AN ANALYSIS OF CONSUMER WILLINGNESS TO PAY FOR GRASS-FED BEEF IN THE SOUTHEAST

by

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(Under the Direction of John C. McKissick)

ABSTRACT

Grassfed beef is a product with several benefits that may appeal to consumers who are health-conscious and place a high value on environmentally sound production practices. To determine consumers' willingness to pay for a grass-fed beef steak and the implicit value of its attributes, a total of 215 consumers from Athens, GA and Clemson, SC participated in a six n^{th} price auction. Results from a hedonic analysis show that willingness to pay estimates and implicit values varied across visual and taste evaluations. Findings show that production and nutrition information largely affect willingness to pay in both presentation formats. Of the 38% of consumers willing to pay at least a 17% premium for grass-fed beef, the latent factor concerning attitudes towards 'happy beef' and sociodemographic variables had the greatest impact on the probability that consumers would pay a premium.

INDEX WORDS: Grass-Fed Beef, Willingness to Pay, Experimental Auctions, Factor Analysis, Hedonic Valuation, Multinomial Logit Model

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CHAPTER ONE

INTRODUCTION

Over the past two decades, consumers' food preferences have shifted away from traditionally-produced, homogeneous beef products. As a result of this well-documented decrease in beef demand (Schroeder and Mark, 2000), cattle producers have been challenged to reassess conventional beef production practices and consider alternative production methods that better satisfy consumers' changing preferences. To sustain the recent modest reversal of the beef demand decrease and to appropriately respond to the increasing demand for heterogeneous food products, the cattle industry must now determine which beef attributes consumers value most highly and their willingness to pay (WTP) for those various differentiable qualities. The specific purpose of this study is to determine consumers' WTP for a grass-fed beef product and grass-fed beef attributes.

Background

The beef sector plays a significant role in the United States agricultural economy. The United States Department of Agriculture (USDA) listed cattle and calves as the top U.S. agricultural commodity in 2005 in farm cash receipts. According to USDA data, the United States is the world leader in beef production, most of which is conventionally produced (grain-fed), high-quality beef. In addition to being a principal producer of beef, the United States is also a net importer of beef (in terms of pounds), which is mainly grass-fed beef consumed primarily as ground beef. Even with the decline in beef exports after the 2003 discovery of BSE in a dairy cow imported from Canada, the 2005 USDA statistics show that the beef industry has continued to grow within the past few years, boasting cash receipts estimated at $49.2 billion annually. (http://www.ers.usda.gov/StateFacts/US.HTM).

Domestically, the beef industry had previously endured a steep decline in demand for a couple of decades. Researchers at Kansas State University have documented this demand decrease through the use of a Retail Choice Beef Demand Index. Using a basic ratio, this beef demand index compares the annual, actual inflation-adjusted Choice retail beef price with the price that would have occurred if beef demand held constant since 1980. (Mintert, Schroeder, and Marsh, 2002). As shown in Figure 1.1, demand has increased to similar levels from the early 1990s, but remains below the 1980 demand level.

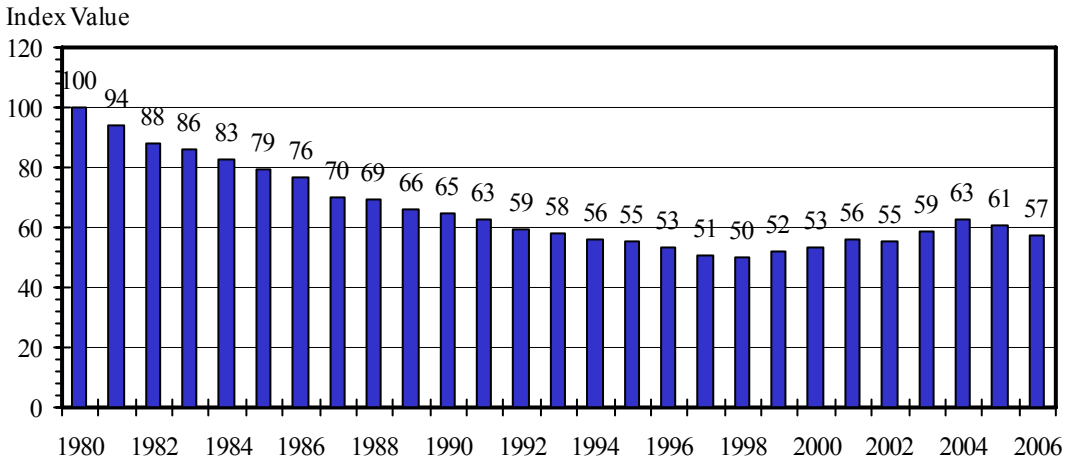

Figure 1.1 Retail Choice Demand Index, 1980-2006
(Source:Livestock Marketing Information Center, 2007)

The decline in beef demand did not go unnoticed by producers and processors. As the beef industry experienced a decrease in demand, cattlemen began searching for strategies to increase demand. Thus, simultaneous with this demand decrease, the requests for research both addressing the causes of the decline and new ways to market beef increased.

One response to such additional research demands was the commission and publication of the National Cattlemen's Beef Quality Audit, which was last conducted in 2005. This study, which collects information from slaughter houses, exporters, purveyors, foodservice, and retail chains, most recently revealed that end-users rank a lack of uniformity/consistency in quality as the No. 1 deficiency in the U.S.

beef industry. This deficiency in "uniformity/consistency in quality" had four contribution factors: (the presence) of marbling; tenderness; palatability; and inconsistency among and within quality grades. Participants in the audit also predicted an increase of approximately 14% in domestic consumer demand for "natural" beef (National Cattlemen's Beef Association, 2006). (http://www.beefusa.org/NEWS2005NATIONALBEEFQUALITYAUDITASKSANSWERSQUESTIONSABOUTUSBEEF27177.aspx).

These results from the beef quality audit highlight the need for increased producer responsiveness to product quality and consistency within the beef industry. In years past, the main source of product differentiation was the USDA voluntary beef grading system. However, consistent with the beef quality audit, additional studies have also shown that most consumers are not generally familiar with the various USDA quality grades or the information that is conveyed through the system (Lusk et al., 1999).

Many successful producers have already recognized the demand for valued-added beef products and certain beef attributes. Some producers, beef packers, and retailers have used consumer preferences for quality differentiated beef products to brand their product based on specific production techniques or processing attributes, such as "natural," "leaner," and more marbling. Consumers have taken notice of these quality differentiated beef products and have been willing to pay the increased prices for such products. As can be seen from Figure 1.2 on the next page, the annual average retail beef price for Choice graded beef products have been on the upward swing for the past few years. One way producers can command a higher price for their differentiated beef products is to create a "brand" for their product. Branding creates an identification system that transmits information about the meat product to the consumer through the simplicity of a single label. Quite popular in several food sectors, this marketing tool serves to create associations or expectations of a particular product to the consumer. If consumers are willing to pay a premium for a particular brand, then that branded firm may experience higher margins.

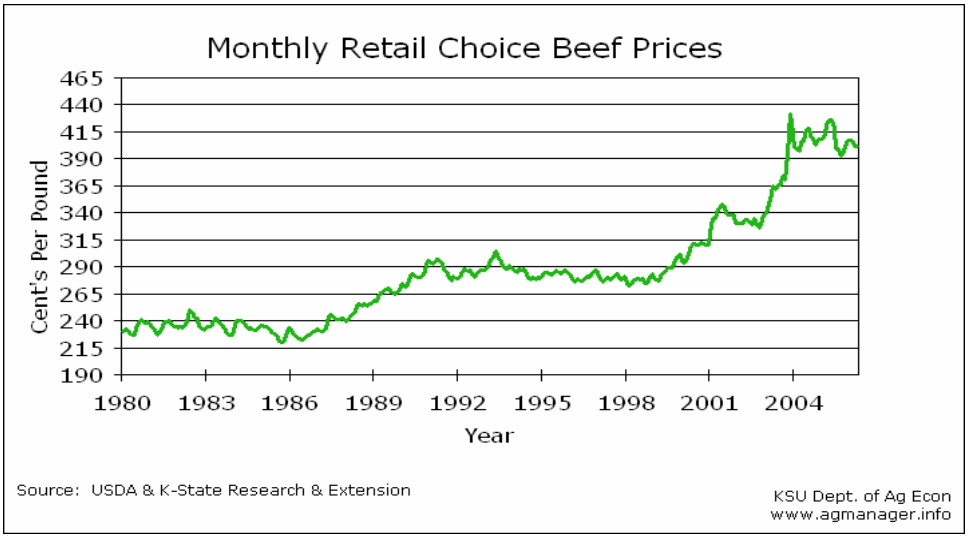

Figure 1.2 Monthly Retail Choice Beef Prices 1980-2006
Source: http://www.agmanager.info/livestock/marketing/Beef%20Demand/default.asp

Similarly, producers and processors may choose to cater to a certain "niche" of consumers. A niche market can be described as a target group of consumers who have similar preferences among the specific group, but different preferences from other groups. One such illustrative use of a niche market was recently studied by the National Cattlemen's Beef Association (NCBA) by relying on FreshLook Marketing scanner data gathered during the sale of natural and organic beef at retail supermarkets. The results of that study show that although the sales of natural and organic beef are small when compared to total beef sales, the sales of this specialty beef are growing more rapidly than traditional beef markets, boasting a 17.2% increase in 2005 (Agricultural Marketing Resource Center). Not only are organic meat sales increasing relative to other meat markets, consumption of these specialty meats is the fastest growing sector of the organic food industry (Organic Monitor, 2006). Considering that the sales of all organic food increased approximately 20-24 percent in the 1990s, specialty meat consumption's leading role is especially significant (Agricultural Marketing Resource Center).

The successful use of marketing strategies to produce and promote certain beef attributes is an example of how the beef industry has responded to the significant decrease in beef demand experienced

since 1980. However, to sustain wide spread acceptance of such niche marketing and value-added branding within the beef industry and continue to pursue a return to the pre-1980 demand levels, producers must continually seek to learn the attributes that consumers most highly value.

Problem Statement

For the past 50 years in the United States, the typical feed regimen for beef cattle has consisted of grass, pasture, and hay and some feed supplements, until they have reached about a year old and the weight of about 700 to 800 pounds. These yearlings are then placed in feedlots where they undergo a process called "finishing" and their diets are supplemented with grains in order to quickly reach the necessary weight needed to be sold to slaughter houses (about 1000 to 1100 lbs). However, in recent years some consumers and consumer groups have expressed concern about the conventional beef production system. These concerns are usually centered on the wholesomeness of the beef produced and the humane treatment of animals.

This concern has given rise to interest in cattle raised exclusively on forage their entire lives, called grass-fed beef. Grass-fed beef can be classified as organic or natural beef. However, despite the similarities shared between grass-fed, organic, and natural beef, it is not necessary that grass-fed beef be produced in an organic system, nor is it necessary for organic beef to be finished on forages. In addition, consumers commonly equate "pasture raised" and "free range" to mean the same as grass-fed. This confusion stems from the fact that even grain-finished animals spend a large part of their lives eating grass in pastures (prior to "finishing"), and therefore many products are misunderstood as grass-fed when grass is only a part of the animals diet. The term "grass-fed" has a rather loose definition that can be easily misinterpreted by consumers and/or those labeling grass-fed beef. As defined by the American Grassfed Association (http://www.americangrassfed.org/AGA%20Background.htm), grass-fed products are those

> "from ruminants, including cattle, bison, goats and sheep, as those food products from animals that have eaten nothing but their mother's milk and fresh grass or grass-type hay from birth to harvest – all their lives. For grassfed non-ruminants, including pigs and poultry, grass is a

> significant part of their diets, but not the entirety of their diets, since these animals need to consume grains."

The National Cattlemen's Beef Association defines the term "grass-finished" similarly to that of the American Grass-fed Association's definition of grass-fed; both terms require that the animal is solely raised on pasture land. This lack of a formal definition for grass-fed beef creates many marketing problems for potential producers and distributors. The American Grassfed Association is lobbying the USDA standardize grass-fed beef products.

A growing body of research shows that grass-fed, natural, and organic foods provide significant health benefits to consumers (Worthington, 2001, American Grassfed Association, 2007). In addition to being raised without synthetic hormones, antibiotics, pesticides and chemical fertilizers, these food products are supposedly healthier than food produced by industrial agriculture (Worthington, 2001). Alternative production methods, such as grass-fed beef, are also promoted as being more environmentally friendly since the animal waste is used as a natural fertilizer. Furthermore, some consumers may believe cattle that are grass finished are treated more humanely because they are allowed to roam freely on pastureland.

Conventionally produced beef, or grain-finished, are fed a high-energy, high fat diet towards the end of the production process, thus causing the cuts of beef to be higher in fat than that of grass-fed beef. Consumers who are concerned about health maybe drawn to grass-fed beef, since those cuts of meat are traditionally leaner than that of grain-finished beef. According to the American Grassfed Association, products from grass-fed animals have been shown to be higher in beta carotene (Vitamin A), conjugated linoleic acid (CLA), and Omega-3 fatty acids, which are important in reducing cholesterol, diabetes, cancer, high blood pressure and other life threatening diseases.

As explained above, grassfed beef is a product with several benefits that may appeal to consumers who are health-conscious and place a high value on environmentally sound production practices. Taking all of the incentives of producing grass-fed beef into consideration, one must question why the product is currently produced on only a limited basis. Some possible explanations are explored below.

Since cattle produced through grass-fed production methods are not given supplemental grains to decrease the production time, it takes much longer (as much as 18 to 24 months) for cattle to reach the required weight (Bearden, 2004). Thus, producing grass-fed beef necessitates intensive forage and grazing management on the behalf of the producer, as well as requiring more acreage.

Favorable weather conditions are essential to successfully feeding and finishing cattle solely on grass. Because of its mild temperature and typically generous amounts of precipitation, in comparison to other parts of the country, the Southeastern[1] United States maybe an ideal location for a prosperous grass-fed production system. Except for years of severe drought, it is conceivable that cattle in the Southeastern United States, for the most part, are able to graze in the pasture almost year-round without producers relying heavily on stored forages. Producers in states such as Alabama, Georgia, Florida, and South Carolina would have a comparative advantage for producing grass-fed beef and possibly gain some market share from the Midwestern feedlots.

Despite all of the evident advantages to Southeastern producers, altering beef production systems can be an arduous endeavor. Since their cattle are finished in the pasture, grass-fed producers must take into consideration feed resources and the availability of labor. For some producers, accommodating these changes in needed resources may also require a change in their calving season and the acquirement of new pastureland. Another concern to producers involves the costs associated with marketing and brand development. Extensive amounts of time and money must be invested in order to establish a successful brand that consumers will associate with quality and consistency, and at this time there is no firm understanding of the resources needed in order to accomplish that task. Lastly, the loss of producer identity may inhibit cattlemen from producing credible branded images. Bailey and Hayes (2002) discuss the evolution of identify preservation in the beef market and determine that the current environment where products from many producers are co-mingled prior to sale is often a counter-incentive to improve quality.

[1] For the purposes of this paper, the Southeastern United States refers to the following states: Alabama; Florida; Georgia; and South Carolina.

Lastly, despite some of the exclusive attributes of grass-fed beef, particularly health attributes, products from a grain-fed beef production system can also meet consumer demand for a quality differentiated beef product. Producers can choose to finish cattle on grain in a pasture opposed to a concentrated feedlot. Therefore, grain-fed beef can be considered "humanely treated,", "natural," "open-range," and "organic," just as easily as a grass-fed beef product.

Thus, before cattlemen are able to capitalize on consumer demand for these grass-fed beef products, additional research regarding consumers' WTP for a quality differentiated beef is needed to fill this information void. A chief concern among producers and researchers is whether consumers are truly willing to put their money where their mouth is. Research conducted by Melton, Huffman, and Shogren (1996) found that consumers valued pork attributes differently when evaluated in two different presentation formats. Although their study involved attributes of pork chops, that finding has important implications for the beef industry as well since the attributes used to attract potential customers may not be the same attribute that encourage repeat sales. Product labels and information, or credence attributes, will initially draw consumers to purchase a product. However, the frequency of successive purchases of the same product depends on the whether or not the consumers' taste expectations are met. Negative meat quality attributes are also associated with grass-finished beef that may decrease its price, such as having a "gamey" or "grassy" flavor and being tougher than conventionally produced beef. This raises a flag to producers who are considering finishing cattle on grass, since many of the positive credence attributes associated with grass-fed beef (leaner, no hormones, no antibiotics, environmentally friendly), may be offset by experience attributes (flavor, juiciness, tenderness). Producers will be reluctant to begin producing grass-fed beef prior to knowing what attributes are most desired by consumers, as well as if the amount consumers are WTP will cover the additional expenses associated with an alternative beef production system. Therefore, though many consumers may suggest they desire these differentiable food products, there is a need for research that both 1) determines the factors that influence those consumers' WTP for these quality differentiated meat products and 2) identifies and describes demographically the

actual consumer who is willing and able to pay the requisite premiums. The main objective of this study then is to determine consumers' WTP for grass-fed beef.

Specific objectives of this research include:

1. Determine the level of consumer acceptance of grass-fed beef.
2. Determine A.) if there is a premium associated with grass-fed beef, and if so, B.) the premium amount consumers are willing to pay.
3. Determine the values that consumers place on the attributes associated with grass-fed beef., specifically information attributes
4. Determine how consumers' values change across visual and taste evaluations.
5. Identify the target market for producers who are considering a shift to a grass-fed production system.

CHAPTER TWO

REVIEW OF LITERATURE

The purpose of this chapter is to review previous empirical research thus providing insight into the methods employed in this study. Grass-fed beef is considered a quality differentiated foodstuff. Therefore, the first section of the chapter provides a review of studies that have analyzed consumer preferences for quality differentiated food products, specifically meat products. Next, research depicting consumer acceptance and demand of grass-fed beef is reviewed. The chapter is rounded out by a discussion of the hedonic price analysis method where relevant studies are presented and examined.

Quality Differentiated Food Products

The growth in demand for quality differentiated products has spurred an abundance of studies, each endeavoring to identify the food attributes that are most highly valued by consumers. This research shows that relative prices and consumer income are not the only demand determinants of beef—other factors that influence beef demand are health/nutrition concerns, food safety concerns, and consumer preferences for meat product attributes (Schroeder and Mark, 2000). Some attributes that have been shown to influence consumer purchases and the amount they are willing to pay for food products are product labeling and packaging, organic, natural, and other production practices, locally produced, and no additives.

Some studies show that consumers are increasingly demanding products that are certified as a safe food source. Through the use of the Vickrey auction, Hayes et al. (1995) set out to determine the premiums consumers place on food safety. Results from the experiment showed that study subjects tended to underestimate the objective risk of food-borne pathogens, and placed more weight on their own prior perceptions than on new information on the odds of illness. Hayes et al. (1995) also found that

participants may use individual values for specific pathogens to act as surrogates for general food safety preferences. The average participant, overall, was willing to pay about $0.70 per meal for safer food.

Similarly, Miller and Unnevehr (2001) used information that was obtained from 609 households in Illinois about the frequency of fresh pork consumption, concerns about pork products and their safety, and consumer confidence in certifying institutions. From the results of a contingent valuation survey, the researchers found an association between lower consumption and higher concern about pork safety. From a ladder-style question, where those unwilling to pay the highest level of $1.00 were given subsequent WTP choices of 50 cents per pound, 25 cents per pound, and 10 cents per pound, the data indicated that approximately 25% of the respondents were willing to pay $1.00 more for a certified safer pork product. Almost another quarter (22.7%) of respondents were willing to pay 50 cents more per pound, and 26% reported that they were willing to pay either $0.25 or $0.10 more per pound. In their study, Miller and Unnevehr (2001) also found that concern about pork safety was greatest among households with children, lower incomes, older consumers, and African Americans. Finally, the study suggests that WTP for certified safer pork was the greatest among women, older consumers with incomes less than $70,000, urban households, and those concerned about pork safety.

Organic production practices are similar to grass-fed practices in the sense that they are viewed as being environmentally sound and cultivate healthier foods; however, consumers may purchase organic food for a variety of reasons. Huang (1996) found that consumers who buy organically grown produce do so for nutritional reasons. Such purchasers are concerned about the use of pesticides on fresh produce and prefer produce that has been tested and certified residue-free. Consumers who prefer organic produce are generally more tolerant of sensory defects, have larger families, have obtained higher levels of education and are Caucasian. Likewise, Govindasamy and Italia (1999) conducted a study to determine which characteristics were significant in predicting whether consumers were willing to pay a premium for organically grown produce. Results indicated that higher earning and smaller sized households were more likely to pay a higher premium for organic produce. Females, younger individuals and persons who are already in the practice of purchasing organic produce were also found to exhibit a higher WTP for

organically grown produce. Other researchers, such as Batte et al. (2004), also have verified that nutrition and a preference for pesticide residue-free commodities motivate consumers to purchase organic foods. Overall, food safety and health attributes have been shown by several studies to be an important concern for consumers (Huang, 1996; Miller and Unnevehr, 2001; Grannis, Hooker, and Thilmany, 2000).

In a study aimed at eliciting consumer preferences for certain attributes of natural beef products, Grannis, Hooker, and Thilmany (2000) found that consumers in the intermountain region of the U.S. are concerned with meat additives (hormones and antibiotics) and are willing to pay a premium for natural beef. For both of the beef products, steak and ground round, evaluated in the contingent valuation portion of the study, meat products with "no use of hormones" had the highest average rank that also trended upwards with increasing premium levels. The second most important attribute was "no use of antibiotics", followed by environmentally friendly production practices (protection of streams and protection of endangered species). Grannis, Hooker, and Thilmany (2000) found that consumers who had made past purchases of natural beef were willing to pay higher premiums for natural beef. Overall, about 38% of the respondents were willing to pay a 10% premium for natural steak, and 67% of consumers were willing to pay a 12% premium for natural ground round. There were a few, 14%, of respondents who were willing to pay a 20% premium for natural steak and about 29% of consumers who would buy natural ground round for 23% more.

Locally produced foods can also garner premiums. Maynard, Burdine, and Meyer (2003) used a focus group, a consumer taste-testing and WTP survey, and a restaurant survey to meet the following specific objectives: identify the sources of value consumers place on locally produced meats; measure consumer WTP for locally produced meats; compare flavor attributes of locally produced and commercial meats; and identify factors affecting restaurants enthusiasm for offering locally produced meats. The products that were evaluated in the taste-testing portion of the study were samples of ground beef, chicken breast, and fish filet. Analysis of the results from the taste-testing segment showed that the locally produced ground beef with higher fat content was the most preferred in terms of juiciness, texture, and overall palatability.

In order to measure WTP, an iterated dichotomous-choice contingent valuation survey was designed for four products: ground beef; beef steak; chicken; and sausage. From the survey responses, Maynard, Burdine, and Meyer (2003) concluded that a minority of respondents were willing to pay the highest premium for the locally produced products, which was 40%. About 15% were willing to pay the 40% premium for locally produced ground beef, while about 20% were willing to pay 40% for locally produced steak. When the ordered logit mode was estimated, it was found that the specific target segment appeared to be primary shoppers in families with children who already shop in specialty food stores or purchase food products directly from farms.

Labeling also plays a role in consumers' WTP. In a previous study, Loureior, McCluskey, and Mittelhammer (2002) surveyed consumers on paying a premium for eco-labeled products. By collecting and analyzing survey data from two different grocery stores in Portland, Oregon, consumers were found to pay a premium of 5 cents per pound of eco-labeled apples over the base price of 99 cents. The demographics of those consumers with the greatest likelihood of paying the premium were female participants with children and those with strong environmental and food safety concerns. Umberger et al. (2003) also found that consumers were willing to pay for beef products that were labeled as "U.S.A. Guaranteed: Born and Raised in the U.S." Results from Umberger et al.(2003) indicated that approximately 75% of the participants preferred the country-of-origin labeled product compared to the unlabeled beef product. Consumers were also asked to specify their maximum WTP per pound to have their beef steaks and hamburger labeled with the country-of-origin. A reference price of $4.00/lb for an unlabeled steak and $1.50/lb for unlabeled hamburger meat was given. Umberger et al. (2003) found that 73% were willing to pay a premium for country-of-origin. On average, participants were willing to pay about an 11% (or $0.42 lb) premium for steaks that were labeled with country-of-origin and an even higher premium for labeled hamburger (24% or $0.36/lb). Furthermore, consumers who choose to purchase their beef from sources other than the supermarket (i.e., butcher shop, direct from producer, or meat market) were 27% more likely to be willing to pay a premium for "U.S.A. Guaranteed" labeled

steak. However, socio-demographic variables were not significant in predicting the probability of a consumer purchasing U.S. labeled beef steak.

Lusk et al. (2001) used the Becker-DeGroot-Marschak (BDM) auction mechanism to determine consumer WTP for more tender steaks. While a number of valuation studies employing the experimental auction have been conducted in laboratory settings, Lusk et al. (2001) conducted the experiment in a grocery store with individual shoppers. Two treatments were utilized to determine WTP for a guaranteed tender steak. The first treatment was "blind" in the sense that participants did not know which steak was tender and which was tough. In the second treatment, the second steaks were labeled as either "probably tough" or "guaranteed tough." The blind taste tests revealed that 69% of participants preferred the tender steak with 72% of consumers indicating their preference was due to tenderness. In the same blind taste test, 36% of consumers were also willing to pay a premium of $1.23 lb for a tender steak in comparison to a tough steak. The percentage of consumers who preferred the tender steak increased to 84% in the second treatment when the steaks were labeled as either tender or tough. Fifty-one percent of consumers were willing to pay, on average, $1.84 lb more for a steak labeled as guaranteed tender. Certain demographics served as indicators of consumers' preference for tender steak and the corresponding premium they were willing to pay for such steaks. Those who preferred tender steaks were older and more highly educated.

Consumers were given the opportunity to upgrade from a probably tough steak to a guaranteed tender steak if they showed preference for the tender steak. A Tobit model was used to estimate the WTP for those who indicated a preference for the guaranteed tender steak. However, Lusk et al. (2001) asserts that estimations using Tobit models are restrictive since the Tobit model assumes the probability of a zero WTP bid and a positive bid are identically affected by the same determinants. Therefore, Cragg's double hurdle model was used since it allows for different determinants to affect zero bids and positive bids. The first hurdle is the consumer's "yes/no" decision to pay for the tender steak and the second hurdle is the price for the steak if the consumer decides to pay. Of those consumers who were willing to pay more for a tender steak, younger females were willing to pay the largest premiums. The information treatment, the

second treatment, was the most important determinant of WTP, with consumers having the tenderness information being willing to pay $0.82 more per pound for a more tender steak.

Research also indicates that the aging process of beef can also influence WTP values. Sitz et al. (2006) conducted a study with the primary objective of quantifying sensory differences between wet- and dry-aged strip loins and establishing the value that consumers placed on their product of preference. There were a total of 273 participants in the study; 132 in the Denver location, and 141 in Chicago. A variation of the Vickery auction, the n^{th} price auction, was utilized in this study

The findings of the study imply that while dry-aging is a more expensive method, the costs may be compensated by the premiums that consumers who prefer the method would pay. Results of the sensory evaluation showed that although there were no statistically significant differences for flavor, juiciness, tenderness, and overall acceptability between the dry-aged Choice strip loins and the wet-aged Choice strip loins, Choice wet-aged samples were numerically greater for all of the above sensory traits. Consumers were willing to pay about $0.25 per pound[2] more for the wet-aged Choice steaks. However, when consumers were grouped according to their preference, those who preferred the dry-aged Choice steaks were willing to pay a higher premium ($2.02 per pound) for their preference when compared to participants who showed a preference to wet-aged Choice steaks.

Willingness to Pay for Grass-fed Beef

Like many related beef products that are produced through alternative beef production systems, grass-fed beef products capture many attributes that consumers have independently expressed demand for in one single package (i.e. produced through "environmentally sound practices," free of additional hormones, lean, and humanely produced). In some instances, grass-fed beef has become a viable option for producers wishing to increase profit margins. Even so, there has not been an extensive amount of research conducted to evaluate just how much consumers are willing to pay for these products. This

[2] The referenced study considered the premium in units of 0.45kg. For consistency, the referenced study's unit basis has been converted to pounds. The unit 0.45kg equals approximately one pound.

section will present an in-depth review of the available research concerning WTP for grass-fed beef products.

U.S. consumers of beef have certain expectations concerning the ideal flavor of a quality beef product, which, not surprisingly, may differ from the preferences of consumers from other cultures and countries. Since the production practices of beef vary from country to country and these practices influence the flavor of the product, Umberger et al. (2002) conducted research to explore consumer's WTP for flavor preference. Experimental auctions were used in two separate study sites, Chicago and San Francisco, to distinguish flavor preferences between domestic corn-fed beef and imported Argentine grass-fed steaks and to determine the premium consumers were willing to pay for the steak of their choice.

To identify consumers by their demographic traits and to predict which flavor they would prefer, a multinomial logit model was estimated. The dependent variable, *FLAVOR PREFERENCE*, was a categorical variable equal to 0 for consumer who preferred the corn-fed beef, equal to 1 for consumers who were indifferent and equal to 2 for consumers who preferred the grass-fed beef. Explanatory variables included: *LOCATION; AGE; GENDER; ETHNIC; INCOME; EDUCATION; FAMILY SIZE; EAT BEEF; PRICE SHOPPER; QUALITY GRADE; and BEEF KNOWLEDGE.*. The variable *PRICE SHOPPER* was a dummy variable for price or budget driven shoppers; *QUALITY GRADE* was the USDA quality grade of beef typically purchased; *BEEF KNOWLEDGE* was the participant's score from a knowledge quiz on a set of general beef questions; and *EAT BEEF* represented the number of times per week that beef was eaten in the participants' home.

A second equation was defined and estimated using OLS regression to predict the premium that consumers would pay for their preferred steak flavor. The dependent variable in equation two, *BID DIFFERENCE*, was each panelist's bid for the domestic corn-fed steak minus their bid for the Argentine grass-fed steak. For consumers who preferred and were willing to pay more for the corn-fed steak than the grass-fed steak, the dependent variable was positive. Conversely, the dependent variable was negative for those consumers who exhibited preferences and were willing to pay for the grass-fed steak. Lastly, if

the consumer was indifferent to the two different steaks, *BID DIFFERENCE* was zero. The explanatory variables used to explain the variation in the dependent variable were the same that were used in the multinomial logit model.

Results from the sensory evaluations showed that consumers, on average, strongly preferred the domestic steak on all sensory traits (flavor, juiciness, tenderness, and overall acceptability) relative to the imported steak. Interestingly, Umberger et al. (2002) found that the magnitude of the difference in the flavor desirability ratings for the two different steaks demonstrated that consumers in both Chicago and San Francisco felt strongly about the flavor of the preferred steak. When evaluating the results from the individual bid prices, a majority (62%) of the panelists were willing to pay an average of $1.61 more per pound for the domestic steak. However, a group of consumers, about 23% of those in the auction procedure, had a preference for the imported beef product. On average, those who preferred the imported steak were willing to pay about $1.36 more for the Argentine sample. Furthermore, the demographic variables that were significant in predicting a consumer with a grass-fed preference were *LOCATION, ETHNIC,* and *EAT BEEF*. The marginal probabilities that were obtained for each explanatory variable suggest that consumers in San Francisco are less likely to prefer the imported product. Those who were non-Caucasian and who ate beef more often in the home were more likely to prefer the grass-fed steak.

More recently, Cox et al. conducted a study in 2006 aimed at determining consumer WTP for an American grass-fed beef product versus a domestic grain-fed product. The objective of the study was to determine the consumer acceptance of forage-finished and grain-finished beef in the Southeastern (i.e., Alabama, Tennessee, and Kentucky) United States. Additionally, the researchers intended to determine the value that consumers associate with forage-finished beef.

Using two survey methods, they sought to determine consumer acceptance and to obtain the subsequent value consumers placed on the forage-finished beef. The study was accomplished by conducting a retail consumer study in nine supermarket locations and a home consumer study in which twenty-four take-home envelopes (containing one steak from each finishing treatment) was randomly assigned to participants at each of the nine locations. Using Analysis of Variance (ANOVA) procedure,

the study found that hot carcass weight, actual fat thickness, and adjusted fat thickness were statistically significantly higher for grain finished carcasses than for forage-finished carcasses.

When flavor, overall palatability, and price ratings were compared in the retail consumer acceptance study for the grain-finished and forage-finished beef, consumers showed favor towards the grain-finished beef. But, there were no statistically significant differences for flavor, palatability or price when consumers took the steak samples home and prepared and seasoned them in the manner they wished. Of the 1,250 total consumers surveyed in the retail study across the three states, 34% preferred the forage-finished beef. Also, when information describing the finishing treatment of each of the tasted steaks was given, no statistically significant difference in preference was reported. The demographic information (age, gender, and income) gathered at the retail locations for each participant did not have any effect on consumer preference.

The value that consumers placed on each of the steaks was also measured. Consumers who preferred the forage-fed product in the retail study were willing to pay on average a $1.08/lb[3] premium. However, those who preferred the forage-fed steak in the home study were willing to pay an even larger amount for their steak of choice. The premium that consumers in the take-home study were willing to pay for the forage-finished steak was about $2.55/lb.[4] In conclusion, Cox et al. (2006) support previous studies' (Umberger et al., 2002) findings by stating that a significant market for forage-fed beef exists.

Another U.S.-raised grass-fed beef study was conducted by McCluskey, Quan, and Wandschneider (2005). Consumers' preferences for grass-fed beef, and the importance of health benefits in the marketing of grass-fed beef were explored. Unlike previous grass-fed beef studies that directed more attention to the country-of-origin aspect of the product, the authors chose to focus on the health benefits associated with grass-fed beef. Since consumers are becoming increasingly health-conscious, the

[3] The referenced study considered the premiums in terms in terms of kg. For consistency, all references to kg used in relied upon studies have been converted to pounds. The referenced study found a premium of $2.38/kg. One kg is the equivalent of 2.2 pounds. Therefore, $2.38/kg would be equal to about $1.08/lb.
[4] See footnote two and three. The referenced study found a premium of $5.61/kg. For consistency, this premium was converted in dollars per pound.

authors expected a consumer preference for meat products that were higher in omega-3 fatty acids and are lower in overall fat and calories.

The data used in the study was colleted with in-person intercept surveys in Spokane, Washington in February 2003. Overall, 603 individuals participated in the survey. Four separate grocery stores-one natural food store and three conventional grocery stores-served as the locations of the study. Demographic information and information regarding the respondents' attitudes about the environment and foods safety, their knowledge about the benefits of grass-fed beef, and factors influencing their purchase decisions was collected from the survey.

In order to isolate the health attributes for grass-fed beef and determine the effect they had on consumer preferences, a choice-based conjoint analysis was used. Choice-based conjoint analysis is an alternative to the traditional ratings or rankings-based conjoint analysis used typically for measuring preference structures. This analysis requires that respondents make one choice from several sets of stimuli derived from an experimental design (McCluskey, Quan, and Wandschneider, 2005). Consumers were asked to choose from among beef cuts with different attributes in the choice experiment. The study examined the qualities most distinctly associated with grass-fed beef: price, fat/calories,[5] and the presence of omega-3 fatty acids.

Results from the choice-experiment showed that both price and fat/calories have a negative effect on consumer choice, while the presence of omega-3 fatty acids had a positive effect. McCluskey, Quan, and Wandschneider (2005) also calculated the relative importance of each attribute and found that price was the most important attribute to 39.5% of respondents. A low level of fat and calories was the second most important attribute (36.9%) and the presence of omega-3 fatty acids was the least important quality (23.6%). The WTP for each attribute was also measured. While holding other attributes the same, two beef steaks were simulated for fat and calories: one with high fat and calories and the other with lower fat and calories. Estimates indicate that a low fat and calorie steak could sell for $5.65 more per pound when

[5] In the study conducted by McCluskey, Quan, and Wandschneider (2005), the effect that fat and calories had on consumers' WTP was measured with the same variable.

compared to the steak with high fat and calories. Further, when a choice between two hypothetical steaks varying in the levels of omega-3 fatty acids was presented, the steak with high omega-3 fatty acids commanded about $3.43 more per pound. McCluskey et al. (2005) noted that one reason these estimates could seem higher than expected was because about half of the sampled consumers were natural food store shoppers who would not find those kinds of price premiums to be unusual.

Typically, cattle produced through the grass-fed production system receive no added growth hormones. Therefore, a review of consumer preferences for growth-hormone-free beef is relevant to this literature review. Lusk, Roosen, and Fox (2003) analyzed the preferences of consumers from France, Germany, the United Kingdom, and the United States for beef from cattle administered growth hormones or fed genetically modified (GM) corn. The objectives of the study were to determine if differences in consumer preferences for hormone-treated/GM-fed beef across the countries were reflected in WTP estimates and to analyze the implications of various trade policies given the estimated differences in consumer preferences. In order to meet the objectives and because market-level data was unavailable, a collection of primary data was needed. Through the development and use of a mail survey which contained a choice experiment, consumers made choices between ribeye steaks with varying levels of price, marbling, tenderness, and use/non-use of growth hormones and GM corn in livestock production. The variables marbling, tenderness, and price were included in the evaluation because of their perceived importance in the consumer steak purchasing behavior.

When the mean levels were calculated for the consumers' level of concern about growth hormones and GM-fed beef (measured on a scale of one to five where one is not concerned and five is very concerned), survey results indicated that on average European consumers were more concerned about the use of genetic engineering and biotechnology than consumers in the United States. American consumers surveyed by Lusk, Roosen, and Fox (2003) were also less concerned, relative to the European consumers, about the use of growth hormones in livestock production.

However, the estimated multinomial logit model showed slightly different results. To the authors' surprise, although the reported "levels of concern" showed a difference between U.S. consumers and

European consumers, the parameter estimates for the growth hormone attribute were similar across the four countries. Estimates also suggested that U.S. consumers were more averse to hormone use than use of GM feed. The price variable yielded the expected negative coefficient for each country; U.S. consumers were slightly more sensitive to changes in price than the European consumers. In contrast to those consumers in France and Germany who preferred a modest[6] amount of marbling, consumers in the United States and United Kingdom preferred steaks with slight marbling. Nonetheless, U.S. consumers were much more sensitive to the changes in steak tenderness than were the European consumers.

A separate model, a random parameters logit model, was estimated to obtain the actual WTP[7] values that consumers in each of the four countries placed on the steak attributes. Point estimates and confidence intervals were obtained for the estimated average value of "hormone-free" and "GM free" steaks in all four countries. Of the four countries, relative to consumers in Germany, the U.K., and the U.S, French consumers showed WTP greater amounts for beef that came from cattle with no growth hormones or GM feed. The premium amount that U.S. consumers were WTP for beef with no added growth hormones was about $8.21/lb, while the upper 95% confidence interval reported was $9.71/lb. By far the lowest WTP among all the four countries surveyed, U.S. consumers were only willing-to-pay a premium of about $3.31/lb for cattle that had not been fed GM corn.

In a related study, Li, McCluskey, and Wahl (2004) analyzed factors that affected the willingness to pay for genetically modified (GM) corn-fed beef by consumers in Spokane, Washington. By collecting data through in-person "convenience" surveys, they investigated whether or not information had a significant impact on the consumers' WTP. A contingent valuation survey was used to determine WTP, as well as elicit information regarding participants' attitudes about environmental and food safety, their

[6] Modest amount of marbling equates to the USDA quality grade Choice. Likewise, slight marbling is graded as Select.

[7] WTP estimates were in US dollars per pound. The authors suggest that the premiums appear large until the magnitude of current retail premiums for such products in the United States is considered. As a basis of comparison, observed prices for beef ribeye steaks labeled "natural" or "hormone-free" from three different retail grocery stores in the Kansas City area on 1 April 2000 were recorded as $24.95/lb, $11.99/lb, and $9.99/lb.

attitudes and knowledge about biotechnology, their beef-consumption habits, and other factors influencing their purchase decisions.

The sample was spit into equal groups to check the effect information had on the participants' responses. Prior to being asked about their preferences towards GM-corn-fed beef products, one-half of the sample was given a paragraph that contained scientific information about GM-corn-fed beef. The contingent valuation questions first asked consumers if they were WTP the same price for GM-fed beef as they would for the non-GM-fed beef. A response of "no" required a follow-up question regarding the consumers' willingness to accept a percentage discount on the GM-fed beef relative to the non-GM-fed-beef. The discount was set to the following levels: 10 percent, 20 percent, 25 percent, 50 percent, or 100 percent, and was randomly assigned to the respondents' version of the survey. Similarly, if the initial question yielded a response of "yes" then the follow-up question asked concerned the additional amount (or premium) that the respondent would be WTP. Again, the potential levels that a respondent could be assigned were 5 percent, 10 percent, 20 percent, 25 percent, or 50 percent.

A double-bounded logit model was used to examine the outcomes of the survey. The four possible outcomes were: 1) the respondent was not willing to purchase the GM product at the same price as the non-GM product, or willing to purchase the GM product at a discount relative to the non-GM product; 2) the respondent was unwilling to purchase the GM product at the same price as the non-GM product, but was willing to accept the product at the random discount offered; 3) the respondent was willing to purchase the product for the same price as the non-GM product, but not WTP a premium; and 4)the respondent was not only willing to purchase the GM product at the same price as the non-GM product, but was also WTP a premium at the random premium amount offered.

Results from the estimated model show that the information variable, positive opinions regarding biotechnology, and low-risk perceptions associated with GM-corn-fed beef increased the consumers' WTP significantly. When the mean WTP was calculated across both information treatments, the authors found that on average consumers would require a discount amount of 8 percent for the GM-product to be chosen over the non-GM product. When viewing the results by information treatment groups, it was

found that consumers that were provided the scientific and benefit information were WTP a small premium of 6 percent. However, the group of consumers who were not provided any information required a discount of 23 percent before they would purchase the GM-beef product. The authors concluded that GM-labeled products would more than likely require a discount before consumers would purchase the product. However, if scientific and benefit information is provided to consumers, GM-corn-fed beef would be more acceptable to consumers.

Hedonic Price Analysis

The exact origin of hedonic analysis[8] is not known. However, one of the earliest hedonic-type analyses reported is Fred Waugh's (1928) analysis of quality factors influencing asparagus, tomato, and hot-house cucumber pricing. Some (Goodman, 1998) have attributed Andrew Court with the pioneering of hedonic price analysis. In Court's 1939 article, he valued the demand for automobiles based on their specific characteristics (weight, wheelbase, and horsepower). Despite Court's work in 1939, Zvi Griliches is often accredited with the popularization of hedonic price analysis with his research that used hedonic valuation techniques for fertilizer demand (Griliches, 1958) and automobiles (Griliches,1961). Then in 1974, Sherwin Rosen's seminal piece, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition" provided a formal theory of modern hedonic analysis. (Rosen, 1974)

The hedonic price analysis method can be used to value the marginal prices of a variety of differentiated commodities. Environmental amenities, which have no explicit market, have also used the hedonic method by relating the amenity (such as parkland or pollution-free air) in question to property value (McMillan et al., 1980). Numerous studies have utilized the hedonic price analysis method to value the attributes of agricultural products, such as quality attributes of tomatoes, beef cattle evaluation with ultrasound technology, low-fat ground beef, prawn and shrimp attributes, and tuna (Jordan et al., 1985; Rimal, Perkins, and Paschal, 2003; Brester et al., 1993; Salayo, Voon, and Selvanathan, 1999; McConnell and Strand, 2000).

[8] The underlying theory behind the hedonic price analysis is explained in .

Boland and Schroeder (2002) used hedonic price analysis to determine the marginal value that consumers place on quality attributes of natural and organic beef produced with organic grains. About 630 beef cattle marketed by a producer-owned cooperative from May 1996 to December 1999 supplied the data for this research. The authors examined the impact on the prices and carcass revenue of eleven beef cuts (Rib Eye, Brisket, Mock Tender, Tenderloin, Strip, Top Butt, Inside Round, Gooseneck, Knuckle, Shoulder Glod, and Flank Steak) of variables that were provided by both producers and processors. Through those eleven cuts, the quantity of wholesale beef produced from each carcass, was determined.

The conceptual model used in the analysis was based on the theory of processor demand, where profit is maximized (contrast with consumer demand which maximizes utility). The first equation, set forth by Boland and Schroeder (2002), equated the observed wholesale price of beef to the summed product of the marginal value and marginal yield of a given attribute of an input that is used in the production of beef. The authors estimated the marginal implicit value of each attribute for each of the eleven primal cuts with the use of seemingly unrelated regression. Since value-based marketing programs for cattle are based on total carcass revenue which is adjusted for various quality targets, a second equation was needed to account for multiple outputs (Boland and Schroeder, 2002). The second equation then used those wholesale prices and multiplied them by their respective weight (measured in pounds) to calculate the producer's total carcass revenue. OLS was used to regress carcass revenue on each attribute, as well as an additional variable which represented the USDA choice boxed beef price.

Results from the system of equations showed that although wholesale prices for some primal cuts were significantly affected by variables that producers have control over (type of feed, Age, Gender), their economic significance was small compared to the variables that processors had some control over (Number of Days Aged and Choice Price). Primal cuts that had increased prices from using corn (in comparison to using milo) in the finishing ration were that of Rib Eye, Top Butt, Shoulder Clod, and Flank Steak. However, using corn decreased prices for Tenderloin and Gooseneck. Using mostly hay in the finishing ration increased prices for the following primal cuts: Brisket, Top Butt, and Inside Round.

Relative to milo, hay usage decreased prices for Gooseneck, Strip, and Knuckle prices. Also, not all of the eleven cuts of meat experienced an increase in price when they were produced and labeled as organic; Rib Eye, Gooseneck, and Knuckle increased when labeled as organically produced, but Top Butt and Inside Round decreased.

When analyzing the entire carcass price the producer received, the variables used in the equation explained about 0.83 of variability in the total carcass revenue. The significant variables were Days Fed Grain, Gender, Carcass Weight, and USDA Boxed Beef. When compared to heifers, steers increased carcass revenue by a $1 per pound increase in the USDA Boxed Beef Price. Boland and Schroeder (2002) found that producers who are a part of the natural marketing alliance should shift their focus from the high quality animals to the high yielding animals. Furthermore, the authors concluded that consumers who purchase natural beef mainly value tenderness (measured by aging) and leanness (measured by USDA Select grade).

Hedonic price analysis is also useful for determining the market effects of producers and processors introducing novel products. While most consumers prefer the taste of beef that contains some fat for added palatability, some consumers are concerned about the dietary intakes of fat. Low-fat ground beef is a very lean beef product that uses flavor-enhancing ingredients (e.g., carrageenan, oat bran, salt) as a substitute for fat (Brester et al., 1993). In an effort to quantify and analyze the effects on producers, meat processors, and consumers, Brester et al. (1993) used the hedonic method to model the consequences related to the introduction of a new consumer product: low-fat ground beef.

At the time of the research, the retail data necessary to estimate consumer demand for low-fat ground beef was unavailable; therefore, proxies for the retail price, monthly wholesale prices of boneless fresh beef with various levels of leanness (75%, 85%, and 90%), were used to account for the *LEAN* variable in the hedonic model. A second variable used in the model was *DINC*, which represented quarterly personal consumption expenditure data that was gathered and interpolated in SAS® to obtain monthly estimates. Both of the aforementioned variables were used to explain the change in the deflated price of ground beef products over a certain period of time, or *DPRICEG*. The results from the OLS

regression of the hedonic model are as follows: the resulting coefficient of determination was 0.84, and the parameter estimates for the variables *LEAN* and *DINC* were 2.06 and .28 respectively. Thus, a one unit increase in the leanness of the ground beef product resulted in a price premium of $0.0206/lb.

To assess consumer's willingness to pay for fresh meat products carrying the PGI (Protected Geographical Identification) "Galician Veal" label, Loureiro and McCluskey (2000) employed the hedonic price model as the theoretical framework. Since the hedonic model helps reveal the intrinsic value of food product attributes, this method may properly be used to obtain the implicit value of PGI labeling. The authors hypothesized that consumers may relate the quality of the product to the geographic production area, in turn affecting whether or not a premium is received.

Fresh meats with the Galician Veal label from Spain are produced in the traditional way. The animals are fed traditional feeds, such as grass, maize, potatoes, turnips, and regulated compound feeds. The quality and sanitary control is very high for this Spanish product. Furthermore, animals carrying the Galician Veal label have not been treated with growth hormones or fed compound feeds from other animals. The data set used in this study contained 962 observations that were gathered from 157 families who for five weeks (March 31 to June 1, 1997) reported their consumption and attitudes regarding meat.

The information collected from the survey can be categorized as consumer behavior (type of meat purchased, price, quantity, etc.), intrinsic quality cues of the meat (amount of fat, freshness, color, PGI label, etc.), consumer's perception information (which were represented by their perceptions at the point of purchase), and sociodemographic characteristics. The variables used in the empirical analysis to explain the changes in price were: *QUALITY* and *LABEL*, which represented the intrinsic and extrinsic effects of the perception of quality; the location variable, *SUPERMARKET*; whether or not the product was on sale (*SALE*); variables representing specific cuts, *SIRLOIN, EXPENSTEAK, OTHERHIGH, RIBS,,* and *STEW*; lastly, the level of fat (*FAT*) and color (*COLOR*). A second equation was needed to account for any interaction effects that may be associated with the label and different cuts. The authors hypothesized that the premium garnered from the label would depend on the product category. Therefore, the four interaction variables included in equation two were: *LABEL* x *EXPENSTEAK*; *LABEL* x

OTHERHIGH; *LABEL* x *RIBS*; and *LABEL* x *STEW*. After using a Box-Cox maximum likelihood analysis for function form, the linear functional form was chosen for the hedonic price model.

About 64% of the variation in price was explained by the model, hence the R^2 of 0.64. Results from the first model (without interaction terms) showed that all of the explanatory variables were significant at the 0.05 level, with the exception of color and fat. When the PGI label was present, fresh beef received a premium of about 32 pesetas per kilo (in dollar terms, about \$0.46/lb[9]). Loureiro and McCLuskey (2000) also found that while the variables representing consumer perception (*QUALITY*) and quality signaling variables (*SUPERMARKET* and *LABEL*) were significant, the standard intrinsic quality cue variables (*FAT* and *COLOR*) were not statistically significant. Compared to meat that had been purchased from the butchers, meat purchased from the supermarket influenced price negatively.

Similar results were found when the second model was estimated using OLS. Estimated parameters for the variables that were also included in the first equation, and their level of significance, were comparable to the previous estimation. When analyzing the results from the interaction terms, the inference may be drawn that including a PGI label played only a limited role in meat prices. Neither quality extremes, sirloin or stew meats, were significantly affected by the label. Nonetheless, the PGI label did play a role in determining the price of expensive steaks, other quality meats, and ribs. The authors state that a possible explanation could be that the quality or reputation of the higher-end steak may stand alone; therefore, the addition of a PGI label will not garner any additional premiums. Consumers who buy lesser quality meats that typically play a limited role in prepared dishes and recipes, such as stew meat, may not be interested in quality at all.

Beef cattle and products derived thereof are not the only meat products that have been analyzed through the use of the hedonic price model. Melton, Huffman, and Shogren (1996) evaluated the economic values of pork attributes through a hedonic price analysis of experimental auction data. Unlike traditional approaches, these researchers also studied the effects of socioeconomic variables on the

[9] At the time of the study, one dollar equaled approximately 150 Spanish pesetas. Thus, in dollar terms, the study found a premium of 0.21/kg. As 1kg equals approximately 2.2 pounds, this premium equals 0.46/lb.

attribute's economic value. Traditionally, secondary data is used in hedonic price applications and consequently, sociodemographic data is difficult to obtain. On the other hand, experimental economics provides an alternative since the method allows for information to be collected on consumers who participate in the auction markets. This socio-demographic information allows for the exploration of the relationship between certain socio-demographic variables and a consumer's utility derived from pork attributes and their corresponding WTP.

Consumers that participated in the study were asked to evaluate and bid on eight different pork chops. The information presented to consumers participating in the experiment auction varied between three different formats: 1) evaluations based on photographs of the chops; 2) evaluations of fresh chops under conditions comparable to a supermarket purchase; and 3) evaluations of fresh chops after tasting comparably prepared chops from adjacent ribs. As a point of informational reference, to reflect the potential availability of "meat" alternatives in consumers' purchase decisions, a USDA Choice T-bone steak and bone-in chicken breast were added to the trial. Characteristics of the pork chops that were evaluated by consumers were: color, marbling, and size.

After exploring linear and log-linear variations of functional forms, the author's chose to specify the empirical hedonic fresh pork price equation as a semi-log function. The hedonic price functions explained about 50 percent of the variance observed in the experimental auction market prices obtained after consumers viewed photographs or tasted the products, but only about 25 percent of the price variance after viewing the fresh chops. The authors of the study found that the marginal value of marbling based on visual evaluations was negative, but they were positive after the participants tasted the chop. When evaluating the photographs, relative to the darker and smaller chops, consumers valued the lighter color and larger size chops. Lighter color and larger size had a negative marginal value after seeing fresh chops or tasting the chops.

Melton, Huffman, and Shogren. (1996) extended traditional hedonic price analysis approaches by including sociodemographic variables into the original empirical model. The socioeconomic characteristics that were added to the equation to explain individual bid prices for pork chops included

continuous variables reflecting differences in household income level, consumer age, and education. Discrete variables, such as experimental replications, sex, or household type, were also added to the modified hedonic price equation. The hedonic model that included socioeconomic variables explained about 40 to 50 percent of the variance for each presentation format. The authors rejected the initial null hypothesis that all socioeconomic variables have a zero effect on individual bid prices after viewing the F-values of 7.3, 10.3, and 5.4 for the three consumer presentation formats of photographs, product appearance, and tasting, respectively.

Results from the extended model showed that women, shoppers with children in the household, and members of multi-income households, tend to bid less for a pork chop regardless of the presentation format. Finally, the authors also found that bid prices fell as the consumer's age and household size increases, but increased slightly or remained unchanged as the consumer's education level increased. As the authors suggest, these results imply that consumer's WTP for pork chops, which usually require significant preparation time, may be negatively affected by the opportunity cost of the consumer's time at home.

Summary

Overall, studies reviewed reveal instances where consumers have shown a positive WTP for food products that share similar attributes to grass-fed beef products. Specifically, past research reveals that niche markets exist for meat products that are safer, have not been administered growth hormones, are labeled with information about the product, produced locally, and are derived from "sustainable" production practices (organic and natural).

Consumers continue to demand quality meat products as well. Tenderness has been shown to largely influence the amount that consumers are WTP, as have the process in which beef is aged and flavor of beef. Interestingly, Cox et al. (2006) found that in the retail setting, consumers preferred grain-fed beef. However, when consumers were able to prepare the beef product to their tastes and preferences, both the grain-fed steak and grass-fed steak were valued similarly. This is important to producers who are

concerned with consumer acceptance of grass-fed beef products that have often been referred to as "gamey" in flavor.

While most of the studies employed a variation of a binary choice model to determine WTP and the factors affecting WTP, there have been a considerable number of studies using hedonic price analysis. Studies valuing similar products have been successful in applying hedonic price analysis to determine the implicit value of meat attributes. One finding of particular importance to this study is that consumers value certain attributes differently depending upon the format in which the product is presented (Melton, Huffman, and Shogren, 1996). To this author's knowledge, there have been no hedonic methods applied to grass-fed beef. Therefore, the research reviewed in this chapter serves as a guide to the methods and procedures applied in this study.

CHAPTER THREE

CONCEPTUAL FRAMEWORK

Determining the value of a hypothetical, or nonmarket, good is a well-known challenge for economists involved in either the introduction of a new product or evaluating environmental amenities. Much of the underlying concepts and ideas of neoclassical economic theory serve as a framework and foundation for which these nonmarket valuation methods are based. This chapter first outlines several essential, economic theories connected to consumers' demand and WTP for novel goods. Discussions of the underlying constructs of experimental auctions follow, and then a formal discussion of the methods underlying the hedonic method is presented. Lastly, the theoretical underpinnings of the multinomial logit model are discussed.

Demand

While demand is contingent upon a consumer's willingness and ability to purchase different quantities of goods and services at different prices during a specific time period (Wetzstein, 2005), it is important to know the relationship between price and quantity of a good. A change in demand refers to a shift in the demand curve. The factors causing demand to shift are: 1) changes in a person's income, 2) consumers preferences, and 3) prices of related goods. Quantity demanded, on the other hand, refers to the number of units of a good that consumers are willing and can afford to buy at a given price. The difference in a change in demand and a change in quantity demanded is that a change in demand is a *shift* in the demand curve while the change in quantity demanded is a movement *along* a given demand curve. The Law of Demand depicts the relationship between price and quantity demanded as being an inverse relationship. Graphically, the relationship between prices and quantities demanded for a product can be illustrated though the use of demand curves. Since the connection between quantity demanded and price

varies inversely the demand curve will have negative slope when graphed. However, while demand functions do represent the quantity demanded at a certain price, they also serve as marginal value curves because goods will only be consumed to the point where marginal benefits equate to marginal costs (Champ, Boyle, and Brown, 2003).

Demand functions can be modeled by using an equation similar to that of the equation of a straight line:

$$Q(P) = a - bP \qquad \text{Equation 3.1}$$

where quantity is a function of price as well as the dependant variable. In this equation, a is the x-intercept term or quantity intercept where the price of the commodity equals zero, b is the slope, or the change in quantity given a change in P, and P is the price of the good in question. As shown from the negative value of b, as long as the Law of Demand holds, quantity and price will always move inversely of one another.

The inverse demand curve will need to be considered, in order to determine a consumer's willingness to pay for a commodity. In this case, rather than quantity being dependent upon price, price will become dependent upon quantity, thus lending the following equation:

$$P(Q) = a - b(q) \qquad \text{Equation 3.2}$$

however, the remaining variables in the equation do not change, but instead continue to represent the same values as with the direct demand function from Equation 3.1.

Willingness to Pay and Consumer Surplus

Agribusinesses are progressively more concerned with meeting consumer demand by producing differentiated products. However, many of these products have no estimated market value by which they can determine. Therefore, gauging consumer demand for these novel goods before adoption of the product is paramount to success (Lusk and Hudson, 2004). Consumer demand for a good or service can be thought of in terms of their WTP for the product. Lusk and Hudson (2004) state that the conventional definition of WTP is simply a Hicksian surplus measure. Another plausible definition of willingness to

pay is the amount someone is willing to take away from their income in order to gain a good or service, all while keeping utility constant.

From the above definition, the usefulness in deriving the associated consumer surplus for a product to achieve a willingness to pay value is apparent. Perhaps the most straightforward definition of consumer surplus is the excess amount of what one paid (market price) in comparison to the maximum amount they were willing to pay (reservation price) for a particular good or service. Thus, graphically, consumer surplus can be represented as the area under the demand curve and above price. Refer to Figure 3.1 to see a graphical illustration.

From Figure 3.1, the area that is under the demand curve and above the market price is denoted as C and is the amount of consumer surplus received. Using the inverse demand and consumer surplus, economists can create a way to cumulate consumers' valuations of the bundles of goods they consume. Aggregated individual consumer surpluses will yield the same amount as it would if one were to obtain consumer surplus via the market demand curve.

Calculating consumer surplus aids in valuing a consumer's WTP for a product. An estimated value can be placed on the utility that is received from a good or service if the change in consumer surplus is determined. Hanemann (1991) asserts that WTP can be expressed in many equivalent manners, such as quality, aside from only changes in price and quantity as typically measured. For example, agribusinesses that are attempting to provide differentiated goods are providing goods that supply consumers with a change in quality. This change in quality can be measured through the use of one of the two Hicksian welfare measures, the compensating welfare measures or the equivalent welfare measure. The difference in the two measures is the difference in the assignment of property rights (Champ, Boyle, and Brown, 2003). Assuming old prices and consumption levels, equivalent welfare measures determine the amount of income required, to place the consumer at the same level of utility as after the change in the new price set and consumption level. Consumer surplus can be measured using the equivalent surplus measure. The equivalent surplus measure is formally defined as the amount of money, paid or received, which places an individual at his or her subsequent utility, if the imposed change does not occur and optimizing

adjustments are not allowed. However, since this study assumes the consumer is assigned the initial level of utility as the basis of comparison, the equivalent surplus measure will not be studied comprehensively.

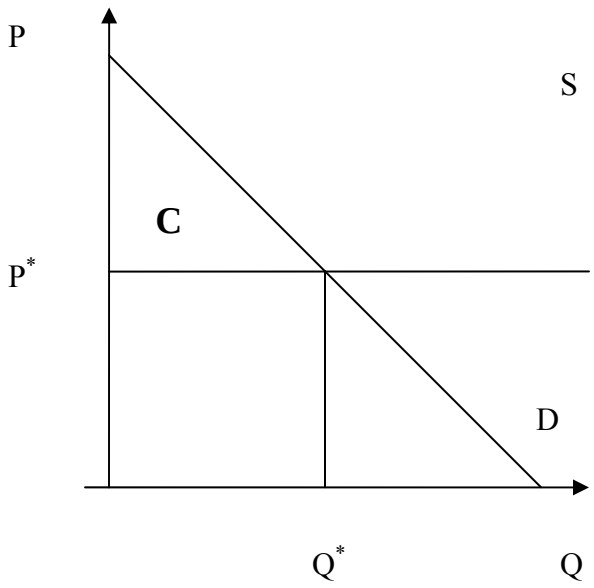

Figure 3.1 Illustration of Consumer Surplus

Compensating welfare measures determine the exact amount of income a consumer would give up in order to reach a desired level of utility, either in the case of the introduction of new product, or the implementation of a policy. Assuming that the consumer has rights to the initial level of quality, they can exchange a portion of their income (WTP measure) for the high quality good, while keeping the consumer at the initial level of utility. The compensating welfare measure in this case can be referred to as compensating surplus and can be expressed by the indirect utility function:

$$V(P^o, Q^o, M^o) = V(P^o, Q^1, M^o - CS) \qquad \text{Equation 3.3}$$

where, P^o is the initial price of the good or service

M^o is the initial income for the individual

Q^o is without the value-added product

Q^1 is with the value-added product

CS is the compensating surplus.

This equation implies that the individual is indifferent between having either a higher level of quality and lower income, or that they are indifferent between an initial (lower) level of quality and initial (higher) income.

The dual of this problem is to use the expenditure function to analyze specific changes in consumer surplus. By using the expenditure function in place of the indirect utility function, the exact amount of income that is needed to keep a consumer at his or her utility level can be found. For an imposed quality increase, CS is an income decrement and WTP can be measured in terms of the expenditure function by the following equation:

$$WTP = CS = | E (P^o, Q^1, U^o) = M^o| – | E (P^o, Q^o, U^o) = M^1| \quad \text{Equation 3.4}$$

$$= |M^1 - M^o|, \text{ where } M^o > M^1 \text{ and } Q^1 > Q^o$$

While Hicksian welfare measures are preferred, such measurements are not directly observable since utility is not directly observable. Therefore, measuring consumer surplus using the Marshallian demand function to obtain an approximate value of a product is useful. Recall that utility maximization requires maximizing the utility function subject to a budget constraint. However, it is unreasonable to assume that the rational consumer will spend the entirety of their income on only one commodity; therefore, for the purposes of this discussion, utility will be a function of two commodities: good A and good B.

$$\text{Max } U(Q_A, Q_B) = f(Q_A,Q_B) \quad \text{s.t. } M^o = (P_A \times Q_A) + (P_B \times Q_B) \quad \text{Equation 3.5}$$

where Q_A is the quantity of good A, Q_B is the quantity of all other goods, and M is income. Q_A and Q_B are functions of price and income described as

$$Q^A = f(P^o_A, M^o)$$

$$Q^B = f(P^o_B, M^o)$$

Once the utility is maximized, Marshallian demand functions are obtained. Through the use of these demand functions, the WTP, or change in consumer surplus is determined. Goods A and B are treated as substitutes; if the quantity of good A increases, a decrease in good B will follow. Refer to Figure 3.2 on the next page to see a graphic representation.

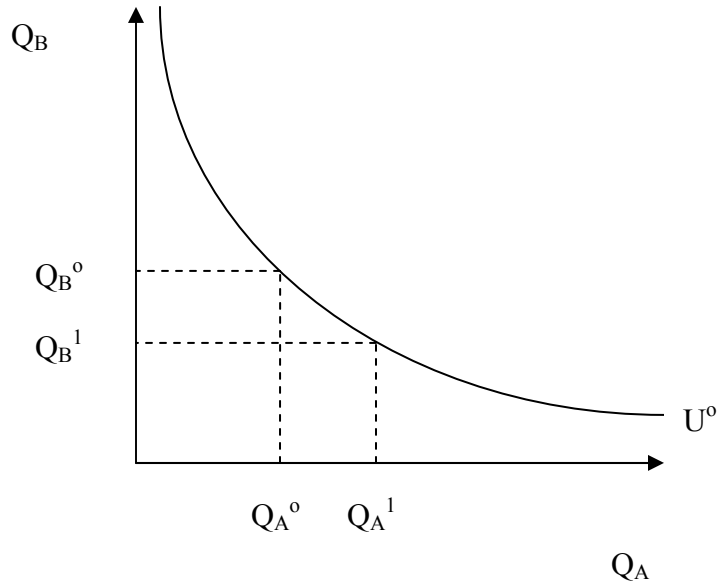

Figure 3.2 Illustration of Utility Maximization for WTP

Experimental Auctions as a Valuation Method of WTP

While most economists would prefer to use market-observable data to determine demand for a particular good or service, when valuing a hypothetical good there is no market data available. Therefore, methods have been created to elicit consumer demand for a potential product by discovering how much consumers may be willing to pay for said good or service. Although the most widely used method of nonmarket valuation is contingent valuation, it is most commonly performed to value recreational activities and environmental factors. Contingent valuation methods use surveys or direct interviews to elicit values placed on goods and services when revealed preferences methods are not applicable or there is no established market for the good or service in question. Because of the hypothetical nature of this

method, some are skeptical and even critical of the results gathered from studies using contingent valuation. Studies using experimental auctions to elicit consumer WTP for product attributes have gained popularity in recent years (Lusk et al., 2001; Umberger et al., 2002; Hoffman et al., 1993; Melton et al., 1996; Hayes et al., 1995). Many researchers choose to use a non-hypothetical method because they reflect a more accurate measure of WTP in comparison to a hypothetical method (Lusk, Feldkamp and Schroeder, 2004).

Umberger and Fuez (2004) found that experimental auctions were effective in measuring a consumer's willingness to pay for quality differences and this method successfully quantified the true value differences assigned by consumers for the sampled commodities. There are four key advantages to using experimental market procedures as determined by Fox et al. (1995): 1) the design of the auction bidding allows participants to reveal preferences truthfully; 2) reliability is ensured with the use of real food, real money, and repeated bidding participation; 3) the non-hypothetical aspect is reinforced with the requirement-to-eat factor; and 4) non-response bias is decreased.

Laboratory experimental economic techniques require that the participants place bids for specific products and the winners of the auction are required to purchase the product at a price determined by the rules of the auction. This bidding process elicits the willingness to pay. Many different auction mechanisms exist to choose from when designing a study involving experimental auctions. When choosing the appropriate mechanism, one must assess whether or not it will be incentive compatible (Lusk, Feldkamp, and Schroeder, 2004). An auction is incentive capable if the dominate strategy for bidders is to bid their true value, also known as the reservation price. Common methods include: the Vickrey auction, or second price auction; the Becker-DeGroot-Marschak procedure (BDM); English auction; and the random n^{th} price auction.

The Vickery auction, or second-price auction, is widely used in laboratory valuation experiments. In general, participants in second-price auctions submit written bids on a specific product. Once the bids are ranked from highest to lowest, the highest bid is deemed the "winner" of the auction, but must purchase the product at the second-highest price. The random n^{th} price auction is similar to both the

Vickrey auction method and the BDM method in the sense that it has an endogenous market-clearing price and it also incorporates randomness when deciding what price the monitor will select to determine the winner(s) Shrogren et al. (2001). The procedures of the random n^{th} price auction are similar to the aforementioned description of how auctions work, however, the monitor randomly selects a number (n) that has a uniform chance of being either a second, third, fourth, etc., price auction is uniformly-distributed between 2 and k (where k is how many bidders there are in each round). Once that number is selected, the monitor sells one unit of the good to each of the (n-1) bidders at the n^{th} price. For example, if three is randomly selected by the monitor, the two highest bidders each purchase one unit priced at the third-highest bid. If there are multiple rounds and multiple goods being auctioned, the monitor can randomly select which round and good will be "binding". Using a binding auction should assure that valuations were not affected by demand reductions, assuming that each participant's expected utility is linear in probabilities (Lusk, Feldkamp, and Schroeder, 2004).

This study utilizes a random n^{th} price auction since there is a need to value the difference in quality attributes of a familiar market good: beef. Because the objective is to accurately estimate the true WTP for each participant, an experimental auction is the most appropriated method to employ. Auctions can be evaluated using the utility maximization theory. Following the explanation in Shogren et al. (2001), assume that each of the k bidders know their individual private value, v_k, for the good being auctioned, which can also be thought of as the maximum amount the bidder is willing to pay for the good. For the nth price to be selected, the integer, $n = \{2, 3, \ldots.k\}$, is randomly selected by the monitor. The bidders will each submit their sealed bids, represented by b_k, and receive u_k as a payoff (or surplus). The n^{th} highest bid will be indicated by β. Bidder k will receive v_k and pay the amount of β if $b_k > \beta$. However if $b_k < \beta$ then the bidder will receive 0. The payoff can be seen in Equation 3.6.

$$u_k = \begin{cases} v_k - \beta & \text{if } b_k > \beta \\ 0 & \text{if } b_k < \beta \end{cases}$$ Equation 3.6

If each bidder were to bid their private value, $b_{k=}v_{k,}$ then they would be exhibiting their dominant strategy. Bidders who bid less than this value will diminish their chance of winning, whereas, bidders who bid more than this value increase the chances of winning the auction at a price higher than their private value. The result should be Pareto-optimal if the bidder who places the highest private value on the good is the winner of the auction.

The goal of the random n^{th} price auction is to measure the participant's willingness to pay. Once these values are established, they will be sorted in descending order and plotted against a linear time trend to determine the inverse demand curve. These calculations can be done only if it is assumed that there will be one unit purchased per person per auction round (Lusk and Hudson, 2004).

Hedonic Price Analysis

The hedonic method is a revealed preference approach which assumes that values are inferred from individual or household choices (Champ, Boyle, and Brown, 2003). The conceptual framework behind the hedonic method can be traced to Kevin Lancaster (1966) who developed an alternative to the neoclassical theory of demand. The neoclassical demand model assumes that goods are direct objects of utility rather than considering the properties or characteristics of the goods that derived utility (Lancaster, 1966). However, Lancaster (1966) asserts that it is the properties or characteristics of the goods from which utility is derived.

Lancaster's alternative consumer theory has been used as the foundation for several agricultural studies with the goal of evaluating the implicit values of the product's characteristics or attributes (Ladd and Suvannunt, 1976; Jordan et al., 1985; McConnell and Strand, 2000; McMillan, Reid, and Gillen,

1980). With Lancaster's approach to consumer demand in mind, Ladd and Suvannunt (1976) maintain that the total amount of utility a consumer enjoys from the purchase of a product is dependent upon the total amounts of product characteristics purchased. This idea that commodities are valued by their attributes, or better said, the total price of a product is simply the summation of the marginal monetary values belonging to that product's distinct characteristics lays the foundation for the hedonic price analysis (Ladd and Suvannunt, 1976).

One of the most basic assumptions of the hedonic model is that products can be differentiated by their attributes. Therefore, by observing the choices consumers make over heterogeneous commodities with varying prices, the implicit value of one of the component characteristics of the commodity can be estimated. Under certain conditions, the implicit prices observed are actually equal to a consumer's WTP (Champ, Boyle, and Brown, 2003).

In his seminal article, Rosen (1974) sketches a model of product differentiation based on the hedonic hypothesis that goods are valued for their utility-bearing attributes of characteristics (Rosen, 1974). Furthermore, Rosen's work established the connections between consumers' preferences for characteristics of heterogeneous good and the equilibrium price function (Champ, Boyle, and Brown, 2003). For instance, consider some class of goods, Y, which is composed of *n* objectively measured attributes. This class of goods, Y, can be represented by a vector of attributes, $Q = (q_1, \ldots, q_n)$. Furthermore, any particular Y, y_i, can be described as a function of its attributes: $y_i = y_i(q_{i1}, \ldots q_{ij}, \ldots, q_{in})$, where q_{ij} is the amount of the *j*th attribute of good y_i. Since the price of the good will depend upon the level of characteristics of which it is composed, information on prices and characteristics of the good in question can be used in regression analysis to estimate the price function. This price function, or hedonic function, can be represented by the following equation:

$$P_y = P_y(q_{i1}, \ldots q_{ij}, \ldots, q_{in}) \qquad \text{Equation 3.7}$$

The hedonic method can be applied to the focus of this research, beef, since beef products are becoming increasingly differentiated. In the case of beef, and following Rosen's hedonic price function, the price of the beef product can expressed as:

$$P_{bi} = P_b(Z_{i1}, Z_{i2}, \ldots, Z_{in}) \quad \text{Equation 3.8}$$

where P_{bi} is the selling price of the beef product i and $Z_{i1}, Z_{i2}, \ldots, Z_{in}$ are attributes of product i that contribute to final price of the beef product.

An assumption important to hedonic price analysis is that an individual consumer's utility function will be a function of their consumption of several commodities that are made up of several characteristics. Utility can be defined as the amount of satisfaction a consumer receives when they consume different bundles of goods or services. A consumer's utility is only limited to the amount of income that is available to purchase the preferred commodities, or a budget constraint. Therefore, the utility function which can be written as:

$$U = U(Z, X) \quad \text{Equation 3.9}$$

where the price of X is equal to1, and $Z=Z_1, Z_2,\ldots,Z_n$. By choosing the model of the differentiated product, Z, and the amount of X to purchase, the consumer maximizes his/her utility, subject to a budget constraint,

$$M = X + P_{bi}(Z) \quad \text{Equation 3.10}$$

Maximization of the consumer's utility function yields the first order conditions, which require that

$$\frac{(\partial U / \partial Z_i)}{(\partial U / \partial X)} = \frac{\partial P(Z)}{\partial Z_i} \quad \text{Equation 3.11}$$

Equation 3.11 simply signifies that the marginal rate of substitution between any characteristic, Z_i, and the composite numeraire commodity, X, is equal to the rate at which the consumer can trade Z_i for X in the market (Champ, Boyle, and Brown, 2003). Thus, the hedonic price of the beef attribute i is simply the derivative of

$$\frac{\partial P(Z)}{\partial Z_i}$$

The amount the consumer is willing to pay for the beef product with the attributes Z, while considering the budget constraint and utility level, can be described by the bid function, θ. The bid function can be formally defined as:

$U = \mathrm{U}(Z, M - \theta)$ Equation 3.12

If utility is maximized in equation 3.12, the result will be that the marginal bid that the consumer is willing to make for Z_i is equal to the marginal rate of substitution between attribute Z_i and X (Champ, Boyle, and Brown, 2003). Logically, it follows that the implicit price of the characteristic *i* must equal the consumer's marginal willingness to pay for that characteristic. This maximization of the consumer's utility function for a given budget constraint and attribute level is what is referred to as the "first-stage" of the hedonic price analysis.

Multinomial Logit Model

At the very base of the multinomial logit model is the theory of the random utility model. As put forth by Umberger et al. (2002), this theory assumes an *i*th consumer has preferences defined over a set of *J* alternatives. The amount of utility received by the *i*th consumer for the choice of *j* will be:

$$U_{ij} = \beta'_{ij}\ x_{ij} + \varepsilon_{ij}$$ Equation 3.13

where x_{ij} is a row vector of independent variables, which include both individual characteristics as well as those of the choices; β_{ij} is a vector comprised of estimated coefficients; and the disturbance term, ε_{ij} is assumed to be independently and identically distributed with extreme value distribution. The choice made by the consumer among the *J* alternatives maximizes their utility, which produces the following statistical model:

Prob ($U_{ij} > U_{ik}$) $\forall$ j…k. Equation 3.14.

which in turn produces the choice probabilities:

$$\Pr ob\left[Y_i = choice_j\right] = \frac{e^{\beta_j' x_{ji}}}{\sum_{j=0}^{J} e^{\beta_j' x_{ji}}}, j = 0,...,J. \qquad \text{Equation 3.15}$$

where Yi is the choice made by the *i*th individual and is equal to 0,…,J. The specific characteristics of the individual and the corresponding estimated coefficients are represented on the right hand side of Equation 3.15.

Summary

Each method of estimating WTP discussed in this chapter is founded upon utility maximization, and based on the assumptions that consumers behave rationally and that they attempt to maximize utility given a specified budget constraint. In this chapter, it was determined that there are a number of measures in which WTP can be measured: using the inverse demand curve; deriving the compensating welfare measurers (or the Hicksian compensating welfare measure); or determining the Marshallian consumer surplus. Understanding the underlying theory behind measuring willingness to pay is paramount to this study.

Experimental auctions, which can be evaluated using the utility maximization theory, can be used to elicit consumer demand for a product. The amount that consumers bid on a product during the auction can be viewed as their WTP. However this study is not only concerned with consumers WTP for a grass-fed beef product, but also the value that they place the attributes of grass-fed beef. The hedonic price analysis was discussed since it is based on the premise that the total amount of utility a consumer enjoys from a product is actually the summation of the marginal monetary values that belong to that product's distinct attributes. Furthermore, after derivations, it was found that the implicit price of a certain characteristic must equal the consumer's marginal WTP for that characteristic. The multinomial logit model, which is founded on the theory of random utility, will be useful in determining the factors that increase the probability of respondent's paying a premium amount of various levels.

CHAPTER FOUR

PROCEDURES FOR DATA COLLECTION AND RESULTS

The purpose of this chapter is to explain the methods used to collect data on consumers' willingness-to-pay for a quality differentiated beef product and to describe the data gathered for the study. First is a discussion of the consumer survey procedures used in this study. Then, the experimental auction procedures used to collect WTP data employed in this study and the results are discussed. A description of the attitudinal and demographic variables, as well as the demographic make-up of participants from this study, is evaluated. Consumer acceptance of the grass-fed beef steak is analyzed, as are the bid amounts and premiums obtained from the study. Finally, a brief discussion of correlated variables is presented.

Survey Procedures and Data Description

The main interest in this study is to determine consumer WTP for grass-fed beef, as well as learning the value consumers place on various attributes—such as experience, search, and credence attributes[10]. This research is a subset of a larger grant-funded project provided by the USDA-Agricultural Marketing Service (AMS), Federal State Marketing Improvement Program (FSMID) that seeks to provide consumer preference information for an alternatively produced beef product, grass-fed beef, to those cattle producers in the Southeastern United States interested in alternative beef production systems. Participants were recruited from two Southeastern locations, Athens, GA and Clemson, SC in December 2005 and March 2006. However, only one location, Clemson, employed recruitment measures to assure a

[10] Products can be distinguished by the various search, experience, and credence attributes they may possess. Consumers can use search attributes that can be examined before purchasing products, which are characteristics such as price, size and color. Experience attributes can be used to evaluate the product after it has been purchased, such as taste. Credence attributes are more difficult to objectively evaluate. Production practices and the pride one takes in supporting a local producer are both types of credence attributes.

representative sample. The data obtained from Clemson, SC was generated from a random selection of participants recruited by a contracted market research firm from the general population in Clemson, SC. The participants recruited for the study in the Athens, GA location, on the other hand, were recruited with mere convenience measures (word-of-mouth, and flyers in limited locations). Because of the diversity of consumers, these two locations should be representative of the Southeastern U.S. Subjects were offered a monetary incentive in the amount of $50 to participate in a steak preference experiment to be conducted in the food laboratory on the local university campus. Individuals that participated were assigned a time and date that was convenient for them.

A total of 224 people participated in the study. However, some of the panelists did not participate in the sensory evaluation of the survey; therefore, those observations were removed from the data set. Thus, the remaining number of participants was 215, which could be divided into two subsets by location; Athens, GA with 107 of the participants, and Clemson, SC with 108 participants. A total of twenty-nine consumer taste panels, eleven of which consisted of ten consumers in Athens, GA and eighteen panels consisting of six consumers in Clemson, SC were used. Several t-tests were conducted, after which it was determined that there was no significant difference between the two locations, thus the data was pooled and analyzed accordingly.

Since acceptance and willingness to pay for a grass-fed beef product can be a function of several of the aforementioned factors, the panelists were given two consumer surveys to complete prior to the experimental auction rounds evaluation. The first survey was a type of stated preference technique which began by asking questions that were used to gather information on the consumers' purchasing behavior of meat products. A series of questions then followed to gauge consumer's attitudes towards various beef production practices, their perceptions of different beef attributes, and if they had heard of and purchased beef with the attributes listed. Although the methods used to evaluate if there possible premiums associated with grass-fed beef was through the use of an experimental auction, one question in the survey employed a stated preference technique to try and estimate the stated WTP for certain beef attributes. To complete the survey, demographic characteristics that included the respondent's age, gender, income

level, education, and other socioeconomic and demographic information was collected from the participants. The second survey obtained information regarding the panelists' beef knowledge. Once the surveys were completed, panelists participated in the sensory evaluation portion of the experiment, which utilized the random n^{th} price auction mechanism. Variables and the descriptive sample statistics are reported in Table 4.1, frequency distributions for selected attitudinal variables and calculated correlation coefficients can be found in Appendix A, while a complete copy of the survey and materials used by the panelists in the experimental auctions can be found in Appendix B.

Steak Selection and Preparation

The steaks used in this study for the experimental auction were from fourteen, yearling Angus steers.[11] The steers were equally divided into two groups where they were assigned one of two dietary treatments: A) grass-fed; or B) grain-fed, and fed until they reached a target slaughter weight. After an overnight fast, the fourteen steers were slaughtered at the University of Georgia Meat Science Technology Center. After slaughter, the hot carcass weights were recorded and the carcass data was collected at 24 hours postmortem before cutting and removing strip loins and ribs. Steaks were aged and stored vacuum packaged at 2°C for 14 days and subsequently stored frozen at -20°C until further analysis.

In order to measure the Warner-Bratzler shear fource value, one steak from the 13^{th} rib of each carcass was thawed for 24 h at 4°C and broiled on Farberware (Bronx, NY) electric grills to an internal temperature of 71°C. Before six 1.27-cm-diameter cores were removed from each steak, they were allowed to cool to room temperature. All cores were sheared perpendicular to the long axis of the core using a Warner-Bratzler shear machine. Steaks from each grass-fed and grain-fed carcass were matched to similar Warner-Bratzler shear force values.

When the panelists arrived at the facility where the experiment was being conducted, taste samples were prepared for each of the three sensory rounds. Steaks were thawed at 4°C for 24 hours and

[11] Information regarding steak selection and preparation was obtained from Dr. Susan K. Duckett from Clemson University, who is a Co-Principal Investigator of the larger grant-funded study.

broiled on Farberware (Bronx, NY) electric grills to an internal temperature of 71°C. Panelists were immediately served the three paired samples that had been cooked and cut into 2.54 cm x 1.27 x 1.27 cm cubes.

Experimental Auction Procedures

The sensory evaluation portion consisted of six auction rounds where panelists were to bid on six pairs of strip loin steaks (one pair per round). Each pair consisted of one grass-fed beef steak, which is typically unfamiliar to most consumers, and one grain-fed beef steak, which is a familiar market product to consumers. Since the effect that information and labeling potentially has on how much a consumer is willing to pay was of interest in this study, each auction round had varying amounts of information, beginning with absolutely no information and continuing until all possible information was presented. Three of the rounds had a "requirement to eat" factor, where the panelist had to actually taste the pair of steaks they were bidding on, hence the "sensory" test, whereas, the other three rounds were only a visual evaluation of the steak pairs. In order to help ensure that the panelists did not try to develop strategies when bidding on the steak pairs, the monitor of the auction encouraged panelists to bid their "true" value, or reservation price, for each of the steak pairs. Through separation of the value from market price, the random n^{th} price auction provides an incentive to reveal one's true preference. Participants receive no benefits in strategizing, since the market price (which is randomly chosen to be the second, third, fourth, etc. highest bid) is independent of the participant's bid. Shrogen et al. (1994) assert that the chance of winning an auction is reduced if someone bids lower than their true value. Consequently, if one chooses to bid higher than their true value, they may increase their chances of winning but possibly at a price much higher than their true value.

Prior to the beginning of the actual auction, the n^{th} price sealed bid auction procedures were explained to the panelists. Depending on the auction round, panelists were asked to either visually assess the steak pairs, or evaluate the steak pairs through taste testing. After the assessment of both steaks in the pair, panelists submitted a bid (one for each steak) in dollars per pound amounts. As the name "random n^{th}

price auction" implies, the monitor then randomly selects a number (n) that has a uniform chance of being either a second, third, fourth, etc., price auction and is uniformly-distributed between 2 and k (where k is how many bidders there are in each round). Since there were multiple rounds and multiple goods being auctioned, the monitor randomly selected which round and good would be "binding" (valid). Selecting a random round to be binding is important because it eliminates the threat of participants reducing their bids since they could obtain the same product in a different round (Melton et al., 1996). For instance, if prior to the auction the monitor randomly chose the grass-fed steak from round five to be the binding auction, and also randomly chose the market-clearing price to be the third highest bid, the participant with the third highest bid in round five would be the "winner" of the auction, but would have to pay the second highest price for the grass-fed steak in that round. Without a practice round, the auction procedures have the potential to be confusing; causing participants to be unsure of what is required of them thereby producing unreliable results. For this reason, a non-binding auction, selling a familiar good such as candy bars or sodas, was completed to introduce the auction mechanism to the respondents. Once the participants finished with the practice auction, the panelists had an opportunity to clarify any instructions before the start of the actual experimental auction bidding began.

As was previously discussed, there were six auction rounds with various levels of information about production methods and health and nutritional information related to each steak. The first two rounds required the panelist to taste and evaluate the two different steaks. It was not only requisite for consumers to indicate their willingness to pay in $/pound for each steak pair, but they also rated the samples for flavor, juiciness, tenderness, and overall acceptability using an eight-point hedonic scale with 1 = extremely undesirable, dry tough and undesirable to 8 = extremely desirable, juicy, tender, desirable. It should be noted that prior to placing their bids on each of the steak pairs, consumers were given a reference point of $5.00/pound for the typical market price of a steak one would find in a retail store. Consumers received no information regarding the production methods or health benefits of either of the steak pairs in both round one and two. In those first two rounds, panelists only received the steak sample number for identification.

Round three began the first visual evaluation of the auction process. Consumers were presented with two steaks, one corn-finished and one grass-fed, both of which were in over-wrapped Styrofoam packaging. Again, steaks were labeled with a number for purposes of identification and recording of the bid amounts for each steak. As with rounds one and two, no information was presented to the participants in round three.

Production information about each beef steak was presented in round four, which was another visual assessment of the pair of steaks. Once again, steaks were presented in over-wrapped Styrofoam packaging and labeled with their identification number. The grain-fed beef steak was increased from only being labeled as "Corn-fed beef, USDA inspected." The grass-fed beef steak was labeled as "Natural Grass-Fed Beef, raised without supplemental hormones or antibiotics; traceable to the farm where it was produced; and USDA inspected." After the information was presented about each steak, consumers submitted bids of how much they were willing to pay per pound for each steak.

Round five presented information regarding production methods and nutritional information for the steaks. The grass-fed beef steak was labeled with the following information: "Grass fed steak 62% lower in fat content than Corn-fed beef; 65% lower in saturated fat than Corn-fed beef; Greater concentrations of Omega-3 Fatty Acids and Conjugated Linoleic Acid (CLA's)." Similar to the previous round, the grain-fed steak was simply labeled as "Corn-fed beef, USDA Inspected." After viewing the steaks and information for each, panelists placed their bids for both of the steaks. Round five was also the third and final visual evaluation consumers completed of the steak pairs. This round should provide insight into exactly how much consumers would pay if they value search or credence attributes such as nutrition, fat content, color, and production practices since essentially these rounds of research mimicked the labeled product one would find in a conventional outlet or supermarket.

Round six was the final auction round where consumers were able to "put it all together," so to speak. Not only did consumers complete a visual evaluation of both of the steaks with complete information for each of the steaks (note that no additional information was given to the consumers beyond what had been given in the round five), participants also completed a taste evaluation where the grass-fed

and grain-fed steaks were identified. After both the visual and taste evaluations were completed, the consumers placed their final bids on the steaks. Just as round five was important in valuing how much consumers would pay for search and credence attributes, round six provides a related, but additional insight into consumer's preferences related to experience attributes. For producers to establish a new niche product, they must garner a suitable customer base that not only will make the initial purchase of a grass-fed beef product, but will also remain loyal and make subsequent purchases as well.

Overview of Attitudinal Variables

Prior to the discussion of the results from both the consumer survey and experimental auction, an explanation of some of the variables used in this study is required. The majority of the variables generated from the survey were qualitative variables, rather than quantitative variables. These dummy or binary variables, as they are often called, are usually utilized in regression analysis to account for some categorical effect that may or may not shift the expected outcome. Examples of these types of variables are gender, race, religion, nationality, etc., and usually take on values of either 0 or 1, where the value is 0 if the attribute is not present and 1 if it is present.

In order to gain a better understanding of how consumers' meat preferences affected their WTP for the grass-fed beef product, participants were asked to choose their most preferred meat product, from which the binary variables were created: beef (*PREFERBEEF)*; chicken (*PREFERCHICK*); lamb (*PREFERLAMB*); pork (*PREFERPORK*); and fish (*PREFERFISH*). Table 4.1 presents the averages and standard deviation for each of the possible preferred meats consumers which consumers could choose. A majority of participants, 52%, preferred beef, while another 35% of the study sample had a preference for chicken. Surprisingly, fish was the third mostly highly preferred meat product (7.4%).

There were several attitudinal related questions in this study that required the responses to be evaluated on a psychometric response scale. The five point Likert scale that ranged from "Not at all Important" to "Extremely Important" was used. The binary variables created from these questions were used to account for the participant's attitudes and perceptions of beef production practices. For example,

Table 4.1 Definition and Summary Statistics of Variables

Variable	Description	Mean	St. Dev.
PreferBeef	= 1 if respondent's preferred meat is beef	0.5209	0.4996
PreferChick	= 1 if respondent's preferred meat is chicken	0.3534	0.4781
PreferLamb	= 1 if respondent's preferred meat is lamb	0.0093	0.0960
PreferPork	= 1 if respondent's preferred meat is pork	0.0232	0.1507
PreferFish	= 1 if respondent's preferred meat is fish	0.0744	0.2625
Open	=1 if open range is not at all important, to 5=extremely important	2.3152	1.1868
Noanti	=1 if no antibiotics is not at all important, to 5=extremely important	2.6244	1.2576
Nohorm	=1 if no growth hormones is not at all important, to 5=extremely important	2.7452	1.2702
Natur	= 1 if natural is not at all important, to 5=extremely important	2.6394	1.1931
Grassfed	= 1 if grass-fed not at all important, to 5=extremely important	2.2300	1.0943
Grazstm	= 1 if grazing to protect streams is not at all important, 5=extremely important	2.4118	1.1235
Grazspec	= 1 if grazing to protect endangered species is not at all important, 5=extremely important	2.5049	1.1659
Treat	= 1 if animals treated humanely is not at all important, to 5=extremely important	3.1586	1.1765
Trace	=1 if traceable from the farm to the consumer is not at all important, to 5=extremely important	3.0926	1.2675
Organic	1 = USDA Certified Organic is not at all important, to 5=extremely important	2.2780	1.1796
Atorgan	= 1 if organic is not at all desirable, to 5=extremely desirable	2.3349	1.1752
Nutval1	=1 if nutritional value is not at all desirable, to5=extremely desirable	3.4879	0.9215
Fresh	=1 if fresh is not at all desirable, to 5=extremely desirable	3.7311	0.9852

Aged	=1 if aged is not at all desirable, to 5=extremely desirable	2.5481	1.0322
Nobone	=1 if boneless is not at all desirable, to 5=extremely desirable	2.9953	1.0875
Prem	=1 if premium brand is not at all desirable, to 5=extremely desirable	2.8076	0.9466
Quick	=1 if quick preparation is not at all desirable, to 5=extremely desirable	2.4407	1.1060
Size	=1 if size of the package is not at all desirable, to5=extremely desirable	3.0331	0.9948
Preseas	=1 if pre-seasoned is not at all desirable, to 5=extremely desirable	2.0186	1.0115
Perlean	=1 if fat content is not at all desirable, to 5=extremely desirable	3.5942	1.0120
Cool	= 1 if country of origin is not at all desirable, to 5=extremely desirable	2.9460	1.2613
Hgrass	= 1 if the panelist has heard of beef that was grass-fed, 0 otherwise	0.6523	0.4763
Pgrass	= 1 if the panelist has purchased of beef that was grass-fed, 0 otherwise	0.3246	0.4683
Interest	Ordinal ranking of the question, "If you could buy a locally grown beef product with the following characteristics: grass-fed, not fed antibiotics, and raised without supplemental hormones, how interested would you be on a scale of 1 to 10 (1 being Not Interested and 10 being Extremely Interested)	6.8224	2.4644
Wtpgrass	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.4375	0.9126
wtppast	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail	2.3853	0.9592

	price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute		
Wtpgrain	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.3106	0.7246
Wtpfree	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.3495	0.94228
Wtpnoanti	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.6715	0.9103
Wtpnofed	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.6390	0.9301
Wtpnohorm	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.7559	0.9140
Wtplocal	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6=	2.6172	0.8226

	would not purchase beef with that attribute		
Wtptender	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.8543	0.9235
Wtpaged	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.6859	1.0371
Wtphum	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.4471	0.7254
Wtptrace	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.6363	0.8595
Wtpnat	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.4782	0.8893
Wtporgan	The most consumers say they would be WTP for a beef product with this attribute =1 less than typical retail price, 2= equal to the typical retail price, 3= 10% above the typical retail price, 4= 25% above the typical retail price, 5= more than 25% above the typical retail price,6= would not purchase beef with that attribute	2.5588	1.1682

Flavor	Ranking of how panelists felt each steak compared in flavor. Ranked 1 -8 (1= being extremely undesirable, 8=extremely desirable)	5.6184	1.3408
Juiciness	Ranking of how panelists felt each steak compared in juiciness. Ranked 1 -8 (1= Extremely juicy, 8=Extremely dry	5.3161	1.3987
Tenderness	Ranking of how panelists felt each steak compared in tenderness. Ranked 1 -8 (1= being extremely tender, 8=extremely tough)	5.6311	1.4128
Overall	Ranking of how panelists felt each steak compared overall. Ranked 1 -8 (1= being extremely undesirable, 8=extremely desirable)	5.5070	1.3798
Marbling	Level of marbling for each sample	492.21	142.51
WBS	Warner-Bratzler shear force value	4.0014	1.0772
PInfor	= 1 if auction round was round four and production information was given, 0 otherwise	0.3333	0.4717
PNinfo	= 1 if auction round was round five and production and nutrition information was given, 0 otherwise	0.3333	0.4717
AllInfo	= 1 if auction round was round size and all information was given	0.3333	0.4717
Grain_bid	Respondents' bid on the grain-fed steak in $/1b	$4.81	2.06
Grass_bid	Respondents' bid on the grass-fed steak in $/lb	$4.86	2.20
Premium	Grass_bid minus Grain_bid	$0.05	1.84
Gender	= 1 if respondent is Female, 0 otherwise	0.5581	0.4978
Asian	= 1 if respondent is Asian, 0 if otherwise	0.0232	0.1507
Black	= 1 if respondent is Black, 0 if otherwise	0.1534	0.3605
Hispanic	= 1 if respondent is Hispanic, 0 otherwise	0.0139	0.1173
White	= 1 if respondent is White, 0 if otherwise	0.7906	0.4068
Ageyrs	Respondents' age	41.47	13.82
Young	=1 if age < or = 29 years, 0 otherwise	0.2604	0.4392
MidAge	= 1 if age is between 30 and 49 years, 0 otherwise	0.4279	0.4951

MatureAge	= 1 if age is over 50 years, 0 otherwise	0.3116	0.4636
Houseincm	= 1 if Under $20,000; 2 = $20,000 - $24,999; 3 = $25,000 – $29,999; 4 = $30,000 – $34,999; 5 = $35,000 - $39,999; 6 = $40,000 - $49,999; 7 = $50,000 - $59,999; 8 = $60,000 - $69,999; 9 = $70,000 - $79,999; 10 = $80,000 - $89,999; 11 = $90,000 - $99,999; 12 = $100, 000 or more	7.0829	3.7449
Inc_Low	= 1 if respondent's annual household income is less than $29,999, 0 otherwise	0.2139	0.4101
Inc_Med	= 1 if respondent's annual household income is between $30,000 to $59,999, 0 otherwise	0.2651	0.4417
Inc_HighMed	= 1 if respondent's annual household income is between $60,000 to $99,999, 0 otherwise	0.2744	0.4465
Inc_High	= 1 if respondent's annual household income is $100,000 or more, 0 otherwise	0.1488	0.3562
Education	=1 if Less than High School; 2 = some college of junior college, 3 = college graduate and/or some graduate work, 4 = graduate degree	2.6930	1.0390
Some HighSchool	= 1 if respondent's highest level of education is some high school, 0 otherwise	0.0139	0.1173
Completed HighSchool	= 1 if respondent's highest level of education is high school, 0 otherwise	0.1116	0.3149
SomeCollege/JuniorCollege	= 1 if respondent's highest level of education is some college or completed junior college	0.3209	0.4669
Completed 4 year	= 1 if respondent's highest level of education is high school, 0 otherwise	0.1302	0.3366
Some Graduate school	= 1 if respondent's highest level of education is some high school, 0 otherwise	0.1162	0.3206
Completed Graduate	= 1 if respondent's highest level of education is some high school, 0 otherwise	0.2930	0.4552
Student	= 1 if respondent is a student, 0 otherwise	0.1302	0.3368
Full-time	= 1 if respondent is employed full-time, 0 otherwise	0.7256	0.4466
Not Employed	= 1 if respondent is not employed, 0 otherwise	0.0744	0.2627
Adults	Number of how many adults (18 yrs+) are living in household	1.8429	0.8002

Child	=1 if there are children under 18 living in household	0.3798	0.4865
NumChild	= number of children under the age of 18 living in the respondent's household	0.5209	0.8455
Family Size	= 1 if size of family is 1, 2 = size of family is 2, 3 =size of family is 3, 4 = size of family is 4 or greater	2.2960	1.1390
Married	= 1 if respondent is married, 0 otherwise	0.5767	0.4945
Single	= 1 if respondent is single, 0 otherwise	0.2465	0.4310
Divorced	= 1 if respondent is divorced, 0 otherwise	0.1116	0.3149
Widowed	= 1 if respondent is widowed, 0 otherwise	0.0186	0.1351
BothWork	= 1 if respondent and spouse both work, 0 otherwise	0.1534	0.3605
Young Singles	= 1 if respondent is a young single, 0 otherwise	0.1302	0.3366
Middle Singles	= 1 if respondent is a middle single, 0 otherwise	0.1581	0.3649
Old Single	= 1 if respondent is an older single, 0 otherwise	0.0232	0.1507
Young Couple	= 1 if respondent's lifestyle is that of a young couple, 0 otherwise	0.0930	0.2905
Working Older Couple	= 1 if respondent's lifestyle is that of a working older couple, 0 otherwise	0.1674	0.3734
Retired Couple	= 1 if respondent's lifestyle is that of a retired couple, 0 otherwise	0.0558	0.2296
Young Parent	= 1 if respondent's lifestyle is that of a young parent, 0 otherwise	0.0690	0.2548
Middle Parent	= 1 if respondent's lifestyle is that of a middle parent, 0 otherwise	0.1302	0.3366
Older Parent	= 1 if respondent's lifestyle is that of an older parent, 0 otherwise	0.1069	0.3091
Roommates	= 1 if respondent lives with non-relatives of the same sex that are 18 years old or older, 0 otherwise	0.0418	0.2003
TestSiteState	= 1 if raised in the state the survey was administered; 0 otherwise	0.6604	0.4736
South	= 1 if raised in a state in the South region, 0 otherwise	0.1395	0.3465
Northeast	= 1 if raised in a state in the Northeast region, 0 otherwise	0.0976	0.2969

Midwest	= 1 if raised in a state in the Midwest region, 0 otherwise	0.0976	0.2969
West	= 1 if raised in a sate in from West region, 0 otherwise	0.0047	0.0680
Podag	= 1 if family is involved in production agriculture, 0 otherwise	0.2651	0.4417
Shopper	= 1 if respondent is primary shopper for household, 0 otherwise	0.7348	0.4414
Location	= 1 if Athens, 0 if Clemson	0.4976	0.5009

if consumers believed that the practice of grass-fed beef production is important, they may be willing to pay more for the grass-fed beef steak. The variables created are listed with their descriptions and mean values in Table 4.1 and they include: open range (*OPEN*)*;* no antibiotics (*NOANTI*)*;* no growth hormones (*NOHORM*)*;* natural (*NATUR*)*;* grass-fed (*GRASSFED*)*;* grazing managed to preserve streams (*GRAZSTM*)*;* grazing managed to protect endangered species (*GRAZSPEC*)*;* animals treated humanely (*TREAT*)*;* traceable from the farm to the consumer (*TRACE*)*;* and organic (*ORGANIC*). Results presented in Table 4.1 show that the production practices with the highest average rankings by respondents are *TREAT* (3.1) and *TRACE* (3.0), which represent the practice of treating animals humanely and whether or not the product is traceable back to the farm level, respectively. Other variables with moderate averages are NOANTI (2.6244) and NOHORM (2.7). Finally, the production practice of finishing cattle on grass received an average ranking of 2.2. Percentages of consumer responses for each "importance level" are presented in Appendix A.

Similar to the production practice dummy variables, consumers were also asked about which beef attributes were desirable, and in turn, attribute-based dummy variables were created. The attributes that consumers were asked to rate and the respective variable names are as follows: organic (*ATORGAN*); good value for the price (*VALUE*); nutritional value (*NUTVAL1*); fresh (*FRESH*); aged for at least 14 days (*AGED*); boneless (*NOBONE*); premium brand (*PREM*); ready to heat (*QUICK*); size of package (*SIZE*); pre-seasoned (*PRESEAS*); percent lean (*PERLEAN*); and labeled with country of origin (*COOL*). Again, the five point Likert scale was used ranging from "Not at all Desirable" to "Extremely Desirable". If participants felt that certain beef attributes associated with those that grass-fed beef exhibit were desirable, such individuals may also be willing to pay more for grass-fed beef. The average consumer ranking of these variables are listed in Table 4.1. From the table, it can be inferred that the variable with the highest average ranking (4.0) was *VALUE*, which represented a beef product that was a 'good value for the price.' Other beef attributes with moderately high rankings included *NUTVAL1*(3.5) , which indicates the nutritional value of the product, *FRESH* (3.7), which meant the product was not frozen, and

PERLEAN (3.6), which represented the amount of fat in the beef product. For a further analysis of consumer responses for this group of variables refer to Appendix A.

Participants were questioned as to whether or not they had heard of products being promoted with certain attributes, as well as if they had knowingly purchased those products. Responses of "yes" were coded with the value of 1, while participants that indicated not having heard or purchased beef with the promoted attributes responded with a "no" (coded as a 0). Two binary variables were created to account for whether or not a participant had heard (*HGRASS*) and purchased grass-fed beef (*PGRASS*). Table 4.1 shows that about 65% of participants had heard of grass-fed beef, but only 32% had actually purchased the product. Consumers were also asked about their interest in a grass-fed product (*INTEREST*). A description and average ranking is provided for the ordinal variable in Table 4.1. In Appendix A, frequency distributions of possible responses for these variables are presented.

Although the primary methods used to determine the premium amount associated with grass-fed beef was through the use of an experimental auction, one question in the survey employed a stated preference technique aimed at estimating the WTP for certain beef attributes, specifically grass-fed (*WTPGRASS*); pastured (*WTPPAST*); grain-fed and/or corn-fed (*WTPGRAIN*); free-range (*WTPFREE*); raised without antibiotics (*WTPNOANTI*); not fed antibiotics (*WTPNOFED*); raised without supplemental hormones (*WTPNOHORM*); locally produced (*WTPLOCAL*); guaranteed tender (*WTPTENDER*); aged (*WTPAGED*); certified humane raised and handled (*WTPHUM*); traceable to the farm (*WTPTRACE*); natural (*WTPNAT*); and organic (*WTPORGAN*). Similar to previous questions regarding consumer preferences and purchasing behavior, a six point Likert scale was used that ranged from "Less than the Typical Retail Price" to "More than 25% Above the Typical Retail Price." There was also a sixth choice which allowed the respondent to choose," Would Not Purchase this type of beef." The variable depicting a WTP for guaranteed tender beef received the highest average (2.8), followed by a WTP for beef raised without supplemental hormones (2.75). The average ranking for consumers' WTP for a grass-fed product was 2.4. A further analysis of the frequency distribution of consumer responses concerning WTP for beef attributes can be found in Appendix A.

During the taste evaluations, consumers reported the acceptability of three sensory characteristics, as well as an overall acceptability, for both grass-fed and grain-fed steaks using an eight-point hedonic scale where 1 was completely unacceptable and 8 was extremely acceptable. The following categorical variables were created for use in further analysis: *FLAVOR*, *JUICINESS*, *TENDERNESS*, and *OVERALL*. Table 4.1 reveals that out of all the sensory characteristics[12], tenderness had the highest average ranking (5.63). However, the average ranking for flavor (5.61) was only marginally smaller than tenderness.

Both the marbling score for each steak being valued, as well as the Warner-Bratzler shear force value (*WBS*) are presented in Table 4.1. Warner-Bratzler shear force values are a more objective measure of tenderness, and are determined by the amount of force needed to shear a one-half inch core of a meat sample. The marbling score and shear force value variables are continuous, and a marbling score of 500 is considered a "small" amount of marbling. Likewise, higher values reported for *WBS* are considered "tough." The average marbling score was 492.2093, and the average value for *WBS* is 4.0014. Steaks with a shear force value greater than approximately 4.6 kg are considered tough.

Three binary variables were created to measure the effect of information on the value consumers placed on the grass-fed steak. The variables, *PINFO*, *PNINFO*, *and ALLINFO*, each correspond to the last three rounds of the auction where increasing amounts of information were given to respondents prior to bidding. Average bid values for each steak are also presented in Table 4.1 and are represented by two continuous variables, GRASS_BID and GRAIN_BID. By taking the difference in average bid for the grass-fed steak and the average bid for the grain-fed steak, the variable PREMIUM was created. It can be seen from Table 4.1 that the average premium was $0.05/lb.

[12] The means reported for the sensory character tics in Table 4.1 include rankings of both the grain-fed and grass-fed steaks. In later section, the average rankings for each type of beef is analyzed.

Overview of Demographic Variables and Characteristics of Participants

A majority of the participants, 55.81%, were female; male participation accounted for the remaining 44.19% of the total (Table 4.1). Of the 215 participants, 79.06% were white, 15.34% were black, 2.32% were Asian, and 1.39% were Hispanic. The average panelist in this study was about 41.5 years old. The oldest participant was 81 years old, while the youngest consumer was 18. In order to compare the effect that different age groups may have on the grass-fed beef bid price, the variable accounting for the respondents' age in years was also separated into three categories: young (29 years old or younger), middle aged (30 to 49 years old), and mature aged (older than 50 years). In the survey sample, 26.04% were categorized as young, 42.79% were considered to be middle aged, and another 31.16% was of a mature age.

Household income data, defined as average household income before taxes, data was also collected (Table 4.1). The average household income reported by respondents was approximately $51,000[13], when rounded up to the nearest thousand. The income variable HOUSEINC was separated into four categories: low (less than $29,999 annually), medium ($30,000 to $59,999 annually), high/medium ($60,000 to $99,999 annually), and high ($100,000 or more). About 21% of the participants were categorized as having a low income, while another 27% were in the medium income range. The variable INC_HIGHMED accounted for 27% of the participants, about 15% of the respondents reported having an annual income of $100,000 or more. When compared to the general population for each study site, these participants reported a larger household income. For example, according to the U.S. Census Bureau, the median household income in Georgia in 2004 was about $42, 679, while South Carolina had a median household income of approximately $39, 454.

With respect to educational attainment among survey panelists, on average participants had at least some college or had completed a junior college. Almost thirty percent of the participants reported

[13]In the questionnaire the respondent had twelve income brackets to choose from. The income range $50,000 to $59,999 corresponds to the seventh bracket (or class) which had a class width of ten. Each "class mark" therefore represents an additional $1000. For instance, the number 7.0 would correspond to $50,000, whereas a mean of 7.1 would be $51,000. Therefore, the mean of 7.08 was rounded up to the nearest tenth to obtain an average annual income of $51,000.

having obtained a graduate degree (29.3%), while another 12% had at least some graduate schooling. In the sample of consumers, 13% listed a high school diploma as their highest level of education, and 1.39% claimed to have only completed some high school.

The majority of the participants, 72.56%, were employed on a full-time basis, and approximately 13% classified themselves as students. Both survey locations known as "college towns" due to nearby Universities, could contribute to this high 'Student' participation in the survey.[14] Hardly any of the participants were not employed; only 7.44% total were unemployed. It should be noted that although the survey allowed for participants to choose the employment status of "Student," there could be students who work full-time or part-time, and chose to label themselves as such.

The average surveyed household had 1.84 adults. In the survey, consumers were also asked if they had any children living in the household. Overall, 37.98% of respondents had children living in the household. A follow up question was asked of panelists who had children living in the household: "How many children, age 18 and under, live in your household?" Overall, 53.42% of participants who answered yes to having children in the household had one child living in their household. Although because some consumers who had previously stated having no children mistakenly responded to the follow-up question with a zero, the mean for the variable NUMCHILD is only 0.5209. A further examination of this variable shows that two children households represented 43.84% of those who answered yes to having children in the home, three children households accounted for 1.37% of those participants, and three children households accounted for 1.37% of those participants. The variable FAMILYSIZE was created by combining the variables representing how many adults were in the household, ADULTS, and the variable representing the number of children in each household, NUMCHILD. On average, the panelist reported having a family size of 2.30.

A majority of the participants in this study were married (57.67%). When asked about marital status, 25.60% of the participants responded that they were single, while another 11.11% were divorced.

[14] Although both Athens, GA and Clemson, SC have high student populations the demographics are consistent with many Southeastern locations.

When asked, "If you are married, do both you and your spouse work?" the study population reported that only about 15.79% of the married participants and their spouse both worked. However, a typographical error in the survey could have caused respondents to overlook this question thus skewing the results to this question.

Participants were asked to indicate the lifestage category that best describes their household. Of the potential 10 categories, 16.74% of the participants were in the category "Working Older Couple". The Working Older Couple was identified as being a multimember household where the age of the head of the house was 45 years old or older and was employed. In such a household, no children were present, but the participant was either married or shared accommodations with a non-related individual older than 18 of the opposite sex. The second highest lifestage category was Stage Two, which was the Middle Singles category. Participants that chose the Middle Singles category were ages 35 to 65 and lived in one member households. Other "lifestyle" categories that participants could select and their means are: Young Singles (.1302); Old Singles (0.0232); Young Couple (0.1674); Retired Couple (0.0558); Young Parent (0.0690); Middle Parent (0.1302); Older Parent (0.1069); and Roommates (0.0418).

While most of the participants were raised in the United States, not all of them were raised in Georgia or South Carolina, the states in which the surveys were administered. Approximately 66.05% were raised in the state in which the survey was administered. Of the participants not raised in the location that the survey was administered, 13.95% were raised in the South.[15] The Midwest and Northeast regions each accounted for 9.77% of the participants and only one participant was raised in a western state (0.47%).

In the survey, participants were questioned about any previous involvement in production agriculture. From Table 4.1, it can be seen that approximately 27% of respondents reported that they, or their family, were either currently or previously involved in production agriculture. When asked, a majority of respondents claimed to be the primary shopper for their household; almost 73%. Finally, a

[15] Regions were determined with guidance from the U.S. Census Bureau and for the purposes of this study are defined as follows: Mid West (IA, IL IN MI, MO, OH, WI); Northeast (CT, DE, MA, MD, NH, NJ, NY, PA, RI); South (FL, GA, KY, LA, MS, NC, SC, TN, TX, and VA); and West (WA).

location variable was used to distinguish participants from both survey locations. As can be seen from Table 4.1, a little more than half of the surveys were conducted at the Clemson location.

Consumer Acceptance of Grass-fed Beef

During the experimental auction, certain rounds required the respondents to evaluate the sensory characteristics of each beef steak (flavor, juiciness, tenderness, and overall acceptability). Figure 5.1 shows the results from the taste panel ratings. Consumers, on average, placed higher ratings on the grain-fed steak for each of the sensory traits. Tenderness appears to have the largest divergence in the mean rating for each of the treatments. However, the magnitude of the differences does not appear to be large. An analysis of variance was conducted for each of the sensory traits to determine if there was a significant difference in the mean for each dietary treatment. The results from the t-tests indicated that there was a significant difference in the mean for the dietary treatment for all of the sensory characteristics.

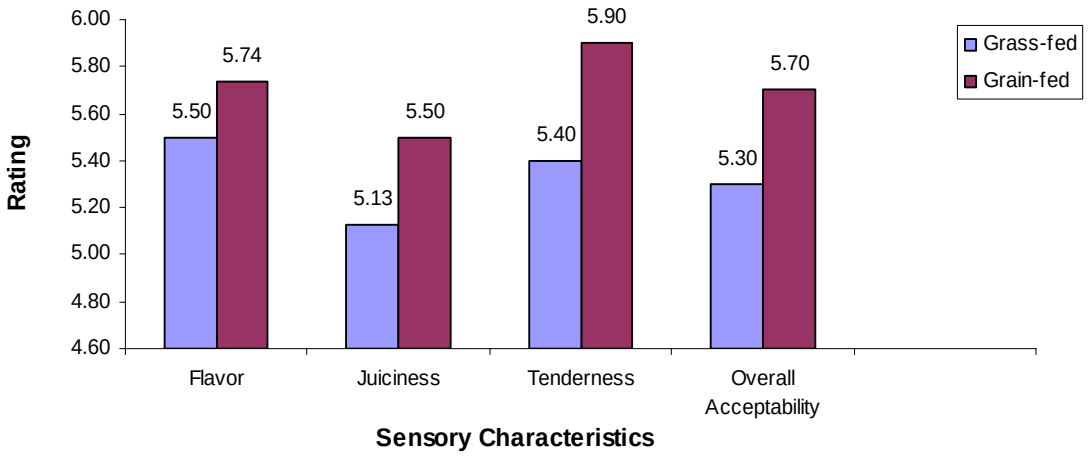

Figure 4.1 Average Taste Panel Ratings for Grass-fed and Grain-fed Beef Steaks

Analysis of Bid Premiums

Since the overall objective of this project is to determine consumer's willingness to pay, and the marginal value that consumers place on the attributes of grass-fed beef, exploration of the actual bid

amounts obtained from the auction rounds was of interest. Averaging the bids for each steak across all rounds reveals that the average grass-fed bid was greater than the grain-fed bid, as can be seen in Table 4.2. The premium amount is positive, indicating a preference, on average, for the grass-fed beef steak. The results from the ANOVA showed that there was a not a significant difference in the premium between treatments. The relative premium was calculated to be (the difference between the grass-fed bid and the grain-fed bid divided by the grain-fed bid) less than 1%. This finding is very important to the purpose of this study, since it basically asserts that consumers, on average, valued the grass-fed steak the same as they did the grain-fed steak. Further, the amount of the premium associated with the grass-fed steak was small.

In evaluating the premiums, it is important to determine the effect that information had on consumers in the sample. One of the hypotheses of this study is that by increasing the amount of information provided to consumers, larger premiums could be extracted. To test this hypothesis, varying levels of information were provided at each auction round. An ANVOA was run to determine if the mean premium was significantly different at each round. Results from the ANOVA confirm that the average premium was significantly different for each auction round. Figure 4.2 provides the average premium amounts by the varying round. After viewing Figure 4.2, it is apparent that information influenced consumers' bids. In the first three rounds of the auction (T1, T2, and V1) consumers, on average, preferred the grain-fed steak. However, when production information was introduced in round four, consumers had a preference for the grass-fed steak. Premiums increased substantially in round five (V3) when both production and nutrition information was given, while they were slightly lower when paired with a taste test in round six (T3).

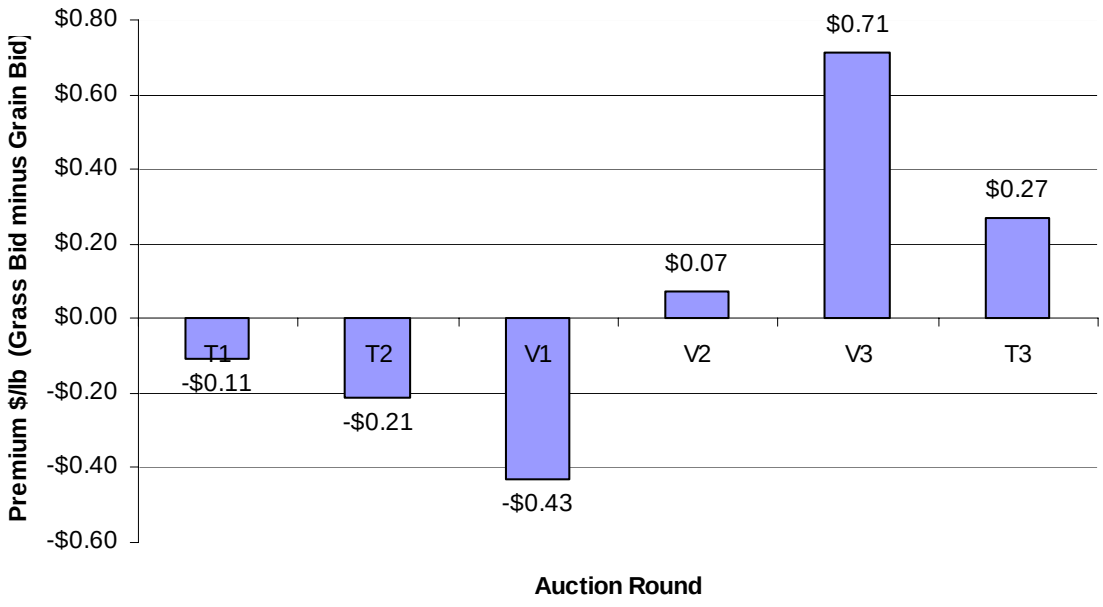

Figure 4.2 Average Grass Premium by Auction Round

Variable Correlation Coefficients

Pearson's technique was used to calculate correlation coefficients between several of the variables obtained from the consumer survey and auction variables. These tables are presented in Appendix A at the end of the manuscript. Correlation coefficients were used to measure the degree of linear association between the variables, and to check the data for multicollinearity. Correlation coefficients were calculated for the sensory characteristics (tenderness, juiciness, flavor, and overall), marbling, and the Warner Bratzler Shear Force Value (wbs). Results show that each of sensory characteristics were highly and positively correlated with one another. An evaluation of the correlation of beef attributes showed an insignificant amount of multicollinearity present within the independent variables that represent beef attributes. However, there are three variables that tend to present themselves together: "ready to heat;" "package size;" and "pre-seasoned." These variables may represent some unobserved "convenience" factor. The correlation of variables representing past purchase behavior were

also calculated, and it was found that several of the independent variables showed a moderate correlation. Specifically, past purchases of pastured beef, grass-fed beef, and certified humanely-produced beef may be measured by the same latent construct. Furthermore, past purchases of beef products grown without the use of hormones, or antibiotics are moderately correlated with each other, suggesting that they may measure either a health or food safety-type factor. Correlation coefficients that were calculated for the WTP responses show that, not surprisingly, a strong relationship exists between the variables "No antibiotics," "Not fed antibiotics," and "No Hormones." As was the case with variables concerning past purchases, a fairly high correlation between the variables "Grass-fed" and "Pastured" was evident. Finally, correlation coefficients were estimated for consumers' attitudes about the eating quality, food safety, and nutritional value of specific beef attributes. The results are reported in three separate tables listed in the Appendix. In each circumstance, the only variables to show some degree of correlation are the three variables that represent what can be perceived by consumers as a measure of safety (No antibiotics, Not fed antibiotics, and No hormones).

Table 4.2 Average Auction Bids for Grass-fed and Grain-fed Beef Steaks in $/lb

Variable	Mean	Standard Deviation
Grass-fed	$4.87	2.2015
Grain-fed	$4.82	2.0623
Premium (Difference)	$0.05	1.8480

CHAPTER FIVE

EMPIRICAL ESTIMATION PROCEDURES

The purpose of this chapter is to discuss the estimation procedures used in this study. After a general review of the common data reduction technique, factor analysis, this chapter describes the latent factors that surfaced from this survey's specific data set. Then, this chapter explains the variables selected for the models and their respective hypothesized expectations. Using the appropriate functional form for hedonic models is imperative in hedonic price analysis; therefore, a brief discussion regarding the chosen functional form for the empirical models is presented. Finally, the models that are estimated are defined. These combined processes will give a greater understanding of the potential consumer demand for grass-fed beef.

Factor Analysis

The previous evaluation of the correlation coefficients in chapter four suggested that multicollinearity may be present in this study's data set. Multicollinearity refers to the presence of an exact, or nearly perfect, linear relationship between some or all of the explanatory variables in the model, and thus violates one of the assumptions of the classical linear regression model (CLRM) (Gujarati, 1995). Gujarati (1995) states that while the OLS estimators remain the Best Linear Unbiased Estimator or BLUE in the presence of multicollinearity, the OLS estimators can have large variances and covariances, making precise estimation difficult. Kennedy (2003) suggests that factor analysis be used as a tool to account for multicollinearity in the data.

Factor analysis, when used as a generic term, describes a number of statistical techniques used to explore the main constructs or dimensions of multivariate data sets (Kline, 1994). Primarily, the purpose of factor analysis is to reduce the number of explanatory variables in data sets to a smaller set of

"factors." Thus, a factor is a combination of variables weighted in such a way that accounts for the variance in the correlations and can be defined in factor loadings (Kline, 1994). Factor loadings are analogous to Pearson correlation coefficients in that these loadings describe the relationship between observed variables and the factor. Variables that exhibit high factor loadings can be used to identify and label the factor. Factor loadings are obtained by multiplying each element of the eigenvector, which is a column of weights each applicable to one of the variables in the correlation matrix, by the square root of the eigenvalue. An eigenvalue, or characteristic root, measures the total amount of variation in the sample accounted for by each factor (Kline, 1994).

Factor analysis was used in this study to extract as much information from the consumer survey as possible, while minimizing the number of variables needed. Before conducting the factor analysis, the factor model that would be used in the analysis needed to be determined. Common factor analysis, the extraction technique that has the goal of explaining as much correlation with the least amount of factors, was selected as the factor model in this study since it is believed that there are certain latent factors that exist exerting causal influence on the observed variables being studied (O'Rourke, Hatcher, and Stepanski, 2005). Common factor analysis only considers the amount of common variance in a variable, which is error free and shared with other variables. Since the total variance was not extracted, the diagonal of the correlation matrix was substituted before the analysis with prior communality estimates. As it is never known exactly what proportion of variance is common and what proportion is unique (containing only the variance specific to the variable and the error variance), estimates of the commonalities were supplied to the statistical package being used for the analysis. If the diagonal was inserted with the value of one, as is the case when using principal component analysis, then all of the variance (common and error variance) would be accounted for. However, in order to separate the common variance from the error variance, while still extracting as much variance as possible, the largest absolute correlation for a variable with any of the other variables was inserted.

Once the communalities were estimated, the number of factors to retain for rotation was determined. Selecting the number of factors is ultimately subjective; however, a few objective methods

can be used. This study employed a combination of three criterions for deciding the number of factors for extraction: the Kaiser-Guttman rule; a scree test; and interpretability. The Kaiser-Guttman rule retains only those variables that have eigenvalues greater than one (i.e. that the factors variance must be comparable to a single variable); whereas the scree test plots the eigenvalues against the corresponding number of factors. Interpretability uses the guideline of theoretical meaningfulness to determine the number of factors extracted and rotated for further analysis. By using these three criterions, seven factors were found and retained for rotation. Factors were assumed to be uncorrelated with one another, thus the orthogonal rotation method, Varimax, was used to obtain a more meaningful and interpretable solution. Once factors were rotated and identified, factor scores were obtained in order for factors to be used as explanatory variables in the regression analysis. When identifying factors, it is important to recognize, as pointed out by Thilmany, Bond, and Bond (2006), that while some of the variables in a factor can be considered a related set, under different circumstances those same variables could have very unique interpretations.

To identify and describe the common factors, the loadings of variables on each of the seven factors were evaluated. The results from the analysis are presented in Table 5.1. Factor one explains about 26% of variability among the consumers surveyed for this study. While all variables representing consumers' attitudes towards the importance of production practices load highly on this factor (open range, no antibiotics, no hormones, natural, grass-fed, grazing to preserve streams, grazing to protect endangered species, humane treatment, traceable from farm to consumer, and organic) the practices "Preserve Streams" and "Protect Endangered Species" have the highest loadings (0.76989 and 0.78968 respectively). This factor was found to be very similar, if not nearly identical, to the "Production Practices" factor found by Thilmany, Umberger, and Ziehl (2006) in their study segmenting the natural beef market in Colorado. Other variables that have moderate loadings on factor one are the variables that correspond to the consumers' feelings about the desirability of meat attributes (aged (0.33284), percent lean (0.31848), and country-of-origin labeled(0.34977)).

Almost all of the variables concerning WTP for beef labeled with quality differentiated attributes have slight to moderate loadings on the second factor: WTP for free-range (0.35950); WTP for beef raised without antibiotics (0.30226); WTP for beef raised without hormones (0.37699); WTP for locally produced beef (0.48700); WTP for guaranteed tender (0.60108); WTP for humane treatment (0.51959); and WTP for beef traceable to the farm (0.53570). For that reason, the second factor is simply defined as "Willingness to Pay." This factor explains approximately 15% of the variability in the sample. Factor two is also slightly influenced by the beef attribute, "Nutritional Value" (0.28859), as well as consumers' responses to the question, "Beef with the grass-fed attribute is safer than regular beef" (0.26414). The second factor shares similarities to the "Preference for Sustainable/Local Ag" factor found by Thilmany, Umberger, and Ziehl (2006), a study that sought to understand consumer interest in product and process-based attributes.

The third factor, summarily referred to as "Happy Beef"[16] in this survey, represents attitudes regarding the importance of natural (0.45929) and organic (0.49991) production practices and the desirability of a beef product certified and labeled as organic (0.45934). Factor three explains about 14% of the variability. Other production practices like "No antibiotics" (0.38154) and "No Hormones" (0.485929), qualities typically associated with foods produced organically and naturally, had moderate loadings on factor four, as did the "Grass-fed"(0.35373) production practice. The variable labeled as "Interest", which indicated the consumer response regarding their interest in a beef product that was raised locally, grass-fed, and was produced without antibiotics or supplemental hormones, had a moderate loading on the "Happy Beef" factor (032159). These findings support the idea that consumers may consider the practice of producing grass-fed beef to be similar to organic or natural beef production practices. Furthermore, questions that described grass-fed beef have better eating quality (0.58050), being safer (0.56390), and more nutritional (0.44482) in comparison to the regular retail product also had high loadings on factor three. Notably, this factor had several negative factor loadings for attributes that

[16] "Happy Beef", a passing reference to a popular television commercial, generally describes consumers' perception of cattle raised in an environment in which they are "happy." Evidently, some consumers believe cattle raised on pasture, without supplementary antibiotics or hormones are more "happy" than conventionally produced animals.

could be considered to signal a desire for convenient meat products (pre-seasoned, package size, ready to heat).

Factor four concerns consumers' feelings towards willingness to pay for beef products that are labeled with certain attributes, specifically "Raised without Antibiotics" (0.80514), "Not Fed Antibiotics" (0.81430), and "Raised Without Hormones" (0.72661). Other variables that loaded moderately onto factor four concerned the importance of beef production methods that do not administer growth hormones or antibiotics (WTPNOANTI, WTPNOFED WTPNOHORM) with loadings of 0.28117, 0.26478, and 0.26478 respectively. This factor explains 14% of the variance in the sample.

The fifth factor that emerged from the common factor analysis also dealt with the consumers' responses to questions concerning WTP for certain attributes, specifically the methods in which cattle are fed. Since the highest factor loadings came from the variables dealing with the different methods of feeding cattle (grass-fed (0.82734), grain-fed (0.84955), or pastured (0.60400)), the fifth factor is labeled as "Willingness to Pay for Feed Regimen." This factor explained almost 12% of the variance in the sample. Other WTP variables dealing with local beef production (WTPLOCAL) and beef that was aged (WTPAGED) also loaded onto this factor, but only slightly. Quality as the primary driver of meat purchases also had a slight loading on factor five (0.27422), suggesting that consumers view certain production practices as producing higher quality beef.

Convenience is the best way to describe the sixth factor that surfaced from the analysis. Meat attributes that all suggest little time required for preparation had high loadings on factor six (boneless, ready to heat, package size, pre-seasoned). Other meat attributes such as percent lean (0.34369) and premium brand (0.33932), as well as a preference for chicken loaded moderately (0.24326) on this factor. Although there was a slight positive influence of brand as a desirable attribute (0.33932), there was also a slight negative loading (-0.17177) from the variable depicting brand as a primary driver of meat shopping decisions. This finding implies that while brand is desired, it may not be the decisive factor of a meat purchase for this segment of consumers. Factor six explains about 10% of variability in the survey.

The last and final factor describes 9% of the variance and can be best described as a simply a preference for beef. There was a negative loading for chicken as the preferred meat product (-0.77527), while a very high loading for beef as the preferred meat product (0.86453). Consumers represented by this factor are not concerned by premium brand (-0.09875), ready to heat beef products (-0.14445), package size (-0.05923), pre-seasoned (-0.10133), the leanness of the meat product (-0.15484), or the country-of-origin of the beef product (-0.15345) as indicated by the slight negative factor loadings.

Model Selection and Estimation Procedures

Variable Selection and Expectation

Typical of hedonic analyses, the dependent variable used in this study was the individual consumer's bid for the grass-fed steak in the experimental auction. While actual market transactions would be preferred, the supply of grass-fed beef to retail venues is limited. Thus, the experimental auction was created as a way to simulate the market for grass-fed beef. Unlike studies that rely on consumers' stated WTP, the creation of this "market" allows for consumers' WTP to be revealed. Since the amount that each panelist bid on the grass-fed beef product is reflective of the value that consumer placed on the grass-fed steak, the bid price should be suitable as a dependent variable.

According to demand theory, in addition to product prices and prices of related goods, factors such as a consumer's income, tastes, and preferences are also demand determinants. The consumer survey used in this study yielded numerous possible explanatory variables. Since the number of variables that were thought to be important in explaining consumers' WTP was very large, factor analysis was used to determine any latent variables that could be used as independent variables. The seven latent factors *(Production, WTP for Sustainable Product, Happy Beef, WTP for Perceived Food Safety, WTP for Feed Regimen, Convenience*, and *Preference for Beef*) that resulted from the analysis were expected to have positive signs, with the belief that an increase in the importance or desirability of the underlying variables that comprise the factor would be followed by an increase in the grass-fed bid price.

The variable *LOCATION* was included in the multinomial logit model to see if respondents from a particular location would be WTP a premium for grass-fed beef. The value of this variable was one if the location of the experiment was in Athens, GA and zero if the experiment was conducted in Clemson, SC. At this time, the expected value that this variable will have is unknown. The dummy variable, *SHOPPER*, was also used to account for whether or not the respondent was the primary shopper for their respective household. While there is no expected outcome of this variable at this time, it is important for producers that the primary shopper is actually willing to pay for grass-fed beef.

Since previous research suggests there is a group of consumers who are health conscious, the relationship between the amount of each steak's marbling and the values of consumers' bid on those respective steaks was of interest. Therefore, the variable *MARBLING* denotes the level of marbling measured for each steak sample used in this study. The coefficient of the marbling score is often inconsistent; sometimes it is positive and sometimes it is negative (Melton, Huffman, and Shogren, 1996). Based on Melton, Huffman, and Shogren's (1995) finding that marbling had different effects depending upon the presentation of the product being auctioned, it is believed that the effect of marbling will be negative in the visual presentations and positive in the taste evaluations. Since tenderness has also been shown to affect consumers' WTP for beef, a more objective measure of tenderness was used along with the consumer's sensory tenderness rating. This measure, as described in , represents the value gathered from the Warner-Bratzler shear force analysis and is represented by the variable *WBS*. It is hypothesized that the steak samples with smaller WBS values will elicit greater premiums.

As explained in chapter four, consumers were asked to rank each steak during the taste evaluation for four different sensory characteristics: tenderness; juiciness; flavor; and overall acceptability. When Pearson's correlation technique was conducted, a determination was made that all four of the sensory characteristics were highly correlated, thus potentially causing unexpected results in the estimated model. Since the rankings of tenderness, juiciness, and flavor correlate with the ranking of overall acceptability, only the variable *OVERALL* is used in the model. The overall evaluation of the grass-fed beef steak should correspond to the amount that consumers are WTP for the product. Therefore, this research

proceeds on the supposition that an increase in the overall acceptability ranking will increase the bid for the grass-fed product.

Some dispute exists over whether gender plays a role in the amount someone is willing to pay for a good or service. While Mukhopadhaya et al. (2004) states that, in general, gender should not affect WTP, other researchers have found gender did influence WTP. For example, Umberger et al. (2003) found that female participants were willing to pay a premium for beef that had been labeled with its country-of-origin. Likewise, Lusk et al. (2001) found that females were willing to pay a premium for tender steaks. Considering the previous beef research regarding gender, it seems reasonable that the consumption and purchasing patterns of males and females will be different, with females being more likely to pay a premium.

A consumer's ethnic background and race may also be an important factor in beef consumption. In this study, a question was asked to solicit the participant's background. Possible responses from which the participant could choose included: African/American; American Indian; Asian; Caucasian; Hispanic; and Other. No participants, in this study, claimed to be of an American Indian or Other ethnic background. In 2002, Umberger et al., found that non-Caucasian consumers were more likely to prefer grass-fed beef. Thus, it is hypothesized that the expected sign on the variable *WHITE* will be negative, indicating that non-Caucasian participants are WTP higher prices for grass-fed beef.

The respondent's age is also thought to influence beef consumption patterns and purchases and was therefore requested from each participant. This study used three dummy variables as measures of age: *YOUNG*; *MIDAGE*; and *MATUREAGE*. Following previous literature (Umberger et al., 2003 and Lusk et al., 2001) that found older consumers were more willing to pay for quality differentiated beef products, this study hypothesizes that the amount one is willing to pay for grass-fed beef will increase as the participant's age increases.

The size of one's family may also have an effect on consumer's WTP for grass-fed beef. Previous research (Huang, 1996) has found that participants with larger families were more willing to pay

premiums for produce that had been grown with alternative production (organic) methods. Therefore, one might expect that premiums will be greater among those respondents with larger households.

The consumer survey recorded the level of education that participants have obtained. The lowest education level completed was elementary school, while the highest level was a graduate degree. The variable, *EDUCATION*, was created to measure the effect that a participant's education level may have on the amount they are willing to pay for a specific beef product. This variable can be broken down by four different categories: Less than high school; some college/completed a junior college; completed a Bachelor's degree and/or some graduate coursework; and completed a graduate degree. Since education has shown to play a role in food consumption decisions (Lusk et al., 2001; Huang, 1996), it is believed that those with higher levels of education will pay more for grass-fed beef.

Participants in the study were also asked about their marital status in the consumer survey. Following Huang's (1996) finding that larger families were willing to pay for organic food, the expectation of this variable is that it will increase bid prices in both assessments and the predicted probability that a premium will be paid. Two binary variables, *STUDENT* and *FULLTIME*, were used in the model to account for any differences in employment status among consumers. Since in most cases college students are concerned about finding products that are a good value for the price, it is hypothesized that the student variable will be negative. However, participants who have full-time jobs may actually be willing to pay a premium for a quality differentiated product. Thus, the consumers with full-time jobs are expected to increase the bid amount for the beef steak.

Respondents were asked to report their annual household income before taxes in order to measure the relationship, if any, between income and a grass-fed beef premium. Since many people are reluctant to disclose their exact level of income, participants were asked to choose between twelve different income ranges (Li, McCluskey, and Wahl, 2004). These ranges were grouped into four different dummy variables: *INC_LOW* (annual income less than $29,999); *INC_MED* (annual income between $30,000 and $59,999)*; INC_HIGHMED* (annual income between $60,000 and $99,999)*;* and *INC_HIGH* (annual

income $100,000 or greater). Respondents with higher levels of income are expected to be willing to pay higher premiums for grass-fed beef.

The binary variable *PRODAG* represents whether or not the participant or a close family member was or had previously been involved in production agriculture. Participants who were involved in the conventional methods of production agriculture are likely to negatively value grass-fed beef; however, those who have experience with alternative production systems (i.e. natural/organic) would be more inclined to place a positive value on the grass-fed beef product. Therefore, since this variable could be either positive or negative, no basis for a reasonable presumption regarding this variable's effect on WTP could be drawn prior to the analysis of this survey's data.

Finally, one of the objectives of this study is to determine the role that product information plays on consumer valuation of a grass-fed beef product. Therefore, three binary variables were used to account for the amount of information given at each auction round, *PINFO* (production information only), *PNINFO* (production and nutrition information), and *ALLINFO* (all information and taste test). It is hypothesized that these three variables will be positive in each of the presentation formats, and they will have the greatest influence on the visual presentation.

Functional Form of the Model

An important aspect of estimating a hedonic price function is determining the appropriate form for the model. Unfortunately, economic theory provides little guidance as to the form that is most appropriate. Thus, deciding upon the form to use is ultimately left to the researcher's discretion. Therefore, researchers typically rely on a goodness-of-fit criterion in choosing the best form for the hedonic function. This malleable standard has lead to a variety of functional forms being used in hedonic estimation including: linear; semi-log; double-log; quadratic; and Box-Cox transformations.

In their assessment of the marginal values associated pork attributes, Melton, Huffman, and Shogren (1996) utilized the semi-log function after having first explored and tested alternative forms. One advantage of the semi-log is that the results show the rate of increase or decrease, caused by the

independent variables, in the dependent variable (Coley, 2005). When estimating implicit marginal prices of the quality characteristics of tomatoes, Jordan et al. (1985), found that the Box-Cox functional form performed best. Box-Cox transformations offer the advantage of allowing different transformations of the dependent and independent variables.

In an evaluation of how errors in measuring marginal attribute prices vary with the form of the hedonic price function, Cropper, Deck, and McConnell (1998) found that when all attributes are observed, linear and quadratic Box-Cox forms produce the lowest mean percentage errors. These economists further state that the simpler forms (linear, semi-log, double-log, and the Box-Cox linear) perform the best in cases where variables have been omitted or replaced by proxies. Other studies have also estimated hedonic price functions in the linear form. Rimal, Perkins, and Paschal (2003) used the linear functional form to evaluate the relationship between attributes of specific cattle and beef prices received for those animals at the packers. The linear functional form was also applied to the hedonic model of ground beef prices by Brester et al. (1993), when quantifying the effects that low-fat ground beef would have on the beef market.

For the purposes of this study, a linear functional form was chosen. As a result of the structure of the majority of independent variables used in this model (binary), the double-log form was found inappropriate. Also, since participants were not prohibited from submitting zero bids, Box-Cox transformations, which do not allow for zero values, was an unsuitable functional form. While semi-log forms are typically more flexible, the preliminary analysis showed that the linear specification outperformed that of the semi-log form. Further, since common factors are used as proxies to measure underlying attitudinal factors, the linear model seems most appropriate.

Empirical Models

Prior to the estimation of the hedonic model, a Chow test was conducted using the AUTOREG[17] procedure in the SAS® system to determine if the data could be pooled and let binary variables account for the presentation type, or whether to estimate the model using two separate equations for the presentation formats. Results from the Chow test showed that there were significant differences in the structure of the data set due to the two different presentation formats (p-value <0.0001). Thus, two separate hedonic models were estimated, one for each presentation format, in order to determine both how attributes of the grass-fed beef steak were valued by consumers and the effect of varying amounts of information presented at each round. Unlike traditional hedonic models that only use product attributes as explanatory variables, latent factors and sociodemographic information were included in the model to determine how they affect bid prices for the grass-fed beef product. The following hedonic models were estimated by ordinary least squares:

$$\begin{aligned} GRASS\_BIDV_i = {} & \beta_0 + \beta_1 PRODUCTION + \beta_2 WTP + \beta_3 HAPPYBEEF \\ & + \beta_4 WTPSAFETY + \beta_5 WTPFEED + \beta_6 CONVENIENCE + \beta_7 BEEFPREF \\ & + \beta_8 MARBLING + \beta_9 FEMALE + \beta_{10} WHITE + \beta_{11} YOUNG + \beta_{12} MIDAGE \\ & + \beta_{13} FAMILYSIZE + \beta_{14} EDUCATION + \beta_{15} STUDENT + \beta_{16} FULLTIME \\ & + \beta_{17} MARRIED + \beta_{18} INC\_MED + \beta_{19} INC\_HIGHMED + \beta_{20} INC\_HIGH \\ & + \beta_{21} PRODAG + \beta_{22} PINFO + \beta_{23} PNINFO + \varepsilon_i \end{aligned} \quad \text{Equation 5.1}$$

$$\begin{aligned} GRASS\_BIDT_i = {} & \beta_0 + \beta_1 PRODUCTION + \beta_2 WTP + \beta_3 HAPPYBEEF \\ & + \beta_4 WTPSAFETY + \beta_5 WTPFEED + \beta_6 CONVENIENCE + \beta_7 BEEFPREF \\ & + \beta_8 MARBLING + \beta_9 WBS + \beta_{10} OVERALL + \beta_{11} FEMALE + \beta_{12} WHITE + \beta_{13} YOUNG \\ & + \beta_{14} MIDAGE + \beta_{15} FAMILYSIZE + \beta_{16} EDUCATION + \beta_{17} STUDENT \\ & + \beta_{18} FULLTIME + \beta_{19} MARRIED + \beta_{20} INC\_MED + \beta_{21} INC\_HIGHMED \\ & + \beta_{22} INC\_HIGH + \beta_{23} PRODAG + \beta_{24} ALLINFO + \varepsilon_i, \end{aligned} \quad \text{Equation 5.2}$$

[17] The Chow test is commonly used in time series analysis. To the author's knowledge, the AUTOREG procedure is the only procedure in SAS that contains the option for a test in structural differences.

Equation 5.1 is the hedonic model estimated for the visual evaluation of the grass-fed steak, while Equation 5.2 represents the model for the taste evaluation of the product. A full description of each variable, along with their respective means, and expected signs are presented in Table 5.2.

The Multinomial Logit Model

In the last round of the auction, consumers were asked to combine all of the production and nutrition information given about each beef steak being valued with a taste test. While the information gathered from the visual presentations was important because it signals whether the initial purchase would be made in a retail setting, the taste portion of the auction is substantially significant since it can identify potential repeat purchasers. Therefore, it is hypothesized that regardless of consumer attitudes towards food safety, nutrition, and production practices, if participants do not value the taste of the grass-fed beef then they will not purchase the product from retailers subsequently. Therefore, consumers who valued the grass-fed beef steak highly even after a taste test have the greatest potential of becoming the producers' target-market segment.

In addition to identifying the consumers who are willing to pay for a novel good, the introduction of a new product into the marketplace also involves the delineation of consumers that are willing to pay a premium. For that reason, a multinomial logit model was estimated. Logit models have been used in various studies regarding consumers' WTP for agricultural products and the identification of target-market segments (Umberger et al., 2002; Maynard, Burdine, and Meyer, 2003; and Lusk et al., 2001). Following the theoretical underpinnings of the multinomial logit model, the following model was estimated:

$$WTPPREM_i = f(\ PRODUCTION,\ WTP,\ HAPPYBEEF,\ WTPSAFETY,\ WTPFEED,\ CONVENIENCE,\ BEEFPREF,\ LOCATION,\ MARBLING,\ WBS,\ OVERALL,\ FEMALE,\ WHITE,\ YOUNG,\ MIDAGE,\ FAMILYSIZE,\ EDUCATION,\ STUDENT,\ FULLTIME,\ MARRIED,\ INC\_MED\ INC\_HIGHMED,\ INC\_HIGH,\ PRODAG,\ ALLINFO)$$

Equation 5.8

where the dependent variable, WTPPREM is a categorical variable used to represent the premium amount a consumer is WTP. If consumers are not willing to pay a premium of 17% or more then the value that WTPPREM takes is 0. If consumers are willing to pay at least a 17% premium for the grass-fed steak, then WTPPREM equals 1. Finally, WTPPREM will be 2 if consumers are willing to pay at least a 50% premium. The descriptions of the right hand side variables are presented in Table 5.2.

The premium levels (17% and 50%) that are used are not random, but rather based on findings from the limited research detailing producers' willingness-to-accept. In 2005, a group of economists from The University of Georgia surveyed cattle producers within a 100 mile radius of Carrollton, GA (this included parts of Alabama) to determine the producers' interest in producing, processing, and marketing a grass-fed beef product (Wolfe, Best, and Hodge, 2005). Using a contingent valuation survey and acknowledging that it would take 20 months from birth to fatten a calf on grass, the premium amount that producers would need to in order to produce grass-fed beef was extracted. The median premium value was $0.40/lb. According to the USDA Economic Research Service (ERS) 2005 statistics, the farmer's share of the retail price of choice beef and all-fresh beef was about 46.9%. Therefore, the additional amount that cattle producers would need to produce grass-fed beef was calculated to equal approximately $0.85/lb ($0.40 price premium needed divided by the farmers share of the retail price in 2005). Using the values obtained from the experimental auction, this amount would equate to about a 17% relative price premium (the average bid for the grain-fed steak was $5.05/lb, so $0.85/$5.05 is an approximate 17% relative price premium).

However, this estimate is with limitations and may undervalue the premium amount needed by producers to produce process and market grass-fed beef. Therefore, an example of a retail beef budget was obtained from Dr. Curt Lacy with the University of Georgia so as to obtain a contrasting measure of the amount grass-fed beef producers would need to receive to break-even. The retail beef budget was an example of the costs and revenues associated with the direct

marketing of 30 beef carcasses with only one full-time person and manager. Dr. Lacy found that the total break-even price needed to produce grass-fed beef cattle would be about $1.50/lb ($148.30/cwt). If processing and marketing costs were also considered, the break-even price needed to cover total costs escalated to about $7.83/lb. Viewed in the context of the bid prices gathered from this study's experimental auction, a required premium of $2.78/lb ($7.83 minus $5.05), or an approximate 50% relative premium, was obtained. However, similar to the 17% premium estimate, this suggested, required premium can not be proffered without the presentation of some corresponding questions about its underlying assumptions. Thus, further research is needed to determine the actual costs associated with the market development of a grass-fed beef product.

Therein rests the need for a multinomial logit model—to determine the segment of consumers willing to pay a premium amount that would be considered a lower level premium (17%) and those that value grass-fed beef at the upper level premium (50%). Results from the estimated logit model should provide insight into the consumer that is willing to pay a premium at either or both amounts.[18]

The procedures outlined in this chapter should provide a greater understanding for the value consumers place on certain attributes of grass-fed beef and the role of information and presentation in grass-fed beef evaluation. Moreover, the results from the multivariate regressions will further producers' knowledge as to the role that consumers' attitudes and sociodemographic backgrounds play in the valuation of grass-fed beef. Finally, the estimated multinomial logit model will assist producers' with the marketing of their grass-fed and finished beef products by supplying essential information about the consumer profile that represents a sustainable target market.

[18] Regardless of the accuracy of the premium amounts used, there is evidence of a niche market for grass-fed beef products. Will Harris, owner of White Oak Pastures, is receiving premiums for producing, processing, and marketing a quality differentiated product. Rather than selling different cuts of beef, White Oak Pastures processes traditional premium cuts of steak into a high quality ground beef product.

Model Diagnostics

When applying the ordinary least squares method of regression, there are several assumptions that must be met, most importantly, when dealing with cross-sectional data, the absence of multicollinearity and heteroscedasticity. A violation of the assumptions underlying OLS would result in the estimates obtained from the regression to no longer be BLUE (Best Linear Unbiased Estimate). Multicollinearity exists when there is an exact relationship between any of the independent variables. In most cases there will not be perfect collinearity; rather cases arise where independent variables are highly correlated. While it is possible to obtain the least-squares estimates of the regression coefficients, the interpretation of the coefficients will be difficult (Pindyck and Rubinfeld, 1991). The easiest way to determine if multicollinearity is problematic is to examine the standard errors of the coefficients. (Pindyck and Rubinfeld, 1999). Steps were taken to check for the presence of multicollinearity in the data, and the results were discussed in chapter four. Although multicollinearity does not alter the estimates from being unbiased, consistent, or efficient, the presence of heteroscedasticity does adversely impact these estimates.

Heteroscedasticity occurs when the assumption of constant variance is violated. In the case of heteroscedasticity, the assumption that the error terms are unrelated, or independent from one another, still holds, but the variance of the error terms varies by observation. Heteroscedasticity can arise for a number of reasons, such as the presence of outliers or important variables being omitted from the model, but it is more common in cross-sectional data than in time series data (Gujarati, 1995). When the assumption of homoscedasticity does not hold, despite retaining the properties of being linear and unbiased, the OLS estimates will no longer be "efficient" or "best." Further, since the standard error is based on the estimators of the variances of the coefficients, the presence of heteroscedasticity will invalidate the standard error for constructing t-statistics. Therefore, inaccurate standard errors result in misleading assumptions about the model.

To check for heteroscedasticity, the predicted values of the variables in the model were plotted against the residuals of the regression, and the Breusch-Pagan test for homoscedasticity was applied. The

Breusch-Pagan test statistic follows a χ^2 distribution and is equal to half of the regression sum of squares. While the interpretation of scatter plots did not yield obvious results of heteroscedasticity, the result from the Breusch-Pagan test for both models is significant and the null hypothesis of homoscedasticity was rejected. Therefore, there is reason to believe that the empirical model suffers from heteroscedasticity.

If the functional form of heteroscedasticity is known, (i.e. we "know" the pattern to the variance of the errors), then it can be corrected either by transformation of the variables or by weighting the variables. For this study, several methods were applied and many transformations made to try and correct the apparent heteroscedasticity. Usually, a simple log-transformation can correct for heteroscedasticity, however from the QQPlot, and the Breusch-Pagan test on the transformed model did not rid the data of unequal variance. Applying Weighted Least Squares (WLS) is also helpful when correcting for heteroscedasticity; however the form that heteroscedasticity takes must be known in order to "weight" the model with the appropriate variable. While WLS was initially applied to the variables that were thought to be causing the unequal variance, this corrective measure also proved unsuccessful. Therefore, the model was estimated in spite of the presence of heteroscedasticity. Since heteroscedasticity can cause confidence intervals and t-statistics to be misleading, caution should be applied when interpreting the results from these hedonic models.

Table 5.1 Factor Loadings

	Factor Loadings						
Variable	**Factor 1: Production Practices**	**Factor 2: Willingness to Pay**	**Factor 3: Happy Beef**	**Factor 4: Willingness to Pay for Perceived Food Safety**	**Factor 5: Willingness to Pay for Feed Regimen**	**Factor 6: Convenience Attributes**	**Factor 7: Preference for Beef**
Meat Product Most Preferred to Consume							
Beef	-0.09055	0.04208	-0.15375	0.08482	0.02525	-0.02288	0.86453*
Chicken	0.00461	-0.02863	0.07684	-0.04922	-0.12582	0.24326	-0.77527*
Lamb	-0.00376	-0.08800	0.01547	-0.03208	0.05201	-0.00596	-0.04134
Fish	0.10815	0.05435	0.10337	-0.03918	0.09088	-0.26146	-0.12791
Pork	0.02968	-0.06796	0.13830	-0.04906	0.05312	-0.09500	-0.03355
Primary Driver of Meat Shopping Decisions							
Value for Price	0.07002	-0.08290	0.17580	0.10579	-0.10146	0.06319	-0.17210
Fits Budget	-0.00376	0.03892	-0.01278	0.10193	-0.13063	-0.08594	-0.01347
Quality	0.05915	0.08406	0.00750	-0.01956	0.27422	-0.19661	0.03722
Brand	-0.18568	-0.24235	-0.04832	-0.11386	-0.01973	-0.17177	0.08038
Cut	-0.01681	0.07127	-0.03614	-0.02748	0.11181	-0.00522	-0.06844
Cooking Occasion	-0.10665	0.06705	-0.12547	-0.19387	-0.15248	0.08535	0.07036
Package Size	0.03258	-0.00823	-0.11766	0.16912	-0.02941	0.08058	-0.27224
Nutritional Value	0.07662	-0.13476	0.07345	0.07985	0.06503	0.07140	-0.27224
Preparation Time	-0.01766	0.01596	-0.10334	0.02098	0.01523	0.11430	-0.14820
Importance of Production Practices (1 to 5, 5=Extremely Important							
Open Range	0.56533*	0.15213	0.06561	0.06561	0.02402	0.02329	0.06904
No antibiotics	0.65317*	-0.13916	0.38154*	0.28117	0.04728	0.00152	-0.05679
No Hormones	0.62803*	-0.12321	0.48418*	0.26478	-0.01928	-0.11411	0.00676
Natural	0.64510*	-0.03801	0.45929*	0.14344	-0.02147	-0.02871	-0.05770
Grass-fed	0.63960*	0.35373	0.35373*	-0.05995	0.10044	-0.02108	-0.02877
Preserve Streams	0.76989*	0.07406	0.09567	-0.00532	0.02522	-0.02011	0.07335
Protect Endangered Species	0.78968*	0.04533	0.03410	0.06947	0.00914	0.07131	-0.08595

Variable	Factor 1: Production Practices	Factor 2: Willingness to Pay	Factor 3: Happy Beef	Factor 4: Willingness to Pay for Perceived Food Safety	Factor 5: Willingness to Pay for Feed Regimen	Factor 6: Convenience Attributes	Factor 7: Preference for Beef
Humane Treatment	0.68455*	0.11216	-0.05170	0.03307	-0.02622	0.10318	0.11860
Traceable from Farm to Consumer	0.62105*	0.22247	-0.05477	-0.01315	-0.08443	0.02952	-0.05080
Organic	0.52754*	-0.01840	0.49991	-0.01899	0.05077	-0.18127	-0.05079
Desirability of Meat Attribute (1 to 5, 5 = Most Desirable)							
Organic	0.23177	0.00397	0.45934*	0.04277	0.07740	-0.08814	-0.00712
Value for Price	0.13569	-0.07306	0.12776	0.03318	-0.07864	0.26805	0.07257
Nutritional Value	0.05114	0.28859	-0.02808	-0.05034	0.03591	-0.05150	0.07756
Fresh	0.26897	0.00270	0.12732	0.00659	0.12897	0.16158	0.05440
Aged >14 days	0.33284*	0.11074	-0.01708	-0.01708	0.08286	-0.00178	0.05090
Boneless	0.08593	-0.08110	0.09167	-0.04446	-0.03509	0.51812*	0.00312
Premium Brand	0.23215	0.18082	0.11088	0.03271	0.02264	0.33932*	-0.09875
Ready to Heat	0.02137	-0.09933	-0.09933	-0.06512	0.05132	0.60342*	-0.14445
Package Size	0.02692	0.03825	-0.08455	0.07446	-0.02794	0.61162*	-0.05923
Pre-Seasoned	-0.07338	0.04982	-0.00480	-0.12176	0.03605	0.46750*	-0.10133
Percent Lean	0.31848*	0.07782	0.06858	0.18894	-0.10570	0.34369*	-0.15484
Country of Origin Labeled	0.34977*	0.09995	0.00179	0.03959	-0.05286	0.05830	-0.15345
Purchased Grass-fed Beef (Yes=1)	0.12793	0.13700	-0.16534	-0.16534	-0.16113	-0.04020	-0.06143
Locally Grown Beef Product that is: grass-fed; not fed antibiotics; raised with no supplemental hormones (1 to 10, 10 = Extremely Interested)							
Interest	0.30410*	0.02839	0.32159*	0.32159	-0.06652	0.06963	0.05657
Maximum Willingness to Pay (1 to 6, 1 = < typical retail price, 2 = retail price, 3 = 10%, 4 = 25%, 5 = > 25%, 6 = would not purchase)							
Grass-Fed	-0.06548	0.05614	0.12858	0.12858	0.82734*	-0.06007	-0.00002
Pastured Beef	0.04348	0.11820	0.15225	0.15225	0.84955*	-0.01835	-0.05107
Grain-Fed	0.02690	0.28671	0.10292	0.10292	0.60400*	0.07823	-0.04626
Free-Range	0.15298	0.35950*	0.29862*	0.29862*	0.35493*	-0.15792	-0.01476

Variable	Factor 1: Production Practices	Factor 2: Willingness to Pay	Factor 3: Happy Beef	Factor 4: Willingness to Pay for Perceived Food Safety	Factor 5: Willingness to Pay for Feed Regimen	Factor 6: Convenience Attributes	Factor 7: Preference for Beef
Raised Without Antibiotics	0.03712	0.30226*	0.05546	0.80514*	0.06901	-0.05607	-0.05022
Not Fed Antibiotics	0.01625	0.23857	0.07936	0.81430*	0.11463	0.00915	-0.04815
Raised Without Hormones	0.13444	0.37699*	0.16207	0.72661*	0.08918	-0.04557	-0.03059
Raised Locally	0.06222	0.48700*	0.04199	0.37054*	0.21402	0.02498	0.02165
Guaranteed Tender	0.00851	0.60108*	0.07073	0.30587*	0.17638	0.10024	-0.03576
Aged	0.07169	0.03262	0.03262	-0.11626	0.22050	0.04803	-0.05108
Humane Treatment	0.23430	0.51959*	0.01741	0.12935	0.08130	0.12993	-0.09661
Traceable to the Farm	0.14982	0.53570*	0.09749	0.26666	0.04748	-0.04975	-0.02963
Natural	0.10744	0.18966	0.18966	0.11220	0.14531	0.09625	0.06164
Organic	-0.04918	0.17720	0.17720	0.06618	-0.03173	-0.14266	-0.03186
Beef with Attribute has better Eating Quality than Regular (Yes = 1)							
Grass-Fed	0.04671	0.17370	0.58050*	-0.00187	0.06558	0.05711*	0.05369
Beef with Attribute is Safer than Regular (Yes = 1)							
Grass-Fed	0.13560	0.26414	0.56390*	0.05216	0.06321	0.03374	-0.06564
Beef with Attribute is more Nutritional than Regular (Yes=1)							
Grass-Fed	0.03008	0.15090	0.44482*	0.06918	0.00172	0.11679	-0.05274

Factor	Variance	Difference	Proportion	Cumulative
1	5.229931	2.124861	0.258603	0.258603
2	3.10507	0.25753	0.153536	0.412139
3	2.84754	0.019449	0.140802	0.552941
4	2.828091	0.453501	0.13984	0.692781
5	2.374591	0.364266	0.117416	0.810197
6	2.010324	0.182124	0.099404	0.909601
7	1.8282	0.000000	0.090399	1.000000

Table 5.2 Description of Variables Used in Models

Variable	Definition	Mean	Standard Deviation	Expected Sign/ Visual	Expected Sign/ Taste
Grass_bidV	Consumers' bid in visual evaluations	5.0511	2.1459		
Grass_bidT	Consumers' bid in taste evaluation	4.5865	2.2217		
WTPPrem	= 0 if consumers are not WTP 17% premium, 2 if consumers are WTP at least a 17% premium, 3 if consumers are WTP at least a 50% premium	0.4511	0.6377		
Production	Standardized Factor Scores for Factor 1	0	1	Positive	Positive
Wtp	Standardized Factor Scores for Factor 2	0	1	Positive	Positive
HappyBeef	Standardized Factor Scores for Factor 4	0	1	Positive	Positive
WtpSafety	Standardized Factor Scores for Factor 3	-0	1	Positive	Positive
WtpFeed	Standardized Factor Scores for Factor 5	0	1	Positive	Positive
Convenience	Standardized Factor Scores for Factor 6	0	1	Positive	Positive
BeefPref	Standardized Factor Scores for Factor 7	0	1	Positive	Positive
Location	= 1 if Athens, 0 if in Clemson	0.4976	0.5009	Unknown	Unknown
Shopper	= 1 if respondent is primary shopper for household, 0 otherwise	0.7348	0.4414	Unknown	Unknown
Marbling	Level of marbling for each sample	358.6201550	56.0566	Negative	Positive

WBS	Warner-Bratzler shear force value	4.3292	0.8643	Negative	Negative
Overall	= 1 to 8, (1=extremely unacceptable, 8 =extremely acceptable)	5.2713	1.4888	Positive	Positive
Female	= 1 if female, 0 if Male	0.5627	0.4964	Positive	Positive
White	= 1 if white, 0 otherwise	0.7907	0.4071	Negative	Negative
Young	= 1 if age < or = 29 years, 0 otherwise	0.2604	0.4392	Negative	Negative
MidAge	= 1 if age is between 30 and 49 years, 0 otherwise	0.4279	0.4951	Positive	Positive
MatureAge*	= 1 if age is over 50 years, 0 otherwise	0.3116	0.4636	Negative	Positive
FamilySize	= 1 if size of family is1, 2 if size of family is 2, 3 if size of family is 3, 4 if family size is > 4	2.2930	1.1390	Positive	Positive
Education	= 1 if education is less than high school, 2 if education is some college or junior college, 3 if college graduate or some graduate work, 4 if graduate degree	2.6930	1.0390	Positive	Positive
Student	= 1 if respondent is a student, 0 otherwise	0.1302	0.3368	Negative	Negative
Full-time	= 1 if respondent is employed full-time, 0 otherwise	0.7256	0.4466	Positive	Positive
Not Employed*	=1 if respondent is not employed, 0 otherwise	0.0744	0.2627	Not estimated	Not estimated
Married	= 1 if respondent is married, 0 otherwise	0.5767	0.4945	Positive	Positive
Inc_Low*	= 1 if respondent's annual household income is less than $29,999, 0 otherwise	0.2139	0.4104	Not estimated	Not estimated

Inc_Med	= 1 if respondent's annual household income is between $30,000 to $59,999, 0 otherwise	0.2651	0.4417	Positive	Positive
Inc_HighMed	= 1 if respondent's annual household income is between $60,000 to $99,999, 0 otherwise	0.2744	0.4465	Positive	Positive
Inc_High	= 1 if respondent's annual household income is $100,000 or more, 0 otherwise	0.1488	0.3562	Positive	Positive
Prodag	= 1 if family is involved in production agriculture, 0 otherwise	0.2651	0.4417	Unknown	Unknown
Pinfo	= 1 if Auction round was round 4, 0 otherwise	0.3333	0.4717	Positive	
PNinfo	=1 if Auction round was round5, 0 otherwise	0.3333	0.4717	Positive	
AllInfo	= 1 if Auction round was round6, 0 otherwise	0.3333	0.4717		Positive

Note: Variables with asterisk are used as baseline groups and are not entered into the model

CHAPTER SIX

RESULTS

The purpose of chapter six is to present the results from the estimated empirical models. The initial discussion focuses on the two traditional hedonic models that were estimated for each presentation format. After determining the value that consumers place on grass-fed beef attributes and reviewing the factors that affect the bid prices, the results from the multinomial logit model are explained. Based on the logit model results, the market for grass-fed beef can be segmented by consumer groups and the outcome can be disseminated to interested producers.

Results from the Hedonic Price Analysis

The models specified in Equations 5.1 and 5.2 were analyzed using the SAS® System. The parameter estimates, t-values, and p-values resulting from the OLS regression are presented in Table 6.1. The F-values for each model are significant (<0.0001), thus the group of independent variables used in the regressions make a statistically significant contribution to explaining individual bid prices in the two presentation formats. When the consumers completed a visual evaluation, the models predict about 19% of the variability in the grass-fed beef bid prices. However, the model used to estimate the marginal values from the taste analysis has an R-square of 0.30. Considering the structure of the data, these R-square values are very acceptable.

Latent Factors

During the visual auction rounds, since consumers' were unable to pair a taste evaluation with the steak that was being evaluated, consumers may have relied more heavily upon their own preferences and attitudes before placing their bids on the grass-fed steak. As a result, all but one of

the latent factors, *WTPFEED*, has the expected sign in the visual presentation model. Two of the factors, *HAPPYBEEF* and *CONVENIENCE*, are significant at the 5% level. When consumers increased the level of importance they place on convenience attributes by one unit, their individual bid increased by a magnitude of 0.1948. Similarly, a one unit increase of their stated willingness to pay for beef that exhibited certain health or safety attributes increases their bid amount by 0.1468. However, when the grass-fed beef steaks are analyzed in the taste presentation, some of the signs on the latent factors have an unexpected negative change. For instance, an increase in the importance of variables underlying the latent factor *PRODUCTION* increased the bid placed on the grass-fed steak by about 0.0032 in the visual evaluations. However, it significantly decreases individual bid prices by 0.2227 when the level of importance for beef production practices increase. Furthermore, although *HAPPYBEEF* is significant in the visual evaluation, it has an unexpected negative outcome in the taste evaluation. Consumers' attitudes regarding food safety (measured by *WTPSAFETY*) was consistently positive across presentation formats, though not significant at any level. The factor measuring a participant's preference for beef increases grass-fed bids by 0.2628 when *BEEFPREF* increases by one unit.

Beef Attributes

Melton, Huffman, and Shogren (1996) asserted that marbling scores were consistently important in explaining market prices. In that study, they found that the value consumers placed on marbling changed for each presentation format. However, the variable that represents the marbling score is unexpectedly positive in the visual format. While consumers usually discount beef products when they perceive too much visible fat, quite contrarily in this case, an increase in the amount of marbling increased the value that consumers placed on the grass-fed beef steak. But, the amount that marbling increased the price was very small (0.0047). A possible explanation as to why marbling had a positive effect is while consumers may value grass-fed beef for reasons other than nutrition (i.e., food safety or environmentally sound production practices), they still desire a certain amount of marbling.

During the fourth and fifth round of the auction, information related to the production practices of grass-fed beef was given to consumers. The dummy variable, *PINFO*, was created to measure the effect that information had on individual bids for the grass-fed product. As expected, the sign on this variable is positive and it has a statistically significant (at the 0.01 level) impact on the grass-fed beef price. This finding affirms the belief that the provision of production information positively influences the amount that consumers are willing to pay for a grass-fed steak. The second dummy variable used to distinguish round five, where consumers were given nutritional information about grass-fed beef, is also positive and statistically significant. These findings indicate that the amount consumers are willing to pay for grass-fed beef, initially, is greatly impacted by the presence of information.

Consumers were asked to rank four sensory characteristics (tenderness, juiciness, flavor, and overall acceptability) on a scale of one to eight for both the grass-fed and grain-fed steak during the taste evaluation. Correlation coefficients that were calculated during the preliminary analysis revealed a high degree of correlation between all four of the sensory characteristics. Therefore, with the exception of *OVERALL*, all sensory variables were removed to prohibit any adverse effects of multicollinearity. Results presented in Table 6.1 reaffirm the expectation that steaks ranked high for overall acceptability would also receive greater bid prices than those with a lower ranking. A one point increase in the rating (or ranking) of overall acceptability significantly (at the 0.01 level) impacts the consumers' bid by an amount of $0.5462/lb.

Table 6.1 also presents evidence that tenderness, as measured by the Warner Bratzler Shear Force Analysis, has a significant influence on the amount that participants are willing to pay for grass-fed beef. As expected, grass-fed beef prices decrease by $0.41/lb when the variable *WBS* increases by one unit of shear force (indicating a tougher steak). This finding confirms the previous supposition that tenderness is an important factor in the valuation of beef steaks (Lusk et al., 2001).

The positive coefficient on the variable *MARBLING* validates the prior belief that the additional "mouth feel" provided by more marbling would be highly valued by consumers when the grass-fed steak was evaluated based on taste. An increase in the amount of marbling significantly increases the bid

amount placed on the grass-fed steak by consumers by $0.0033/lb. Previous research found that a small amount of fat provides extra flavor and juiciness that consumers value (Melton, Huffman, and Shogren, 1996). This finding is important to potential grass-fed beef producers who want to ensure an adequate amount of marbling without compromising their grass-only production system. The selection of cattle breeds with naturally-occurring, high levels of marbling is at least one alternative available to interested producers committed to growing humanely treated and environmentally friendly beef cattle with an adequate amount of marbling.

Similarly to the visual presentation, when information was paired with a taste evaluation, the magnitude of the estimate representing all information, *ALLINFO*, was large ($0.89/lb) and statistically significant. When viewing the results from the estimated hedonic model on the taste evaluation data, it can be inferred that while information has a high implicit value, variables that signal product quality (overall acceptability and the Warner-Bratzler shear force value) are also important in securing repeat customers.

Sociodemographic Information

Most of the sociodemographic variables have the anticipated effects and are consistent across the two presentation formats. The demographics of consumers having a significantly (at the 1%, 5%, or 10% significance levels) positive effect on the bids in the visual format were female, had a higher level educational attainment, and were married. Regardless of the presentation format, participants who are middle aged, have larger families, are employed full-time, and classify themselves as being in the medium (or middle) income bracket tend to bid less on the grass-fed steak. This finding contradicts the expectation that consumers with larger families would be WTP for grass-fed beef. Surprisingly, consumers in the lower level income bracket apparently value grass-fed beef more highly when presented in the visual evaluation. Consumers with involvement in agriculture bid less than those who had no involvement in production agriculture.

When comparing the effects of the sociodemographic data on individual bids between the two presentation formats, the data in Table 6.1 demonstrates that most of the signs on the parameters remain unchanged; however, their level of significance is not constant. While females continue to pay more for grass-fed steaks, the effect is no longer significant in the taste test. The variable *WHITE* becomes negative and significant in the taste presentation. Contrary to the expected sign, after tasting the grass-fed steak, older consumers tended to bid less than their younger counterparts. Consumers with medium-high and high levels of income tended to bid more for the grass-fed steak than the lower income respondents, which is opposite of the results from the visual presentation. Surprisingly, since higher levels of income are generally associated with a full-time employment, consumers employed fulltime bid less for grass-fed beef. One possible explanation of this counter-intuitive result is there may be a significant portion of respondents who view steak in terms of home preparation. If participants with fulltime jobs have less time to devote to preparing meals at home, (the opportunity costs increase proportionally to the additional preparation time) then the amount they would be willing to pay for a steak would decrease.

The effects of educational levels are similar in the taste presentation format as in the visual evaluation; the amount participants are willing to pay for the grass-fed steak increases as the level of education increases. Finally, after tasting the grass-fed steak, consumers claiming involvement in production agriculture increase the bid price of the grass-fed steak by a level of 0.2549.

Results from the Multinomial Logit Model

The multinomial logit model was estimated as a method of determining the potential target market for grass-fed beef. Since the last round, where consumers had full information, is most likely to indicate the consumers who are likely to make subsequent purchases of grass-fed beef, only the data obtained from that round is used. While the hedonic valuation models also included sociodemographic variables, there, those variables were used primarily for explaining variation in individual bid prices for the grass-fed steak. However, the multinomial logit model provides

insight into the marginal probabilities that certain consumers will choose to pay either less than a 17% premium, a premium greater than or equal to 17%, and those who value grass-fed beef enough to pay a 50% premium. The coefficients in Table 6.2 are the predicted change in probability that a consumer would not be WTP a premium of at least 17%, be WTP at least a 17% premium, or be WTP at least a 50% premium based on a one unit increase in the value of the independent variable. The predicted changes in probabilities should be viewed as relative changes rather than absolute changes. The model's chi-squared value is 109.8596 and is significant at the 0.01 level. The results are presented in Table 6.2.

Although in the hedonic model, *HAPPYBEEF* decreased the average bid prices for grass-fed beef, results from the multinomial logit model indicates that increasing the importance of those variables represented by the latent factor *HAPPYBEEF* actually increases the probability that a consumer is willing to pay a 17% premium by the amount of 5.07%. While this would seem inconsistent at first, recall that the hedonic model analyzes the variables that cause an increase or decrease in the average bids for all consumer bids (it does not differentiate between consumers who are WTP and those who are not). However, the multinomial logit model allows an evaluation of the factors affecting the probability that a consumer will choose a certain choice—in this case the choices are to not pay a premium, to pay at least a 17% premium, or to pay a least a 50% premium. Since that particular latent factor is mostly correlated with consumer interest in grass-fed beef and/or those closely related (natural and organic) production methods, the logical conclusion follows that consumers who highly value this factor will also place a higher monetary value on a grass-fed beef product. An increase in the importance of the latent factor *WTPFEED* decreases the probability of a participant paying at least a 17% premium by 6.83%. Finally, the coefficient for *WTPSAFETY* was positive for both premium levels estimated (17% and 50%).

The variable *SHOPPER* represents whether or not the respondent considers themselves to be the primary grocery shopper in their household. Consumers that listed themselves as the primary shopper increased the probability of paying a 17% premium by 16.41%. If the participant

was female, the probability that she would pay a premium of 17% or more increased by 12.13%. Also, consumers with smaller families are more likely to pay a premium for grass-fed beef at the 17% level. As shown in Table 6.3, an increase in the size of the family decreased the probability of a 17% premium by 6.48%.

During previous estimations and prior to the multinomial logit model being estimated, the variable representing whether a respondent classified themselves as a student had not shown any level of significance. However, as evidenced by Table 6.3, students are 23.72% more likely than non-students to pay a premium of at least 17%. As revealed in Table 6.3, married respondents are also 17.12% more likely to pay a premium of 17%.

Consistent with expectations, consumers reporting a high ($100,000 or more) annual household income are more willing to pay a premium for grass-fed beef. As a matter-of-fact, high earning individuals increase the probability by an amount higher than any of the other variables used in the estimation—32.36%. Lastly, consumers with a previous involvement or connection with production agriculture contributed to an 18.2% decrease in the probability of being WTP a 17% premium.

There are similarities in the consumer profile of those WTP at least a 17% premium and those who are willing to pay a 50% premium or more. Regarding the latent factors, an increase in the importance of the factor *HAPPYBEEF* increases the probability of paying a 50% premium for grass-fed beef by 2.22%. Consumers surveyed in the Athens, GA location were 5.97% more likely to pay a 50% premium compared to the consumers in the Clemson, SC location.

As was the case with the 17% premium, those consumers who are the primary grocery shoppers increase the probability of paying a 50% premium for the grass-fed steak by 7.20%. Surprisingly, female consumers decreased the probability by 3.85%. Thus, unlike at the lower 17% premium, males are more likely to pay a 50% premium than are females.

Based on the results in Table 6.2, an inference should be drawn that older consumers are more likely than other age groups to highly value grass-fed beef products. Both age variables used

in the multinomial logit model, *YOUNG* and *MIDAGE*, decrease the chance of a consumer's willingness to pay a 50% premium by the respective amounts: 6.53% and 5.67%. Lastly, an increase in the size of the respondents' family is shown to decrease the likelihood that a consumer will pay a 50% premium by 2.11%.

Concluding Remarks on the Empirical Analysis

Results from the estimated hedonic models show that consumers valued an increase in marbling for both presentations. Consumers also highly valued the tenderness of the steak, which supports previous findings that tenderness is one of the most important characteristics to beef consumers (Lusk et al., 2001). Reaffirming the belief that in order for grass-fed beef to become a successful niche market, producers must label and market their products using the production and nutritional information, this analysis indicates that consumers highly valued the binary variables that were used as proxies for information. Latent factors that surfaced from the factor analysis play a larger role in the valuation of grass-fed beef for the visual format. Two of the latent factors are significant at the .05 significance level: *HAPPYBEEF* and *CONVENIENCE*. However, the expected signs of some of the latent factors changed when they were used as explanatory variables in the taste test model. That change in the expected sign reaffirms the belief that consumers' bids are affected more by taste and information than anything else. Consumer demographics that influenced the bid prices in the visual evaluation were: female, young, higher education levels, married, and no involvement with production agriculture. Likewise, the sociodemographic information that impacted bids in the taste evaluation are: non-Caucasian; smaller family sizes; and higher earning individuals.

A multinomial logit model was used to gain a better understanding of the target market for producers. The results of the model indicate that consumers who valued *HAPPYBEEF*, but did not value *WTPFEED* or *CONVENIENCE* were more likely to pay at least a 17% premium. This segment also includes primary shoppers for the households, women, and smaller family sizes. Consumers who exhibited characteristics of being students, married, and having no previous involvement with production

agriculture were likely to pay a premium for grass-fed beef. Finally, as expected, participants that reported high levels of annual household income are also among the segment of consumers willing to pay premiums of at least 17%.

The segment of consumers who valued grass-fed beef at a 50% premium is also more likely to find the variables contributing to the *HAPPYBEEF* factor important. More survey panelists in Athens, GA than in Clemson, SC were willing to pay this 50% premium. Further, participants in this sample who were the primary grocery shoppers for their respective households increased the predicted probability of a 50% premium being paid. Other demographics of this segment included males, older consumers, and consumer with smaller sized families.

Results from these empirical models give producers a clearer picture of the attributes possessed by grass-fed beef that are most valued by consumers. Furthermore, the variables that represented the information given to consumers were found to be statistically significant in all of the estimated models. Because grass-fed beef is a multi-faceted product, producers have several options to consider when marketing the product. More specifically, results from this study show that producers may market their product by appealing to consumers' propensity to value tenderness, perceived safer products (no antibiotics or hormones), "naturalness" of beef, or "happy" beef, and convenient beef products. Finally, producers should be aware of the demographic that makes up their target market and develop strategies to market their grass-fed beef produce to such segments.

Table 6.1 Results of the Hedonic Price Analysis

	Visual		Taste	
Parameter	**Estimate**	**t-value**	**Estimate**	**t-value**
Intercept	1.8700[c]	3.51	2.3840[c]	3.20
Production	0.0032	0.21	-0.2227[b]	-2.61
Wtp	0.0075	0.06	-0.1050	-1.20
HappyBeef	0.1811[b]	2.07	-0.1350	-1.41
WtpSafety	0.1468	1.50	0.0679	0.79
WtpFeed	-0.0910	-1.06	-0.1330	-1.59
Convenience	0.1948[b]	2.15	0.0727	0.82
BeefPref	0.0322	0.37	0.2628[c]	3.13
Overall			0.5462[c]	10.21
WBS			-0.4134[c]	-4.30
Marbling	0.0047[c]	6.32	0.0033[b]	2.28
Female	0.5698[c]	3.41	0.0525	0.32
White	0.2890	1.38	-0.4942[c]	-2.40
Young	0.3363	1.26	0.3664	1.41
MidAge	-0.4878[b]	-2.32	-0.1710	-0.83
FamilySize	-0.1082	-1.24	-0.1596[a]	-1.88
Education	0.2744[c]	2.83	0.0201	0.21
Student	-0.0434	-0.11	0.3136	0.85
Full-time	-0.3354	-1.28	-0.3213	-1.26
Married	0.5638[c]	2.47	0.2914	1.31
Inc_Med	-0.0021	-0.01	-0.1915	-0.78
Inc_HighMed	-0.1649	-0.58	0.5765[c]	2.09
Inc_High	-0.1619	-0.44	0.8433[c]	2.36
ProdAg	-0.6110[c]	-3.17	0.2549	1.37

PInfo	0.5141 [c]	2.72		
PNInfo	1.1275 [c]	5.95		
AllInfo			0.8889 [c]	5.36
Number of Observations	645		645	
R-Square	0.19		0.30	
Adjusted R-Square	0.16		0.27	
F-Value	6.45		11.23	

a Indicates significant at the 10% level
b Indicates significant at the 5% level
c Indicates significant at the 1% level

Table 6.2 Marginal Probabilities for WTP 17% Premium and WTP 50% Premium

	Not WTP		WTP 17%		WTP 50%	
Parameter	**Estimate**	**z-value**	**Estimate**	**z-value**	**Estimate**	**z-value**
Intercept	0.5286[c]	3.954	-0.4295[c]	-3.335	-0.0990[b]	-2.059
Production	0.1192	0.439	.0022	0.85	-0.0141	-1.472
Wtp	0.0170	0.594	-0.0095	-0.342	-0.0075	0.793
HappyBeef	-0.0730[c]	-2.367	0.0507[a]	1.733	0.0222[a]	1.826
WtpSafety	-0.0439[a]	-1.621	0.0394	1.520	0.0045	0.470
WtpFeed	0.0780[c]	2.648	-0.0683[c]	-2.367	-0.0096	-1.052
Convenience	0.0735[c]	2.574	-0.0784[c]	-2.824	0.0048	0.480
BeefPref	0.0017	0.066	0.0010	0.042	-0.0028	-0.294
Location	-0.0883[a]	-1.648	0.0285	0.559	0.0597[c]	2.985
Shopper	-0.2362[c]	-3.360	0.1641[c]	2.431	0.0720[c]	2.548
Female	-0.0827	-1.420	0.1213[b]	2.159	-0.0385[a]	-1.795
White	-0.0435	-0.665	0.0480	0.765	-0.0045	-0.205
Young	0.0014	0.016	0.0639	0.759	-0.0653[b]	-1.904
MidAge	-0.0153	-0.225	0.0721	1.088	-0.0567[c]	-2.479
FamilySize	0.0859[c]	3.041	-0.0648[c]	-2.388	-0.0211[b]	-2.058
Education	0.0138	0.446	-0.0053	-0.177	-0.0085	-0.791
Student	-0.2983[c]	-2.399	0.2372[b]	1.995	0.0611	1.287
Full-time	-0.0219	-0.263	-0.0111	-0.140	0.0331	1.172
Married	-0.1862[c]	-2.540	0.1712[c]	2.418	0.0149	0.599
Inc_Med	-0.0190	-0.239	0.0293	0.380	-0.0102	-0.358
Inc_HighMed	-0.1403	-1.558	0.1016	1.164	0.0387	1.261
Inc_High	-0.2987[c]	-2.540	0.3236[c]	2.897	-0.0248	-0.505
ProdAg	0.1689[c]	2.678	-0.182[c]	-2.953	0.0132	0.630

Number of Observations	430
Log Likelihood Function	-311.6562
Chi-Squared	109.8596
Prob(ChiSqqd > value)	0.0000
Degrees of freedom	44

a Indicates significant at the 10% level
b Indicates significant at the 5% level
c Indicates significant at the 1% level

CHAPTER SEVEN

SUMMARY AND CONCLUDING REMARKS

The purpose of this chapter is to provide a brief overview of the research presented in this study. After an initial review of the overall goal and specific objectives of this study, a discussion follows both of the methods and procedures utilized and the conclusions drawn from the results of the empirical models. This chapter concludes with an explanation of the limitations of this research and recommendations for further proceedings.

Overview of Thesis

The overall goal of this study was to determine the amount consumers were willing to pay for grass-fed beef produced in the Southeastern United States. Specifically, this study had the following objectives: to quantify the level of consumer acceptance of grass-fed beef; to determine whether a grass-fed beef product would receive any premium amount; to identify the role of information and beef attributes in consumers' valuation; and to identify a demographic profile of a potential grass-fed consumer. To accomplish these goals, several empirical techniques were employed.

Since the retail market for grass-fed beef is limited to only a few retail locations, data concerning the actual market transactions of grass-fed beef was unavailable. Therefore, through the use of an experimental auction procedure, the random n^{th} price auction, information on consumers' WTP for grass-fed beef was obtained. The experimental auction consisted of six distinct bidding rounds; three of which allowed consumers to visually analyze the grass-fed beef product and three which required the panelist to perform a taste analysis of the grass-fed beef product. Varying amounts of information was provided to the consumers concerning production methods and nutritional information in order to assess the effect that labeling had on consumers' valuation. Furthermore, the visual versus taste analysis allowed an

evaluation concerning the role of information in the presence of palatability preferences. In other words, different presentation formats allowed for the determination of whether consumers were consistent in their valuations between analyses.

During the taste evaluations, consumers were asked to rank each steak (grass-fed and grain-fed) on a scale of one to eight for tenderness, juiciness, flavor, and overall acceptability. As discussed in chapter four, on average panelists ranked the grain-fed beef higher for each of the four sensory characteristics. However, the scope of these differences does not appear to be large. Results from an ANOVA indicate that there is a significant difference in the means of the sensory characteristics for both of the dietary treatments. Furthermore, results from a t-test signify that the difference in bids for each dietary treatment (the premium) is not statistically significant for the two treatments. This result indicates that, on average, consumers valued the two different steaks the same. However, when evaluating the difference in bids for each steak (the premium) for each auction round there was a group of consumers who valued grass-fed beef more than grain-fed beef.

Factor analysis was used as a method of data reduction and to extract any latent variables from the consumer survey, which was administered simultaneously with the experimental auction. The seven underlying factors that were identified after the factor analysis were used as explanatory variables in a hedonic valuation model. The latent factors, along with consumer demographic information, were used to explain the variation in consumers bid prices.

Although hedonic price analysis is most commonly used in property valuation, there have been studies concerning meat products that also used the hedonic method (Melton, Huffman, and Shogren, 1996; Rimal, Perkins, and Paschal, 2003; and Brester et al., 1993). Effective at measuring implicit prices of product attributes, the hedonic model was the appropriate method to obtain an idea of how consumers value beef attributes and labeling information.

The hedonic model used for each presentation format was a simple linear model and was estimated by applying the ordinary least squares (OLS) method. Results confirm the expectation that the provision of information has a statistically significant impact on a consumer's bid price for a grass-fed

beef product. While production information given in the fourth round was important in the visual presentation format, when production and nutrition information was given to the consumer in the fifth round, the effect on the bid price was greater.

Results from the hedonic analysis also affirm that consumer attitudes and beliefs, as well as labeling information, play a significant role in their visual valuation of grass-fed beef. However, results indicate that consumers place a high implicit value on their preference for taste and quality. Notably, the significant explanatory sociodemographic information was fairly consistent across the two presentation formats. Specifically, participants who positively affect the bid price for grass-fed steak were females, younger consumers, consumers with a higher education, married consumers, and consumers with smaller families. However, in the taste test, consumers who reported higher income levels and those who were non-Caucasian were willing to pay more for grass-fed steak.

Identifying the target market population for a novel product is essential to a niche-marketer's success. Therefore, a multinomial logit model was used to determine the target-market segment for grass-fed beef products. Results indicate that 29.3% of consumers are willing to pay at least a 17% premium (or $0.85/lb relative to grain-fed steak). This segment of consumers highly values the beef production practices and attributes that perpetuated the perception of "happy beef." Conversely these consumers are less concerned about convenience. Furthermore, consumers in this market segment are generally their household's primary grocery shopper, female, married, and part of a smaller family. A large proportion of student participants were also willing to pay premiums of at least 17%. Lastly, consumers in the upper echelons of the income brackets and those with no previous involvement in agriculture were more likely to value grass-fed beef.

Only about 8% of consumers were willing to pay a 50% premium for grass-fed beef. The demographics of this segment consist most significantly of male or older consumers who value "happy beef," their household's primary shopper, and are members of a smaller family. Furthermore, more consumers at the Athens location than at the Clemson site were willing to pay this significantly higher premium.

Implications

The empirical procedures' results support the belief that a group of consumers exist who is willing to pay for grass-fed beef. This finding is consistent with previous literature that suggests that consumer demand for beef is increasingly becoming segmented and that there are consumer groups who are willing to pay for quality differentiated products (Grannis, Hooker, and Thilmany,2000; Maynard, Burdine, and Meyer, 2003; Umberger et al., 2003; Lusk et al., 2001). Additionally, this research, by potentially empowering producers with important marketing information, may contribute to further successful expansion of the grass-fed beef sector.

A consistent result throughout every estimated model was that labeling information plays a critical role in persuading consumers to purchase a quality differentiated product. Therefore, consumer attitudes and demographical background drive their initial purchase decisions. This result implies for producers to initially attract consumers to grass-fed beef, extensive time (and money) should be spent in marketing endeavors and in educating consumers about the benefits of grass-fed beef. While grass-fed beef is a multi-faceted product that can be marketed as safer, healthier, and having been produced with environmentally sound agricultural practices, this study's results show that the attribute that has the greatest potential to extract premiums are those that represent the idea of "happy beef," which share similarities to natural, organic, and pastured beef[19] and represents the cattle's quality of life. Furthermore, consumers were highly influenced by the information presented in the fifth auction round that stated the health benefits of grass-fed beef, some of which are distinct to grass-finished cattle. Therefore, cattlemen producing beef finished with forages should focus on the health benefits of grass-fed beef to distinguish it from other beef products produced from alternative production systems. Products labeled with the health attributes and production methods of grass-finished beef are more likely to be able to initially attract consumers to the product.

[19] Recall that beef can be produced naturally and organically, while not being finished on forages. Furthermore, beef that is produced from a grass-fed production system does not have to be organic or natural to be considered "grass-finished."

But, drawing consumers to a product is only the first step. In this study, when the taste evaluation of the product was combined with the labeling information, attributes signaling quality (tenderness, overall acceptability, and marbling) were also important to consumers. Thus, to ensure those highly sought after first-time purchasers make subsequent purchases and eventually establish brand loyalty, cattlemen must still focus heavily on producing a high quality, desired beef product. Previously mentioned in chapter six, one way producers of grass-finished beef can increase marbling is by selecting cattle breeds that are predisposed to yield high marbled beef. Brands such as Certified Angus Beef® have increased their market share by marketing a quality, high marbled beef product. Similarly, there are also methods that can be used to increase the degree of tenderness in beef. One such method commonly used to promote tenderness in beef is aging. Therefore, producers who are interested in producing grass-fed beef should consider both the natural/organic aspect of grass-fed beef production systems and consumers' enduring preferences for quality beef.

However, it is important to note that many of the desirable attributes identified by this study are not unique to grass-fed beef. Producers can meet consumer demand for high quality beef that is tender, has high marbling levels, and has led "happy" lives without having to produce grass-fed beef. Grain-finished beef can be considered "happy" if cattle are finished with grains on pasture rather than in a feedlot. In addition, producers can market their grain-finished product as safe and natural by simply excluding antibiotics and hormones from their production methods. This conclusion implies that cattlemen currently producing grain-finished beef may be able to garner premiums for their product by not drastically altering their production system.

Lastly, producers should be aware of the demographics that describe their target market. A majority of the respondents in this survey use supermarkets as their primary source for meat products, implying that producers should focus their marketing efforts on consumers at such retail locations. Furthermore, more female consumers were willing to pay at least a 17% premium for grass-fed beef, while more male consumers willing to pay a 50% premium. Since women are typically the primary grocery shopper for their household, producers should develop marketing strategies geared towards

women. Two findings, consumers with larger sized families are less likely to purchase grass-fed beef and the "convenience" factor was not valued highly by potential grass-fed beef steak consumers, suggest that consumers view grass-fed beef steaks as a product that requires a great deal of time to prepare. Therefore, producers may widen their market segment if they market grass-fed products that are not necessarily time intensive (like ground beef or pre-cooked entrees). However, such efforts to appeal to a more diverse consumer demographic should not undermine the quality attributes of the beef product, as consumers continue to value tenderness, marbling, and overall acceptability.

Limitations and Future Research

For the most part, the results of this study are consistent with the previously stated expectations. However, these results cannot be viewed without a degree of caution. In addition to the problems created by the presence of heteroscedasticity in the data, this research is also subject to several limitations.

First, while participants in the study at the South Carolina location were generated by a method of random selection, the recruitment methods used at the Georgia location may not have provided the most representative sample of the population. Therefore, further research using this data may need to consider utilizing only the observations from the South Carolina location. Second, to generate market prices (defined as the n^{th} highest price), participants in the Clemson study who "won" the binding auction were required to either purchase the product they "won", or they could "bid up" to purchase the steak of their preference. However, this market price data was not collected for the Georgia location. Thus, the dependent variable in this study includes all bid prices placed on the grass-fed steak (both market prices and the prices that were "priced out" of the market). An even more reliable method would have been to use the market price, since this price would provide a better estimate of how much consumers were WTP as well as a better demographic profile of the consumers that actually paid for the grass finished beef product.

Another limitation of this study that future studies could improve upon was the actual length of the consumer survey. Recall that upon arrival at the study location, consumers were asked to complete

two surveys. Although the information that was obtained from these surveys is valuable, many consumers did not have enough time to complete the surveys which lead to a large number of missing values. Though not ideal, in order to complete the analysis, these missing values had to be replaced with zeros. Since experimental auctions are a rather costly method of extracting WTP values, it is important to obtain as much information as possible during the experiment. However, it is also important that the extraction of information does not jeopardize the validity of the experiment. Future experiments should re-evaluate the consumer survey used in this study to see if there is a way to maximize the amount of information obtained while keeping the survey at a reasonable length.

Although experimental auctions are more reliable gauges of consumer demand for a product than contingent valuation methods, it would be interesting to conduct a hedonic price analysis using the retail scanner data collected from those supermarkets that are currently retailing grass-fed beef products. However, the availability of such scanner data is limited in situations where grass-fed products are sold primarily in only one certain form (i.e. ground beef rather than steaks) at the retail locations. If such cases experimental auctions, such as the one used in this study, remain a reliable option to determine WTP for grass-fed beef products in different forms.

While based on the limited, available research, the prices calculated that producers would need to produce, process, and market grass-fed beef are gross estimates. Currently, the costs involved in producing and marketing grass-fed beef are uncertain and may actually be higher or lower than was assumed for this study. Furthermore, attempting to equate the premium required by grass-fed producers with a retail price premium is challenging considering the uncertainty of the proportionate amount of added value for a particular cut during processing, where a whole cattle carcass is transformed into several different beef cuts. Thus, additional research is needed concerning the costs associated with grass-finishing systems, so as to better estimate producers' willingness to accept prices. Although this study has shown that about a third of the surveyed consumers are willing to pay a premium of at least 17%, if this amount is not equal to the premium that producers are willing to accept, then any present attempt to establish a market for grass-fed beef will come at a costly price for many producers.

Quite troubling for grass-fed beef producers are the results suggesting that the consumers who are WTP for grass-fed beef are not as concerned with the actual type of feed given to cattle (measured by the negative coefficient for WTPFEED), but instead value the lifestyle of the cattle (measured by HAPPYBEEF), or "naturalness" of the production methods, as well as hormone and antibiotic free products (WTPSAFETY). Furthermore, this provides evidence supporting the prior belief that consumers may equate the term "grass-fed" to mean "natural." If that is the case, then cattlemen looking to extract excess consumer surplus may be more successful marketing a product that is "natural" or "safer" rather than grass-fed. However, before this statement can be made with 100% certainty, a clearer definition of the term "grass-fed" is needed to resolve any consumer uncertainty as to the meaning of grass-fed.

Despite there being a great deal of literature concerning demand for quality differentiated beef products, only a limited amount of research has been completed specifically on grass-fed beef. Further, to this author's knowledge, no previous studies have utilized the hedonic method to determine the implicit value that consumers place on the attributes of a grass-fed beef product. This study sought to investigate whether consumers in the Southeastern United States would be wiling to pay for a product of a grass-only production system and if so, determine the potential target-market profile. Hopefully, information obtained from this study can be used to empower cattlemen considering entry into grass-fed beef production and serve as a basis for additional analyses and future research dealing with consumers' WTP for a quality differentiated beef.

REFERENCES

AgManager.info, Department of Agricultural Economics, Kansas State University. Accessed on July 3, 2007: http://www.agmanager.info/livestock/marketing/default.asp

Agricultural Marketing Resource Center, Commodities and Products, "Organic Beef Profile." Accessed on June 15, 2006: http://www.agmrc.org/agmrc/commodity/livestock/beef/organicbeefprofile.htm

American Grassfed Association, 2006. http://americangrassfed.org/AGA%20Background.htm

Baily, D., and D. Hayes. "The Evolution of Identity Preservation in Red Meat Markets," *Managing for Today's Cattle Market and Beyond.* March 2002

Batte, M.T., Beaverson, J., Hooker, N.H., and Haab, T. "Consumer Willingness to Pay for MultiIngredient, Processed Organic Food Products," Paper presented at annual meetings of the American Agricultural Economics Association, Denver, CO, 1-4 August 2004.

Bearden, R. "Grass-fed Beef Viable Market Option." *Southeast Farm Press* June 16, 2004 http://southeastfarmpress.com/mag/farming_grassfed_beef_viable/

Boland, M., and T. Schroder "Marginal Value of Quality Attributes for Natural (Organic) Beef." *Journal of Agricultural and Applied Economics*, 34(1) (April 2002):39-49.

Boleman, S. J., Boleman, S. L., Miller, R. K., Taylor, J. F., Cross, H. R., Wheeler, T. L., Koohmaraie, M., Shackelford, S. D., Miller, M. F., West, R. L., Johnson, D. D., and Savell, J. W. "Consumer Evaluation of Beef of Known Categories of Tenderness." *Journal of Animal Science.* 75(6) 1997:1521-1524.

Brester, G., Lhermite, P., Goodwin, B., and Hunt, M. "Quantifying the Effects of New Product Development: The Case of Low-Fat Ground Beef." *Journal of Agricultural and Resource Economics*, 18(2)(1993):239-250.

Byrne, P.J., Bacon, J.R., and Toensmeyer, U.C. "Pesticide Residue Concerns and Shopping Location Likelihood. *Agribusiness* 10(6)(1994):491-501.

Certified Angus Beef® http://www.certifiedangusbeef.com/

Champ, P.A., Boyle, K. J., and Brown, T.C. *A Primer on Non-Market Valuation*. Kluwer Academic Publishers, 2003.

Clause, R. "Organic Beef Profile" Agricultural Marketing Resource Center, Iowa State University (May 2006) Online. Available at http://www.agmrc.org/agmrc/commodity/livestock/beef/organicbeefprofile.htm

Coleman's Natural Beef Products. Accessed on May 23, 2007: .http://colemannatural.com/products/beef.php

Court, A.T. “Hedonic Price Indexes with Automotive Examples.” In *The Dynamics of Automobile Demand*. New York, NY: General Motors, 1939.

Cox, R., Kerth, C., Gentry, J., Prevatt, J., Braden, K., and Jones, W. “Determining Acceptance of Domestic Forage-or Grain-Finished Beef by Consumers from Three Southeastern U.S. States.” *Journal of Food Science*, 71(7)(2006):542-546.

Dimitri, C., and C. Green. “Recent Growth Patterns in the U.S. Organic Food Market.” Information Bulletin No. 777, U.S. Department of Agriculture/Agricultural Research Service, Resource Economics Division, Washington, DC, September 2002.

Fox, J.A., Shogren, J.F., Hayes, D.J.,and Kliebenstein, J.B. “Experimental Auctions to Measure Willingness to Pay for Food Safety.” Chapter 6. *Valuing Food Safety and Nutrition*. Ed: J.A. Caswell Boulder, CO. Westview Press. 1995.

Goodman, A. “Andrew Court and the Invention of Hedonic Price Analysis.” *Journal of Urban Economics* 44 (1998):291-298.

Govindaswamy, R. and J. Italia. “Predicting Willingness-to-Pay a Premium for Organically Grown Fresh Produce,” *Journal of Food Distribution Research,* 30(2)(July 1999):44-53.

Grannis, J., Hooker, N.H., and Thilmany, D., “Consumer Preference for Specific Attributes in Natural Beef Products.” Paper presented at the Western Agricultural Economics Association Meeting, Vancouver, British Columbia. 29 July-1 July 2000.

Griliches, Z. “The Demand for Fertilizer: An Econometric Reinterpretation of a Technical Change.” *Journal of Farm Economics,* 40(1958):591-606.

Griliches, Z. “Hedonic Prices for Automobiles: An Econometric Analysis of Quality Change.” In *The Price Statistics of the Federal Government*. New York, NY: Columbia University Press for the National Bureau of Economic Research, 1961.

Gujarati, Damodar N. *Basic Econometrics*. Third Edition. McGraw Hill, 1995.

Hanemann, W. Michael. “Willingness to Pay and Willingness to Accept: How Much Can They Differ?” *The American Economic Review*, 81(3)(1991):635-647.

Hayes, D.J., Shogren, J.F., Shin, S.Y., and Kliebenstein, J.B. “Valuing Food Safety in Experimental Auction Markets,” *American Journal of Agricultural Economics*, 77(1) (Feb.1995):40-53.

Hoffman, E., Menkhaus, D., Chakravarti, D., Field, R., and Whipple, G. “Using Laboratory Experimental Auctions in Marketing Research: A Case Study of New Packaging for Fresh Beef.” *Marketing Science*, 12(3)(Summer 1993):318-338.

Huang, C. “Consumer Preferences and Attitudes Towards Organically Grown Produce,” *European Review of Agricultural Economics,* 23(1996):331-342.

Jordan, J., Shewfelt, R., Prussia, S., and Hurst, W. “Estimating Implicit Marginal Prices of Quality Characteristics of Tomatoes.” *Southern Journal of Agricultural Economics*, 17(December 1985):139-46.

Killinger, K. M., Calkins, C. R., Umberger, W. J., Feuz, D. M., and Eskridge, K. M. "Consumer Sensory Acceptance and Value for Beef Steaks of Similar Tenderness, but Differing in Marbling Level." *J. Anim Sci*. 2004 82: 3294-3301.

Kennedy, P. *A Guide to Econometrics*. Cambridge, Massachusetts: The MIT Press, 2003.

Lacy, Curt. "Economics of Grass-fed Beef Production." Department of Agricultural and Applied Economics, The University of Georgia, 2007.

Lacy, Curt. "Retail Beef Budget." Department of Agricultural and Applied Economics, The University of Georgia, 2007

Ladd, G.W. and M.B. Martin. "Prices and Demands for Impact Characteristics." *American Journal of Agricultural Economics* 58(1976):21-30.

Ladd, G., and V. Suvannunt "A Model of Consumer Goods Characteristics," *American Journal of Agricultural Economics*, 58(1976):504-510.

Lancaster, K. "A New Approach to Consumer Theory." *The Journal of Political Economy*, 74(2)(April 1966):132-157.

Laura's Lean Beef® http://www.laurasleanbeef.com/

Li, Q., McCluskey, J.J., and Wahl, T. "Effects of Information on Consumers' Willingness to Pay for GM-Corn-Fed Beef." *Journal of Agricultural & Food Industrial Organization*, 2(9)(2004):1058-1058.

Livestock Marketing Information Center, Graphs, Special, "Annual & Quarterly Beef Demand Index." Accessed on July 5, 2007: http://www.lmic.info/tac/graphs/graphframe.html

Loureiro, M., and McCluskey, J., "Assessing Consumer Response to Protected Geographical Identification Labeling." *Agribusiness,* 16(3)(2000):309-320.

Loureiro, M.L., McCluskey, J., and Mittelhammer, R. "Will Consumers Pay a Premium for Eco-Labeled Apples?" *The Journal of Consumer Affairs*, 36(2)(2002):203-219.

Lusk, J., Fox, J., Schroeder, T., Mintert, J., and Koohmaraie, M. "Will Consumers Pay for Guaranteed Tender Steak?" Research Bulletin, 3-99. Blacksburg, VA: Research Institute on Livestock Pricing Agricultural and Applied Economics, Virginia Tech. (1999).

Lusk, J., Fox, J., Schroeder, T., Mintert, J., and Koohmaraie, M. "In-Store Valuation of Steak Tenderness." *American Journal of Agricultural Economics*, 83(3)(August 2001):539-550.

Lusk, J., Roosen, J., and Fox, J. "Demand for Beef From Cattle Administered Growth Hormones or Fed Genertically Modified Corn: A Comparison of Consumers in France, Germany, The United Kingdom, and The United States." *American Journal of Agricultural Economics*, 85(1)(February 2003):16-29.

Lusk, J., Feldkamp, T., Schroeder, T. "Experimental Auction Procedure: Impact on Valuation of Quality Differentiated Goods," *American Journal of Agricultural Economics*, 86(2)(May 2004):289-405.

Lusk, J. L., and Darren Hudson. "Willingness-to-Pay Estimates and Their Relevance to Agribusiness Decision Making." *Review of Agricultural Economic,* 26(2)(2004):152-169.

Maynard, L., Burdine, K., and Meyer, A. "Market Potential for Locally Produced Meat Products." *Journal of Food Distribution Research*, 34(2)(July 2003):27-37

McCluskey, J., Wahl, T., Quan., L., Wandschneider, P. "U.S. Grass-Fed Beef: Marketing Health Benefits." *Journal of Food Distribution Research*, 36(3)(November 2005):1-8

McConnell, K., and I. Strand "Hedonic Prices for Fish: Tuna Prices in Hawaii." *American Journal of Agricultural Economics*, 82(February 2006):133-144.

McMillian, M., Reid, B., and Gillen, D., "An Extension of the Hedonic Approach for Estimating the Value of Quiet." *Land Economics*, 56(3)(August 1980):315-328

Melusky, M. "Niche Beef Products Comprise Small Share of Total Retail Beef Sales." National Beef Cattlemen's Association, Issues Update, March-April 2006. Available at http://www.beef.org/uDocs/nichebeefproducts.pdf

Melton, B.E., Huffman, W.E., Shogren, J.F., and Fox, J.A., "Consumer Preferences for Fresh Food Items with Multiple Quality Attributes: Evidence from an Experimental Auction of Pork Chops." *American Journal of Agricultural Economics,* 78(1996):916-923.

Melton, B.E., Huffman, W., and Shogren, J.F. "Economic Values of Pork Attributes: Hedonic Price Analysis of Experimental Auction Data." *Review of Agricultural Economics*, 18(1996):613-627.

Menkhaus, D., Borden, G., Whipple, G., Hoffman, E., and Field, R. "An Empirical Application of Laboratory Experimental Auctions in Marketing Research." *Journal of Agricultural and Resource Economics*, 17(1992):44-55.

Miller, G.Y., and L.J. Unnevehr, "Characteristics of Consumers Demanding and Their Willingness to Pay for Certified Safer Pork." *Journal of Agribusiness,* 19(2)(Fall 2001):101-119.

Morgan, J. B., Savell, J. W., Hale, D. S., Miller, R. K., Griffin, D. B., Cross, H. R., and Shackelford, S. D. "National Beef Tenderness Survey." *Journal of Animal Science*, 69(1991):3274-3283

Mukhopadhaya, Kaushik, Bishwa Adhikari, Gerald Mumma, and Mario Teisl. "Consumer's Willingness to Pay for Food Safety: A Pathogen Specific Analysis." Selected paper presented at the American Agricultural Economics Association Annual Meeting, Denver, CO, August 2004.

National Cattlemen's Beef Association. "Producer Education." 21(5)(Fall 2006):6-7

National Cattlemen's Beef Association. "2005 National Beef Quality Audit Asks, Answers Questions about U.S. Beef." *Checkoff News*, (July 11, 2006) Available at: http://www.beefusa.org/NEWS2005NATIONALBEEFQUALITYAUDITASKSANSWERSQUESTIONSABOUTUSBEEF27177.aspx

National Cattlemen's Beef Association. "U.S. Cattlemen Push for OIE "Provisionally Free" Designation." *NCBA News*, (March 10, 2005) Available at: http://www.beefusa.org/newsuscattlemenpushforoieprovisionallyfreedesignation21237.aspx

Organic Monitor. "The North American Market for Organic Meat Products." Research Publication #3002-44. (May 2006):1-138.

Pindyck R. and Rubinfeld D. *Econometric Models and Economic Forecasts*. McGraw-Hill, Inc. Third Edition. 1991.

Rimal, A., Perkins, T., and Paschal, J. "Relationship between Attributes of Beef Cattle Raised Using Ultrasound Technology and Prices Received at the Packers: A Hedonic Price Analysis." Selected paper presented at the Annual Meeting of American Agricultural Economics Association, Montreal, Canada 27-30 July 2003.

Rosen, S. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy* 82(1974):34-55.

Salayo, N., Voon, T., and Selvanathan, S. "Implicit Prices of Prawn and Shrimp Attributes in the Philippine Domestic Market." *Marine Resource Economics*, 14(1999): 65-78.

Schroeder, T., and Mark, D. "How Can the Beef Industry Recapture Lost Consumer Demand?" Proceedings of the American Society of Animal Science, 1999. American Society of Animal Science 2000.

Shogren, J., Margolis, M., Koo, C., and List, J. "A Random Nth Price Auction." *Journal of Economic Behavior & Organization*, 46(4)(2001):409-421

Sitz, B., Calkins, C., Feuz, D., Umberger, W., and Eskridge, K. "Consumer Sensory Acceptance and Value of Wet-Aged and Dry-Aged Beef Steaks." *Journal of Animal Science*, 84(2006):1221-1226.

Shi, H., and D. Price. "Impacts of Sociodemographic Variables on the Implicit Values of Breakfast Cereal Characteristics." *Journal of Agricultural and Resource Economics* 23(1)(July1998):126-139.

Thilmany, D., Umberger, W., and Ziehl, A. "Strategic Market Planning for Value-Added Natural Beef Products: A Cluster Analysis of Colorado Consumers." *Renewable Agriculture and Food Systems*, 21(3)(September 2006):192-203

Thilmany, D., Bond, J., and Bond, C. "Direct Marketing of Fresh Produce: Understanding Consumer Interest in Product and Process-Based Attributes," Selected paper presented at annual meetings of the American Agricultural Economics Association, Long Beach, CA 23-23 July 2006.

Umberger, W.J., Feuz, D.M., Calkins, C.R., and Killinger-Mann, K. "U.S. Consumer Preference and Willingness-to-Pay for Domestic Corn-fed Beef versus International Grass-fed Beef Measured Through an Experimental Auction." *Agribusiness.* 18(Autumn 2002):491-504.

Umberger, W., Feuz, D., Calkins, C., and Sitz, B. "Country-of-Origin Labeling of Beef Products: U.S. Consumers' Perceptions." *Journal of Food Distribution Research*, 34(3)(November 2003):103-116.

Umberger, W.J., and Feuz, D.M. "The Usefulness of Experimental Auctions in Determining Conumers' Willingness to Pay for Quality Differentiated Products." *Review of Agricultural Economics,* 26(Summer 2004):170-185.

United States Census Bureau, Small Area Income & Poverty Estimates, "Model Based Estimates for States, Counties & School Districts." May 30, 2007 http://www.census.gov/hhes/www/saipe/index.html

United States Department of Agriculture, Economic Research Service, Data Sets, "Beef Values and Price Spreads." Accessed on June 28, 2007: http://www.ers.usda.gov/Data/MeatPriceSpreads/

United States Department of Agriculture, Data Sets, "State Facts Sheets: United States." Accessed on May 30, 2007: http://www.ers.usda.gov/StateFacts/US.HTM

Waugh, F. "Quality Factors Influencing Vegetable Prices." *Journal of Farm Economics,* 10(2)(April 1928):185-196.

Wetzstein, Michael J. Microeconomic Theory. South-Western, 2005.

Wolfe, K., Best, M., and Hodge, B. "Cattle Producer Interest on Growing Grass Fed Beef Study." Center Report 05-04. Athens, GA: Center for Agribusiness and Economic Development, The University of Georgia. (2005).

Worthington, V. "Nutritional Quality of Organic Versus Conventional Fruits, Vegetables, and Grains." *The Journal of Alternative and Complementary Medicine*, 7(2)(2001):161-173.

APPENDIX A:

ANALYSIS OF SELECTED ATTITUDINAL VARIABLES

AND CORRELATION COEFFICIENTS

Table A.1 Frequency Distribution of the Importance of Various Beef Production Practices

		Frequency Distribution									
N	**Practice**	**Not at all important**		**Somewhat important**		**Important**		**Very Important**		**Extremely Important**	
		N	%	N	%	N	%	N	%	N	%
203	Open Range	62	30.54%	61	30.05%	47	23.15%	20	9.85%	12	6.40%
205	No antibiotics	46	22.44%	52	25.37%	55	26.83%	32	15.61%	19	9.27%
208	No growth hormones	44	21.15%	46	22.12%	60	28.85%	35	16.83%	23	11.06%
208	Natural	44	21.15%	53	25.48%	59	28.37%	38	18.27%	14	6.73%
200	Grassfed	64	32.00%	58	29.00%	52	26.00%	20	10.00%	6	3.00%
204	Grazing to preserve streams	54	26.47%	56	27.45%	56	27.45%	32	15.69%	6	2.94%
202	Grazing to protect endangered species	46	22.77%	61	30.20%	55	27.23%	27	13.37%	13	6.44%
208	Humane Treatment	20	9.62%	40	19.23%	65	31.25%	53	25.48%	30	14.42%
205	Traceable	25	12.20%	44	21.46%	60	29.27%	39	19.02%	37	18.05%
205	Organic	70	34.15%	51	24.88%	50	24.39%	25	12.20%	9	4.39%
17	Other	7	41.18%	3	17.65%	3	17.65%	0	0.00%	4	23.53%

Table A.2 Frequency Distribution of Participants Indicated Desirability for Various Beef Attributes

Frequency Distribution											
N	**Attribute**	**Not at all desirable**		**Somewhat desirable**		**Desirable**		**Very Desirable**		**Extremely Desirable**	
		N	%	N	%	N	%	N	%	N	%
209	Organic	65	31.10%	55	26.32%	53	25.36%	26	12.44%	10	4.78%
214	Good Value	2	0.93%	3	1.40%	44	20.56%	95	44.39%	70	32.71%
192	Nutritional Value	31	16.15%	41	21.35%	54	28.13%	30	15.63%	36	18.75%
212	Fresh	5	2.36%	16	7.55%	61	28.77%	79	37.26%	51	24.06%
208	Aged	35	16.83%	67	32.21%	70	33.65%	29	13.94%	7	3.37%
214	Boneless	19	8.88%	49	22.90%	81	37.85%	44	20.56%	21	9.81%
208	Premium brand	19	9.13%	55	26.44%	89	41.35%	43	20.67%	5	2.40%
211	Ready to eat	50	23.70%	64	30.33%	58	27.49%	32	15.17%	7	3.32%
211	Size of package	14	6.64%	46	21.80%	83	39.34%	55	26.07%	13	6.16%
215	Pre-seasoned	80	37.21%	76	35.35%	37	17.21%	19	8.84%	3	1.40%
207	Percent Lean	5	2.42%	24	11.59%	63	30.43%	73	35.27%	42	20.29%
204	Country of origin	32	15.69%	44	21.57%	59	28.92%	41	20.10%	28	13.73%
12	Other	6	50.00%	1	8.33%	2	16.67%	2	16.67%	1	8.33%

Table A.3 Frequency Distribution of Participants Who Have Heard and Purchased Beef With Various Attributes

Frequency Distribution									
N	**Attribute**	**Heard of this beef**		**Heard of this beef**		**N**	**Purchased this beef**		**Purchased this beef**	
		Yes		No			Yes		No	
		N	%	N	%		N	%	N	%
210	Grass-Fed	137	35.24%	73	34.76%	191	62	32.46%	129	67.54%
210	Pastured	113	53.81%	97	46.49%	191	51	26.70%	140	73.30%
209	Grain or Corn Fed	165	78.95%	44	21.05%	188	112	59.57%	76	40.43%
208	Free-Range	122	58.65%	86	41.35%	189	46	24.34%	143	75.66%
208	Raised without antibiotics	130	62.50%	78	37.50%	188	44	23.40%	144	76.60%
206	Not fed antibiotics	108	52.43%	98	47.57%	187	30	16.04%	157	83.96%
207	No Supplemental Hormones	127	61.35%	80	38.65%	183	34	18.58%	149	81.42%
208	Raised Locally	141	67.79%	67	32.21%	187	79	42.25%	108	57.75%
207	Guaranteed Tender	122	58.94%	85	41.06%	186	73	39.25%	113	60.75%
209	Aged	160	76.56%	49	23.44%	190	104	54.74%	86	45.26%
207	Certified Humane Raised & Handled	72	34.78%	135	65.22%	189	24	12.70%	165	87.30%
209	Traceable to the farm	75	35.89%	134	64.11%	187	29	15.51%	158	84.49%

Table A.4 Frequency Distribution of Consumers' Level of Interest

Interest Level	*Frequency*	*Percent*
0	4	1.87%
1	4	1.87%
2	7	3.27%
3	8	3.74%
4	12	5.61%
5	30	14.02%
6	16	7.48%
7	24	11.21%
8	54	25.23%
9	26	12.15%
10	29	13.55%

Table A.5 Frequency Distribution of Consumers' Stated WTP for Beef Attributes

		Frequency Distribution											
N	**Attribute**	**Less than typical retail price**		**Equal to typical retail price**		**10% above typical retail price**		**25% above retail price**		**More than 25% above retail price**		**Would not purchase**	
		N	%	N	%	N	%	N	%	N	%	N	%
208	Grass-Fed	9	4.33%	131	62.98%	51	24.52%	7	3.37%	5	2.40%	5	2.40%
205	Pastured	10	4.88%	141	68.78%	37	18.05%	6	2.93%	4	1.95%	7	3.41%
206	Grain or Corn Fed	5	2.43%	152	73.79%	34	16.50%	12	5.83%	1	0.49%	2	0.97%
206	Free-Range	23	11.17%	116	56.31%	51	24.76%	9	4.37%	2	0.97%	5	2.43%
204	Raised without antibiotics	7	3.43%	91	44.61%	81	39.71%	16	7.84%	5	2.45%	4	1.96%
205	Not fed antibiotics	9	4.39%	95	46.34%	75	36.59%	17	8.29%	5	2.44%	4	1.95%
209	No Supplemental Hormones	4	1.91%	90	43.06%	82	39.23%	22	10.53%	8	3.83%	3	1.44%
209	Raised Locally	4	1.91%	106	50.72%	73	34.93%	18	8.61%	8	3.83%	0	0.00%
206	Guaranteed Tender	6	2.91%	73	35.44%	85	41.26%	30	14.56%	11	5.34%	1	0.49%
207	Aged	6	2.90%	106	51.21%	63	30.43%	20	9.66%	3	1.45%	9	4.35%
208	Certified Humane Raised & Handled	4	1.92%	129	62.02%	56	26.92%	16	7.69%	3	1.44%	0	0.00%
209	Traceable to the farm	2	0.96%	110	52.63%	71	33.97%	15	7.18%	10	4.78%	1	0.48%
207	Natural Beef	1	0.48%	135	65.22%	53	25.60%	7	3.38%	5	2.42%	5	2.42%
204	Organic Beef	15	7.35%	112	54.90%	49	24.02%	12	5.88%	2	0.98%	13	6.37%

Table A.6 Correlation Between Sensory Characteristics, Marbling, and WBS

	Flavor	Juiciness	Tenderness	Overall	Marbling	WBS
Flavor	1.000					
Juiciness	0.954[a]	1.000				
Tenderness	0.949[a]	0.954[a]	1.000			
Overall	0.978[a]	0.966[a]	0.968[a]	1.000		
Marbling	-0.114[a]	-0.103[a]	-0.114[a]	-0.111[a]	1.000	
WBS	-0.118[a]	-0.123[a]	-0.139[a]	-0.111[a]	-0.327	1.000

[a] = significant at the 0.05 level

Table A.7 Correlation of Production Practices

	Open Range	No antibiotics	No growth hormones	Natural	Grass-fed	Preserves Streams	Protects Endangered Species	Humane	Traceable	Organic
Open Range	1.000									
No antibiotics	0.524[a]	1.000								
No growth hormones	0.499[a]	0.781[a]	1.000							
Natural	0.553[a]	0.686[a]	0.713[a]	1.000						
Grass-fed	0.458[a]	0.541[a]	0.536[a]	0.574[a]	1.000					
Preserves Streams	0.453[a]	0.479[a]	0.440[a]	0.480[a]	0.562[a]	1.000				
Protects Endangered Species	0.443[a]	0.467[a]	0.467[a]	0.492[a]	0.550[a]	0.766[a]	1.000			
Humane	0.398[a]	0.454[a]	0.334[a]	0.396[a]	0.311[a]	0.578[a]	0.565[a]	1.000		
Traceable	0.324[a]	0.332[a]	0.380[a]	0.342[a]	0.413[a]	0.405[a]	0.444[a]	0.477[a]	1.000	
Organic	0.399[a]	0.480[a]	0.558[a]	0.618[a]	0.566[a]	0.460[a]	0.446[a]	0.304[a]	0.242[a]	1.000

[a] = significant at the 0.05 level

Table A.8 Correlation of Beef Attributes

	Organic	Good Value	Nutritional Value	Fresh	Aged	Boneless	Premium brand	Ready to heat	Package size	Pre-seasoned	Leanness	COOL
Organic	1.000											
Good Value	0.151[a]	1.000										
Nutritional Value	-0.024	-0.057[a]	1.000									
Fresh	0.172[a]	0.217[a]	-0.037	1.000								
Aged	0.075[a]	-0.066	0.045[a]	0.195[a]	1.000							
Boneless	-0.010	0.216[a]	-0.097[a]	0.120[a]	0.029	1.000						
Premium brand	0.124[a]	-0.067[a]	0.023[a]	0.186[a]	0.227[a]	0.230[a]	1.000					
Ready to heat	-0.123[a]	0.089[a]	0.029[a]	0.057[a]	0.005	0.252[a]	0.208[a]	1.000				
Package size	-0.055[a]	0.152[a]	-0.006[a]	0.054[a]	0.036	0.244[a]	0.270[a]	0.430[a]	1.000			
Pre-seasoned	-0.071[a]	-0.011[a]	-0.059[a]	0.005	-0.053[a]	0.250[a]	0.170[a]	0.415[a]	0.194[a]	1.000		
Leanness	0.118[a]	0.270[a]	-0.009	0.161[a]	0.121[a]	0.265[a]	0.2565[a]	0.198[a]	0.283[a]	0.065[a]	1.000	
COOL	0.040[a]	0.019[a]	0.001	0.083[a]	0.164[a]	0.021	0.150[a]	0.012	0.115[a]	-0.056[a]	0.237[a]	1.000

[a] = significant at the 0.05 level

Table A.9 Correlation of Past Purchases

	Grass-Fed	Pastured	Grain-Fed	Free-Range	No antibiotic	Not fed antibiotic	No Hormone	Local	Tender	Aged	Humane	Trace
Grass-Fed	1.000											
Pastured	0.489 [a]	1.000										
Grain-Fed	0.219 [a]	0.118 [a]	1.000									
Free-Range	0.368 [a]	0.322 [a]	0.227 [a]	1.000								
No antibiotics	0.135 [a]	0.204 [a]	0.278 [a]	0.325 [a]	1.000							
Not fed antibiotics	0.128 [a]	0.154 [a]	0.224 [a]	0.3463 [a]	0.560 [a]	1.000						
No Hormones	0.174 [a]	0.207 [a]	0.185 [a]	0.209 [a]	0.475 [a]	0.450 [a]	1.000					
Local	0.217 [a]	0.255 [a]	0.267 [a]	0.166 [a]	-0.027	0.110 [a]	0.092 [a]	1.000				
Tender	0.215 [a]	0.362 [a]	0.097 [a]	0.128 [a]	0.025	0.221 [a]	0.093 [a]	0.309 [a]	1.000			
Aged	0.102 [a]	-0.080 [a]	0.238 [a]	0.153 [a]	-0.029	0.039 [a]	0.141 [a]	0.208 [a]	0.190 [a]	1.000		
Humane	0.328 [a]	0.427 [a]	0.103 [a]	0.391 [a]	0.186 [a]	0.326 [a]	0.291 [a]	0.250 [a]	0.338 [a]	0.070 [a]	1.000	
Traceable	0.169 [a]	0.227 [a]	0.269 [a]	0.192 [a]	0.170 [a]	0.273 [a]	0.276 [a]	0.276 [a]	0.320 [a]	0.162 [a]	0.508 [a]	1.000

[a] = significant at the 0.05 level

Table A.10 Correlation of Consumer Attitudes Towards the Eating Quality of Attributes

	Grass-Fed	Pastured	Grain-Fed	Free-Range	No antibiotics	Not fed antibiotic	No Hormone	Local	Tender	Aged	Humane	Trace	Natural	Organic
Grass-Fed	1.000													
Pastured	0.566 [a]	1.000												
Grain-Fed	0.026	.007	1.000											
Free-Range	0.340 [a]	0.342 [a]	0.015	1.000										
No antibiotics	0.340 [a]	0.277 [a]	-0.005	0.32 [a]	1.000									
Not fed antibiotics	0.321 [a]	0.257 [a]	-0.04[a]	0.38 [a]	0.844 [a]	1.000								
No Hormones	0.379 [a]	0.222 [a]	-0.08 [a]	0.37 [a]	0.748 [a]	0.806 [a]	1.000							
Local	0.265 [a]	0.275 [a]	0.185 [a]	0.177[a]	0.337 [a]	0.275 [a]	0.241 [a]	1.000						
Tender	0.054 [a]	0.046 [a]	0.165 [a]	0.07 [a]	0.160 [a]	0.137 [a]	0.170 [a]	0.176 [a]	1.000					
Aged	0.001	-0.017	0.285 [a]	0.014	0.005	0.005	0.038 [a]	0.114 [a]	0.240 [a]	1.000				
Humane	0.301 [a]	0.315 [a]	0.079 [a]	0.298 [a]	0.354 [a]	0.423 [a]	0.366 [a]	0.288 [a]	0.162 [a]	0.07 [a]	1.000			
Traceable	0.327 [a]	0.313 [a]	0.195 [a]	0.266 [a]	0.332 [a]	0.332 [a]	0.251 [a]	0.482 [a]	0.125 [a]	0.08 [a]	0.557 [a]	1.000		
Natural	0.398 [a]	0.288 [a]	0.111 [a]	0.350 [a]	0.411 [a]	0.470 [a]	0.532 [a]	0.219 [a]	0.162 [a]	0.037	0.401 [a]	0.449 [a]	1.000	
Organic	0.384 [a]	0.262 [a]	0.041 [a]	0.327 [a]	0.320 [a]	0.320 [a]	0.366 [a]	0.068 [a]	0.055 [a]	-0.04[a]	0.190 [a]	0.209 [a]	0.555 [a]	1.000

[a] = significant at the 0.05 level

Table A.11 Correlation of Consumer Attitudes Towards the Food Safety of Attributes

	Grass-Fed	Pastured	Grain-Fed	Free-Range	No antibiotics	Not fed antibiotic	No Hormone	Local	Tender	Aged	Humane	Trace	Natural	Organic
Grass-Fed	1.000													
Pastured	0.649 [a]	1.000												
Grain-Fed	0.461 [a]	0.443 [a]	1.000											
Free-Range	0.504 [a]	0.477 [a]	0.334 [a]	1.000										
No antibiotics	0.346 [a]	0.281 [a]	0.256 [a]	0.327 [a]	1.000									
Not fed antibiotics	0.296 [a]	0.284 [a]	0.170 [a]	0.340 [a]	0.802 [a]	1.000								
No Hormones	0.340 [a]	0.257 [a]	0.129 [a]	0.308 [a]	0.730 [a]	0.747 [a]	1.000							
Local	0.263 [a]	0.329 [a]	0.312 [a]	0.288 [a]	0.216 [a]	0.175 [a]	0.193 [a]	1.000						
Tender	0.275 [a]	0.308 [a]	0.469 [a]	0.306 [a]	0.141 [a]	0.086 [a]	0.167 [a]	0.446 [a]	1.000					
Aged	0.344 [a]	0.227 [a]	0.333 [a]	0.325 [a]	0.174 [a]	0.122 [a]	0.133 [a]	0.343 [a]	0.506 [a]	1.000				
Humane	0.344 [a]	0.358 [a]	0.333 [a]	0.322 [a]	0.325 [a]	0.331 [a]	0.339 [a]	0.412 [a]	0.386 [a]	0.359 [a]	1.000			
Traceable	0.281 [a]	0.213 [a]	0.184 [a]	0.293 [a]	0.350 [a]	0.309 [a]	0.366 [a]	0.372 [a]	0.308 [a]	0.208 [a]	0.377 [a]	1.000		
Natural	0.374 [a]	0.418 [a]	0.258 [a]	0.385 [a]	0.404 [a]	0.397 [a]	0.453 [a]	0.333 [a]	0.342 [a]	0.358 [a]	0.361 [a]	0.437 [a]	1.000	
Organic	0.330 [a]	0.290 [a]	0.229 [a]	0.332 [a]	0.409 [a]	0.458 [a]	0.420 [a]	0.118 [a]	0.104 [a]	0.130 [a]	0.317 [a]	0.346 [a]	0.612 [a]	1.000

[a] = significant at the 0.05 level

Table A.12 Correlation of Consumer Attitudes Towards the Nutritional Value of Attributes

	Grass-Fed	Pastured	Grain-Fed	Free-Range	No antibiotic	Not fed antibiotic	No Hormone	Local	Tender	Aged	Humane	Trace	Natural	Organic
Grass-Fed	1.000													
Pastured	0.653 [a]	1.000												
Grain-Fed	0.295 [a]	0.178 [a]	1.000											
Free-Range	0.466 [a]	0.533 [a]	0.267 [a]	1.000										
No antibiotics	0.409 [a]	0.243 [a]	0.190 [a]	0.294 [a]	1.000									
Not fed antibiotics	0.397 [a]	0.32 [a]	0.208 [a]	0.377 [a]	0.870 [a]	1.000								
No Hormones	0.388 [a]	0.287 [a]	0.218 [a]	0.314 [a]	0.766 [a]	0.812 [a]	1.000							
Local	0.320 [a]	0.296 [a]	0.325 [a]	0.218 [a]	0.408 [a]	0.390 [a]	0.345 [a]	1.000						
Tender	0.250 [a]	0.205 [a]	0.384 [a]	0.164 [a]	0.323 [a]	0.282 [a]	0.269 [a]	0.526	1.000					
Aged	0.169 [a]	0.112 [a]	0.305 [a]	0.164 [a]	0.349 [a]	0.308 [a]	0.279 [a]	0.438	0.548 [a]	1.000				
Humane	0.288 [a]	0.211 [a]	0.337 [a]	0.227 [a]	0.277 [a]	0.307 [a]	0.312 [a]	0.512	0.536 [a]	0.478 [a]	1.000			
Traceable	0.319 [a]	0.290 [a]	0.296 [a]	0.245 [a]	0.420 [a]	0.356 [a]	0.440 [a]	0.562	0.566 [a]	0.520 [a]	0.546 [a]	1.000		
Natural	0.352 [a]	0.361 [a]	0.173 [a]	0.327 [a]	0.489 [a]	0.538 [a]	0.563 [a]	0.379	0.327 [a]	0.418 [a]	0.392 [a]	0.496 [a]	1.000	
Organic	0.393 [a]	0.328 [a]	0.138 [a]	0.410 [a]	0.478 [a]	0.549 [a]	0.561 [a]	0.181	0.164 [a]	0.130 [a]	0.285 [a]	0.331 [a]	0.674 [a]	1.000

[a] = significant at the 0.05 level

APPENDIX B:

SURVEY MATERIALS USED IN EXPERIMENT

University of Georgia

Beef Survey I

Panelist ID Number _____

Please answer all questions carefully. Unless otherwise indicated, please select only one answer. If none of the answers completely reflect your opinion, please select the answer that comes closest. Thank you.

1. Are you the person who usually purchases most of the groceries for your household?

1 □ Yes	2 □ No

2. Do you eat meat and meat products?

1 □ Yes	2 □ No (please contact the monitor)

3. Where do you prefer to purchase your Food and Meat? "X" ONE Box for your Primary Source of Food and Meat, "X" ONE Box for your Secondary Source of Food and Meat, and "X" ALL APPLICABLE Boxes for Occasional Sources of Food and locations where you Never purchase Food and/or Meat.

	FOOD Source				MEAT Source			
Location	**Primary Source ("X" One)**	**Secondary Source ("X" One)**	**Occasional Source ("X" All that Apply)**	**Never ("X" All that Apply)**	**Primary Source ("X" One)**	**Secondary Source ("X" One)**	**Occasional Source "X" All that Apply**	**Never ("X" All that Apply)**
Supermarket	□	□	□	□	□	□	□	□
Health/Natural Foods Store	□	□	□	□	□	□	□	□
Retail Meat Store	□	□	□	□	□	□	□	□
Farmer's Market (in season)	□	□	□	□	□	□	□	□
Direct from producer	□	□	□	□	□	□	□	□
Internet & Direct Mail Order	□	□	□	□	□	□	□	□

4. What does your family/household spend on food type groceries in an average week? (X ONE box)

1 □ Less than $50	3 □ $100 to $149	5 □ $200 to $299	7 □ $400 to $499
2 □ $50 to $99	4 □ $150 to $199	6 □ $300 to $399	8 □ $500 or more

5. Please make your best estimate of the amount of money your family/household spends on meat in an average week. Round to the nearest dollar: $_____/week.

6. Which meat product do you most prefer to consume? (X ONE box)

1 □ Beef	2 □ Chicken	3 □ Lamb	4 □ Pork
5 □ Fish	6 □ Other (please specify):		

7. What is the primary driver of your meat shopping decisions? (X ONE box)

1 □ Value for Price	2 □ Fits into budget	3 □ Quality	4 □ Brand
5 □ Cut	6 □ Cooking Occasion	7 □ Package Size	8 □ Cooking Occasion
9 □ Nutritional value	10 □ Preparation time	11 □ Other (please specify):	

8. How often do you prepare each of the following cuts of beef throughout the year? (X ONE box per cut)

Cut of Beef	**Several times a week**	**Weekly**	**Monthly**	**Yearly**	**Not at all**
Ground Beef	1□	2□	3□	4□	5□
Ground Beef Patties	1□	2□	3□	4□	5□
Steak	1□	2□	3□	4□	5□
Roast	1□	2□	3□	4□	5□
Ribs	1□	2□	3□	4□	5□
Processed Beef (sausage, hot dogs)	1□	2□	3□	4□	5□
Cured Products (jerky, meat sticks)	1□	2□	3□	4□	5□
Variety Cut (liver, heart)	1□	2□	3□	4□	5□
Precooked Entrées	1□	2□	3□	4□	5□
Other (please describe)_____	1□	2□	3□	4□	5□

9. What type of information do you look for when buying beef and beef products? **(please rank 1-5; 1= most important)**

____ Expiration date
____ Nutritional value
____ Price
____ USDA Choice or Select label
____ Other industry brand labels such as Certified Angus Beef, Coleman's Beef, Cattleman's Collection, etc.
____ Production techniques labels (Organic Beef, "Natural Beef," Hormone-Free Beef)
____ Other (please describe)-

_____

10. What motivates you to purchase **beef products** from a particular location? (X ONE Box)

Motivation	**Not at all Motivated**	**Somewhat Motivated**	**Motivated**	**Very Motivated**	**Extremely Motivated**
Meat department offerings	1□	2□	3□	4□	5□
Superior products (taste and flavor)	1□	2□	3□	4□	5□
Safety of the product	1□	2□	3□	4□	5□
Support local producer and community	1□	2□	3□	4□	5□
Convenient purchase location	1□	2□	3□	4□	5□
Aesthetic appeal	1□	2□	3□	4□	5□
Suggestion by family member or friend	1□	2□	3□	4□	5□
Reasonable prices	1□	2□	3□	4□	5□
Other (please describe)_____	1□	2□	3□	4□	5□

11. How important are various beef production practices to you? (X ONE Box for EACH practice)

Production Practice	Not at All Important	Somewhat Important	Important	Very Important	Extremely Important
Open range (no small or crowded pens)	1☐	2☐	3☐	4☐	5☐
No antibiotics	1☐	2☐	3☐	4☐	5☐
No growth hormones	1☐	2☐	3☐	4☐	5☐
Natural	1☐	2☐	3☐	4☐	5☐
Grassfed	1☐	2☐	3☐	4☐	5☐
Grazing managed to preserve streams	1☐	2☐	3☐	4☐	5☐
Grazing managed to protect endangered species	1☐	2☐	3☐	4☐	5☐
Animals treated humanely	1☐	2☐	3☐	4☐	5☐
Traceable from the farm to the consumer	1☐	2☐	3☐	4☐	5☐
Organic (USDA Certified Organic)	1☐	2☐	3☐	4☐	5☐
Other (please describe)	1☐	2☐	3☐	4☐	5☐

12. The following is a list of attributes many people look for when purchasing beef. Please indicate the desirability of each feature with an "X" for each attribute. (X ONE Box for EACH Attribute)

BEEF ATTRIBUTE	Not at All Desirable	Somewhat Desirable	Desirable	Very Desirable	Extremely Desirable
Organic (USDA Certified Organic)	1☐	2☐	3☐	4☐	5☐
Good Value for the Price	1☐	2☐	3☐	4☐	5☐
Nutritional Value (iron, protein)	1☐	2☐	3☐	4☐	5☐
Fresh (not frozen)	1☐	2☐	3☐	4☐	5☐
Aged for at least 14 days	1☐	2☐	3☐	4☐	5☐
Boneless	1☐	2☐	3☐	4☐	5☐
Premium brand	1☐	2☐	3☐	4☐	5☐
Ready to heat – Quick preparation time	1☐	2☐	3☐	4☐	5☐
Size of package (convenient size)	1☐	2☐	3☐	4☐	5☐
Pre-seasoned (marinated, sauce added, cooked)	1☐	2☐	3☐	4☐	5☐
Percent lean / Fat content	1☐	2☐	3☐	4☐	5☐
Labeled with country of origin	1☐	2☐	3☐	4☐	5☐
Other (please describe)	1☐	2☐	3☐	4☐	5☐

13. In the following table please indicate by checking "yes" or "no" if you have a) heard of beef being promoted with each of the attributes; and b) if you have knowingly purchased a beef product with each of the attributes?

BEEF ATTRIBUTE	13 a. Have You HEARD of Beef Being Promoted with the Following Attributes? (Check "Yes" or "No")		13 b. Have You PURCHASED Beef with the Following Attributes? (Check "Yes" or "No")	
Grass-Fed Beef	1 □ Yes	2 □ No	1 □ Yes	2 □ No
Pastured Beef	1 □ Yes	2 □ No	1 □ Yes	2 □ No
Grain-Fed and/or Corn-Fed Beef	1 □ Yes	2 □ No	1 □ Yes	2 □ No
Free-Range Beef	1 □ Yes	2 □ No	1 □ Yes	2 □ No
Beef that was "Raised Without Antibiotics	1 □ Yes	2 □ No	1 □ Yes	2 □ No
Beef that was "Not Fed Antibiotics"	1 □ Yes	2 □ No	1 □ Yes	2 □ No
Beef that was "Raised Without Supplemental Hormones"	1 □ Yes	2 □ No	1 □ Yes	2 □ No
Beef that was "Raised Locally"	1 □ Yes	2 □ No	1 □ Yes	2 □ No
Beef that is "Guaranteed Tender"	1 □ Yes	2 □ No	1 □ Yes	2 □ No
Beef that was "Aged"	1 □ Yes	2 □ No	1 □ Yes	2 □ No
Beef that is "Certified Humane Raised & Handled"	1 □ Yes	2 □ No	1 □ Yes	2 □ No
Beef that is "Traceable to the farm"	1 □ Yes	2 □ No	1 □ Yes	2 □ No

14. Please use the space below to explain what you believe the term "Grass-Fed" beef means.

_____
_____

15. If you could buy a locally grown beef product with the following characteristics: grass-fed, not fed antibiotics, and raised without supplemental hormones, how interested would you be on a scale of 1 to 10 (1 being Not Interested and 10 being Extremely Interested) in such a product? (Circle the number that corresponds to your interest)

Not Interested		**Somewhat Interested**			**Very Interested**			**Extremely Interested**	
1	2	3	4	5	6	7	8	9	10

16. What product characteristics or missing characteristics influenced your answer to question 15 above?

_____

17. What is the most that you would be willing to pay for beef that was labeled and guaranteed to contain a product with each of the following attributes**? Indicate your willingness to pay by checking one box for each beef attribute.**

BEEF ATTRIBUTE	**Less than** the Typical Retail Price	**Equal to** the Typical Retail Price	**10% Above** the Typical retail price	**25% Above** the Typical retail price	**More than 25% above** the Typical retail price	**Would Not Purchase** this type of beef.
Grass-Fed Beef	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Pastured Beef	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Grain-Fed and/or Corn-Fed Beef	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Free-Range Beef	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Beef "Raised Without Antibiotics	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Beef "Not Fed Antibiotics"	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Beef "Raised Without Supplemental Hormones"	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Beef "Raised Locally"	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Beef that is "Guaranteed Tender"	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Beef that was "Aged"	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Beef that is "Certified Humane Raised & Handled"	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Beef that is "Traceable to the farm"	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Natural Beef	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐
Organic Beef	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐

18. Imagine a beef product that is labeled with each of the following attributes. For each food characteristic column (Eating Quality, Food Safety, and Nutritional Value), please indicate by checking "Yes" or "No" what you would expect the beef to be like compared to regular beef.

	18a. Eating Quality (Check "Yes" or "No")		**18b. Food Safety** (Check "Yes" or "No")		**18c. Nutritional Value** (Check "Yes" or "No")	
BEEF ATTRIBUTE	**Yes:** Beef **with Attribute** has **Better Eating Quality** than Regular	**No: Regular is as good or better** than beef with attribute	**Yes:** Beef **with Attribute is Safer** than Regular	**No: Regular is as safe or safer** than beef with attribute	**Yes:** Beef **with Attribute** is more **Nutritional** than Regular	**No: Regular is as good or better** than beef with attribute
Grass-Fed Beef	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Pastured Beef	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Grain-Fed and/or Corn-Fed Beef	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Free-Range Beef	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Beef "Raised Without Antibiotics	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Beef "Not Fed Antibiotics"	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Beef "Raised Without Supplemental Hormones"	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Beef "Raised Locally"	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Beef that is "Guaranteed Tender"	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Beef that was "Aged"	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Beef that is "Certified Humane Raised & Handled"	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Beef that is "Traceable to the farm"	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Natural Beef	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No
Organic Beef	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No	1 ☐ Yes	2 ☐ No

19. Are you usually familiar with the origination of the beef products that you purchase?

1 □ Yes	2 □ No	3 □ Don't know

20. Have you ever purchased a meat product labeled with its country of origin?

1 □ Yes	2 □ No	3 □ Don't know

21. In general, <u>how SAFE</u> do you consider the <u>meat products</u> originating from the following countries?

Country of Origin	Extremely Safe	Very Safe	Somewhat Safe	Not very Safe	Not at all Safe
a. United States	1□	2□	3□	4□	5□
b. Canada	1□	2□	3□	4□	5□
c. México	1□	2□	3□	4□	5□
d. Australia	1□	2□	3□	4□	5□
e. New Zealand	1□	2□	3□	4□	5□
f. Brazil	1□	2□	3□	4□	5□
g. Argentina	1□	2□	3□	4□	5□
h. Japan	1□	2□	3□	4□	5□

Section II:

The following information is necessary for statistical analysis only and will be held confidentially.

22. What is your gender? (X ONE Box)

1 □ Female	2 □ Male

23. What is your ethnic background? (X ONE Box)

1 □ African/American	2 □ American Indian	3 □ Asian	4 □ Caucasian
5 □ Hispanic	6 □ Other (please describe)		

24. In what year were you born? Please state the year that you were born: _____

25. What is your age? Please state your age in years: _____years

26. Please indicate the highest level of education that you have completed. (X ONE Box)

1 □ Elementary school	2 □ Some high school	3 □ Completed high school	4 □ Some college
5 □ Completed junior college	6 □ Completed a 4-year university	7 □ Some graduate school	8 □ Completed graduate degree
9 □ Any other education (please describe):_____			

27. What is your current employment status outside of the home? (X ONE Box)

1 □ Not employed	2 □ Student
3 □ Part-time	4 □ Full-time

28. Are you or your family currently or have you or your family been previously involved in production agriculture? (X ONE Box)

1 □ Yes	2 □ No

28b. If yes, please explain you involvement. (crops (type), livestock (type), % of household of income , etc).

_____
_____

29. Including yourself, how many adults (18 yrs+) are living within your household?_____

30. Do you have children living in your household? (X ONE Box)

1 □ Yes	2 □ No (Skip to question 31)

30b. If yes, how many children (age 18 and under) are living in your household?

_____

31. What is your current marital status? (X ONE Box)

1 □ Single (Never Married)	2 □ Divorced (Now Single)	3 □ Married
4 □ Domestic Partnership	5 □ Widowed (Not Remarried)	

If you are married, do both you and your spouse work

32. Which of the following ranges describes your annual household income before taxes? (X ONE Box)

1 □ Under $20,000	2 □ $20,000 to $24,999	3 □ $25,000 to $29,999	4 □$30,000 to $34,999
5 □ $35,000 to $39,999	6 □ $40,000 to $49,999	7 □$50,000 to $59,999	8 □$60,000 to $69,999
9 □ $70,000 to $79,999	10 □ $80,000 to $89,999	11 □ $90,000 to $99,999	12 □ $100,000 or more

33. What is your zip code? _____

34. In which state or country were you raised? _____(please write abbreviation of state).

35. How long have you lived in the Athens area? _____(# of years)

36. Please indicate the lifestage category that *best fits* your household. (**X only one box, 1- 10. Please contact the monitor if you have questions).**

1 ☐	**YOUNG SINGLES:** 1-Member Household, Age of Head Under 35
2 ☐	**MIDDLE SINGLES:** 1-Member Household, Age of Head from 35 to 65
3 ☐	**OLDER SINGLES:** 1-Member Household, Age of Head Over 65
4 ☐	**YOUNG COUPLE:** Multimember Household, Age of Head Under 45, Married or Nonrelated Individual(s) of Opposite Sex 18+ Present, No Children Present
5 ☐	**WORKING OLDER COUPLE:** Multimember Household, Age of Head 45 and Over, Head of Household Employed, No Children Present, Married or Nonrelated Individual(s) of Opposite Sex 18+ Present
6 ☐	**RETIRED OLDER COUPLE:** Multimember Household, Age of Head 45 and Over, Head of Household NOT Employed, No Children Present Married Nonrelated Individual(s) of Opposite Sex 18+ Present
7 ☐	**YOUNG PARENT:** Multimember Household, Age of Head Under 45, Youngest Child Under 6
8 ☐	**MIDDLE PARENT:** Multimember Household, Age of Head Under 45, Youngest Child 6+
91 ☐	**OLDER PARENT:** Multimember Household, Age of Head 45 and Over, Child at Home - Any Age
10 ☐	**ROOMMATES:** Head of Household Living with a Nonrelative 18+ of Same Sex

Dialogue of moderator for taste panels evaluations and auction.

THE VALUE OF BEEF PALATABILITY TRAITS
Dialogue for Taste Panels

We would like to thank you for taking time out of your day to participate in this study. My name is Wendy Umberger and I am an agricultural economist at Colorado State University. I am working with the folks here at the University of Georgia to conduct this taste panel as part of our research on the value of beef palatability traits. In order to maintain consistency throughout all of the panels we conduct, I will be reading this dialogue.

First let me briefly explain what you will be doing for this taste panel. You will be tasting and visually evaluating beef steak samples. You will rate the tenderness, juiciness, flavor, and overall acceptability of each sample. After tasting a pair of samples, you will have the opportunity to participate in a silent auction on steaks that if you "win" you will get to take home with you.

You will be tasting and visually evaluating pairs of ____Strip Loin_____ steaks. First you will taste 2 pairs (4 steaks) and evaluate each steak in the pair for palatability traits, after you finish tasting a pair, you will be asked to provide bids for each steak in the pair. You will be bidding on 1 pound of frozen steaks of similar quality to the sample you taste. Each package to be auctioned will contain 2 steaks. The total weight of each package is approximately 1 pound. The steaks are vacuum sealed and are frozen. After you finish tasting and bidding 1 pair, you will be asked to taste and bid on a second pair.

You will then be moved back into this room and asked to visually evaluate 3 more pairs of steaks. This time you will only visually evaluate. After visually evaluating a pair, you will be given a bid sheet and again asked to indicate your willingness to pay by producing your bids for each steak on a bid sheet. You will do this for 2 more visual pairs.

Finally, you will go back to the taste booths and get to taste and bid on another pair of steaks.
In total you will taste and bid on 3 pairs of steaks (6 steak samples) and you will visually evaluate 3 pairs of steaks (6 pairs). You will bid 12 times.

When you have finished visually evaluating and tasting all steaks, there will be 3 people who will have the opportunity to "upgrade" their steak to one they preferred in a given pair. We will randomly

determine one of the steaks to be a “binding” steak. Let’s call the people who get to upgrade “winners”. These winners will be the 3 people who bid the highest premium for that steak. They will then get to upgrade to their chosen steak in the pair by paying the difference between their price on the “binding” steak and the price they were willing to pay for their less preferred steak in the pair.

You will be setting the prices in the auctions, if you choose to bid. The premiums, set by you, will be the only cost associated with this study. There are no hidden costs. There will not even be a sales tax on the purchased steaks. The prices, determined by the panelists during the auction, will determine the amount you pay.

Let’s go through an example. Assume ten of you evaluated steaks for two steak samples, steak A and steak B. The following are the pairs of bids that you submitted.

It is in your best interest to bid EXACTLY as much as you are willing to pay for the steaks. You do NOT want to bid more than you are willing to pay for the steaks because the premium may be more than you are willing to pay to upgrade.

There is no right or wrong amount to bid. Bid only the price you are willing to pay. These steaks sell for around 5.00 pound

BID SHEET

BEEF TASTE PANELS

Pair Order #_____

Panelist ID: _____ **Initials:_____**

Sample Number	Amount Bid for Sample
	$ per pound
	$ per pound
Which one of the two samples would you prefer to purchase? (Please write the sample # below. If you are indifferent between the two please write "indifferent".)	**Please briefly explain why you preferred the sample that you did:**

If you choose not to bid (bid of $0/pound) for either steak, please explain why.

Beef Survey II

Panelist ID Number _____

Please answer all questions carefully. All of the questions are multiple choice – please select your answer by circling the letter next to your appropriate answer. Unless otherwise indicated, please select only one answer. If you are unsure of the answer, please mark "Do Not Know" rather than guessing. Thank you.

Please mark only one answer and answer all questions. If you are unsure of the answer, please mark "*Do Not Know*" (rather than guessing).

1) What is marbling?
   a. Seams of fat running through a steak
   b. Small flecks of fat in the lean tissue of a steak
   c. Fat surrounding the outside of a steak
   d. Small muscles surrounding the main muscle in a steak
   e. Do Not Know

2) Which of the following are the top three quality grades of beef?
   a. AAA, AA, A
   b. Choice, Prime, Good
   c. Choice, Select, Fine
   d. Prime, Choice, Select
   e. AAA, Choice, AA
   f. Do Not Know

3) Beef is not a good source of which one of the following nutrients?
   a. Iron
   b. Zinc
   c. Vitamin C
   d. B-vitamins
   e. Protein
   f. Do Not Know

4) What is the average amount of cholesterol in a 3-ounce cooked serving of beef?
   a. 65 mg
   b. 100 mg
   c. 200 mg
   d. 400 mg
   e. Do Not Know

5) In general, which cuts of beef are the leanest - ones from the chuck or ones from the round?
   a. Chuck b. Round

6) From which of the following cuts does the New York (Kansas City) strip steak come from?
   a. Round
   b. Rib
   c. Chuck
   d. Loin
   e. Do Not Know

7) What is the minimum temperature to which ground beef should be cooked in order to be considered safe to eat?
   a. 40°F
   b. 140°F
   c. 160°F
   d. 180°F
   e. Do Not Know

8) Which of the following ingredients is least responsible for tenderizing meat in a marinade?
   a. Lemon Juice
   b. Vinegar
   c. Soy (or teriyaki) sauce
   d. Vegetable Oil
   e. Wine
   f. Do Not Know

9) For which of the following beef cuts would it be best to cook by braising?
   a. New York (Kansas City) strip steak
   b. Chuck eye steak
   c. Ribeye steak
   d. Tenderloin steak
   e. Do Not Know

10) For which of the following beef cuts would it be best to cook by broiling?
   a. T-Bone steak
   b. Flank steak
   c. Arm pot roast
   d. Round steak
   e. Do Not Knowj