim, Quality Grade, Organic, Religious Claim, Mean Price per Pound). (5)

Based on the function above the standard empirical model is derived to represent all the estimated models as seen below:

$$PLB_i = \beta_0 + \sum_{a=1}^{5} \beta_a \, Brand_a + \sum_{b=1}^{5} \beta_b \, BreedClaim_b + \sum_{c=1}^{4} \beta_c \; QualityGrade_c + \beta_d Organic + \sum_{e=1}^{4} \beta_e \, ReligiousClaim_e + \beta_f MeanPricePerPound + \sum_{n=1}^{N} \beta_n \, X_n{}^{*} + \varepsilon \quad (6)$$

PLB is the price per pound of each beef cut category. The subscript *i* = steak, roast, ground, strip, cube and rib. The brand, breed claim, quality grade, organic, and religious claim, independent variables are dummy variables in the linear regression models and will be discussed in detail in Section 4.3.

Because the data in each model comprise a collection of numerous specific products from each set of cuts (e.g., there are 33 different steak products in the steak cut model) and are weekly aggregate time series over the 2004 – March 2009 time frame, they constitute a panel data set for each model. To adjust for changing aggregate meat prices over time in the models, we need a base price or anchor price that reflects aggregate market supply and demand conditions each week. Ideally, we would like this anchor price to be exogenous to the particular model and taken from an external source. Unfortunately, no weekly external retail price by individual cut (e.g., steaks, roasts, etc.) exists. Thus, we created an index of prices for each cut as the anchor price using the weighted-average price internally from the data set used for estimation. The hope is that this weighted-average which comprises all of the products in each model would not be endogenous with any single product price. The mean price per pound is a calculated weekly volume weighted average price for the particular beef cut being regressed. The calculation is weighted by pounds, meaning total dollars is divided by total pounds and aggregated into a weekly price per pound.

The variable x^* represents all other variables that are unique to each model. Chapter 5 will provide the exact variables included for each model and will discuss the impact they have on the price per pound for each individual beef cut category. The last term, ε, is the error term. Each empirical model will be regressed using the OLS regression method through SAS 9.1.3 Service Pack 4.

4.3 Definition of Variables

The brand dummy variables consist of five categories which are defined below. The data set consists of 129 different product brands that are classified into the following categories.

1.) A national brand is a brand that is distributed to retail locations nationwide and is controlled by the company or the supplier(s) who owns the brand.

2.) A local private brand is a brand that is only distributed within a local geographic area and is privately owned and controlled by a small company. Distribution can be to a retail store owned by the company who owns and controls the brand or to another local retailer.

3.) A regional private brand is a brand distributed regionally to retail locations and is owned and controlled by a private company. Distribution can be to one or more regions but not considered a national supplier.

4.) A store brand is a brand that is specific to a certain retail store or chain of stores that is owned and controlled by the retail grocery store or chain of stores. The brand may have the actual store name on the label or it can have a brand developed specifically for a particular retail store or chain of stores. A store brand may also have no specific brand name on the packaging label but is still considered to be a product offered by a specific retail store or chain of stores. The product may be obtained from more than one supplier and can be further processed at the retail store location.

5.) Other/Not branded is a product without a brand name on the label.

The categorical definitions were developed from several sources. Reicks et al. (2008) conducted a study evaluating the fresh meat case in the retail setting across 104 stores in 29 states. The purpose of this study was to analyze trends in the meat case as well as collect significant data on the products being offered in the meat case at each retail location. Branding information was collected on each package and was divided into two categories; national brands and store brands. National brands were defined as brands that were "offered by more than one store chain across multiple United States regions" (Reicks et al., 2008). More information from this study is presented in the literature review chapter.

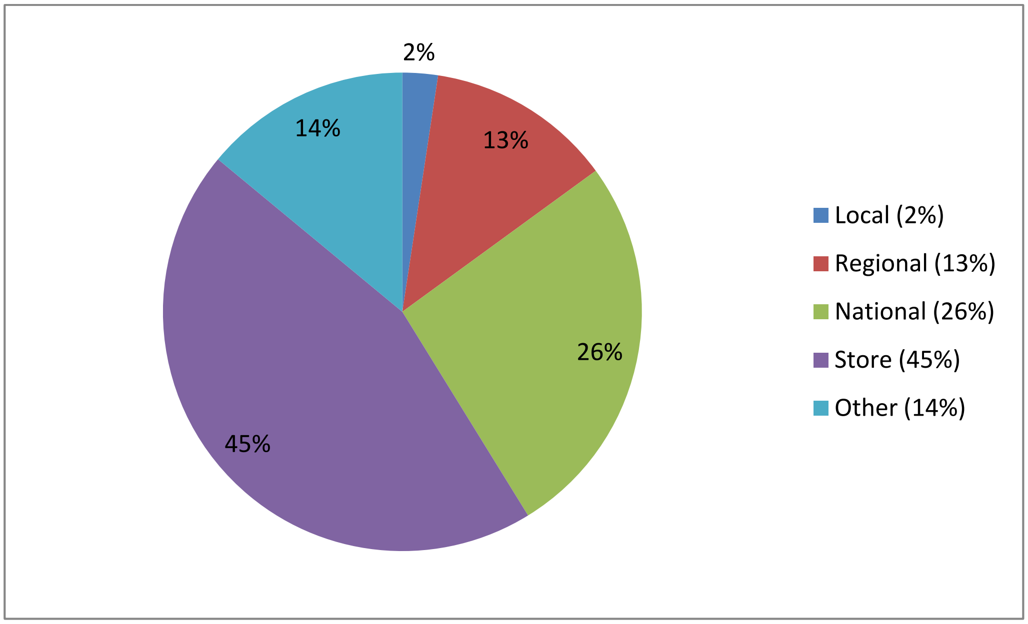
Another source used to formulate the definitions in this study was Ward, Lusk, and Dutton (2008b) who collected information that is obtainable by consumers purchasing beef products from retail stores. The data collected were used to develop hedonic pricing models in order to assess the value of retail beef attributes. Included in the sample data collected, was the brand name and brand category that each package exhibited. Ward, Lusk, and Dutton sorted the beef brands into four categories. Special, program, store, and other categories were defined for the study. Special brands were defined as brands "that carried special labels related to production practices such as "all natural." Program brands were defined as brands that were "breed-specific, often national brands." Store brands were defined as brands that were "unique to a certain store or store chain." The last category that the authors used was other brands. Other brands consisted of brands that "could not be classified readily into one of the previous three brand categories." Results from this study are presented in detail in the literature review chapter.

Shugoll Research and Midan Marketing (2009) conducted extensive research to address consumer attitudes toward purchasing and consuming meat and poultry. An online consumer survey was conducted to collect data to compare with retail sales data. The sales data were obtained from FreshLook Marketing as well as Meat Solutions' VMMEAT®. The data from Meat Solutions' VMMEAT® was divided into brand categories. The brand definitions developed by Midan Marketing and Shugoll Research for the review of the sales data include national/regional brands, private label brands, natural/organic brands, and store/commodity brands. National/regional brands are defined as "brands offered by a supplier that are available to retailers on a national or regional basis." Private label brands are brands that are "developed and offered specifically for a given retailer." Natural/organic brands are brands are considered natural or organic if it is presented on the label. Store/commodity brands are defined as "no brand or a commodity product that is labeled with a store's name only."

The last source reviewed to develop the brand categorizations used in this study is meattrack.com. Meattrack.com was created with the objective to provide "a communication platform for maintaining current and future standards for variable measure meat products" (The Beef Checkoff, America's Pork Producers and the Lamb Checkoff, 2010). Meattrack.com is funded in part by The Beef Checkoff, America's Pork Producers and the Lamb Checkoff. A large dictionary that contains extensive meat and poultry definitions is provided through this website for the respective industry participants who utilize this information. Brand categorical definitions are specifically listed. The categories include national, regional, local, private, and no brand. National brands contain "supplier offered brands that have name recognition in most markets nationwide. The name, specification and marketing is controlled by the supplier." Local and regional brands are similar to national brands in that the name, specification, and marketing are all controlled by the supplier. Local brands are defined as "supplier offered brands that have name recognition in one market or a small geographical area" and regional brands are defined as "Supplier offered brands that have name recognition in more than one market and a large geographical area, but does not have nationwide recognition." Private brands are defined similarly to store brands used in this study. Brands classified as private brands consist of "products that are provided by a supplier for offer under a retailer's company brand. They are often positioned as lower cost alternative to regional or national brands. The name and specification is owned and controlled by the retailer and in some instances are produced by a retailer's in a store, commissary or plant" (The Beef Checkoff, America's Pork Producers and the Lamb Checkoff, 2010). The category no brand includes brands that have "no declared brand name."

Out of the 129 brands from the data set, 28, 41, 38, 19 and 3 brands were classified as local private brands, regional private brands, national brands, store brands, and other brands, respectively. The categorical definitions were formed from the sources listed above and also from discretionally grouping the similar brands together to aid in forming categories. Brands were considered similar according to the structure of the company or supplier(s) who owns and controls the brand and also by the distribution area of the branded product. Figure 4.1 illustrates the brand category frequencies for each of the categories discussed above.

Figure 4.1 Frequency of Brand Type



The FreshLook Marketing data set consists of four beef cattle breeds that are associated with the retail products captured by the scanner data. Due to confidentiality, the specific breed names cannot be used. As seen in the models, the breed claims will be listed as Breed 1, Breed 2, Breed 3, Breed 4, and no breed claim.

The quality grade dummy variables consist of the USDA grades including Prime, Choice, and Select. Also included is the category for products with no grade information available. Quality grades provide information about eating content such as marbling and tenderness. They help the consumer identify palatability and indicate quality (North American Meat Processors Association, 2007). The grade that a carcass receives is based upon the "evaluation of its sex characteristics, maturity, the quality of the lean muscle, and the degree of marbling content" (North American Meat Processors Association, 2007, p. xxv).

The religious claim dummy variables consist of Kosher, Kosher-Glatt, Halal, and the default variable no religious claim. Kosher beef is processed under the authority of a Rabbi.

The Kosher dietary regulations establish what foods are suitable for consumption by Jewish consumers (Curtis, 2005). The slaughtering process is different from regular slaughtering processes. A religious slaughterer must be properly trained and use a special knife that measures twice the length of the neck of the animal (Curtis, 2005). The trained slaughterer, or shochet, must also say a blessing before slaughtering (Curtis, 2005). Furthermore, red meat must be soaked and salted to remove prohibited blood (Curtis, 2005).

Stricter than Kosher is Kosher-Glatt in terms of slaughtering standards. The main requirement for products that are processed through the Kosher-Glatt process is that the lungs do not exhibit any adhesions (Curtis, 2005). The inspector is trained to look for the lacerations before and after the animal is slaughtered to insure the lungs are smooth, which is the meaning of glatt (Curtis, 2005).

Halal slaughtering processes are practiced under the Islamic law. Humane and gentle treatment is of high stress both before and during the process of slaughtering an animal under Halal guidelines (Curtis, 2005). The actual slaughter process is similar to kosher practices by using a sharp knife and saying a prayer before slaughtering occurs (Curtis, 2005). Once the animal is slaughtered the meat does not have to be soaked and salted like kosher red meat products do thus it is further processed the same as commercial meats (Curtis, 2005).

4.4 Individual Model Specifications

Steak Model

The following thirty-two steak cuts in Table 4.1 are included as variables in the steak regression. The Beef Checkoff has developed retail publications that have provided guidelines for determining what to include and also which specific cuts will garner a premium and which will negatively affect the price of steak relative to sirloin steaks.

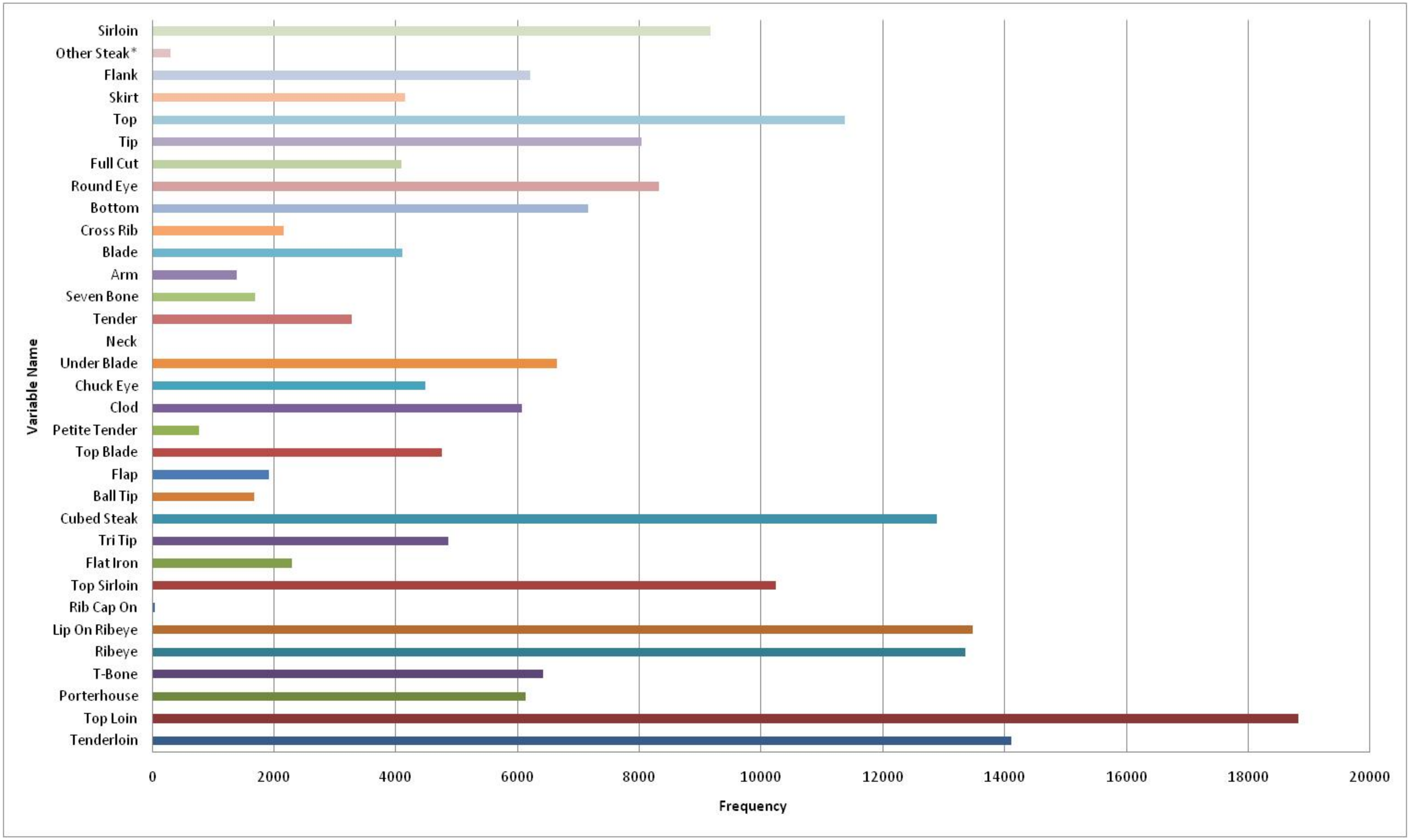
Table 4.1 Steak Variable Categorizations

Premium Steaks	Everyday Steaks		
Loin	Chuck	Plate	Cubed Steak*
Porterhouse	7-Bone	Skirt	Other Steak*
T-Bone	Arm	Rib	
Tenderloin	Blade	Rib Cap On	
Top Loin	Chuck Eye	Round	
Rib	Cross Rib	Bottom	
Lip On Ribeye	Neck	Full Cut	
Ribeye	Tender	Round Eye	
	Under Blade	Tip	
	Flank	Top	
	Flank Steak	Shoulder	
	Loin	Clod	
	Ball Tip	Flat Iron	
	Flap	Petite Tender	
	Tri Tip	Top Blade	
	Top Sirloin		

Other steaks include cutlet and sundry cuts. These are miscellaneous cuts that are not directly identified in the data set. Cubed Steaks can originate from the chuck, loin, round, and shoulder. The steak products classified as premium steaks are expected to have positive coefficients in the hedonic model and everyday steaks are expected to be negative relative to the default variable, sirloin.

Figure 4.2 displays the frequency of observations for the steak variables included in this model. Sirloin, the default variable, is also included in this graph. Top loin steaks have the highest frequency in this particular data set followed by tenderloin steaks. Top loin, tenderloin, followed by, lip on ribeye, and ribeye are all considered premium steaks as seen in Table 4.1. This indicates that consumers are purchasing the largest frequencies of higher quality steaks when compared to the other thirty variables included. The total frequency for premium steaks and the total frequency of everyday steaks is 72,313 and 128,094, respectively.

Figure 4.2 Frequency of Steak Variable Observations



Roast

The specific variables included in the roast regression consist of oven premium roasts, pot roasts, holiday roasts, and oven everyday roasts as the default category. The Beef Training Camp publication provided by The Beef Checkoff was used as a guideline to place the specific cuts into popular purchasing categories as shown below in Table 4.2.

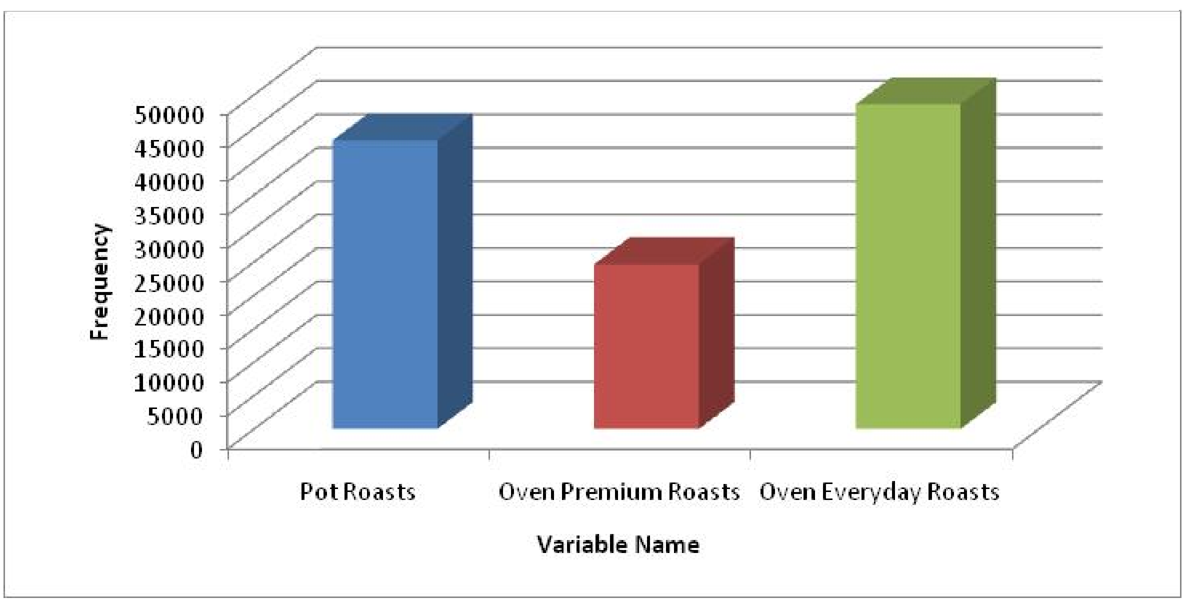
Table 4.2 Roast Variable Categorizations

Pot Roasts	Oven Everyday Roasts	Oven Premium Roasts	Holiday Roasts
Brisket	Chuck	Loin	Chuck
Chuck	Eye	Tenderloin	Eye
7-Bone	Neck	Top Sirloin	Loin
Arm	Tender	Rib	Tenderloin
Blade	Under Blade	Lip on Ribeye	Tri Tip
Cross Rib	Flank	Rib Cap On	Rib
Round	Loin	Ribeye	Lip on Ribeye
Bottom	Ball Tip	Shoulder	Rib Cap On
Shoulder	Flap	Flat Iron	Ribeye
Clod	Sirloin	Top Blade	Round
	Top Loin		Eye
	Tri Tip		Tip
	Plate		Top
	Skirt		Shoulder
	Round		Petite Tender
	Eye		
	Full Cut		
	Mixed		
	Tip		
	Top Loin		
	Shoulder		
	Petite Tender		

A discount is expected to be associated with the pot roast coefficient relative to everyday roasts. This is expected because pot roasts are typically leaner cuts and require more preparation and longer time to cook properly (The Beef Checkoff, 2008). The premium roasts are expected to have positive coefficients signifying that they will cost more than everyday roast products. These cuts included as premium roasts are of higher quality and also are considered some of the most tender roasts available. Holiday roasts include a mixture of premium and everyday oven roasts. The holiday roast variable is important to include because there is a significant increase in roast purchases around certain holidays throughout the year. Table 5.6 in Chapter 5 portrays the frequency of holiday roast sales. The highest frequencies occur mainly around Easter and Christmas. The holiday roast coefficient is expected to be positive for the reason that prices tend to increase around the holiday seasons and also because the roasts chosen as holiday roasts are of good quality.

The frequency of pot roasts, oven everyday roasts, and oven premium roasts is presented in Figure 4.3. The roasts with the highest frequency are oven everyday roasts indicating that consumers are purchasing the most of average quality roasts. Pot roasts follow closely behind oven everyday roasts with a frequency of 43,180 observations.

Figure 4.3 Frequency of Pot Roasts, Oven Premium Roasts, and Oven Everyday Roasts

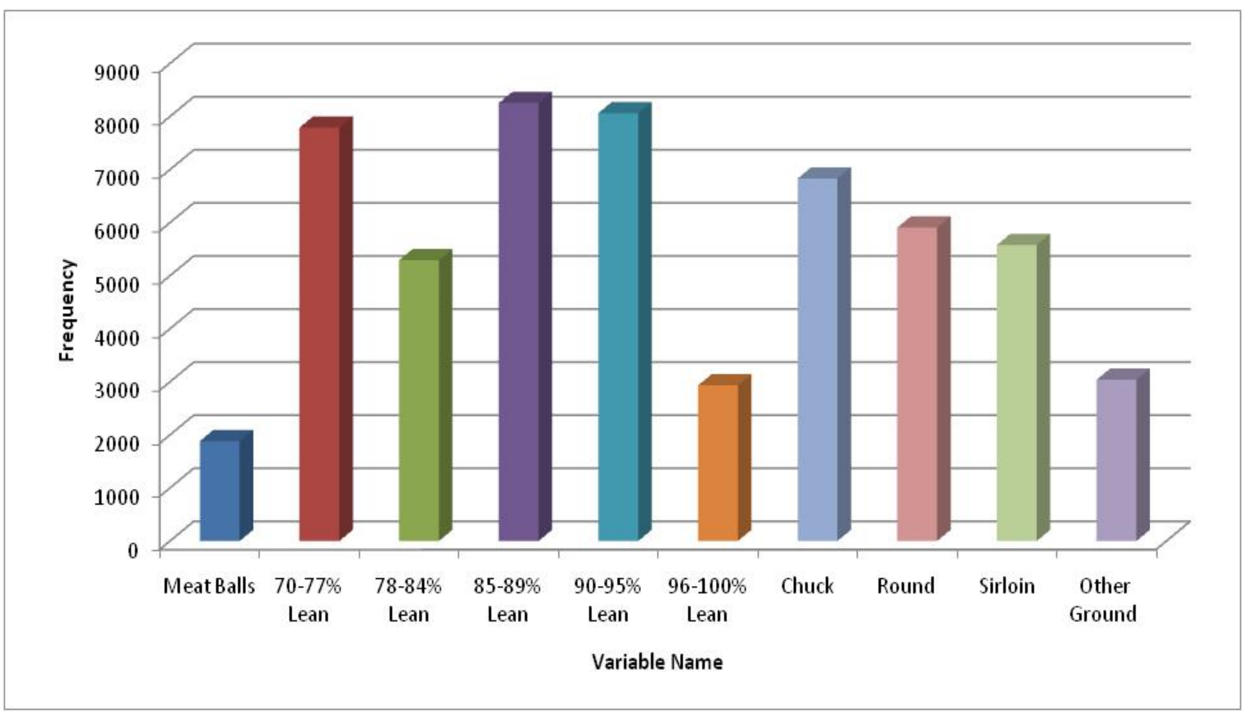


Ground

The variables added to the ground beef model include meat balls, 70-77% lean, 78-84% lean, 85-89% lean, 90-95% lean, 96-100% lean, chuck, round, and sirloin. The default variable is the category of other ground beef. Other ground beef is considered chili meat, meat loaf, and trim. The ground product that has a lower lean percentage will expect to garner a discount. The higher lean percentage products as well as the chuck, round, and sirloin categories are expected to have positive coefficients. Meat balls can be expected to garner a premium as well because they are a value added product.

Figure 4.4 portrays the frequency of each of the ground beef variables discussed above. The ground beef categories with the highest frequencies are the 85-89% Lean and the 90-95% Lean. Consumers typically purchase higher lean percentages for nutritional reasons to reduce the amount of fat consumed.

Figure 4.4 Frequency of Ground Beef Variable Observations



Strip

The strip model is comprised of stir fry, fajita meat, and the default variable, other strip. Stir fry cuts come from the short loin, sirloin, rib, round, and flank as seen in Table 4.3 (The Beef Checkoff, 2008). Beef strips for stir fry are typically cooked in a small amount of cooking oil over high heat and stirred constantly (North American Meat Processors Association, 2007). Vegetables can be mixed in with the stir fry beef. Fajita meat usually comes from the plate, flank, round or loin (The Beef Checkoff, 2008). Originally, fajita meat came from outside plate skirt steak and was cooked by Mexican ranch hands in southwest Texas in the 1930's (The Beef Checkoff, 2008). Fajita's are commonly served with an assortment of bell peppers and onions and arranged inside a tortilla. Other strip meat consists of the following cuts shown in Table 4.3.

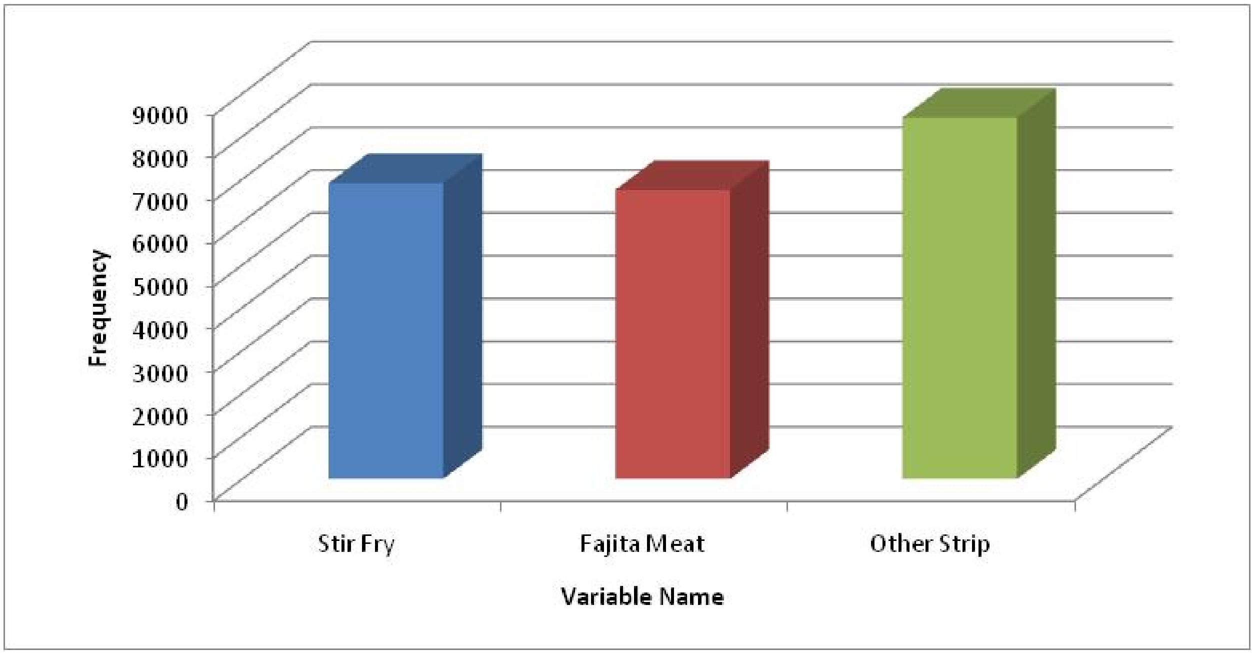
Table 4.3 Strip Variable Categorizations

Stir Fry	Fajita	Other Strips
Chuck	Flank	Brisket
Loin	Loin	Stew
Miscellaneous	Sirloin	Strips
Round	Top Sirloin	Chuck
	Plate	Cutlet
	Short Plate	Strips
	Skirt	Loin
	Round	Flap
	Bottom	Sundry
	Full Cut	Tenderloin
	Tip	Miscellaneous
	Top	Cutlet
		Strips
		Rib
		Strips
		Round
		Strips
		Tip
		Shoulder
		Strips
		Top Blade

When compared to other strips, stir fry and fajita coefficients are expected to be positive indicating that they have a premium associated with them. This is because these products are positioned as convenient and “recipe ready” for consumers to prepare.

The figure below represents the frequency distribution of the strip variables. The other strip variable is the default variable in the OLS regressions. This variable exhibits the highest frequency of 8,442 observations. Stir fry and fajita strip products almost have the same number of observations with stir fry products having a slightly higher frequency.

Figure 4.5 Frequency of Strip Product Variable Observations

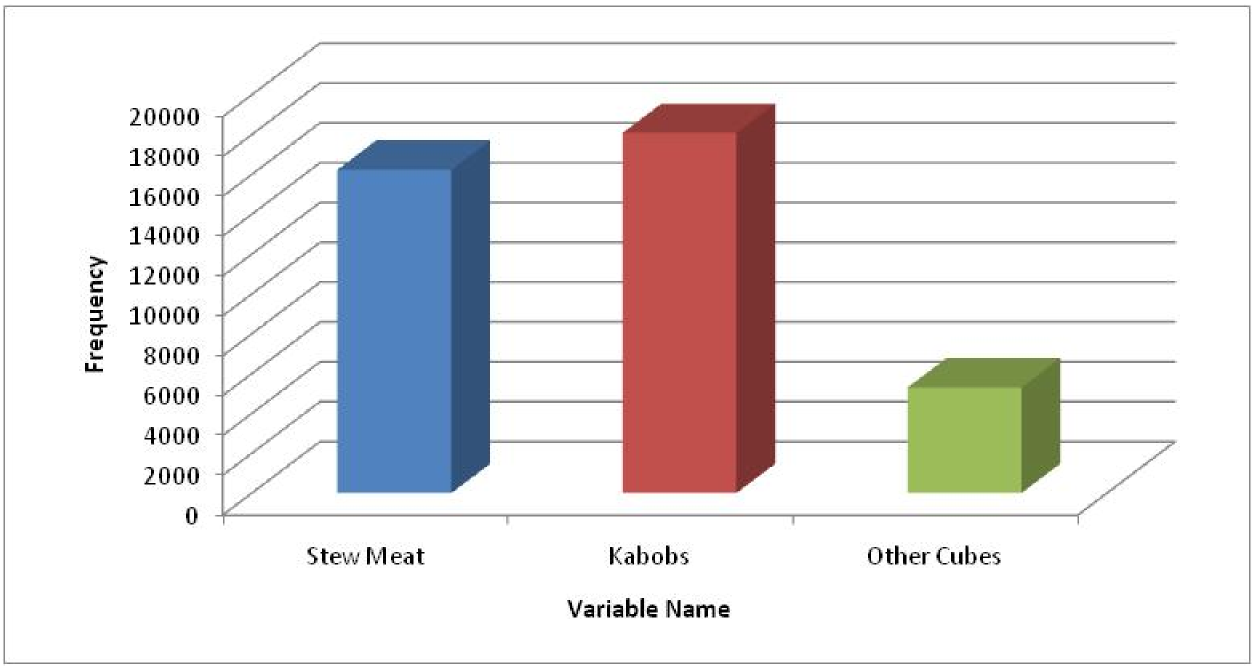


Cube

Specific cubed beef products used in the cube regression model were kabobs, stew meat, and other cubes. Kabobs are usually cut from the loin and are cut into 1-1/4 to 1-1/2-inch pieces (The Beef Checkoff, 2008). Kabobs are often referred to as skewer meat and are typically combined with vegetables and grilled (The Beef Checkoff, 2008). Stew meat mainly comes from the chuck and round and is cut into 3/4 to 1-1/2-inch pieces (The Beef Checkoff, 2008). The other cubes variable is comprised of beef from the shoulder, rib, round, plate, and miscellaneous categories. Kabobs are expected to have positive coefficients when estimated for similar reasons that stir fry and fajita meat are expected to be positive relative to other cubed beef. Kabobs are considered "recipe ready" products and are processed further into the correct size for their specific intentions. Stew meat is expected to have a discount due to the fact that it comes from lower quality cuts that are less lean relative to other cubed products, making them ideal for slow cooking in stew recipes.

Figure 4.6 is a graphical representation of the cubed beef product frequencies. The cube variable with the highest frequency is the kabob category. Both the kabobs and stew beef cubes are popular among consumers due to the fact that they are conveniently cut and “recipe ready.” Shown by their high frequencies, kabobs and stew beef cubes are popular purchase items for consumers looking for cubed beef products.

Figure 4.6 Frequency of Cubed Product Variable Observations



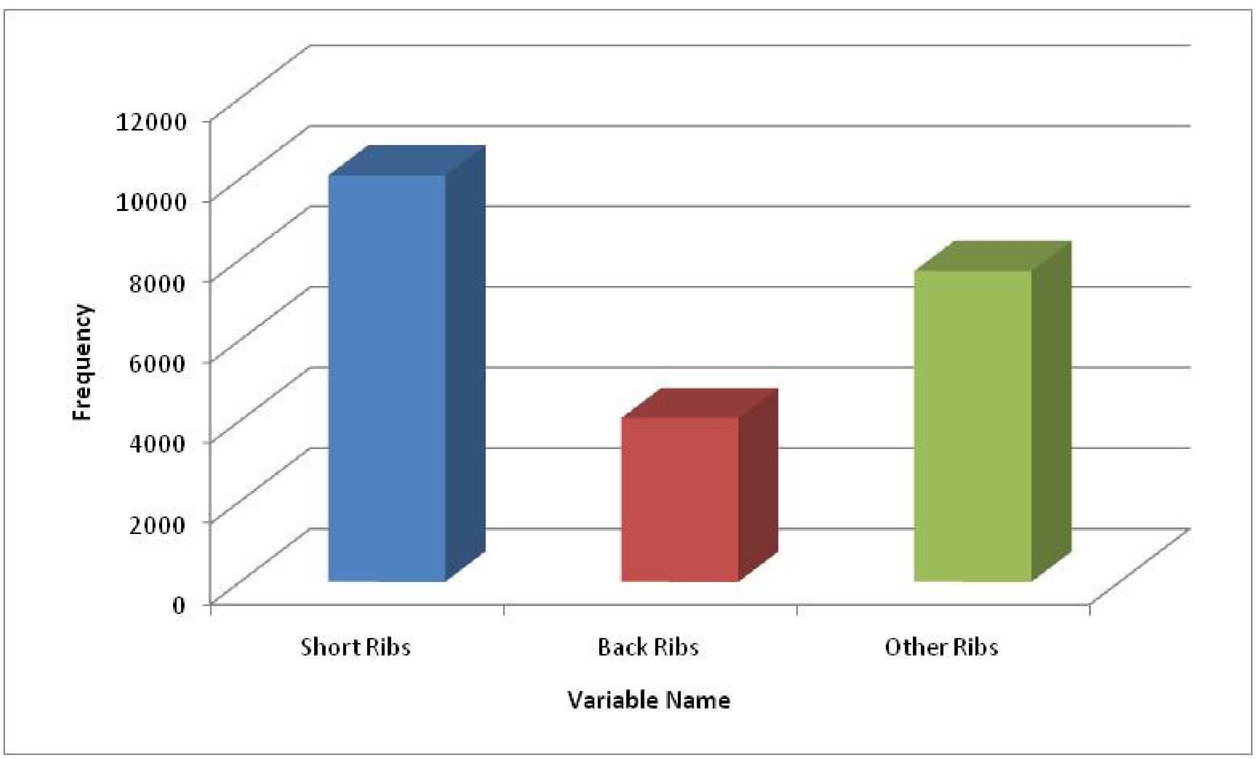
Ribs

There are two additional variables for the rib regression model. Short ribs and back ribs are categorized separately and are compared to the default variable, other ribs. Back ribs are considered the sixth to twelfth ribs and can be sold as seven ribs, three to four ribs, or individually (The Beef Checkoff, 2008). Short ribs can be bone-in or boneless and are typically sold as individual ribs (The Beef Checkoff, 2008). It is anticipated that the short ribs coefficient will be positive and the back ribs coefficient will exhibit a discount. One explanation for this expectation is the short ribs require more processing and therefore adds more value to the product.

Also included in this model is the process level. The process level indicates whether the product was minimally processed or processed. This parameter estimation is expected to be positive because of the value added to products that are further processed.

The frequency of the variables, short ribs, back ribs, and other ribs is shown below in Figure 4.7. One explanation for the frequency of short ribs exceeding the frequency of back ribs and other ribs is that short ribs are sold in smaller portions, typically as individual ribs. Smaller portion size appeals to some consumers and therefore more shorts ribs are being purchased.

Figure 4.7 Frequency of Rib Product Variable Observations



CHAPTER 5 - OLS Regression Results

This chapter will explain the results from the six models estimated using Ordinary Least Squares regressions analysis. Information will include how well the model represents the data, whether the variables have statistically significant coefficient estimates, and how the independent variables affect the dependent variable. Section 5.8 discusses an alternative analysis to the linear OLS approach shown in Sections 5.1-5.6.

Listed in Table 5.1 are the summary statistics for each dependent variable. Out of the six beef models, the steak model portrays the highest mean price per pound, followed by cube and roast. Ground beef has the smallest mean price per pound which is to be expected given that ground beef is typically a lower end product.

Table 5.1 Summary Statistics of the Six Dependent Variables for the Linear Models ($/lb)

	Model					
	Steak	Roast	Ground	Strip	Cube	Ribs
Mean	7.87	5.98	4.15	5.34	6.07	4.17
Standard Deviation	4.28	3.47	1.24	1.74	3.06	1.72
Minimum	0.99	0.39	0.96	1.01	1.24	0.90
Maximum	36.51	33.27	14.55	17.25	28.09	13.82

5.1 Results for Model 1 – Steak

Model 1 explains the price per pound for the dependent variable steak price. Overall, the model is a good fit for the data. The R-Square and the Adjusted R-Square are 0.70 indicating that approximately seventy percent of the variation in the price per pound of steak is being explained by this linear regression model. All of the variables in the model are statistically significant at the one percent level except for the Halal religious label and the neck steak cut variables. The Halal religious claim variable is significant at the four percent level indicating 96 percent confidence that the estimate is different from zero. Halal receives a premium of $0.50/lb compared to steak products without a religious claim. The steak cut variable neck is significant at the seven percent level, indicating we are 93 percent confident that the estimate is different from zero. The Root MSE is lower than the standard deviation of the dependent variable steak price by $1.95 per pound which shows that the model is more accurate than simply using the average steak price as a predictor. Tables 5.2 and 5.3 display the regression results.

Table 5.2 OLS Regression Results for Model 1 – Steak Examining the Determinants of Steak Price Per Pound

Variable		Parameter Estimate	Standard Error	t Value	Pr > |t|
	Intercept	4.95941	0.07784	63.71	<.0001
Brand Dummy Variable (Unknown Brand Default)					
	Local	2.95116	0.03906	75.54	<.0001
	Regional	2.61488	0.02346	111.46	<.0001
	National	2.23764	0.02106	106.26	<.0001
	Store	2.04643	0.02058	99.42	<.0001
Breed Claim Dummy Variable (No Breed Default)					
	Breed 1	-0.91239	0.01283	-71.1	<.0001
	Breed 2	3.19205	0.50821	6.28	<.0001
	Breed 3	-2.35097	0.06489	-36.23	<.0001
Quality Grade Dummy Variable (Choice Default)					
	Prime	2.97625	0.03136	94.90	<.0001
	Select	-1.90744	0.04725	-40.37	<.0001
	Not Graded	-0.27940	0.01367	-20.44	<.0001
Organic Claim Dummy Variable					
	Organic	3.14736	0.02768	113.69	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)					
	Halal	0.49859	0.23331	2.14	0.0326
	Kosher	0.87716	0.03224	27.20	<.0001
	KoGlatt	1.89746	0.03251	58.36	<.0001
Bone State Dummy Variable					
	Bone In	-0.70137	0.02137	-32.82	<.0001
Steak Cuts Dummy Variables (Sirloin Steak Default)					
	Tenderloin	7.47724	0.03250	230.06	<.0001
	Top Loin	2.10902	0.02977	70.84	<.0001
	Porterhouse	3.05747	0.04050	75.49	<.0001

Continued……

Table 5.2 Continued

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Steak Cuts Dummy Variables (Sirloin Steak Default)				
T-Bone	3.00825	0.03998	75.23	<.0001
Ribeye	2.39905	0.03293	72.86	<.0001
Lip On Ribeye	2.17869	0.03220	67.65	<.0001
Rib Cap On	-2.49534	0.34840	-7.16	<.0001
Top Sirloin	-1.61766	0.03465	-46.68	<.0001
Flat Iron	-2.25544	0.05525	-40.82	<.0001
Tri Tip	-1.41493	0.04245	-33.33	<.0001
Cubed Steak	-3.33501	0.03329	-100.17	<.0001
Ball Tip	-1.90578	0.06278	-30.36	<.0001
Flap	-2.31223	0.05949	-38.87	<.0001
Top Blade	-3.25678	0.04262	-76.42	<.0001
Petite Tender	-1.00359	0.08862	-11.32	<.0001
Clod	-3.55748	0.03979	-89.41	<.0001
Chuck Eye	-3.22535	0.04361	-73.96	<.0001
Under Blade	-3.88937	0.03874	-100.40	<.0001
Neck	-4.25697	2.32803	-1.83	0.0675
Tender	-3.19391	0.04855	-65.78	<.0001
Seven Bone	-3.28592	0.06235	-52.70	<.0001
Arm	-3.70112	0.06745	-54.87	<.0001
Blade	-3.59939	0.04574	-78.69	<.0001
Cross Rib	-2.94522	0.05637	-52.25	<.0001
Bottom	-3.56588	0.03793	-94.02	<.0001
Round Eye	-3.13861	0.03647	-86.06	<.0001
Full Cut	-3.53643	0.04392	-80.52	<.0001
Tip	-3.24189	0.03689	-87.89	<.0001
Top	-3.25674	0.03401	-95.76	<.0001
Skirt	-1.48744	0.04467	-33.30	<.0001
Flank	0.18163	0.03944	4.61	<.0001
Other Steak*	-0.59107	0.13842	-4.27	<.0001
Volume Weighted Mean Price Per Pound Variable				
Mpricelb	0.44445	0.01682	26.42	<.0001

*Other Steak includes loin sundry and miscellaneous cutlet

Table 5.3 Regression Output for Model 1 - Steak

Root MSE	2.32766
R-Square	0.7038
Adjusted R-Square	0.7037
Number of Observations Used	200,407

Looking at the brand parameter coefficients, the local brands have the highest premium for the price of steak when compared to steak products that are not branded or the brand is unknown. A premium of $2.95/lb is associated with local brand products when compared to unbranded products. Locally branded steak products could be considered specialty products that are only found in small quantities in a limited distribution area. Local, regional, national, and store brands all receive premiums greater than $2.00/lb relative to unbranded steak products. This indicates that compared to steak products that are not branded or if the brand is unknown there is likely a price premium for steak that is branded regardless of the brand specifications. Interestingly, the different brand categories have premiums that are similar to each other ranging from $2.05/lb to $2.95/lb relative to unbranded products. Apparently, brand equity for steaks is similar across brand categories.

The breed claim parameter coefficients do not present the same consistency as the brand variable estimates. According to the regression results, Breed 1 and Breed 3 are estimated to have discounts compared to steaks with no breed claim. It was not expected for a breed claim coefficient to have a negative sign; however, there is considerable collinearity present between the Prime dummy variable and the Breed 3 dummy variable. Breed 3 beef products are considered to be of premium quality. In the data set used, all Breed 3 beef observations are graded Prime and are also all branded as national products. For example, in this particular model, to predict the price of a steak that is considered to be Breed 3, one would need to take into consideration the Prime parameter estimate as well as the national brand estimate together with the Breed 3 variable. The Prime coefficient is estimated at a premium of approximately \$2.98/lb. Taking this premium into account, Breed 3 steaks could be exhibiting a slight premium of \$0.63/lb when compared to Choice steak products without a breed claim. Similarly, the premium of \$2.24/lb for national brands could be analyzed with the Breed 3 coefficient.

The Breed 1 coefficient was also estimated at a discount and exhibits significant collinearity with the Prime variable. Out of the total Prime steak observations nearly 42 percent had a Breed 1 claim associated with them. The Breed 2 claim parameter estimate is the opposite from the previous variables discussed. The magnitude of the Breed 2 estimation is a positive 3.19. The indication represented here is that the Breed 2 claim offers a premium for the price of steak per pound when contrasted with steaks that do not specify a breed claim. The Breed 2 coefficient in this model is statistically significant; however, there are only 21 Breed 2 observations which is a small percentage compared to the other breed claim variables relevant to the total.

The parameter estimates for the grades, Prime, Choice, and Select are all statistically significant at the one percent level. The estimation for Prime has the largest impact of the quality grades. There is a \$2.98/lb premium associated with steak products graded Prime compared to steak products that are graded Choice. The unclassified coefficient that represents product that is not graded or the grade is unknown has a negative sign, thus portraying a small discount of \$0.28/lb. For the grade Select variable there is a discount of \$1.91/lb relative to grade Choice steak products. This is to be expected because grade Select is the lowest quality grade out of Prime, Choice, and Select and would be expected to be a discount compared to Choice graded steak products.

There is a premium of $3.15/lb for an organic steak product compared to a steak product that has no organic connection. The regression result concurs with expectations because products that are organic tend to exhibit a higher price because they represent a particular niche market that is costly to supply relative to conventionally produced products. The other important market estimated in this model was the religious claim product market. Premiums are associated with the religious labels Kosher and Kosher-Glatt and are statistically significant at the one percent level. The Halal estimate exhibits a premium as well but is not statistically at the one percent level. It is statistically significant at the four percent level. The Halal and Kosher religious claims have smaller magnitudes than the Kosher-Glatt claim when all of the religious claim variables are compared with the default variable, no religious claim. For a steak that is classified as Kosher-Glatt a premium of approximately $1.90/lb will be associated with the price per pound of steak when compared to a steak that has no religious label. Kosher-Glatt is expected to be estimated at a premium because it requires extra examination of the lungs in order to determine that there are no adhesions at the time of slaughter (Curtis, 2005).

There are thirty-two steak cuts included as dummy variables in the regression results. The majority of the various steak cuts have negative signs. Tenderloin, top loin, porterhouse, T-bone, ribeye, and lip on ribeye positively affect the dependent variable when compared to the default variable sirloin. The premium steak cut coefficients reveal an average premium of $3.37/lb. The tenderloin cut garners the highest premium of $7.48/lb relative to sirloin steaks. The steak cut coefficients that have positive values are classified as premium steak products according to The Beef Checkoff. The Beef Check Off has classified steak cuts into premium steak cuts and everyday steak cuts. The parameter estimates included in this model for steak cuts coincide with The Beef Checkoff's classifications. The higher quality cuts exhibit premium dollar amounts and the cuts classified as everyday steak cuts contain a discount amount relative to sirloin cuts. The three parameter estimates that do not conform to expectations are the rib cap on, top sirloin, and flank parameter estimations. The rib cap on is discounted when compared to sirloin steaks. Rib steaks are usually considered premium steaks. The top sirloin coefficient is exhibiting a discount of $1.61/lb relative to sirloin steaks. Typically the top sirloin is a higher quality cut than sirloin. The flank estimation garners a premium of $0.18/lb in relation to sirloin steaks. Flank steaks are usually less tender cuts compared to sirloin and would be expected to portray a discount when compared with a sirloin cut.

The sign on the volume-weighted average weekly price per pound of steak variable also agrees with expectations. For a $1.00 increase in the mean price per pound of steaks in the market each week, the individual steak product price per pound increases by $0.44/lb. The premium has a high statistical significance with a 99 percent confidence level. We would expect this coefficient to be close to 1.0 if the same mixture of steaks, across all relevant price determinants, were sold each week. Apparently, some variation in steak product characteristics mixture occurs over time so that the weighted-average price and prices of each individual cut do not change in one for one fashion.

5.2 Results for Model 2 – Roast

Looking at the regression results for the variables that affect the price per pound of roast products, the model explains approximately 52 percent of the variability in the price per pound of roasts for this particular regression analysis. All of the independent variables for the roast model are statistically significant at the 99 percent confidence level except for the religious claim dummy variable Halal. The Root MSE is lower than the standard deviation of the dependent variable roast by $1.08 per pound which shows that the model is more accurate than simply using the average steak price as a predictor. Tables 5.4 and 5.5 display the regression results and summary statistics, respectively.

Table 5.4 OLS Regression Results for Model 2 – Roast Examining the Determinants of Roast Price Per Pound

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1.90907	0.10021	19.05	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	1.23842	0.04598	26.93	<.0001
Regional	1.35407	0.02807	48.24	<.0001
National	1.67866	0.02577	65.14	<.0001
Store	1.57655	0.02634	59.85	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.46799	0.01910	-24.51	<.0001
Breed 2	2.45734	0.59763	4.11	<.0001
Breed 3	-3.12642	0.15179	-20.60	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	3.44520	0.05361	64.27	<.0001
Select	-1.37370	0.06367	-21.57	<.0001
Not Graded	-0.19223	0.01974	-9.74	<.0001
Organic Claim Dummy Variable				
Organic	2.29546	0.05095	45.05	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Halal	0.52149	0.63908	0.82	0.4145
Kosher	1.85209	0.03753	49.35	<.0001
KoGlatt	2.91222	0.04626	62.95	<.0001
Bone State Dummy Variable				
Bone In	-0.27965	0.02112	-13.24	<.0001
Roast Categories Dummy Variables (Oven Everyday* Default)				
Pot Roasts	-0.53140	0.01922	-27.65	<.0001
Oven Premium Roasts	4.37489	0.01995	219.29	<.0001
Holiday Roasts	1.11595	0.01926	57.94	<.0001
Volume Weighted Mean Price Per Pound Variable				
Mpricelb	0.40255	0.02266	17.76	<.0001

*Oven Everyday Roasts include chuck: eye, neck, tender, and under blade; loin: ball tip, tri tip, sirloin, flap, and top loin; round: tip, top, eye, full cut, and mixed; shoulder: petite tender; plate skirt; flank

Table 5.5 Regression Output for Model 2 – Roast

Root MSE	2.38895
R-Square	0.5249
Adjusted R-Square	0.5248
Number of Observations Used	116,428

Interpreting the brand dummy variables, it is clear that the local, regional, national, and store brands have a premium associated with them when compared to roast products that do not have a brand claim. The breed claim variable coefficient signs match the signs of the steak model discussed above. Branded roast products receive similar premiums ranging from $1.24/lb to $1.68/lb.

The Breed 1 estimation is a small discount of $0.47/lb relative to a roast product with no breed claim. Typically there is a premium associated with a product with a breed claim and as a result this particular sign was not expected. However, there does appear to be some collinearity between the Breed 1 variable and the Prime variable. Out of the total number of observations for Prime roasts, 67 percent are Breed 1 roasts. Taking into consideration the connection between Breed 1 and Prime, Breed 1 roasts would actually result in a premium of $2.98/lb ($3.45 - $0.47) when contrasted against roasts that do not come from a particular breed. A similar case exists for the Breed 2 coefficient where all of the Breed 2 roasts are graded Prime and are also all categorized as national branded products. The Breed 2 parameter estimation does exhibit the expected premium in the amount of $2.46/lb when compared to roasts with no breed associated with the product.

For the quality grade parameter coefficients the signs agree with expectations. There is a premium associated with the Prime dummy variable of $3.45/lb relative to Choice roast products. Both the grade Select and ungraded variables portray discounted amounts. This is to be expected when compared to grade Choice because Select is a lower quality grade and roasts that are not graded are generally lower quality grade.

The organic claim variable also concurs with expectations when compared to products that are not certified organic. There is a premium of $2.30/lb for roast products that have an organic claim associated with them. The religious claim dummy variable coefficients have premiums associated with them as well when to the default variable, no religious claim. The Kosher-Glatt estimation of $2.91/lb exhibits the highest premium. The smallest premium of $0.52/lb is the Halal coefficient; however, this parameter estimate is not statistically significant. This result was not unforeseen due to the fact that there are only 14 roast observations among these products with the religious claim Halal in the data set.

The variable concerned with whether the roast product was bone in or boneless has a small discount of $0.28/lb for bone in roasts. This estimation could be affected by the percentage of roasts that are bone in compared to boneless roasts available. Only 14 percent of roast products were bone in which is small relative to the 116,428 roast observations.

As discussed in Chapter 4, the sources for roast cuts were divided in familiar purchasing categories for analysis purposes. The pot roast dummy variable coefficient, which primarily consisted of brisket, chuck, and round, exhibits a slight discount when compared with the everyday roasts. The pot roast selections typically come from lean, well exercised muscles and often require braising and slow cooking in order to tenderize the meat (The Beef Checkoff, 2008). The discount is to be expected when compared to everyday roast products. Everyday roasts are considered higher end cuts as well as more tender due to the fact that the majority of the roasts come from the top and eye round, tri-tip, sirloin, top loin, chuck under blade and chuck eye. In contrast, when analyzing premium roasts with everyday roast there is a significant premium of \$4.37/lb. Clearly, premium roasts have higher prices and are considered to be of higher quality when compared to the everyday roasts. As explained in Chapter 4, the premium roasts consist of the tenderloin, rib, and ribeye. According to the North American Meat Processors Association's 2007 Meat Buyer's Guide, the cuts included in the premium roast category are contained in the top five most tender beef muscles. "Collectively, past research demonstrates that beef product tenderness, especially for products from the Loin and Rib, is important to consumer satisfaction and consumers demonstrate willingness to pay for tender relative to tough beef" (Schroeder, Riley, Frasier, 2008, p. 1). The results from this model support previous conclusions and also further prove consumers purchasing behavior. Consumers also tend to purchase certain roast products during the holiday season (The Beef Checkoff, 2008). The dummy variable coefficient for holiday roasts associates a premium for these items of \$1.12/lb when compared to all other roasts used in this model. In accordance with The Beef Checkoff's Beef Training Camp information for retailers, holiday roast consist primarily of rib, ribeye, tenderloin, round tip or sirloin tip center, eye round, top round, tri-tip, chuck eye, and shoulder petite tender, roasts. Examining the frequency of the roast cuts listed above, the results from Table 5.6 confirms that the cuts that have been classified as holiday roasts are purchased around particular holiday times. For example, the months of March and December have the highest frequencies for holiday roast purchases. One holiday that is in March that could potentially influence this increase in purchased holiday roasts is Easter. The second highest frequency appears in December which could be a result of the Christmas holiday season.

Table 5.6 2004-2009 Frequency of Holiday Roasts

Month	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	4209	9.11	4209	9.11
2	4189	9.06	8398	18.17
3	5243	11.35	13641	29.52
4	3305	7.15	16946	36.67
5	3256	7.05	20202	43.71
6	4057	8.78	24259	52.49
7	3264	7.06	27523	59.56
8	3252	7.04	30775	66.59
9	4134	8.95	34909	75.54
10	3337	7.22	38246	82.76
11	3440	7.44	41686	90.2
12	4528	9.80	46214	100

Capps (1989) also found similar frequencies for the purchase of roasts in that they were highest between December and February compared to the base period used (September through November). The last variable in this model is the mean price per pound of roast products. For every \$1.00 increase in the weight-average weekly price of roasts there is a \$0.40/lb increase in the price of individual roast products.

5.3 Results for Model 3 – Ground Beef

Section 5.3 will interpret the results from the ground beef model. As seen in Table 5.8, the R-Square and Adjusted R-Square show that approximately 39 percent of the variation is being explained for the price per pound of ground beef. When determining the accuracy of the model, the Root MSE is smaller than the standard deviation of the price per pound of ground beef by \$0.26/lb. Looking at Table 5.7, only two parameter coefficients appear to be not statistically significant when compared to all of the variables estimated in the model that show evidence of a 99 percent confidence level. The Breed 2 claim dummy variable is insignificant;

however, the ground chuck dummy variable is significant at the five percent level exhibiting 95 percent confidence.

Table 5.7 OLS Regression Results for Model 3 – Ground Examining the Determinants of Ground Beef Price Per Pound

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	2.35375	0.05437	43.29	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	0.33192	0.02644	12.55	<.0001
Regional	0.78804	0.01598	49.30	<.0001
National	0.65196	0.01336	48.81	<.0001
Store	0.74249	0.01433	51.80	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.55813	0.01113	-50.13	<.0001
Breed 2	-0.21672	0.56100	-0.39	0.6993
Breed 3	-1.63243	0.07133	-22.89	<.0001
Breed 4	3.18361	0.19889	16.01	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	0.64721	0.04979	13.00	<.0001
Select	-2.66103	0.22950	-11.59	<.0001
Not Graded	-0.31563	0.01256	-25.13	<.0001
Organic Claim Dummy Variable				
Organic	1.75838	0.02553	68.86	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Halal	-1.47568	0.07288	-20.25	<.0001
Kosher	0.83371	0.02169	38.43	<.0001
KoGlatt	1.60848	0.02334	68.91	<.0001
Ground Beef Category Dummy Variables (Other Ground* Default)				
Meat Balls	0.33221	0.02953	11.25	<.0001
70-77% Lean	-0.19928	0.02115	-9.42	<.0001
78-84% Lean	-0.21861	0.02248	-9.73	<.0001
85-89% Lean	0.37374	0.02104	17.76	<.0001
90-95% Lean	0.88411	0.02113	41.83	<.0001
96-100% Lean	1.20638	0.02555	47.21	<.0001
Chuck	0.04239	0.02143	1.98	0.0479
Round	0.41229	0.02180	18.91	<.0001
Sirloin	0.96936	0.02220	43.67	<.0001
Volume Weighted Mean Price Per Pound Variable				
Mpricelb	0.28109	0.01174	23.93	<.0001

* Other Ground includes Chili Meat, Meat Loaf, and Trim

Table 5.8 Regression Output for Model 3 – Ground Beef

Root MSE	0.97135
R-Square	0.3829
Adjusted R-Square	0.3826
Number of Observations Used	55,579

Parallel to the steak and roast models, all of the brand category dummy variable estimations have a premium associated with them when compared to ground beef products that do not have a brand name. The premium amounts are less than $0.80/lb but compared with steak and roast products, ground beef is typically not a premium product and consequently the smaller premiums are to be expected with ground products.

The breed claim coefficients are negative, except for Breed 4, indicating that compared with ground products that do not have a breed designation; breed identified ground beef is discounted. This is not concurrent with expectations. Typically beef with a breed claim would be expected to have a premium. Why else would someone place a breed claim on the product unless it garnered at a premium. In order to explain this result, collinearity analysis shows that some of the breed claim variables are correlated with some of the brand category and ground beef category variables. For example, all Breed 3 beef observations are graded Prime and are also all national branded products. Given this finding, there is reason to look at the premiums associated with the national brand coefficient and the graded Prime coefficient in relation to the discount that the Breed 3 claim has estimated. The other breed claim variables that have significant collinearity are Breed 2 and Breed 4. Breed 2 is correlated with national and chuck; however, there is a limited amount of ground beef Breed 2 observations and the coefficient is not statistically significant. Breed 4 observations are all store brand products and are all 70-77% Lean. This parameter estimate is statistically significant at the 99 percent level.

The grade dummy variables carry the expected signs and all parameters are statistically significant. The Prime coefficient exhibits a slight premium when compared to Choice products which is consistent with expectations because grade Prime is a higher quality grade than Choice products. The Select and not graded estimations carry negative signs and are discounted when compared to the default Choice.

The premium represented by the organic variable agrees with expectation as organic products generally are considered premium due to the program qualifications and the demand for this product by the consumers. The religious claim variables display premiums except for the Halal religious label when compared to products that do not have religious claims associated with them. The Halal label was not expected to be at a discounted amount but one important point to mention is that there are less than one percent of ground Halal observations in the data set.

When analyzing the ground beef form variables, all of the variables have premiums associated with them except for 70-77% Lean and 78-84% Lean when compared to other ground beef products not included in the variables. The other ground beef forms are comprised of chili meat, meat loaf, and trim. The parameter coefficient with the largest premium is the 96-100% Lean resulting in a $1.21/lb premium when compared to the other ground beef categorization. There is also a positive coefficient with the weekly weighted-average price per pound of ground beef variable. A $1.00 increase in the weekly weighted-average price per pound will cause an increase of $0.28/lb in individual ground beef prices.

5.4 Results for Model 4 – Strip

The overall fit of this model is not as strong as some of the other models in this study. The R-Square and Adjusted R-Squared represent that 33 percent of the variation of the data for the strip model is being explained. Although this is a lower percentage it is not unexpected given this broad category of products included in this model and all of the variables are statistically significant at the 99 percent confidence level as seen in Table 5.9 below. The Root MSE is lower than the standard deviation of the dependent variable by $0.31/lb which portrays that the model is more accurate than using the average strip price as a predictor. The strip model also has one of the smallest observation sets out of all of the regression models estimated as seen in Table 5.10.

Table 5.9 OLS Regression Results for Model 4 – Strip Examining the Determinants of Strip Product Price Per Pound

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	3.42192	0.13547	25.26	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	1.83392	0.11072	16.56	<.0001
Regional	1.48472	0.04262	34.84	<.0001
National	1.51930	0.03348	45.38	<.0001
Store	1.54589	0.03584	43.14	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.52480	0.03246	-16.17	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	2.07186	0.12370	16.75	<.0001
Select	-1.37959	0.08337	-16.55	<.0001
Not Graded	-0.20257	0.03077	-6.58	<.0001
Organic Claim Dummy Variable				
Organic	4.09753	0.08442	48.54	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Kosher	1.30103	0.06000	21.68	<.0001
KoGlatt	1.76260	0.08871	19.87	<.0001
Strip Product Category Dummy Variables (Other Strip* Default)				
Stir Fry	0.63199	0.02413	26.19	<.0001
Fajita Meat	0.61556	0.02358	26.11	<.0001
Volume Weighted Mean Price Per Pound Variable				
Mpricelb	0.17820	0.03094	5.76	<.0001

* Other Strip includes miscellaneous: strips and cutlet; brisket: stew and strips; chuck: cutlet and strips; loin: flap, sundry, and tenderloin; shoulder: strips and top blade; round: tip and bottom; rib strips

Table 5.10 Regression Output for Model 4 – Strip

Root MSE	1.42417
R-Square	0.3279
Adjusted R-Square	0.3275
Number of Observations Used	22,100

The brand category parameter coefficients all exhibit the expected signs. Local, Regional, National, and Store brand categories have premiums associated with them in relation to strip products that do not have a brand name all bringing premiums ranging from \$1.48/lb to \$1.83/lb.

The only strip observations with a breed claim associated with them are Breed 1 strip products. The Breed 1 dummy variable estimation is significant at the 99 percent level but does not portray the expected sign. There is a discount associated with the Breed 1 strip products in this model when compared to strip products that do not have a breed claim attached. In order to give reason for this unexpected discount, the Breed 1 variable can be checked for collinearity with other variables in the strip model. Frequency results found that there is high correlation, at approximately 75 percent, with the store brand category variable. An assumption can be made that some of the premium associated with the store branded strip products can be connected to the Breed 1 coefficient and potentially exhibit a premium amount for Breed 1 strip products.

The quality grade coefficients coincide with expectations with grade Prime products at a premium in relation to Choice strip products. Prime strip products exhibited a premium of $2.07/lb relative to strip products that are grade Choice. Beef strips that are grade Select or not graded reveal a discount of $1.38/lb and $0.20/lb respectively relative to Choice graded strip products. Noticeably, the Prime strip products will reflect higher prices due to the higher quality they provide. The opposite is observed for the Select and not graded products because they do not have as high of quality as the Choice products.

The organic parameter coefficient has a premium of $4.10/lb when compared to non-organic strip products. There are two religious claim variables present in this particular model. Kosher and Kosher-Glatt strip products both exhibit a premium measured in comparison to strip products that are not processed and marketed with any religious affiliation. The two sub-category variables classified in the strip model also have premiums associated with them in relation to unclassified strip meat. The stir fry dummy variable includes strip cuts can typically come from the loin, rib, round, and flank areas. Stir fry meat is commonly trimmed and cut into strips of the same length and width (The Beef Checkoff, 2008). An explanation for why the stir fry and fajita meat coefficients estimate a premium is because the items may be further processed at the retail location and for convenience for the consumer who is looking for a quick easy meal. The last variable shown on Table 5.9 is the mean price per pound parameter estimate. Interpreting this variable, for every $1.00 increase in the weighted average weekly price per pound the overall price of strip products will increase by $0.18/lb.

5.5 Results for Model 5 – Cube

The regression model, shown below in Tables 5.11 and 5.12, for beef products in the form of cubes represents that 31 percent of the variation is being explained for the price per pound of cube products. The Root MSE is an indicator of accuracy and is $0.52 per pound lower than the standard deviation of the cube model. As discussed previously, beef in the form of cubes is typically cut into 3-demensional uniform pieces (The Beef Checkoff, America's Pork Producers and the Lamb Checkoff, 2010). Within the product form cube there is also stew meat and kabob meat in which the consumer can recognize these terms easily as "recipe ready beef" (The Beef Checkoff, 2008).

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Table 5.11 OLS Regression Results for Model 5 – Cube Examining the Determinants of Cubed Product Price Per Pound

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	2.96617	0.18287	16.22	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	0.89360	0.11016	8.11	<.0001
Regional	1.79851	0.05430	33.12	<.0001
National	1.53921	0.04559	33.76	<.0001
Store	1.39293	0.04441	31.36	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.64744	0.03297	-19.64	<.0001
Breed 3	-6.04911	0.23918	-25.29	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	5.31257	0.10415	51.01	<.0001
Select	-2.17373	0.11963	-18.17	<.0001
Not Graded	-0.26702	0.03395	-7.86	<.0001
Organic Claim Dummy Variable				
Organic	1.47424	0.08741	16.87	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Halal	0.05123	0.80457	0.06	0.9492
Kosher	0.19290	0.07229	2.67	0.0076
KoGlatt	1.80986	0.07525	24.05	<.0001
Cube Product Category Dummy Variables (Other Cubes* Default)				
Stew Meat	-1.36584	0.04088	-33.41	<.0001
Kabobs	1.70446	0.04090	41.68	<.0001
Volume Weighted Mean Price Per Pound Variable				
Mpricelb	0.50537	0.04180	12.09	<.0001

*Other Cubes include shoulder: petite tender and cubes; rib ribeye; miscellaneous cubes; top round ; plate skirt

Table 5.12 Regression Output for Model 5 - Cube

Root MSE	2.54187
R-Square	0.3112
Adjusted R-Square	0.3110
Number of Observations Used	39,605

As for branded products that offer cubed beef, all categories exhibit premium amounts when compared to products that are not branded. The regional category has the highest premium of $1.80/lb. Following the regional category are the national branded cubed products and the store branded products. All of the brand parameter estimates have a premium greater than $1.00/lb when compared to unbranded cubed products except for the locally branded beef which has a premium of $0.89/lb.

There are two breed claim estimations that offer cubed beef that have not resulted in the expected signs. The Breed 1 claim for cubed beef results in a discount when compared to cubed product that is not associated with a specific breed; however, there is some collinearity that could explain this estimation. The Breed 1 coefficient is highly correlated with store branded cubed with 61 percent of the Breed 1 products being store branded. This observation is reasonable because cubed products often require more processing than some other products forms in which the retail store would cut the cubed product on site at the retail location and it is sensible that almost half of all of the cube observations are categorized as store brands. There is also multicollinearity between Breed 3, Prime, and national. All Breed 3 beef is graded Prime and also branded as national products. This correlation could explain why the expected sign is reversed.

The quality grade variable coefficients concur with expectations. The Prime quality grade has a $5.31/lb premium in relation to Choice graded cube products. Select and ungraded products both have discounts associated with them when compared to grade Choice. The organic parameter estimate is also estimated at a premium and is significant at the one percent level. The Halal and Kosher religious claim estimations result in a premium when compared to cube products that do not associate with any religious affiliation; however, neither coefficient is statistically significant. The Kosher-Glatt estimate is significant at the 99 percent confidence level and exhibits a premium of $1.81/lb in relation to products with no religious claim.

The cubed stew meat parameter coefficient is negative relevant to miscellaneous cubed products. One explanation for this estimation is that the stew meat products usually come from cuts that are less lean and typically consider lower quality which are better for stewing. The miscellaneous cube products come from a variety of different cuts including some that are leaner and could be considered more of a premium than the stew meat category. The estimation for kabob cubes shows a premium of $1.70/lb when contrasted against miscellaneous cube products. This is to be expected due to the fact that cuts for kabob cubes primarily comes from the loin which makes a great lean product for grilling (The Beef Checkoff, 2008). The cube product price per pound estimation reveals a premium of $0.50/lb meaning that if there is a $1.00 increase in the weekly weighted-average price per pound of cube products then there will be an increase of $0.50 in individual cubed product price per pound.

5.6 Results for Model 6 – Ribs

The model discussed in this sub-section pertains to beef products contained in the data set that are in the product form of ribs. The independent variables explain the dependent variable of the price per pound of ribs. The output in Table 5.14 shows that 53 percent of the variation is being explained. All parameter estimates are statistically significant at the one percent level, meaning that all the variables result in 99 percent confidence that they are statistically significant in determining the price per pound of ribs. The Root MSE represents the accuracy of the model by looking at the difference with the standard deviation. The Root MSE is $0.54 per pound less than the standard deviation of $1.72/lb for rib products.

Table 5.13 OLS Regression Results for Model 6 – Ribs Examining the Determinants of Rib Product Price Per Pound

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	3.00049	0.11247	26.68	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	0.39200	0.04745	8.26	<.0001
Regional	1.36840	0.03607	37.94	<.0001
National	0.40785	0.03285	12.41	<.0001
Store	1.00367	0.03246	30.92	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.34391	0.02638	-13.04	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	1.36390	0.16000	8.52	<.0001
Select	-1.73212	0.06319	-27.41	<.0001
Not Graded	-0.66626	0.02550	-26.13	<.0001
Organic Claim Dummy Variable				
Organic	0.80530	0.08440	9.54	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Kosher	3.22068	0.04264	75.53	<.0001
KoGlatt	2.11292	0.03574	59.13	<.0001
Bone State Dummy Variable				
Bone In	-0.21047	0.01828	-11.51	<.0001
Process Level Dummy Variable				
Processed	0.73277	0.03779	19.39	<.0001
Rib Product Category Dummy Variables (Other Ribs* Default)				
Short Ribs	0.52450	0.01851	28.33	<.0001
Back Ribs	-1.06957	0.02448	-43.69	<.0001
Volume Weighted Mean Price Per Pound Variable				
Mpricelb	0.20118	0.02534	7.94	<.0001

* Other Ribs includes Plate, Chuck, and Rib

Table 5.14 Regression Output for Model 6 – Ribs

Root MSE	1.17591
R-Square	0.5333
Adjusted R-Square	0.5329
Number of Observations Used	21,860

As shown on Table 5.13 above, the parameter estimates for the brand categories are all positive and show a premium when analyzed with rib products that are not branded or the brand is unknown. Consistent with the cube, ground, and steak model, regionally branded rib products have the highest premium of $1.37/lb relative to ribs products not exhibiting a brand. The second largest premium for branded beef ribs is store branded products. The smallest premium is for local branded ribs at $0.39/lb.

The only breed claim that is associated with rib products in this particular data set is Breed 1. The coefficient portrays a discount which does not agree with expectations. It can be assumed that the Breed 1 estimate is correlated with another variable being regressed in this model. The store brand category variable appears to have a high level of collinearity with the Breed 1 claim variable. Nearly 65 percent of Breed 1 rib products are classified as store brands which offer an explanation for the sign reversal of the Breed 1 estimation.

Prime, Select, and not graded coincide with expectations in relation to grade Choice. Grade Prime has a premium of $1.35/lb when compared with grade Choice. Grade Select ribs and rib products not exhibiting a grade result in discounts of $1.73/lb and $0.67/lb respectively, when compared with grade Choice ribs. Organic rib products as well as the religious claim variables are estimated as premium amounts. These results are also expected when compared with non-organic products and non-religious claim products, respectively.

The bone in parameter estimate, at a discount of $0.21/lb, explains that there is a premium for products that are deboned. This is logical because a product must be minimally processed or processed in order to remove the meat from the bone for rib meat to cater to consumer needs of convenience. There is also a premium associated with rib products that are fully processed when related to ribs that are not processed fully. The coefficient premium of \$0.73/lb is significant at the 99 percent confidence level. When analyzing the different product forms, the short ribs exhibit a premium of \$0.52/lb and back ribs result in a discount of \$1.07/lb when compared to all other ribs not classified as short ribs or back ribs. The mean price per pound parameter estimate explains that when there is a \$1.00 increase in the weekly weighted-average price per pound of ribs then there will be an increase of \$0.20/lb in the individual price of ribs.

5.7 Linear Model Comparison

When comparing the six regression models, it is clear that there is a premium for all branded beef products used in this study in relation to the products that are not branded or unclassified.

Table 5.15 Summary Table for Brand Dummy Variable OLS Regression Parameter Estimates

Brand Dummy Variable (Unknown Brand Default)	Model: Steak		Roast		Ground		Strip		Cube		Ribs	
Local	2.95	(2.22%)*	1.24	(2.82%)*	0.33	(2.99%)*	1.83	(0.77%)*	0.89	(1.46%)*	0.39	(3.46%)*
Regional	2.62	(13.14%)*	1.35	(13.82%)*	0.79	(12.64%)*	1.48	(7.59%)*	1.80	(10.91%)*	1.37	(8.48%)*
National	2.24	(26.09%)*	1.68	(25.55%)*	0.65	(32.68%)*	1.52	(17.82%)*	1.54	(26.43%)*	0.41	(22.86%)*
Store	2.04	(48.42%)*	1.58	(43.93%)*	0.74	(33.95%)*	1.55	(43.09%)*	1.39	(44.33%)*	1.00	(46.31%)*
Mean Price Per Pound Variable ($/lb)	7.87		5.98		4.15		5.34		6.07		4.17	
Percent of Average Price per Pound												
Local	37%		21%		8%		34%		15%		9%	
Regional	33%		23%		19%		28%		30%		33%	
National	28%		28%		16%		28%		25%		10%	
Store	26%		26%		18%		29%		23%		24%	

* Indicates the percentage of local, regional, national, and store branded products for each individual cut.

This result agrees with previous literature presented by Parcell and Schroeder (2007); Ward, Lusk and Dutton (2008b); Schroeder, Riley, and Frasier (2008). It is important to note that although the results from the Parcell and Schroeder study exhibited the same signs for the branded steak and roast products, ground beef was found to be a discount which was not the case in this research. Ward, Lusk, and Dutton as well as Schroeder, Riley, and Fraiser, did however find a premium for branded ground beef products which coincides with the results in Table 5.15.

Also present across all six cuts of beef is that on a weighted average, the regional branded products have the highest premiums relative to unbranded products. Behind regionally branded products, local brands garner the next highest weighted average premium followed by national and store. Table 5.15 displays the brand parameter estimates for the six different cuts analyzed. The percentage of each premium in relation to the average price for steak, roasts, ground beef, strip beef, cubed beef, and ribs is exhibited in Table 5.15. As a percentage of average price, steaks have the highest total percentage across all brand levels.

Although the study completed by Parcell and Schroeder does not divide the branded products into categories like we have done here, a premium for steaks and roasts is still associated with branded products relative to store brands. Ward, Lusk and Dutton did however include brand categories that are similar to what was used in this study. The results illustrate premiums for all brand categories (special, program/breed, store, and other) for ground beef and roast/steak products in comparison to generic or unbranded products.

The quality grade coefficients also exhibit the same predicted signs across all of the models. It is apparent that for all product forms of beef a premium is associated with grade Prime and a discount is estimated for Select and ungraded products when compared with grade Choice. Parcell and Schroeder also found similar conclusions regarding quality grade. They found that there was a premium ranging from $0.27/lb to $2.46/lb for steak products that exhibited a Prime quality grade when compared to products that did not have a quality grade present on the label.

The organic parameter coefficients exhibit an average premium of $2.26/lb across all steaks, roasts, ground, strips, cubes, and ribs. Religious claim variables and the mean price per pound for all models result in a consistent premium amount when regressed with the exception of ground Halal meat. There is significant variation between the breed claim variables. Although the signs are not to be expected for some of the breed claim coefficients, it is consistently the Breed 1 and Breed 3 estimations that are negative across all the regression models.

In order to compare the Root MSE accuracy measure across all the regression models, it can be analyzed in a percentage form. Table 5.16 displays the Root MSE percentages and indicated that the cube model has the highest percentage at 42 percent. The model estimating the lowest percentage is the ground beef model at 23 percent.

Table 5.16 Root MSE in Percentage Form for Comparison Across Models

	Model					
	Steak	Roast	Ground	Strip	Cube	Ribs
RMSE	2.33	2.39	0.97	1.42	2.54	1.18
Mean Price Per Pound	7.87	5.98	4.15	5.34	6.07	4.17
RMSE %	30%	40%	23%	27%	42%	28%

Overall the entire set of regressed models exhibit a good fit for the data used to indicate the price per pound of each of the six product forms of beef in the retail market. The independent variables explaining the price per pound are good indicators of what factors affect the price of steak, roast, ground, strip, cube, and rib products.

5.8 Additional Econometric Modeling – Semi Log OLS Regressions

In order to determine if there is a better fit for the data, a log-linear regression can be used to transform some of the variables. By taking the natural log of the dependent variable we can analyze the percentage change in the price per pound of a certain cut of beef with respect to a change in the independent variables. Equation 7 represents the standard empirical model designed for estimating the percentage change for each model.

$$lnPLB_i = \beta_0 + \sum_{a=1}^{5} \beta_a \, Brand_a + \sum_{b=1}^{5} \beta_b \, BreedClaim_b + \sum_{c=1}^{4} \beta_c \, QualityGrade_c + \beta_d Organic \quad (7)$$

$$+ \sum_{e=1}^{4} \beta_e \, ReligiousClaim_e + \beta_f ln(MeanPricePerPound) + \sum_{n=1}^{N} \beta_n \, X_n{}^{*} + \varepsilon$$

The weighted weekly mean price per pound variable is also logged in this model. This is important for comparison because both the dependent price per pound and the weighted weekly mean price per pound should change at the same rate. By estimating the log-linear models for steak, roast, ground, strip, cube, and ribs we can verify whether or not the results presented in Chapter 5 represent the data well. If there is no change in the coefficient signage for the log-linear results it can be implied that either method is sufficient in fitting the data well.

The log-linear results are presented in Appendix A. In general, the parameter estimate interpretations do not vary from the interpretations of the linear regression modeling in Chapter 5. The coefficients exhibiting a discounted amount and the coefficients exhibiting premiums to the price per pound of the individual beef cuts do not change when comparing the linear regressions to the log-linear regressions. This observation indicates that both methods of estimation represent the data well. There is only one coefficient in which the sign changes and that is found in Table A.5. The chuck dummy variable in the ground beef model becomes negative in the log-linear regression however, it is not statistically significant. This can be interpreted by saying a one percent increase in the price per pound of chuck ground beef products results in a 0.95 percent decrease in the overall price per pound of ground beef. Also worth noting, the Breed 2 dummy variable is not statistically significant in the steak and roast log-linear models whereas it was statistically significant at the 99 percent confidence level in the linear regressions. This is also seen in the cubed product model with the Kosher dummy variable.

Even though there are minor differences between the two modeling techniques, the results presented for the linear regression in Chapter 5 are preferred. The linear regressions are preferred because the results are easier to interpret and understand. The price per pound interpretations are more straightforward than the percentage changes for comprehending the value of this data set and what it is telling us about the price per pound of various beef cuts.

CHAPTER 6 - Influence Diagnostics OLS Regression Results

Chapter 6 will present OLS regression results using influence diagnostics. Identifying the influential observations will determine whether or not the price per pound outliers are affecting the regression results. Throughout the analysis process it was found that there was some price per pound observations that appeared outside the scope of the data to the extent they could be influencing the model results. It is important to address outliers to determine if there are subsets of the data that have disproportionate influence on the regression results. If there is little change from the results in Chapter 5 then the influential data observations will have little effect on the regression results. If the influence diagnostics indicate that the regression results are influenced by the outlier observations then removing those observations should be considered. If a subset of the data has disproportionate influence on the parameter coefficients then it is quite possible that the regression estimations could be based on the subset of data rather than the entire data set. It is important to use a method that involves both the explained variable and the explanatory variables because methods that do not use both fail to identify the multivariate influential observations (Belsley, Kuh, and Welsch, 1980).

The following six sections present the influence diagnostics regression results. Belsley, Kuh, and Welsch (1980) recommend eliminating data having studentized residuals greater than two. The studentized residuals represent the residuals divided by their standard errors without the *ith* observation. The recommended cut off of two indicates that all observations in which their studentized residuals exceed two are influential. Comparison will be made between the results in Chapter 5 and the results presented here to establish if the parameter estimates depend on the extreme data points.

Shown in Table 5.1 are the summary statistics for the linear regression dependent variables. In Table 6.1 the summary statistics for the influence diagnostics regression six dependent variables are displayed. Comparing the two estimation processes, the steak model still portrays the highest mean price per pound. The mean prices per pound of the other dependent variables however, are not as similar between the different estimation techniques. In Chapter 5, the second highest mean price per pound is the cube dependent variable, followed by, roast, strip, rib, and ground. As shown in Table 6.1, the second highest mean price per pound is the roast dependent variable, followed by cube, strip, ground, and rib. Without the influential observations included, the mean prices per pound are lower than the original regression estimates in Chapter 5.

Table 6.1 Summary Statistics of the Six Dependent Variables for the Influence Diagnostics Models ($/lb)

	Model					
	Steak	Roast	Ground	Strip	Cube	Rib
Mean	7.58	5.63	4.06	5.21	5.59	4.05
Standard Deviation	3.87	2.77	1.09	1.45	1.89	1.52
Minimum	0.99	0.39	1.15	1.55	1.24	0.90
Maximum	24.39	18.86	8.30	10.90	18.45	10.86

6.1 Influence Diagnostic Results for Model 1 – Steak

Table 6.2 represents the influence diagnostics OLS regression results for the dependent variable steak. The results display the determinants of steak on a price per pound basis with the inclusion of influence diagnostics. The measure of fit indicator, r-square, which is shown in Table 6.3, is slightly higher than the original regression results for steak products by 0.1075. The adjusted r-square is also greater by 0.1076. Although the R-Square and Adjusted R-Square are not comparable across the different models, it is worth noting the change in magnitude. With the identification of disproportionate influence some data observations exhibit, the number of observations that are used in the regression estimation decreases from 200,407 to 189,865.

Table 6.2 Influence Diagnostics OLS Regression Results for Model 1 – Steak Examining the Determinants of Steak Price Per Pound

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.70836	0.05768	81.63	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	2.53315	0.02926	86.59	<.0001
Regional	2.60927	0.01746	149.45	<.0001
National	2.37122	0.01557	152.33	<.0001
Store	2.14384	0.01529	140.25	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.95179	0.00958	-99.31	<.0001
Breed 2	3.94767	0.42003	9.40	<.0001
Breed 3	-2.83065	0.05102	-55.48	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	2.63996	0.02509	105.20	<.0001
Select	-1.73147	0.03457	-50.08	<.0001
Not Graded	-0.19145	0.01008	-18.99	<.0001
Organic Claim Dummy Variable				
Organic	2.75421	0.02139	128.74	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Halal	0.49076	0.16835	2.92	0.0036
Kosher	1.42277	0.02423	58.72	<.0001
KoGlatt	2.35831	0.02437	96.79	<.0001
Bone State Dummy Variable				
Bone In	-0.66258	0.01596	-41.51	<.0001
Steak Cuts Dummy Variables (Sirloin Steak Default)				
Tenderloin	8.48412	0.02527	335.77	<.0001
Top Loin	2.22272	0.02248	98.87	<.0001
Porterhouse	3.14094	0.03073	102.22	<.0001
T-Bone	3.20278	0.03020	106.04	<.0001
Ribeye	2.63747	0.02469	106.81	<.0001
Lip On Ribeye	2.44457	0.02419	101.04	<.0001
Rib Cap On	-2.21457	0.25147	-8.81	<.0001
Top Sirloin	-1.55568	0.02567	-60.61	<.0001
Flat Iron	-1.94483	0.04017	-48.41	<.0001
Tri Tip	-1.12601	0.03105	-36.27	<.0001
Cubed Steak	-3.10490	0.02450	-126.73	<.0001

Continued……

Table 6.2 Continued

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Steak Cuts Dummy Variables (Sirloin Steak Default)				
Ball Tip	-1.62169	0.04554	-35.61	<.0001
Flap	-2.05940	0.04332	-47.54	<.0001
Top Blade	-3.04854	0.03113	-97.92	<.0001
Petite Tender	-0.71570	0.06417	-11.15	<.0001
Clod	-3.31178	0.02912	-113.72	<.0001
Chuck Eye	-3.02537	0.03194	-94.72	<.0001
Under Blade	-3.67628	0.02837	-129.57	<.0001
Neck	-4.63556	1.67975	-2.76	0.0058
Tender	-2.96768	0.03537	-83.89	<.0001
Seven Bone	-3.10068	0.04540	-68.30	<.0001
Arm	-3.50819	0.04895	-71.66	<.0001
Blade	-3.40948	0.03372	-101.13	<.0001
Cross Rib	-2.85497	0.04112	-69.44	<.0001
Bottom	-3.35467	0.02806	-119.55	<.0001
Round Eye	-2.83397	0.02675	-105.96	<.0001
Full Cut	-3.25589	0.03213	-101.34	<.0001
Tip	-2.98610	0.02707	-110.33	<.0001
Top	-3.05654	0.02514	-121.57	<.0001
Skirt	-1.13343	0.03277	-34.58	<.0001
Flank	0.37387	0.02905	12.87	<.0001
Other Steak*	-2.06360	0.11049	-18.68	<.0001
Volume Weighted Mean Price Per Pound Variable				
Mpricelb	0.40666	0.01248	32.58	<.0001

*Other Steak includes Sundry and Cutlet

Table 6.3 Influence Diagnostics OLS Regression Output for Model 1 - Steak

Root MSE	1.67946
R-Square	0.8113
Adjusted R-Square	0.8113
Number of Observations Used	189,865

When comparing the parameter estimations for the two models, the other steak coefficient is the most influenced variable with a change in magnitude of $1.47/lb. The only other parameter coefficient that exhibits a change in magnitude of $1.00/lb or more is the tenderloin estimation. As seen in Table 6.4, all other parameter estimates have a slight change when looking at the original regression results and the influential estimation results.

Table 6.4 Comparison of OLS Regression Parameter Estimations and Influence Diagnostics Regression Parameter Estimations for Steak ($/lb)

	OLS Regression Results for Model 1 - Steak ($/lb)	Influence Diagnostics OLS Regression Results for Model 1 – Steak ($/lb)	
Variable	**Parameter Estimate**	**Parameter Estimate**	**Change in Magnitude**
Intercept	4.95941	4.70836	0.25105
Brand Dummy Variable (Unknown Brand Default)			
Local	2.95116	2.53315	0.41801
Regional	2.61488	2.60927	0.00561
National	2.23764	2.37122	0.13358
Store	2.04643	2.14384	0.09741
Breed Claim Dummy Variable (No Breed Default)			
Breed 1	-0.91239	-0.95179	0.03940
Breed 2	3.19205	3.94767	0.75562
Breed 3	-2.35097	-2.83065	0.47968
Quality Grade Dummy Variable (Choice Default)			
Prime	2.97625	2.63996	0.33629
Select	-1.90744	-1.73147	0.17597
Not Graded	-0.27940	-0.19145	0.08795
Organic Claim Dummy Variable			
Organic	3.14736	2.75421	0.39315
Religious Claim Dummy Variable (No Religious Claim Default)			
Halal	0.49859	0.49076	0.00783
Kosher	0.87716	1.42277	0.54561
KoGlatt	1.89746	2.35831	0.46085
Bone State Dummy Variable			
Bone In	-0.70137	-0.66258	0.03879
Steak Cuts Dummy Variables (Sirloin Steak Default)			
Tenderloin	7.47724	8.48412	1.00688
Top Loin	2.10902	2.22272	0.11370
Porterhouse	3.05747	3.14094	0.08347
T-Bone	3.00825	3.20278	0.19453
Ribeye	2.39905	2.63747	0.23842
Lip On Ribeye	2.17869	2.44457	0.26588

Rib Cap On	-2.49534	-2.21457	0.28077

Continued……

Table 6.4 Continued

	OLS Regression Results for Model 1 - Steak ($/lb)	Influence Diagnostics OLS Regression Results for Model 1 – Steak ($/lb)	
Variable	**Parameter Estimate**	**Parameter Estimate**	**Change in Magnitude**
Steak Cuts Dummy Variables (Sirloin Steak Default)			
Top Sirloin	-1.61766	-1.55568	0.06198
Flat Iron	-2.25544	-1.94483	0.31061
Tri Tip	-1.41493	-1.12601	0.28892
Cubed Steak	-3.33501	-3.10490	0.23011
Ball Tip	-1.90578	-1.62169	0.28409
Flap	-2.31223	-2.05940	0.25283
Top Blade	-3.25678	-3.04854	0.20824
Petite Tender	-1.00359	-0.71570	0.28789
Clod	-3.55748	-3.31178	0.24570
Chuck Eye	-3.22535	-3.02537	0.19998
Under Blade	-3.88937	-3.67628	0.21309
Neck	-4.25697	-4.63556	0.37859
Tender	-3.19391	-2.96768	0.22623
Seven Bone	-3.28592	-3.10068	0.18524
Arm	-3.70112	-3.50819	0.19293
Blade	-3.59939	-3.40948	0.18991
Cross Rib	-2.94522	-2.85497	0.09025
Bottom	-3.56588	-3.35467	0.21121
Round Eye	-3.13861	-2.83397	0.30464
Full Cut	-3.53643	-3.25589	0.28054
Tip	-3.24189	-2.98610	0.25579
Top	-3.25674	-3.05654	0.20020
Skirt	-1.48744	-1.13343	0.35401
Flank	0.18163	0.37387	0.19224
Other Steak*	-0.59107	-2.06360	1.47253
Volume Weighted Mean Price Per Pound Variable			
Mpricelb	0.44445	0.40666	0.03779

*Other Steak includes Sundry and Cutlet

Table 6.5 Comparison of OLS Regression Output and Influence Diagnostics Regression Output for Steak

	OLS Regression Output for Model 1 - Steak ($/lb)	Influence Diagnostics OLS Regression Output for Model 1 – Steak ($/lb)	Change in Magnitude
Root MSE	2.32766	1.67946	0.64820
R-Square	0.7038	0.8113	0.1075
Adjusted R-Square	0.7037	0.8113	0.1076
Number of Observations Used	200,407	189,865	10,542

Overall, the parameter coefficients do not appear to be influenced by a specific subset of outlier data. The influential observations do not affect the regression results in an alarming way. The changes in parameter estimations are minimal therefore the results suggest that the model estimations with the exclusion of influential outliers are slightly more representative of the data set as a whole when compared to the original regression results in Chapter 5.

6.2 Influence Diagnostic Results for Model 2 – Roast

Similar to the regression estimations for the steak model above, the roast model parameter estimations, as seen in Table 6.6, exhibit only a minor change from the regression results that do not include the influence diagnostics. Most of the coefficients have only small changes with the Breed 2 and 3 claims being the most influenced variables for the price per pound of roasts.

Table 6.6 Influence Diagnostics OLS Regression Results for Model 2 – Roast Examining the Determinants of Roast Price Per Pound

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	2.10238	0.0729	28.84	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	1.23908	0.03267	37.93	<.0001
Regional	1.25537	0.02028	61.90	<.0001
National	1.35452	0.01861	72.78	<.0001
Store	1.38491	0.01909	72.57	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.34982	0.01401	-24.97	<.0001
Breed 2	3.64395	0.43666	8.35	<.0001
Breed 3	-2.03292	0.11085	-18.34	<.0001
Quality Grade Dummy Variable(Choice Default)				
Prime	2.60415	0.04309	60.44	<.0001
Select	-1.21420	0.04573	-26.55	<.0001
Not Graded	-0.11926	0.01442	-8.27	<.0001
Organic Claim Dummy Variable				
Organic	2.16682	0.03712	58.38	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Halal	0.42462	0.45212	0.94	0.3476
Kosher	2.18655	0.02716	80.51	<.0001
KoGlatt	3.50651	0.03458	101.39	<.0001
Bone State Dummy Variable				
Bone In	-0.04402	0.01542	-2.86	0.0043
Roast Categories Dummy Variables (Oven Everyday Default)				
Pot Roasts	-0.60309	0.01401	-43.05	<.0001
Oven Premium Roasts	4.08430	0.01534	266.19	<.0001
Holiday Roasts	0.77744	0.01433	54.27	<.0001
Volume Weighted Mean Price Per Pound Variable				
Mpricelb	0.36991	0.01649	22.44	<.0001

Table 6.7 Influence Diagnostics OLS Regression Output for Model 2 - Roast

Root MSE	1.68998
R-Square	0.6270
Adjusted R-Square	0.6269
Number of Observations Used	109,849

Shown in Table 6.7, the regression output for the influence diagnostics roast model signifies a change in the OLS regression estimations. Table 6.9 exhibits the comparable regression output in more detail. The number of observations decreases by 6,579 with the influential observations removed. The comparison between the regression models in Chapter 5 and the regression estimations present in this chapter can be seen in Table 6.8. The Breed 2 coefficient increases by $1.19/lb and the Breed 3 estimation moves closer to zero by $1.09/lb. All of the other variable estimations display very small changes in magnitude therefore it can be said that the influential observations do not have a large affect on the overall regression results.

Table 6.8 Comparison of OLS Regression Parameter Estimations and Influence Diagnostics Regression Parameter Estimations for Roast ($/lb)

	OLS Regression Results for Model 2 - Roast ($/lb)	Influence Diagnostics OLS Regression Results for Model 2 – Roast ($/lb)	
Variable	**Parameter Estimate**	**Parameter Estimate**	**Change in Magnitude**
Intercept	1.90907	2.10238	0.19331
Brand Dummy Variable (Unknown Brand Default)			
Local	1.23842	1.23908	0.00066
Regional	1.35407	1.25537	0.09870
National	1.67866	1.35452	0.32414
Store	1.57655	1.38491	0.19164
Breed Claim Dummy Variable (No Breed Default)			
Breed 1	-0.46799	-0.34982	0.11817
Breed 2	2.45734	3.64395	1.18661
Breed 3	-3.12642	-2.03292	1.09350
Quality Grade Dummy Variable (Choice Default)			
Prime	3.44520	2.60415	0.84105
Select	-1.37370	-1.21420	0.15950
Not Graded	-0.19223	-0.11926	0.07297
Organic Claim Dummy Variable			
Organic	2.29546	2.16682	0.12864
Religious Claim Dummy Variable (No Religious Claim Default)			
Halal	0.52149	0.42462	0.09687
Kosher	1.85209	2.18655	0.33446
KoGlatt	2.91222	3.50651	0.59429
Bone State Dummy Variable			
Bone In	-0.27965	-0.04402	0.23563
Roast Categories Dummy Variables (Oven Everyday Default)			
Pot Roasts	-0.53140	-0.60309	0.07169
Oven Premium Roasts	4.37489	4.08430	0.29059
Holiday Roasts	1.11595	0.77744	0.33851
Volume Weighted Mean Price Per Pound Variable			
Mpricelb	0.40255	0.36991	0.03264

Table 6.9 Comparison of OLS Regression Output and Influence Diagnostics Regression Output for Roast

	OLS Regression Output for Model 2- Roast ($/lb)	Influence Diagnostics OLS Regression Output for Model 2 – Roast ($/lb)	Change in Magnitude
Root MSE	2.38895	1.68998	0.69897
R-Square	0.5249	0.6270	0.1021
Adjusted R-Square	0.5248	0.6269	0.1021
Number of Observations Used	116,428	109,849	6,579

6.3 Influence Diagnostic Results for Model 3 – Ground

The results from the influence diagnostic regression ground beef model, shown in Table 6.10, indicate the affect of the removal of influential observations. The 78-84% Lean variable exhibits the largest change from the OLS regression in Chapter 5. The parameter estimate changes from -0.21 ($/lb) to -0.03 ($/lb) and also becomes statistically insignificant. Therefore there is a $0.03/lb discount for 78-84% Lean ground beef when compared to other ground beef products. This variation indicates that the 78-84% Lean observations were highly influenced by the outliers. This variable is highly insignificant under the influence diagnostics OLS regression where as it was significant at the 99 percent level in the regression model results presented in Chapter 5.

Table 6.10 Influence Diagnostics OLS Regression Results for Model 3– Ground Examining the Determinants of Ground Beef Price Per Pound

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	2.32413	0.04392	52.92	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	0.43786	0.02097	20.88	<.0001
Regional	0.77906	0.01285	60.62	<.0001
National	0.69336	0.01084	63.95	<.0001
Store	0.77151	0.01158	66.63	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.50289	0.00901	-55.84	<.0001
Breed 2	-0.02383	0.44144	-0.05	0.9570
Breed 3	-1.80445	0.05743	-31.42	<.0001
Breed 4	3.33304	0.15655	21.29	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	0.70749	0.03925	18.03	<.0001
Select	-2.61693	0.18062	-14.49	<.0001
Not Graded	-0.26915	0.0103	-26.13	<.0001
Organic Claim Dummy Variable				
Organic	2.03738	0.02087	97.61	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Halal	-1.53956	0.05847	-26.33	<.0001
Kosher	0.83570	0.01753	47.67	<.0001
KoGlatt	1.41930	0.02007	70.72	<.0001
Ground Beef Category Dummy Variables (Other Ground* Default)				
Meat Balls	0.43722	0.02376	18.40	<.0001
70-77% Lean	-0.17247	0.01737	-9.93	<.0001
78-84% Lean	-0.02663	0.01814	-1.47	0.1422
85-89% Lean	0.49930	0.01705	29.29	<.0001
90-95% Lean	0.96465	0.01713	56.31	<.0001
96-100% Lean	1.35375	0.02062	65.66	<.0001
Chuck	0.00180	0.01744	0.10	0.9179
Round	0.56746	0.01760	32.24	<.0001
Sirloin	1.02511	0.01800	56.94	<.0001
Volume Weighted Mean Price Per Pound Variable				
Mpricelb	0.23029	0.00947	24.31	<.0001

* Other Ground includes Chili Meat, Meat Loaf, and Trim

Table 6.11 Influence Diagnostics OLS Regression Output for Model 3 - Ground Beef

Root MSE	0.76432
R-Square	0.5066
Adjusted R-Square	0.5063
Number of Observations Used	52,768

Table 6.12 shows the comparable parameter estimates. All of the changes in magnitude are less than $0.28/lb. The variables with the largest shift in magnitude are organic, 78-84% Lean, and Kosher-Glatt.

Table 6.12 Comparison of OLS Regression Parameter Estimations and Influence Diagnostics Regression Parameter Estimations for Ground Beef ($/lb)

	OLS Regression Results for Model 3 – Ground ($/lb)	Influence Diagnostics OLS Regression Results for Model 3 – Ground ($/lb)	
Variable	**Parameter Estimate**	**Parameter Estimate**	**Change in Magnitude**
Intercept	2.35375	2.32413	0.02962
Brand Dummy Variable (Unknown Brand Default)			
Local	0.33192	0.43786	0.10594
Regional	0.78804	0.77906	0.00898
National	0.65196	0.69336	0.04140
Store	0.74249	0.77151	0.02902
Breed Claim Dummy Variable (No Breed Default)			
Breed 1	-0.55813	-0.50289	0.05524
Breed 2	-0.21672	-0.02383	0.19289
Breed 3	-1.63243	-1.80445	0.17202
Breed 4	3.18361	3.33304	0.14943
Quality Grade Dummy Variable (Choice Default)			
Prime	0.64721	0.70749	0.06028
Select	-2.66103	-2.61693	0.04410
Not Graded	-0.31563	-0.26915	0.04648
Organic Claim Dummy Variable			
Organic	1.75838	2.03738	0.27900
Religious Claim Dummy Variable (No Religious Claim Default)			
Halal	-1.47568	-1.53956	0.06388
Kosher	0.83371	0.83570	0.00199
KoGlatt	1.60848	1.41930	0.18918
Ground Beef Category Dummy Variables (Other Ground* Default)			
Meat Balls	0.33221	0.43722	0.10501
70-77% Lean	-0.19928	-0.17247	0.02681
78-84% Lean	-0.21861	-0.02663	0.19198
85-89% Lean	0.37374	0.49930	0.12556
90-95% Lean	0.88411	0.96465	0.08054
96-100% Lean	1.20638	1.35375	0.14737
Chuck	0.04239	0.00180	0.04059
Round	0.41229	0.56746	0.15517
Sirloin	0.96936	1.02511	0.05575
Volume Weighted Mean Price Per Pound Variable			
Mpricelb	0.28109	0.23029	0.05080

* Other Ground includes Chili Meat, Meat Loaf, and Trim

Table 6.13 Comparison of OLS Regression Output and Influence Diagnostics Regression Output for Ground Beef

	OLS Regression Output for Model 3- Ground ($/lb)	Influence Diagnostics OLS Regression Output for Model 3 – Ground ($/lb)
Root MSE	0.97135	0.76432
R-Square	0.3829	0.5066
Adjusted R-Square	0.3826	0.5063
Number of Observations Used	55,579	52,768

Looking at the table above, the number of observations decreases by 2,811 when omitting the influential observations with studentized residuals greater than two. Although not comparable across the two models, the R-square and Adjusted R-Square are higher with the influence diagnostics.

6.4 Influence Diagnostic Results for Model 4 – Strip

The strip product model regression results with the influential observations removed are shown in Table 6.14. All of the parameter estimates show small changes except for the not graded variable when compared to the OLS regression results in Chapter 5. The P-value for the strip products with no grade coefficient changes with the influence diagnostic regression. However, it is still significant with a P-value of 0.0104.

Table 6.14 Influence Diagnostics OLS Regression Results for Model 4– Strip Examining the Determinants of Strip Product Price Per Pound

<table>
<tr><th>Variable</th><th>Parameter Estimate</th><th>Standard Error</th><th>t Value</th><th>Pr > |t|</th></tr>
<tr><td>Intercept</td><td>3.24305</td><td>0.10723</td><td>30.24</td><td><.0001</td></tr>
<tr><td>Brand Dummy Variable (Unknown Brand Default)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Local</td><td>1.98242</td><td>0.08529</td><td>23.24</td><td><.0001</td></tr>
<tr><td>Regional</td><td>1.60482</td><td>0.03361</td><td>47.75</td><td><.0001</td></tr>
<tr><td>National</td><td>1.57979</td><td>0.02665</td><td>59.27</td><td><.0001</td></tr>
<tr><td>Store</td><td>1.35438</td><td>0.02891</td><td>46.86</td><td><.0001</td></tr>
<tr><td>Breed Claim Dummy Variable (No Breed Default)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Breed 1</td><td>-0.35186</td><td>0.02609</td><td>-13.48</td><td><.0001</td></tr>
<tr><td>Quality Grade Dummy Variable (Choice Default)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Prime</td><td>2.60639</td><td>0.09785</td><td>26.64</td><td><.0001</td></tr>
<tr><td>Select</td><td>-0.92832</td><td>0.06536</td><td>-14.20</td><td><.0001</td></tr>
<tr><td>Not Graded</td><td>-0.06237</td><td>0.02434</td><td>-2.56</td><td>0.0104</td></tr>
<tr><td>Organic Claim Dummy Variable</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Organic</td><td>3.36367</td><td>0.08087</td><td>41.59</td><td><.0001</td></tr>
<tr><td>Religious Claim Dummy Variable (No Religious Claim Default)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Kosher</td><td>1.21390</td><td>0.04813</td><td>25.22</td><td><.0001</td></tr>
<tr><td>KoGlatt</td><td>1.24379</td><td>0.08007</td><td>15.53</td><td><.0001</td></tr>
<tr><td>Strip Product Category Dummy Variables (Other Strip* Default)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Stir Fry</td><td>0.83694</td><td>0.01897</td><td>44.13</td><td><.0001</td></tr>
<tr><td>Fajita Meat</td><td>0.63315</td><td>0.01864</td><td>33.97</td><td><.0001</td></tr>
<tr><td>Volume Weighted Mean Price Per Pound Variable</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Mpricelb</td><td>0.14964</td><td>0.02447</td><td>6.12</td><td><.0001</td></tr>
</table>

* Other Strip includes Cutlet, Stew, Strips, Flap, Sundry, Tenderloin, Tip, Top Blade, and Bottom

Table 6.15 Influence Diagnostics OLS Regression Output for Model 4 - Strip

Root MSE	1.09618
R-Square	0.4272
Adjusted R-Square	0.4268
Number of Observations Used	21,147

Table 6.15 displays the regression output for the influence diagnostics strip model. The number of observations decreases by 953 observations. The comparison of the different models is shown in detail in Table 6.17. The comparison of the coefficient estimations between the original OLS regression and the influence diagnostic regression are shown in Table 6.16. The variables with the largest shift in degree are Organic, Prime, and Kosher-Glatt.

Table 6.16 Comparison of OLS Regression Parameter Estimations and Influence Diagnostics Regression Parameter Estimations for Strip Products ($/lb)

	OLS Regression Results for Model 4 - Strip ($/lb)	Influence Diagnostics OLS Regression Results for Model 4 – Strip ($/lb)	
Variable	**Parameter Estimate**	**Parameter Estimate**	**Change in Magnitude**
Intercept	3.42192	3.24305	0.17887
Brand Dummy Variable (Unknown Brand Default)			
Local	1.83392	1.98242	0.14850
Regional	1.48472	1.60482	0.12010
National	1.51930	1.57979	0.06049
Store	1.54589	1.35438	0.19151
Breed Claim Dummy Variable (No Breed Default)			
Breed 1	-0.5248	-0.35186	0.17294
Quality Grade Dummy Variable(No Grade Default)			
Prime	2.07186	2.60639	0.53453
Select	-1.37959	-0.92832	0.45127
Not Graded	-0.20257	-0.06237	0.14020
Organic Claim Dummy Variable			
Organic	4.09753	3.36367	0.73386
Religious Claim Dummy Variable (No Religious Claim Default)			
Kosher	1.30103	1.21390	0.08713
KoGlatt	1.76260	1.24379	0.51881
Strip Product Category Dummy Variables (Other Strip* Default)			
Stir Fry	0.63199	0.83694	0.20495
Fajita Meat	0.61556	0.63315	0.01759
Volume Weighted Mean Price Per Pound Variable			
Mpricelb	0.17820	0.14964	0.02856

* Other Strip includes Cutlet, Stew, Strips, Flap, Sundry, Tenderloin, Tip, Top Blade, and Bottom

Table 6.17 Comparison of OLS Regression Output and Influence Diagnostics Regression Output for Strip Products

	OLS Regression Output for Model 4- Strip ($/lb)	Influence Diagnostics OLS Regression Output for Model 4 – Strip ($/lb)
Root MSE	1.42417	1.09618
R-Square	0.3279	0.4272
Adjusted R-Square	0.3275	0.4268
Number of Observations Used	22,100	21,147

6.5 Influence Diagnostic Results for Model 5– Cube

When analyzing the influence diagnostics regression results for cubed beef products several noteworthy changes occur with the removal of influential observations. The variable not graded becomes slightly less than 99 percent statistically significant with a P-value of 0.0043 when estimated against grade Choice products. The Kosher dummy variable presents the opposite coefficient results becoming statistically significant under the influential diagnostics regression. This result suggests that the Kosher dummy variable was influenced by extreme outlier observations.

Table 6.18 Influence Diagnostics OLS Regression Results for Model 5– Cube Examining the Determinants of Cubed Product Price Per Pound

Variable		Parameter Estimate	Standard Error	t Value	Pr > |t|
	Intercept	3.19241	0.10908	29.27	<.0001
Brand Dummy Variable (Unknown Brand Default)					
	Local	0.92657	0.06435	14.40	<.0001
	Regional	0.95438	0.03233	29.52	<.0001
	National	1.03005	0.02712	37.98	<.0001
	Store	0.86759	0.02653	32.70	<.0001
Breed Claim Dummy Variable (No Breed Default)					
	Breed 1	-0.21892	0.01983	-11.04	<.0001
	Breed 3	-4.10438	0.14894	-27.56	<.0001
Quality Grade Dummy Variable (Choice Default)					
	Prime	4.09140	0.08007	51.10	<.0001
	Select	-1.72062	0.07139	-24.10	<.0001
	Not Graded	-0.05784	0.02024	-2.86	0.0043
Organic Claim Dummy Variable					
	Organic	1.60386	0.05142	31.19	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)					
	Halal	0.24895	0.46860	0.53	0.5952
	Kosher	0.88130	0.04255	20.71	<.0001
	KoGlatt	2.24272	0.04419	50.75	<.0001
Cube Product Category Dummy Variables (Other Cubes* Default)					
	Stew Meat	-0.81503	0.02427	-33.59	<.0001
	Kabobs	1.29136	0.02449	52.73	<.0001
Volume Weighted Mean Price Per Pound Variable					
	Mpricelb	0.35242	0.02492	14.14	<.0001

*Other Cubes include Petite Tender, Ribeye, Cubes, Top, and Skirt

Table 6.19 Influence Diagnostics OLS Regression Output for Model 5 - Cube

Root MSE	1.48038
R-Square	0.3893
Adjusted R-Square	0.3891
Number of Observations Used	37,688

Table 6.19 exhibits the regression output from estimating the cube regression with influence diagnostics. As seen in more detail in Table 6.21, the number of observations is reduced by 1,917. The parameter estimation comparison is shown in Table 6.20. The variables

with the largest shifts in magnitude are Breed 3, Prime, and regional. The Breed 3 parameter estimate becomes less negative by $1.94/lb. The Prime coefficient premium amount decreases by $1.22/lb. The regional estimation also decreases from $1.80/lb to $0.93/lb.

Table 6.20 Comparison of OLS Regression Parameter Estimations and Influence Diagnostics Regression Parameter Estimations for Cubed Products ($/lb)

	OLS Regression Results for Model 5 - Cube ($/lb)	Influence Diagnostics OLS Regression Results for Model 5 – Cube ($/lb)	
Variable	**Parameter Estimate**	**Parameter Estimate**	**Change in Magnitude**
Intercept	2.96617	3.19241	0.22624
Brand Dummy Variable (Unknown Brand Default)			
Local	0.89360	0.92657	0.03297
Regional	1.79851	0.95438	0.84413
National	1.53921	1.03005	0.50916
Store	1.39293	0.86759	0.52534
Breed Claim Dummy Variable (Choice Default)			
Breed 1	-0.64744	-0.21892	0.42852
Breed 3	-6.04911	-4.10438	1.94473
Quality Grade Dummy Variable (Choice Default)			
Prime	5.31257	4.09140	1.22117
Select	-2.17373	-1.72062	0.45311
Not Graded	-0.26702	-0.05784	0.20918
Organic Claim Dummy Variable			
Organic	1.47424	1.60386	0.12962
Religious Claim Dummy Variable (No Religious Claim Default)			
Halal	0.05123	0.24895	0.19772
Kosher	0.19290	0.88130	0.68840
KoGlatt	1.80986	2.24272	0.43286
Cube Product Category Dummy Variables (Other Cubes* Default)			
Stew Meat	-1.36584	-0.81503	0.55081
Kabobs	1.70446	1.29136	0.41310
Volume Weighted Mean Price Per Pound Variable			
Mpricelb	0.50537	0.35242	0.15295

*Other Cubes include Petite Tender, Ribeye, Cubes, Top, and Skirt

Table 6.21 Comparison of OLS Regression Output and Influence Diagnostics Regression Output for Cubed Products

	OLS Regression Output for Model 5 – Cube ($/lb)	Influence Diagnostics OLS Regression Output for Model 5 – Cube ($/lb)
Root MSE	2.54187	1.48038
R-Square	0.3112	0.3893
Adjusted R-Square	0.3110	0.3891
Number of Observations Used	39,605	37,688

6.6 Influence Diagnostic Results for Model 6 – Ribs

The rib product model that includes the elimination of influential observations does not display as many changes as some of the other models. All of the parameter estimations are still statistically significant at the 99 percent confidence level. Table 6.22 exhibits the OLS regression results ran with the inclusion of influence diagnostics. The regression output is found in Table 6.23.

Table 6.22 Influence Diagnostics OLS Regression Results for Model 6 - Ribs Examining the Determinants of Rib Price Per Pound

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	2.96582	0.09009	32.92	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	0.40594	0.03727	10.89	<.0001
Regional	0.93954	0.02920	32.17	<.0001
National	0.55484	0.02621	21.17	<.0001
Store	0.95923	0.02574	37.26	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.27462	0.02100	-13.08	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	1.43437	0.12507	11.47	<.0001
Select	-1.45435	0.04963	-29.31	<.0001
Not Graded	-0.45194	0.02038	-22.18	<.0001
Organic Claim Dummy Variable				
Organic	0.70638	0.06763	10.44	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Kosher	3.46024	0.03958	87.43	<.0001
KoGlatt	2.27302	0.02908	78.17	<.0001
Bone State Dummy Variable				
Bone In	-0.39572	0.01466	-27.00	<.0001
Process Level Dummy Variable				
Processed	0.55436	0.03006	18.44	<.0001
Rib Product Category Dummy Variables (Other Ribs* Default)				
Stir Fry	0.61162	0.01482	41.28	<.0001
Fajita Meat	-0.89601	0.01942	-46.13	<.0001
Volume Weighted Mean Price Per Pound Variable				
Mpricelb	0.16541	0.02036	8.13	<.0001

* Other Ribs includes Plate, Chuck, and Rib

Table 6.23 Influence Diagnostics OLS Regression Output for Model 6 - Ribs

Root MSE	0.91865
R-Square	0.6351
Adjusted R-Square	0.6349
Number of Observations Used	20,860

Evaluating the change in magnitude between the original OLS regression estimations and the influence diagnostics OLS regression results, none of the estimated coefficients show a change greater than $0.43/lb. The variables with the highest change in dollar amount per pound are regional, Select, and Kosher.

Table 6.25, shown below, exhibits the different regression output between the two models. It is worth noting that the number of observations decreases from 21,860 to 20,860. The 1,000 observation decrease illustrates the influential observations that are dropped due to not being within the cutoff of two for the studentized residuals.

Table 6.24 Comparison of OLS Regression Parameter Estimations and Influence Diagnostics Regression Parameter Estimations for Ribs ($/lb)

	OLS Regression Results for Model 6 - Ribs ($/lb)	Influence Diagnostics OLS Regression Results for Model 6 – Ribs ($/lb)	
Variable	**Parameter Estimate**	**Parameter Estimate**	**Change in Magnitude**
Intercept	3.00049	2.96582	0.03467
Brand Dummy Variable (Unknown Brand Default)			
Local	0.39200	0.40594	0.01394
Regional	1.36840	0.93954	0.42886
National	0.40785	0.55484	0.14699
Store	1.00367	0.95923	0.04444
Breed Claim Dummy Variable (No Breed Default)			
Breed 1	-0.34391	-0.27462	0.06929
Quality Grade Dummy Variable (Choice Default)			
Prime	1.3639	1.43437	0.07047
Select	-1.73212	-1.45435	0.27777
Not Graded	-0.66626	-0.45194	0.21432
Organic Claim Dummy Variable			
Organic	0.80530	0.70638	0.09892
Religious Claim Dummy Variable (No Religious Claim Default)			
Kosher	3.22068	3.46024	0.23956
KoGlatt	2.11292	2.27302	0.16010
Bone State Dummy Variable			
Bone In	-0.21047	-0.39572	0.18525
Process Level Dummy Variable			
Processed	0.73277	0.55436	0.17841
Rib Product Category Dummy Variables (Other Ribs* Default)			
Stir Fry	0.52450	0.61162	0.08712
Fajita Meat	-1.06957	-0.89601	0.17356
Volume Weighted Mean Price Per Pound Variable			
Mpricelb	0.20118	0.16541	0.03577

* Other Ribs includes Plate, Chuck, and Rib

Table 6.25 Comparison of OLS Regression Output and Influence Diagnostics Regression Output for Ribs

	OLS Regression Output for Model 6 - Ribs ($/lb)	Influence Diagnostics OLS Regression Output for Model 6 – Ribs ($/lb)
Root MSE	1.17591	0.91865
R-Square	0.5333	0.6351
Adjusted R-Square	0.5329	0.6349
Number of Observations Used	21,860	20,860

6.7 Concluding Remarks

Although there are more suitable methods of estimation than OLS regressions for detecting and analyzing data inefficiencies, the influence diagnostics still provide the means for detecting the peculiar observations and also the severity of these outliers. The influential diagnostics method may not be a perfect method of examining the affects the prominent data subsets have on the whole data compilation, but it does offer strong diagnostics for multiple regression analysis. The removal of subsets of influential data emphasizes on the consequential change in parameter estimates and fitted values (Belsley, Kuh, and Welsch, 1980).

Specific examination of the brand variables is presented in Table 6.26. The original regression estimations are in the first six columns to the left and the influence diagnostic regression estimations are in the last six columns of the table to the right. There is still a premium for all branded beef products when compared to unbranded beef products. However, looking at the individual categories of brands across all six cuts of beef, national now portrays the second highest premium followed by local and store brands. The regression results in Chapter 5 exhibited the second highest premium across all cuts as store brands followed by national and local. The total percent of average price per pound for all six model brand parameter estimates still follows the same pattern with the highest percentage associated with regional brands followed by store, national, and local. As for the percentage of average price per pound evaluated by each particular beef cut, the steak parameter estimate still has the highest percentage of 1.27 percent. This percentage decreased by 3 percent from the original regression estimations. The next highest percentage is the strip model at 1.25 percent followed by roast, ribs, cube and ground. The percentage of average price per pound for ribs and cubed beef are reversed in the influence diagnostics modeling therefore ribs has a higher average percentage of 0.78 percent than the regression results in Chapter 5.

Table 6.26 Summary Table for Brand Dummy Variable Parameter Estimate Comparisons for the OLS Regressions and the Influence Diagnostics OLS Regressions

Brand Dummy Variable (Unknown Brand Default)	OLS Regression Estimations						Influence Diagnostic OLS Regressions Estimations					
	Steak	**Roast**	**Ground**	**Strip**	**Cube**	**Ribs**	**Steak**	**Roast**	**Ground**	**Strip**	**Cube**	**Ribs**
Local	2.95	1.24	0.33	1.83	0.89	0.39	2.53	1.24	0.44	1.98	0.93	0.41
Regional	2.62	1.35	0.79	1.48	1.80	1.37	2.61	1.26	0.78	1.60	0.95	0.94
National	2.24	1.68	0.65	1.52	1.54	0.41	2.37	1.35	0.69	1.58	1.03	0.55
Store	2.04	1.58	0.74	1.55	1.39	1.00	2.14	1.38	0.77	1.35	0.87	0.96
Mean Price Per Pound Variable ($/lb)	7.87	5.98	4.15	5.34	6.07	4.17	7.58	5.63	4.06	5.21	5.59	4.05
Percent of Average Price per Pound												
Local	39%	22%	8%	35%	16%	10%	33%	22%	11%	38%	17%	10%
Regional	35%	24%	19%	29%	32%	34%	34%	22%	19%	31%	17%	23%
National	30%	30%	16%	29%	28%	10%	31%	24%	17%	30%	18%	14%
Store	27%	28%	18%	30%	%25	25%	28%	25%	19%	26%	16%	24%

Based on the results in Chapter 5 and Chapter 6, the estimations in Chapter 6 are preferred. They are preferred due to the fact that the influential subsets of data are removed therefore providing a more efficient outcome representing the data set as a whole. The estimations and measure of fit of each of the six models reflect more accurate results. Overall, the changes in coefficient estimates and regression outputs are merely slight changes and none of the estimate signs reverse. The OLS regressions presented in Chapter 5 are still valid interpretations of the beef retail scanner data.

CHAPTER 7 - Conclusions

The objective of this thesis research was to determine if branding beef is a sales incentive and if different brand types garnered different premiums to the overall price of certain well known cuts of beef in the retail meat case. Also analyzed was which other product attributes exhibit premiums or discounts to the price of the beef cuts chosen for this study. Today's average consumer exhibits complex purchasing behavior in which different beef industry sectors are now gearing toward delivering a desired product. This research was designed to help every sector of the beef industry understand what the consumer is actually purchasing and also what product attributes, particularly branding, contribute to the overall price through the use of retail scanner data. The data set contains weekly scanner data observations from 2004 through March of 2009. Through Hedonic modeling, OLS regressions were estimated in order to determine the premiums and discounts in which product attributes offer to the overall price per pound of the six beef cuts used for analysis.

Results indicate that there is an incentive to brand beef products at the retail level. The brand type with the largest frequency of observations was the store brand of beef products. Following the store brands were national, other, regional, and local brands. Store brands represent almost half of all observations in the data set indicating that consumers are purchasing an abundance of store branded beef products. Local, regional, national, and store brands garner premiums across the six models for the beef cuts, steak, roast, ground, strip, cube, and ribs in relation to products with no brand. Even though all brand categories have premiums, there is not one particular brand that is consistently the highest premium across all of the models estimated. Looking at the brand parameter coefficients for the steak regression, the local brands exhibit the highest premium for the price of steak when compared to steak products that are not branded. A premium of $2.95/lb is associated with local brand products when compared to unbranded products. Locally branded steak products could be considered specialty products that are only found in small quantities in a limited distribution area. Followed by the local brand premium is the regional, national, and store brands which all garner premiums over $2.00/lb relative to unbranded steak products. For the roast model, national brands garner the most premium of $1.68/lb relative to unbranded roast products followed by store, regional, and local brands. The brand category that exhibits the highest premium for ground beef is the regional brand estimation, with a premium of $0.79/lb. Store brands, national brands, and local brands trail behind regional brands with premiums of $0.74/lb, $0.65/lb, and $0.33/lb, respectively. Branded products for strip beef also garner premiums with local brands garnering the most premium at $1.83/lb followed by store, national, and regional brands in relation to unbranded strip products. Brand premium estimations for cubed beef are greater than $1.00/lb with regional brands having the highest premium amount to the individual price per pound of strip products compared to unbranded products. Following regional branded products are national, store and local brands. Regional branded ribs exhibit the highest premium at $1.37/lb relative to unbranded rib products. Store branded ribs follow closely as the second highest premium with national and local brands exhibiting the lowest premiums.

Statistically significant steak variables other than brand variables that garner a premium to the individual price per pound of steaks include Breed 2, Prime quality grade, organic, Halal, Kosher, and Kosher-Glatt. Specific to the steak model, the premium steak variables, such as tenderloin, exhibits premiums when compared to sirloin steaks. Steak cuts perceived to be of less quality, such as eye of round, reveal a discount. For the roast model, the variables that reveal a premium to the price of roasts are Breed 2, Prime quality grade, Halal, Kosher, Kosher-

Glatt, oven premium roasts, and holiday roasts. Breed 4, Prime quality grade, Kosher, Kosher-Glatt, meatballs, 85-89% Lean, 90-95% Lean 96-100% Lean, chuck, round, and sirloin all portray premiums to the price per pound of ground beef. The attributes that have a premium when looking at the parameter coefficients for strip beef include the Prime quality grade, organic, Kosher, Kosher-Glatt, stir fry strip beef, and fajita meat. The cubed beef model estimations that contribute a premium to the individual price of cubed beef includes the following attributes the Prime quality grade, organic, Halal, Kosher, Kosher-Glatt, and kabobs. The last model, ribs, contains the following parameter estimations that exhibit a premium to the individual price per pound of ribs: the Prime quality grade, organic, Kosher, Kosher-Glatt, processed ribs, and short ribs. According to the parameter estimates, all the attributes that garner a premium tend to be associated with quality and also with religious practices and emotional attachments.

When looking at the brand parameter estimates across all six regression models, the regional brand estimation has the highest weighted average premium followed by local, national, and store brands relative to unbranded products. This implies that branding beef regionally garnered the highest weighted average premium for all beef cuts analyzed in this research from 2004 through March 2009. Other variables that garner premiums across all models include organic, Prime quality grade, and Kosher and Kosher-Glatt religious labels. The steak dependent variable exhibited the highest mean price per pound followed by cube, roast, strip, ribs and ground. In all of models regressed, there were very few coefficients that were statistically insignificant.

There were also some issues with the data regarding price per pound observations that were considered outliers to the overall data set. To address these outliers additional modeling was done to determine if the outlier observations were influencing the regression results. It was found that there were very small changes in parameter estimations and that the influential observations did not deter the original regression results. The influence diagnostic regression results are preferred because the data is better represented with the elimination of the influential observations.

The research presented in this paper is just the beginning analysis of the retail scanner data. There is potential for further research to be done with the data set as a whole or also looking at specific components such as s specific cut or attribute. There is also potential for econometric modeling techniques to be used with this data that are beyond the scope of this project. For example, panel data analysis can be used to further analyze this particular set of retail beef scanner data. This method would be useful for further research because the data presents multiple observations over multiple time periods and would provide a two-dimensional interpretation.

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Appendix A - Semi-Log OLS Regression Results

Table 7.1 Semi-Log OLS Regression Results for Model 1 – Steak Examining the Determinants of Steak as a Percentage Change

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1.45855	0.01230	118.60	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	0.39782	0.00465	85.49	<.0001
Regional	0.36787	0.00279	131.64	<.0001
National	0.33614	0.00251	134.01	<.0001
Store	0.31544	0.00245	128.66	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.12088	0.00153	-79.07	<.0001
Breed 2	0.22646	0.06054	3.74	0.0002
Breed 3	-0.17398	0.00773	-22.51	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	0.25279	0.00374	67.67	<.0001
Select	-0.26233	0.00562	-46.64	<.0001
Not Graded	-0.03155	0.00163	-19.37	<.0001
Organic Claim Dummy Variable				
Organic	0.30774	0.00330	93.32	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Halal	0.13252	0.02779	4.77	<.0001
Kosher	0.20800	0.00384	54.16	<.0001
KoGlatt	0.32700	0.00387	84.44	<.0001
Bone State Dummy Variable				
Bone In	-0.09335	0.00255	-36.68	<.0001
Steak Cuts Dummy Variables (Sirloin Steak Default)				
Tenderloin	0.61634	0.00387	159.19	<.0001
Top Loin	0.21922	0.00355	61.81	<.0001
Porterhouse	0.35334	0.00482	73.24	<.0001
T-Bone	0.34660	0.00476	72.77	<.0001
Ribeye	0.23981	0.00392	61.14	<.0001
Lip On Ribeye	0.24410	0.00384	63.63	<.0001
Rib Cap On	-0.61724	0.04150	-14.87	<.0001
Top Sirloin	-0.21114	0.00413	-51.15	<.0001
Flat Iron	-0.31872	0.00658	-48.43	<.0001
Tri Tip	-0.18243	0.00506	-36.07	<.0001
Cubed Steak	-0.51339	0.00397	-129.45	<.0001

Continued……

Table A.1 Continued

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Steak Cuts Dummy Variables (Sirloin Steak Default)				
Ball Tip	-0.27059	0.00748	-36.18	<.0001
Flap	-0.33816	0.00709	-47.72	<.0001
Top Blade	-0.52591	0.00508	-103.60	<.0001
Petite Tender	-0.11798	0.01056	-11.18	<.0001
Clod	-0.54785	0.00474	-115.59	<.0001
Chuck Eye	-0.49742	0.00519	-95.75	<.0001
Under Blade	-0.65343	0.00461	-141.60	<.0001
Neck	-0.74708	0.27732	-2.69	0.0071
Tender	-0.48517	0.00578	-83.88	<.0001
Seven Bone	-0.66329	0.00743	-89.30	<.0001
Arm	-0.69387	0.00804	-86.35	<.0001
Blade	-0.64764	0.00545	-118.86	<.0001
Cross Rib	-0.52576	0.00672	-78.29	<.0001
Bottom	-0.58496	0.00452	-129.48	<.0001
Round Eye	-0.45770	0.00434	-105.35	<.0001
Full Cut	-0.60678	0.00523	-115.98	<.0001
Tip	-0.49742	0.00439	-113.21	<.0001
Top	-0.47592	0.00405	-117.48	<.0001
Skirt	-0.19423	0.00532	-36.51	<.0001
Flank	0.04686	0.00470	9.97	<.0001
Other Steak*	-0.19550	0.01649	-11.86	<.0001
Volume Weighted Mean Price Per Pound Variable				
lnMpricelb	0.26481	0.00815	32.50	<.0001

*Other Steak includes Sundry and Cutlet

Table 7.2 Summary Statistics for Semi-Log Model 1 - Steak

Root MSE	0.27727
R-Square	0.7107
Adjusted R-Square	0.7106
Dependent Mean	1.92906
Dependent Standard Deviation	0.51544
Number of Observations Used	200,407

Table 7.3 Semi-Log OLS Regression Results for Model 2 – Roast Examining the Determinants of Roast as a Percentage Change

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	0.84440	0.02052	41.15	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	0.26718	0.00695	38.42	<.0001
Regional	0.24512	0.00424	57.74	<.0001
National	0.28773	0.00390	73.84	<.0001
Store	0.29078	0.00398	73.00	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.06259	0.00289	-21.68	<.0001
Breed 2	0.32885	0.09037	3.64	0.0003
Breed 3	-0.21381	0.02295	-9.32	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	0.33612	0.00811	41.46	<.0001
Select	-0.25402	0.00962	-26.39	<.0001
Not Graded	-0.04791	0.00299	-16.05	<.0001
Organic Claim Dummy Variable				
Organic	0.37845	0.00770	49.12	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Halal	0.15647	0.09664	1.62	0.1054
Kosher	0.37466	0.00567	66.02	<.0001
KoGlatt	0.47275	0.00700	67.58	<.0001
Bone State Dummy Variable				
Bone In	-0.03203	0.00319	-10.03	<.0001
Roast Categories Dummy Variables (Oven Everyday Default)				
Pot Roasts	-0.16112	0.00291	-55.43	<.0001
Oven Premium Roasts	0.55186	0.00302	182.93	<.0001
Holiday Roasts	0.15883	0.00291	54.53	<.0001
Volume Weighted Mean Price Per Pound Variable				
lnMpricelb	0.32944	0.01393	23.65	<.0001

Table 7.4 Summary Statistics for Semi-Log Model 2 - Roast

Root MSE	0.36126
R-Square	0.5047
Adjusted R-Square	0.5047
Dependent Mean	1.65056
Dependent Standard Deviation	0.51329
Number of Observations Used	116,428

Table 7.5 Semi-Log OLS Regression Results for Model 3 – Ground Examining the Determinants of Ground Beef as a Percentage Change

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	0.83391	0.01746	47.76	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	0.11477	0.00655	17.53	<.0001
Regional	0.19427	0.00396	49.08	<.0001
National	0.17531	0.00331	53.00	<.0001
Store	0.19166	0.00355	54.01	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.12973	0.00276	-47.05	<.0001
Breed 2	-0.00427	0.13893	-0.03	0.9755
Breed 3	-0.40935	0.01766	-23.17	<.0001
Breed 4	0.67345	0.04925	13.67	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	0.17573	0.01233	14.25	<.0001
Select	-0.97606	0.05684	-17.17	<.0001
Not Graded	-0.05021	0.00311	-16.14	<.0001
Organic Claim Dummy Variable				
Organic	0.36893	0.00632	58.35	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Halal	-0.43831	0.01805	-24.29	<.0001
Kosher	0.20342	0.00537	37.87	<.0001
KoGlatt	0.35640	0.00578	61.66	<.0001
Ground Beef Category Dummy Variables (Other Ground* Default)				
Meat Balls	0.10672	0.00739	14.44	<.0001
70-77% Lean	-0.07468	0.00524	-14.26	<.0001
78-84% Lean	-0.04997	0.00557	-8.98	<.0001
85-89% Lean	0.10849	0.00521	20.82	<.0001
90-95% Lean	0.22970	0.00523	43.89	<.0001
96-100% Lean	0.30698	0.00633	48.51	<.0001
Chuck	-0.00956	0.00531	-1.80	0.0716
Round	0.10871	0.00540	20.13	<.0001
Sirloin	0.25343	0.00550	46.10	<.0001
Volume Weighted Mean Price Per Pound Variable				
lnMpricelb	0.25148	0.01153	21.81	<.0001

* Other Ground includes Chili Meat, Meat Loaf, and Trim

Table 7.6 Summary Statistics for Semi-Log Model 3 – Ground

Root MSE	0.24055
R-Square	0.3810
Adjusted R-Square	0.3807
Dependent Mean	1.37725
Dependent Standard Deviation	0.30568
Number of Observations Used	55,579

Table 7.7 Semi-Log OLS Regression Results for Model 4 – Strip Examining the Determinants of Strip Products as a Percentage Change

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1.17133	0.03492	33.55	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	0.40568	0.02099	19.33	<.0001
Regional	0.30358	0.00808	37.58	<.0001
National	0.29935	0.00635	47.16	<.0001
Store	0.29018	0.00679	42.73	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.05910	0.00615	-9.61	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	0.33822	0.02345	14.42	<.0001
Select	-0.24161	0.01580	-15.29	<.0001
Not Graded	-0.03627	0.00583	-6.22	<.0001
Organic Claim Dummy Variable				
Organic	0.62065	0.01600	38.78	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Kosher	0.23365	0.01137	20.54	<.0001
KoGlatt	0.24666	0.01682	14.67	<.0001
Strip Product Category Dummy Variables (Other Strip* Default)				
Stir Fry	0.15160	0.00457	33.15	<.0001
Fajita Meat	0.11996	0.00447	26.84	<.0001
Volume Weighted Mean Price Per Pound Variable				
lnMpricelb	0.14003	0.02384	5.87	<.0001

* Other Strip includes Cutlet, Stew, Strips, Flap, Sundry, Tenderloin, Tip, Top Blade, and Bottom

Table 7.8 Summary Statistics for Semi-Log Model 4 – Strip

Root MSE	0.26997
R-Square	0.3270
Adjusted R-Square	0.3266
Dependent Mean	1.62364
Dependent Standard Deviation	0.32897
Number of Observations Used	22,100

Table 7.9 Semi-Log OLS Regression Results for Model 5 – Cube Examining the Determinants of Cubed Products as a Percentage Change

Variable	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1.08998	0.03114	35.00	<.0001
Brand Dummy Variable (Unknown Brand Default)				
Local	0.19457	0.01381	14.09	<.0001
Regional	0.24558	0.00681	36.07	<.0001
National	0.23833	0.00572	41.70	<.0001
Store	0.19789	0.00557	35.54	<.0001
Breed Claim Dummy Variable (No Breed Default)				
Breed 1	-0.05858	0.00413	-14.17	<.0001
Breed 3	-0.53207	0.02999	-17.74	<.0001
Quality Grade Dummy Variable (Choice Default)				
Prime	0.50482	0.01306	38.66	<.0001
Select	-0.39868	0.01499	-26.59	<.0001
Not Graded	-0.02921	0.00426	-6.86	<.0001
Organic Claim Dummy Variable				
Organic	0.29523	0.01096	26.94	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)				
Halal	0.08344	0.10088	0.83	0.4082
Kosher	0.12687	0.00906	14.00	<.0001
KoGlatt	0.34150	0.00944	36.19	<.0001
Cube Product Category Dummy Variables (Other Cubes* Default)				
Stew Meat	-0.20666	0.00513	-40.32	<.0001
Kabobs	0.25293	0.00513	49.32	<.0001
Volume Weighted Mean Price Per Pound Variable				
lnMpricelb	0.31818	0.02130	14.94	<.0001

*Other Cubes include Petite Tender, Ribeye, Cubes, Top, and Skirt

Table 7.10 Summary Statistics for Semi-Log Model 5 - Cube

Root MSE	0.31870
R-Square	0.3722
Adjusted R-Square	0.3719
Dependent Mean	1.71427
Dependent Standard Deviation	0.40214
Number of Observations Used	39,605

Table 7.11 Semi-Log OLS Regression Results for Model 6 – Ribs Examining the Determinants of Ribs as a Percentage Change

Variable		Parameter Estimate	Standard Error	t Value	Pr > |t|
	Intercept	1.12001	0.03629	30.86	<.0001
Brand Dummy Variable (Unknown Brand Default)					
	Local	0.11593	0.01132	10.24	<.0001
	Regional	0.28159	0.00861	32.72	<.0001
	National	0.13685	0.00784	17.46	<.0001
	Store	0.27588	0.00774	35.64	<.0001
Breed Claim Dummy Variable (No Breed Default)					
	Breed 1	-0.07401	0.00629	-11.76	<.0001
Quality Grade Dummy Variable (Choice Default)					
	Prime	0.28175	0.03817	7.38	<.0001
	Select	-0.47311	0.01507	-31.39	<.0001
	Not Graded	-0.15902	0.00608	-26.14	<.0001
Organic Claim Dummy Variable					
	Organic	0.13716	0.02014	6.81	<.0001
Religious Claim Dummy Variable (No Religious Claim Default)					
	Kosher	0.59285	0.01017	58.27	<.0001
	KoGlatt	0.44078	0.00852	51.71	<.0001
Bone State Dummy Variable					
	Bone In	-0.09438	0.00436	-21.64	<.0001
Process Level Dummy Variable					
	Processed	0.23211	0.00902	25.74	<.0001
Rib Product Category Dummy Variables (Other Ribs* Default)					
	Short Ribs	0.14471	0.00442	32.76	<.0001
	Back Ribs	-0.30243	0.00584	-51.77	<.0001
Volume Weighted Mean Price Per Pound Variable					
	lnMpricelb	0.11650	0.02460	4.74	<.0001

* Other Ribs includes Plate, Chuck, and Rib

Table 7.12 Summary Statistics for Semi-Log Model 6 – Ribs

Root MSE	0.28058
R-Square	0.5160
Adjusted R-Square	0.5156
Dependent Mean	1.34793
Dependent Standard Deviation	0.40314
Number of Observations Used	21,860