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Application of Choice-Based Conjoint Analysis to Determine Consumers' Preferences and Willingness to Pay for Grass Fed Beef in the United States

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APPLICATION OF CHOICE-BASED CONJOINT ANALYSIS TO
DETERMINE CONSUMERS' PREFERENCES AND WILLINGNESS TO PAY
FOR GRASS FED BEEF IN THE UNITED STATES

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Agricultural Economics & Agribusiness

by

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*A mi padre Fernando, por su motivación y por ser un ejemplo de dedicación y trabajo.
(To my father Fernando for his encouragement, and for being an example of dedication and hard
work)*

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(To my mother Myriam for her infinite love, wisdom, and motivation)*

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cada día hasta alcanzar este objetivo
(To my wife Adriana, “Adri”, for being my inspiration, energy and happiness, and for walking
together each day in the pursuit of this goal)*

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(To my brother David and my sister-in-law Kirsten for their continuous trust and unconditional
support)*

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(To my brother Miguel Angel, for his encouragement to always make a difference in this world)*

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ABSTRACT

U.S. consumption of beef has declined during the last three decades. Consumer preferences have shifted toward products that are considered healthy, environmentally friendly and obtained through sustainable production methods. Because of the characteristics of grass-fed beef production, consumers are becoming more interested in grass-fed beef products than conventional beef products. A choice-based experiment was used to assess consumer's preferences for grass-fed beef. A national online survey was conducted in May 2012 and the information from 4000 respondents was collected from the entire U.S. The respondents were divided in two groups of similar size: grass-fed beef eaters, comprised by the respondents who had eaten grass-fed beef in the last year and 2000 respondents from the general population. The participants were asked to evaluate three sets of three hypothetical beef steaks. Each set also included the "no purchase" option. In addition to the choice experiment, information regarding the consumers' lifestyle, belief and attitudes towards grass-fed beef along with their demographic and socioeconomic information was requested.

The attributes that consumers evaluated for the grass-fed beef choice experiment included the type of production (grass-fed or grain-fed beef) with USDA certification, source grade and price. Price was the most important attribute for consumers' choice, followed by the type of production. The results revealed that on average, grass-fed beef with USDA certification was preferred over grain-fed beef. Consumers valued steaks produced in the U.S. more than imported. The interactions between the consumers' demographic characteristics and the product attributes revealed that female consumers prefer grass-fed beef with USDA certification and were willing to pay more for this product. The USDA certification was valued by the consumer and certified grass-fed beef products were preferred over grass-fed beef products without

certification. The analysis also showed that sustainability, novelty and convenience are consumer's attitudinal and behavioral characteristics that affect their choice for grass-fed beef products. The nutrition dimension, which accounts for the consumer's interest in food composition and weight control, did not affect his choice for beef products.

CHAPTER 1: INTRODUCTION

U.S. consumption of beef has declined during the last three decades. Schroeder and Mark (2000) identified the relative prices of competing meats, consumer income, health and nutrition concerns, food safety, and the interaction between product attributes and shifting consumer preferences as the five major determinants for this decline. Consumer preferences have shifted towards products that are considered healthy, environmentally friendly, and obtained through sustainable production methods. As a way to respond to these challenges, the cattle industry reevaluated its conventional beef production systems and developed alternative production methods that can better satisfy the consumers' preferences. During the last decade, there has been a slight increase in the demand for beef products mainly supported by an increasing demand for value-added beef products and specific beef attributes. It becomes important for the beef industry to determine the beef attributes that are more desirable by the consumer and their willingness to pay (WTP) for those qualities. The purpose of this study is to determine consumers' preferences and WTP for grass-fed beef products and their attributes.

1.1 Background

The beef sector is the second major contributor to the United States agricultural economy; in 2011 the major contributor was corn. The Economic Research Service (ERS) of the United States Department of Agriculture (2013) reported that in 2011 the total farm receipts for cattle and calves accounted for \$62.9 billion. The United States has the largest fed-cattle industry in the world, the majority of which is high-quality grain-fed beef for domestic use and export. However, the U.S. is also a net importer, principally of grass-fed beef which is destined for processing (consumed as ground beef). The USDA's Agricultural Projections to 2020 (USDA and Committee, 2013) for the food and agricultural sector reports that overall meat production in the U.S. has declined during the last decade. The decrease in production along with projected

increases in meat exports led to higher meat prices and a decrease in per capita consumption in the short term. Annual average consumption of meat increased since 1980 and reached its maximum level in the period 2004-2007 (221 pounds per capita). Per capita consumption has fallen since 2008; in 2012, average per capita consumption of meat was 202 pounds and it was projected that in 2013 it would be less than 198 pounds (Figure 1).

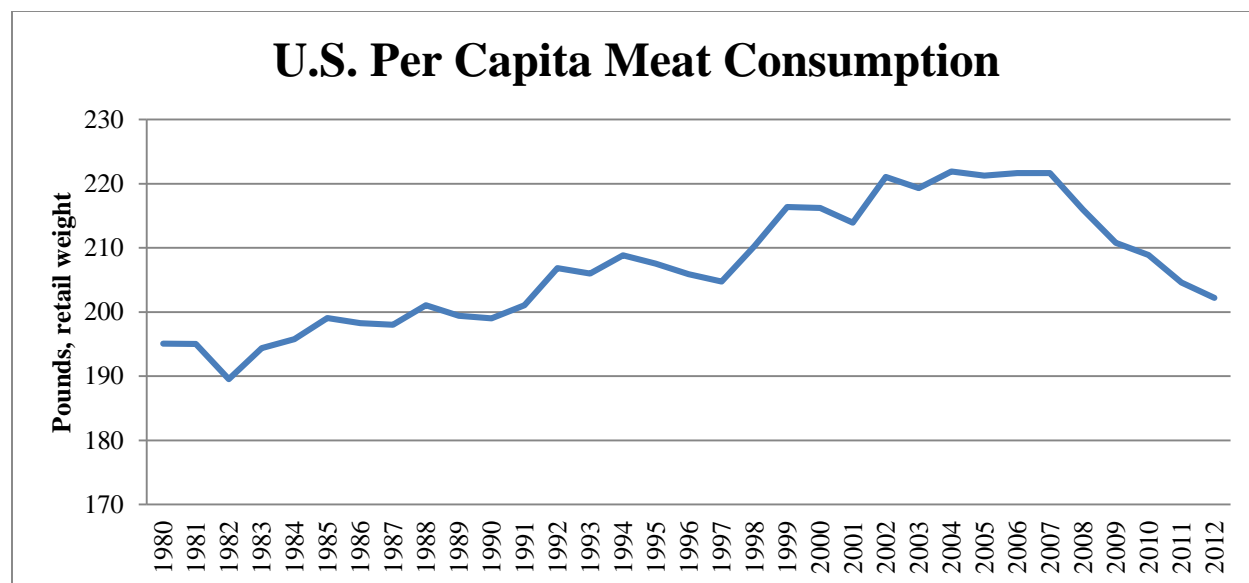


Figure 1. United States Total Per Capita Meat Consumption

Source: Livestock & Meat Domestic Data, Economic Research Service, USDA (2013)

Increases in the overall per capita meat consumption from 1980 to 2005 were maintained thanks to an increase in the consumption of poultry products. The per capita consumption of beef and pork declined during the same timeframe, and the per capita beef consumption was the most affected (Figure 2). According to USDA projections, per capita beef consumption is expected to decline through 2015. Per capita pork consumption is expected to increase gradually after 2013 as a result of rises in pork production. Poultry production and consumption are expected to increase throughout the entire next decade.

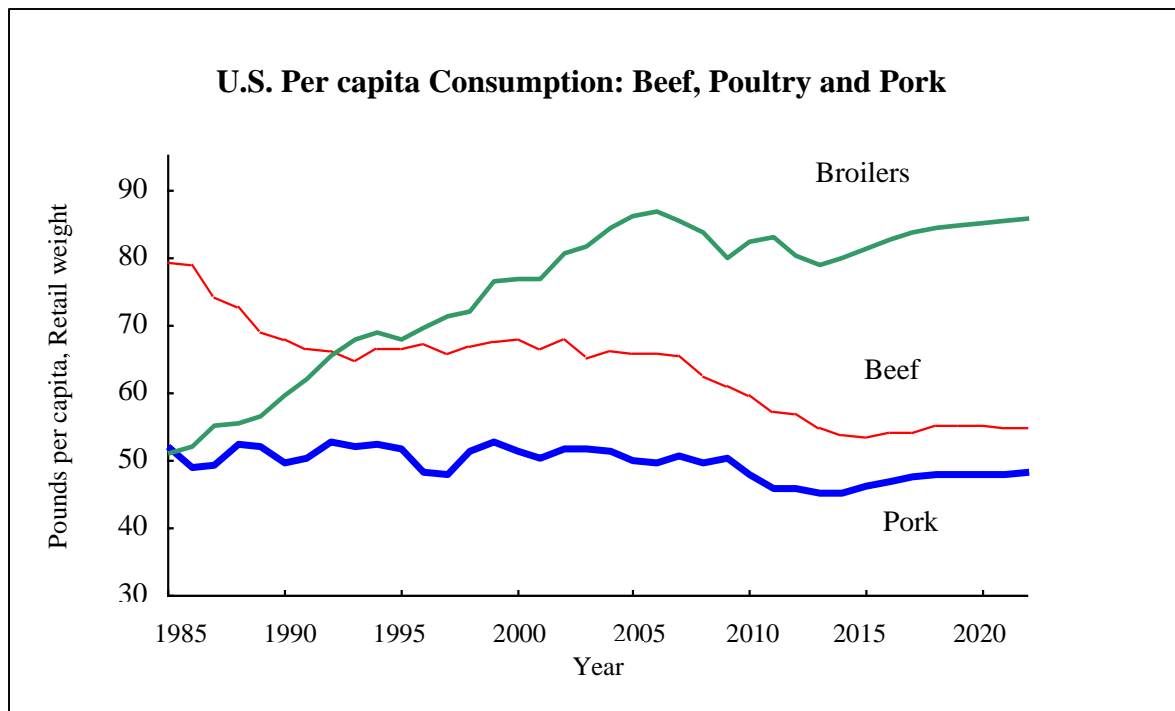


Figure 2. United States Per Capita Consumption for Beef, Poultry and Pork
Source: USDA Agricultural Projections to 2022

Producers and processors were concerned by the decrease in the demand for beef. Cattlemen decided to invest in research to define the causes of the decline and to find new alternatives to increase the marketability of beef. As a result, the National Beef Quality Audit (NBQA) program was implemented by the National Cattlemen’s Beef Association (NCBA) to “identify quality challenges, shortfalls, and targets of desired quality levels for the beef industry” (NCBA, 2012). The NBQA program is funded by the Beef Checkoff program and the audits are applied every five years and are conducted to define the most pressing issues affecting the industry. The audits are comprehensive and collect information from producers, feedlot operators, slaughterhouses, packers, purveyors, foodservice operators, and retailers. The results from the 2005 National Cattlemen’s Beef Quality Audit (NCBA, 2006) showed that purveyors, retailers, and restaurateurs rank insufficient marbling, too heavy cut weights, and lack of uniformity in cuts as the three main quality concerns as shown in Table 1. The results from the

audit evidenced the need for improvements in product quality and consistency. The 2005 audit also emphasized the importance of fostering communication between the different stakeholders of the industry to implement the improvements required to reach uniformity and consistency in cattle production and meat quality. Along with the improvements in quality, the survey also emphasized that the consumer is not really familiar with the USDA beef grading system and the information that it conveys to the buyer, which is consistent with the studies developed by Lusk, et al. (1999) and Clark (2007).

Table 1. Greatest Quality Challenges: Aggregated Responses of Purveyors, Retailers and Restaurateurs.

Characteristic	Rank
Insufficient marbling	1
Cut Weights too Heavy	2
Lack of Uniformity in Cuts	3
Inadequate Tenderness	4
Excess Fat Cover	5
Inadequate Juiciness	6
Inadequate Flavor	7
Inadequate Overall Palatability	8
Low Cutability	9
Too Large Ribeyes	10

Source: Executive Summary of the 2005 National Beef Quality Audit

The 2005 National Beef Quality Audit (and previous audits) was mostly focused on physical attributes of beef products (marbling, external fat, and carcass weight and blemishes). In 2011, a new beef quality audit was implemented. The 2011 audit identified food safety, sustainability, animal well-being, and the disconnection between producers and consumers as the five more pressing issues for the industry. During the last audit, a component of face to face interviews that gathered quantitative information was included as a pilot study to evaluate quality

indicators in the feeder cattle supply. The objective was to provide more information about the producer and to get a deeper and more accurate assessment of the industry.

The results of the study showed that there is a growing consumer concern for product integrity and eating satisfaction. Product integrity is achieved through the combined efforts to preserve the quality of the final product and the attributes that are preferred by the consumer. Food safety, production system, and animal health care, handling and well-being were the attributes considered to be determinant to maintain the integrity of the product. The consumer's eating satisfaction is primarily influenced by flavor profile, tenderness, juiciness and palatability. The results from the 2011 audit showed that the consumer is not only interested in the physical attributes of the product (reflected in their eating experience) but also in the origin and production conditions and environment. The consumer demands more information about the product from the food providers and is interested in knowing the story behind the product. This information is determinant in their selection process.

Several producers recognized the importance of value-added products and beef attributes and were able to capitalize on it. Producers, packers, and retailers recognized the consumers' preferences for specific attributes and have used these attributes (marbling, production technique) as a strategy to differentiate their products. The consumer responded favorably to the quality-differentiated beef products and was willing to pay more for products that exhibited the aforementioned attributes. As shown in Figure 3, the monthly average retail beef price has increased steadily since 1996. Clark (2007) suggests the use of "branding" as a way for the producers to market their quality differentiated beef products and to garner the benefits of providing products that have the attributes desired by the consumer. Branding will allow the consumer to easily identify the products that have the attributes that they are seeking. The use of

brands as a way to differentiate products that have specific sets of characteristics helps to develop expectations of a particular product to the consumer. If the producing firm is effective at satisfying the consumer expectations implied by their specific brand then the producer will benefit from the higher margins resulting from consumers' willingness to pay more for the product.

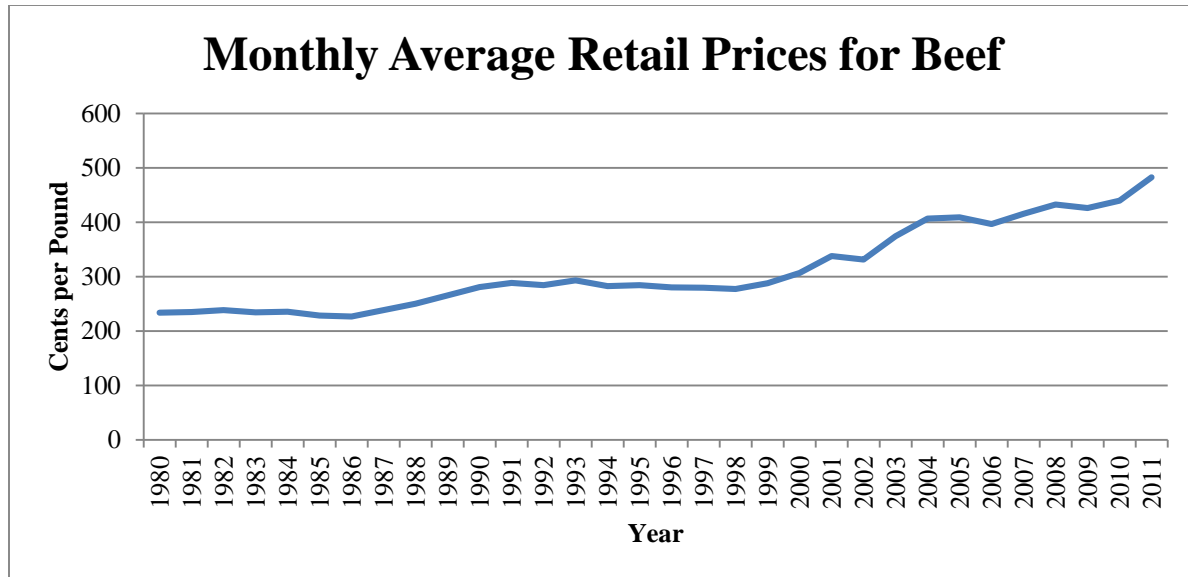


Figure 3. Monthly Average Retail Prices for Beef
Source: Economic Research Service, USDA (2013)

Quality differentiated beef products open the opportunity for producers, processors and retailers to specialize in specific niche markets by supplying products that are developed to satisfy groups of consumers who have similar preferences within a specific market. The growth of the natural/organic beef niche market is a successful example of the importance of offering quality differentiated products to the consumer. The National Cattlemen's Beef Association and the Cattlemen's Beef Board (CBB) (2013) report in their Retail Marketing Website that in the first quarter of 2013, the natural/organic beef category accounted for 4.1% of the share of the U.S. beef market. The report also showed that in the same quarter the natural/organic category had an increase of 1.4% in dollar sales compared to the results from the first quarter of 2012,

whereas the dollar sales of the entire beef market increased only by 1.2%. The total pounds of beef sold in the first quarter of 2013 decreased by 2.4% compared to the same quarter the previous year; on the other hand, the total pounds of natural/organic beef sold increased by 0.4%. Mathews and Johnson (2013) in their report “Alternative Beef Production Systems: Issues and Implications” explain that the beef market is changing rapidly because consumers demand combinations of attributes in their products. Animal welfare, production systems, and health claims along with the physical attributes of the products are part of the mix of components expected in the beef product by the consumer. The consumer’s perception about the importance of these attributes is the main driver for the demand of these products. New research and media play an important role in communicating the different attributes and influence consumer perceptions. Nevertheless, Mathews and Johnson (2013) explain that consumers perceptions about the type of production system are not always accurate which evidences a disconnection between the consumer’s understanding and the meaning or significance of the attribute.

The continuous demand for beef value-added products with specific attributes presents an opportunity for producers and retailers to differentiate their products and obtain higher returns for them. It becomes necessary to define the product attributes that the consumer values the most as well as the marketing strategies focused on the promotion of these attributes to effectively market beef products. The adequate segmentation and selection of the target markets that value these products are also fundamental to be effective in their delivery. The continuous evaluation of the attributes preferred by the consumer is an important source of information for the industry to offer products with attributes aligned with consumer preferences which will help increase the demand for beef products.

1.2 Problem Statement

Beef produced in the U.S. can be classified as produced thorough the conventional grain-fed system or any of the alternative systems. Clark (2007) explains that under the conventional or traditional system, the feed regimen for beef cattle consists of grass, pasture, hay, and the use of supplements until the animal reaches a weight of 700 to 800 pounds in a year. The so called “yearlings” then pass through a “finishing” process in which their diets are supplemented with grains as a way to accelerate weight gain to about 1000 to 1100 pounds, the weight required for them to be sold at the slaughter houses. In many cases, the animal is under confinement during the finishing phase to reduce the necessary time to achieve the final weight. During the last ten years, consumers have expressed concerns about the production practices used in the conventional system. The concerns have been summarized in terms of the impact of the conventional system on the quality and nutritional profile of the final product, animal welfare, and the impact of these practices over the environment and human health. These concerns have motivated the demand for beef finished without grains, antibiotics, hormones, and many of the procedures used in the conventional system to accelerate weight gain. Alternative beef production systems such as the grass-fed beef system were established as a way to address these concerns and to supply beef products that have the set of characteristics that are preferred by the consumer.

Grass-fed beef products are obtained from cattle that have been raised on forage or grass their entire lives with the exception of the period prior to weaning where milk was consumed. Grass-fed beef products can also be classified as organic or natural beef depending on the characteristics used in each system. It’s not necessary for grass-fed beef to be organic or natural, and natural or organic beef does not necessarily imply that the product came from a grass-fed system. There are organic beef products that were obtained from beef finished on grain.

Additionally, consumers usually assume that grain-fed beef production takes place under confinement, but since grass-fed beef is only fed pastures, the consumer associates this feeding system with the animal roaming freely on pastures (“free range”). Some products can be mistaken because the consumer may purchase beef products advertised as “free range” or “pasture raised”, thinking that they were produced under grass-fed conditions, but in reality, the animals were raised in open pastures but grain-finished.

The lack of knowledge by the consumer or the companies labeling the products can easily lead to wrong interpretations. The USDA’s Agricultural Marketing Service (AMS) (2008) proposed a grass (forage) fed marketing claim standard on May 11, 2006 and the claim standard was published on the Federal Register in October 16, 2007 (72 FR 58631). The grass fed marketing claim standard states that for a product to be grass fed “Grass and forage shall be the feed source consumed for the lifetime of the ruminant animal, with the exception of milk consumed prior to weaning. The diet shall be derived solely from forage consisting of grass (annual and perennial), forbs (e.g., legumes, *Brassica*), browse, or cereal grain crops in the vegetative (pre-grain) state. Animals cannot be fed grain or grain byproducts and must have continuous access to pasture during the growing season. Hay, haylage, baleage, silage, crop residue without grain, and other roughage sources may also be included as acceptable feed sources. Routine mineral and vitamin supplementation may also be included in the feeding regimen. If incidental supplementation occurs due to inadvertent exposure to non-forage feedstuffs or to ensure the animal’s well-being at all times during adverse environmental or physical conditions, the producer must fully document (e.g., receipts, ingredients, and tear tags) the supplementation that occurs including the amount, the frequency, and the supplements

provided.” The publication of this standard also allowed the producers to voluntarily participate in the USDA’s- verified program involving a grass (forage) fed beef claim.

The American Grassfed Association (AGA) developed a stricter standard, and their standard and certification program were introduced in 2009. The AGA website (2013) explains that their definition is more comprehensive than the USDA’s and describes “grass fed animals as those that have eaten nothing but grass and forage from weaning to harvest, have not been raised in confinement, and have never been fed antibiotics or growth hormones. In addition, all AGA-Certified Producers are American family farms and their livestock is born and raised in the U.S.” The National Cattlemen’s Beef Association (2013) in their Beef Basics for Consumers manual uses the term “grass finished” beef and defines that the animal must have continuous access to pasture during the growing season. The AGA’s and NCBA’s definitions of grass fed beef are more restrictive because they limit the use of antibiotics, and promote animal welfare because they require that the animal be raised in open pastures. These initiatives have found support among several animal welfare advocacy groups and consumers.

Worthington (2001) presented evidence that organic crops had a higher content of nutrients (minerals and vitamins) than their counterparts obtained through conventional production systems. Duckett, et al. (2009) found evidence that grass finished beef cuts had less total, saturated, and monounsaturated fat content with greater contents of Omega-3 fatty acids, B-vitamins, and vitamins E and A (beta carotene) which are important antioxidants for the body. The ratio of Omega-6 to Omega-3 fatty acids is below the 4:1 level which is recommended by health professionals for a healthy diet. The presence of these nutrients is very relevant because they have valuable properties to reduce cholesterol, reduce the risk of diabetes, and alleviate high blood pressure (Duckett, et al., 2009).

Grass fed beef is a product that offers a wide variety of benefits that are aligned with the preferences of consumers that are health conscious and that seek products obtained through environmentally sound and sustainable production practices. Consumers interested in these attributes are willing to pay more for these products, making them more valuable, which leads us to question the small size of the market for grass fed beef compared to the entire beef market. One of the reasons that explains this difference comes from the production side. Cattle produced in a grass production system take longer than the grain produced beef to reach the required weight (Bearden, 2004, Martin and Rogers, 2004, Prevatt, et al., 2006). Grass-fed beef production requires continuous supply of forage which implies larger areas for pastures and an adequate grazing management system. These requirements lead to an increase in production costs.

Weather conditions need to be considered to have an ample supply of forage during the finishing stage. Clark (2007) explains that the states located in the Southeastern region of the U.S. may have an advantage over the rest regarding the weather conditions because of the mild temperatures and the adequate level of precipitation found in this part of the country. During the last years, severe droughts have affected this region, but in general producers are able to rely on their pastures almost the entire year, limiting the use of stored forages to a minimum. The National Cattlemen's Beef Association, during the 2011 quality audit, emphasized the importance of good pastures on the final quality of the product. The transition from a grain-finishing system to a grass-finishing system also brings changes in the production system. Longer production cycles and the availability of pastures and labor lead producers to rethink their calving season and system they have in place.

Another major sources of concern for the producer are the marketing and branding costs for grass-fed beef products. Organizations such as the National Cattlemen's Beef Association and the American Grassfed Association have devoted many resources for the development of a brand, but more investment is necessary to establish a brand that the consumer can associate with quality and consistency in the product attributes. The development of brands can help position the product in the consumer's mind, allowing the consumer to identify the grass-fed beef brands that provide their preferred attributes. Clark (2007) explains that the grain-fed beef producer can also allow the cattle to eat grain in open pastures and claim that the cattle were "humanely treated" or "free-range" raised and offer the product to consumers seeking that attribute in the products. Therefore, the animal welfare attribute is not exclusive of the grass-fed beef production system.

There are many attributes that grass-fed beef products have; therefore, it becomes important for the producer to understand the attributes that are more valuable for the consumer and their willingness to pay for the quality differentiated beef products that present those attributes. The presence of credence attributes (free range, grass fed-beef, no hormones, etc.) and health information can be attractive for consumers and motivate the first purchase of the product. Nevertheless, the consistency in the presence of desirable physical and sensory attributes (marbling, palatability, taste, etc.) will be determinant for repeated purchases. Along with the positive meat quality attributes, negative attributes that can affect the desirability of the product have been reported. Several authors (Daley, et al., 2010, Mandell, et al., 1998, Scollan, et al., 2006) report that grass-fed beef products are leaner, have less intramuscular fat, and present off-flavors which can be attributed to differences in the rate of fatty acids present as compared to meat cuts from grain fed animals. These differences are also affected by the variability in the

forages used to feed the cattle. Martin and Rogers (2004) and Daley, et al. (2010) explain that the fat from grass fed beef may have a yellowish color due to the elevated carotenoid content, which affects the product desirability. Since the grass-fed beef system is characterized by leaner products, this characteristic can negatively affect the overall taste, juiciness and tenderness of the final product.

Thus, it becomes important to analyze the beef attributes that are valued by the consumer, the different trade-offs the consumer makes among these attributes, and the consumer's willingness to pay for them. The transition from a conventional system to a grass fed system and the profitability of a grass-fed system rely on the premium that the consumer is willing to pay for those products.

1.3 Purpose and Objectives

The main objective of this study is to determine the factors that motivate the consumer to pay for quality differentiated products (grass-fed beef), to identify the demographic characteristics of the consumer of grass-fed beef products, and to evaluate the level of knowledge that the consumer has about the health attributes of grass-fed beef.

The specific objectives of this research are to:

1. Describe the grass-fed beef consumer in the United States based on the consumer's socio-demographic data and behavioral and attitudinal information.
2. Determine the relative importance placed by consumers on credence attributes associated with grass-fed beef.
3. Estimate the consumer's willingness-to-pay for grass fed beef credence attributes.
4. Compare the level of importance that the credence attributes of grass fed beef have for a consumer from the general population (that might have consumed the product during the last year) and a consumer that ate grass fed beef recently.

5. Determine the relative importance that the consumer places on the USDA's grass (forage) fed claim.

1.4 Significance of the Study

This study is a contribution to the current literature on grass-fed beef preferences. First, this study used two representative samples of meat consumers from throughout the United States. The first sample included people that might or might not have consumed grass-fed beef products during the last year. The second sample included only people that had consumed grass-fed beef during the last year. Conjoint analysis is used to analyze consumer preferences for grass-fed beef in both groups. The analysis will provide grass-fed beef producers with valuable information on grass-fed beef consumers, their socio-economic characteristics, as well as the importance that the consumer places on the attributes. Health related attributes were also considered in the analysis to estimate the level of awareness and importance of these attributes during the consumer valuation of the product. This information will allow producers to develop effective marketing campaigns by focusing on the attributes that are more important from the consumer standpoint, thereby increasing the demand for grass fed beef.

CHAPTER 2: REVIEW OF LITERATURE

Fields, et al. (2006), Umberger, et al. (2009) and Clark (2007) conducted studies to estimate the differences in consumers' preferences for grass-fed over grain-fed beef products in the southeastern region of the United States. Gwin, et al. (2012), on the other hand, elicited consumers' preferences for grass-finished beef products in Portland, OR. Xue, et al. (2010) analyzed consumers' preferences and WTP in three cities Knoxville, TN; Middlesboro, KY; and Bluefield, WV in order to obtain a more heterogeneous sample. All these studies considered the use of socio-demographic consumer characteristics along with the availability of nutritional information as factors that influence the consumer decision to purchase grass-fed beef products. These studies have also shown that consumer attitudes towards the animal welfare, the environment and sustainable agriculture can also influence the likelihood of selecting grass-fed beef products. The study made by Lin (2013) provides evidence of the importance of the grass-fed beef USDA certification as an attribute that can positively influence consumers' preferences for these products. All the authors agree that there is a strong need for more research regarding the factors that influence the consumer's perception of grass fed beef products. The literature has also shown that credence attributes along with consumer attitudes and behavior can be used to determine the characteristics of the segment of consumers willing to pay a higher premium for these products.

Fields, et al. (2006) conducted a survey at a grocery store in Alabama which elicited information on consumer preferences for beef meat attributes. The data were collected using in-person interviews and the treatments of the experimental design varied depending on type of meat (ribeye steak or ground beef), type of conjoint ranking method used (hypothetical or non-hypothetical), and whether information about the health benefits of grass-fed beef was presented.

Six attributes were considered for the product profiles: feeding system (whether the animal was pasture-fed or not), whether the product was hormone and/or antibiotics free or not, traceability (whether the product could be traced back to the farm), package size and price.

There were a total of 515 respondents; about 81% of them were white and 59% of the sample attended college and/or graduate school. The majority of respondents were female (60%), the average age was 44, and 48% (74%) of the sample reported eating steaks (ground beef) at least once a week. The data were analyzed using a random parameters model and the results suggested that the hormone-free attribute was more valued than pasture or traceability. There was heterogeneity present in the population for all the attributes with the exception of cash. As expected, the display of information about the potential health-benefits of grass-fed beef consumption increased consumers' willingness –to-pay for that attribute. On average, individuals were willing to pay \$1.99 more for a grass-fed beef ribeye than a non-forage fed steak when information about the health benefits was not displayed. That price differential increased to \$2.56 when the health-benefit information was displayed in the description of the product. On average, consumers' willingness to pay for traceability was less than for hormone use or feeding-system information.

The results from the conjoint analysis were used to estimate market share simulations considering 6 scenarios. Under the first scenario, steaks or ground beef conventionally produced were the only products available in the market. The rest of the scenarios considered the introduction of forage-fed beef products that displayed or did not display information about health-benefits of grass-fed beef, hormone use and/or traceability. Each scenario had either one, two or three products and it was assumed that the consumer selected the alternative that gave him the highest utility. Forage-fed beef products with no-growth hormones and traceable that

displayed those characteristics had a higher market share than beef products produced conventionally. The addition of information about the health-benefits associated with the consumption of pasture-fed products increased the market share of grass-fed beef products about 10% more than without it. Fields, et al. (2006) showed that “providing information to the respondents increased their utility for the various beef attributes”. It also showed that females and highly educated consumers had higher utility levels for grass-fed, hormone free and traceable beef products. Females also expressed lower preference for larger cuts. One of the limitations of the Fields, et al. (2006) study is that it is not representative of the state or U.S. population since all the respondents were selected from a very specific geographic area. Nevertheless, this study also evidences the importance of providing information about the health-benefits of grass-fed beef products, along with hormone-free and traceability, as ways to increase the market potential of these products in the market.

Umberger, et al. (2009) analyzed the effect that the display of information about different product attributes had over respondents preference and willingness-to-pay for grass-finished versus grain-finished steaks. A total of 225 consumers from Clemson, South Carolina, and Athens, Georgia, participated in six rounds of auctions, in which they had to bid for one grain-finished and one grass-finished steak after evaluating their intrinsic characteristics or based on the information provided. Each round, the respondent evaluated or was presented with different sets of information. The respondents tasted the two steaks during the first and second rounds and rated the steak’s tenderness, juiciness and acceptability before bidding, but since the product was already cooked they did not evaluate the appearance of the products. Raw products were presented during the third round for visual evaluation and bidding, but no labelling information was provided. During the fourth round, the products were visually evaluated and information

about the production system was displayed on the label of each product. During the fifth round, additional information about the health benefits of consuming grass-finished beef was added to the information of the grass-finished steak. Consumers did not taste the product in rounds three, four or five. During the last round, consumers were presented with all the information from round five and they also tasted the steaks. After the bids were submitted, the premium that the respondents were willing to pay for grass-finished steaks was estimated by subtracting the grain-finished and grass-finished-steaks' bids. First, a random effects linear regression was used to analyze the effect of the production, health and taste information on the respondents' premiums for grass-fed beef products. The respondents' psychographic and socio-demographic characteristics along with the products' intrinsic and credence attributes were analyzed using a Cragg two-stage model to prove that "some of the variables used to explain preferences for grass beef ($GrassPremium > 0$) were different than those used to explain $GrassPremium$ " (Umberger, et al., 2009).

The results from the study showed that the proportion of respondents willing-to-pay a premium for grass-fed beef increases when additional production and health information is displayed, similar to the findings reported on the Fields, et al. (2006) study. During the taste evaluation grass-fed beef steaks had a negative premium due in most part to the lower palatability and flavor of the grass-finished steaks with respect to the grain-finished cuts. The visual evaluation showed that when there is no information displayed, on average the grain-finished is preferred over the grass-finished product. The proportion of respondents that preferred the grass-finished product increased from 37% to 53% when the production information was provided. The addition of health information to the description of the grass-finished product, during the fifth auction increased the proportion of consumers that preferred the

grass product to 63%, and the average premium increased from \$0.04/lb to \$0.67/lb. The premium decreased to \$0.03/lb during the last auction once the respondents tasted the product. The market share of respondents that preferred the grass-fed beef product also decreased to 46%.

The results from the Cragg two-stage model showed that respondents were 16.9% more likely to purchase grass-fed beef when information about the production system (grass-fed animal and free of hormones) was included. Taste and the involvement of the respondent in agricultural production had a negative effect on the likelihood of selecting a grass-fed beef product. This poses a potential problem for repeat purchases. A consumer may be willing to try the grass-fed beef product once, but the taste of it might discourage him from buying it again. The display of information related to the health benefits of the grass-finished products had the largest positive marginal effect over the premium for the grass-fed steak, whereas the number of children and age of the buyer had a negative effect. The results suggest that consumers that were income constrained or that had children were less likely to pay a premium for grass-fed beef products.

Respondents that expressed higher preference levels for production systems without the addition of hormones or antibiotics were willing to pay a higher premium for grass-fed beef products. Umberger, et al. (2009) explained that when more credence attributes are included, it is likely that the premium to be paid for the grass-fed beef product is the result of the interaction between different credence attributes and not the grass-finished attribute alone. The study also showed that there is additional production information (natural, hormone free and traceability) that has the potential to influence the consumer's decision, could be included in marketing campaigns for grass-fed beef products, and could significantly contribute to maintaining and growing niche markets for these products in the U.S.

Consumer attitudes about grass-fed beef have also been analyzed as important factors that could influence consumers' preference for grass-finished products. Gwin, et al. (2012) considered the effect of demographics, attitudinal consumer characteristics as well as place of purchase to explain the differences in preferences between grass-fed and grain fed ground beef products. The study took place in Portland, Oregon and only respondents that consume ground beef were considered for the analysis. The proportion of mainstream and natural-food store shoppers was evenly distributed in the sample. The consumers participated in the sensory evaluation first, where they tasted and evaluated two ground beef sample simultaneously. The consumers were asked to select a product based on their taste preference and then to rate color, juiciness and tenderness and overall liking on a 9-point scale. After the sensory evaluation, they participated on a survey with questions about their purchasing experience as well as willingness to buy beef in bulk sizes from producers. The choice-based experiment was the third element of the analysis, in which the participants answered six choice questions. Each set of questions had two products, at the same or different price levels and each one was accompanied with one of two levels of information about grass-fed beef production. The first one, included information about the grass-fed beef diet only, whereas the second included information about the production system and nutritional attributes. The survey ended with demographic and attitudinal questions.

The taste analysis showed that the preference difference between grass-fed and grain-fed ground beef was not statistically significant. The place of purchase, either mainstream or natural-store shoppers, did not play a significant role on the taste preference of the consumers. The information from the attitudinal questions was analyzed using principal components analysis and four factor dimensions were found: Seasonal and local buyer, environmentalism, nutrition ingredient concerns, farm preservation and animal welfare. These four dimensions were included

as explanatory variables to determine their influence over the consumers' willingness to buy and pay for grass-fed ground beef. Consumer's age negatively impacted the selection of grass-finished products. On the other hand, income had a positive effect over the consumption of grass-fed ground beef. In general, the results showed that consumers were willing to pay more for grass-fed beef ground beef versus the conventional product.

Mainstream shoppers were willing to pay a higher premium than natural store shoppers. The willingness-to-pay estimates showed that there was a premium of \$0.90-0.94 per pound associated for grass-finished products, "approximately 35-40% higher than WTP for grass-fed ground beef" (Gwin, et al., 2012). The authors stated that the high values of the premiums found in the study could be explained by the fact that Portland, Oregon, is considered a market in which many of the consumers are knowledgeable and prefer natural, local and sustainable food products. The model predicted that when grass-fed beef is priced \$2 per pound above grain-fed beef (\$2.50 per pound), 48% of the sample chose the grass-finished product. The authors stated that this level of preference (despite the price differential) could be explained due to the fact that a good proportion of the sample was comprised by shoppers that prefer natural stores and half of them received additional information. The premium price is also influenced by the level of prior knowledge that the respondent had. Prior knowledge about grass-fed beef production had more influence in increasing the preference for grass-fed beef than the level of information provided during the experiment. The respondents' attitudes and interest for animal welfare was also associated with higher premiums, whereas the nutrition and ingredient dimension was not relevant. The explanation for these findings is due to the fact that ground beef is not viewed as a healthy alternative in a consumers' diet.

The analysis of the consumers' willingness-to-buy in bulk showed that 69% of the respondents would be willing to buy in bulk if information about the producer was available. This number would increase to 73% if a price reduction would be offered because of the bulk size. The majority of the participants (72%) would be willing to purchase frozen beef. The lack of storage space was one of the main reasons given by those that preferred not to buy in bulk sizes. Natural store shoppers were more willing to buy in bulk sizes than mainstream shoppers. Respondents that preferred bulk sizes were older and they acquired these products at warehouse stores. One of the major contributions of the Gwin, et al. (2012) study is that previous knowledge about grass-fed beef production has a higher influence over willingness-to-pay (WTP) than the information presented with the product. The consumer's knowledge about production practices and the product's nutritional attributes along with the attitudinal variables reduce the effect of place of purchase for WTP estimation. The findings from this study come from a very small area in Portland, Oregon, but as the authors mention it, they could be applied to places with similar characteristics where there is a consumer basis that is more knowledgeable about food production practices and that values the potential food benefits of those production systems.

The effect of nutrition knowledge on consumer preference and willingness-to-pay for grass-fed beef products was also analyzed by Xue, et al. (2010). Auction in-store experiments were implemented to determine consumer preferences and WTP in three cities: Knoxville, TN; Middlesboro, KY; and Bluefield, WV. These cities were considered in order to obtain a heterogeneous sample for the analysis. A total of 404 participants were considered. To be considered, each participant was at least 18 years or older, a beef consumer, and the responsible person for buying or preparing food at their households. The experiment had three sections. The first section collected information regarding household characteristics, beef consumption

behavior, prior grass-fed beef consumption, respondents' health, and knowledge about nutrition. The knowledge about nutrition was separated in two variables: knowledge about the functions/benefits of the nutrients present in grass-fed beef and the knowledge about alternative sources/products where those nutrients can be present. The second section included visual and taste evaluation of paired grass-fed and grass-finished New York strip steaks. There were three levels of nutritional information that were randomly assigned during the visual and taste evaluation. Only those consumers that preferred grass-fed beef (a total of 159) were considered for the final part of the experiment. The third part of the experiment evaluated the consumers' WTP for grass-fed beef steaks. The relationship between the consumers' sensory information and their preferences was analyzed using a probit model. The WTP for grass-fed beef steaks was estimated using a Tobit model. The variables frequency of consumption, knowledge about nutritional function and alternative sources of nutrients, prior consumption of grass-fed beef, environment and animal welfare perceptions, and ratings of the sensory characteristics of the products were included in the model. The last part of the experiment was devoted to explaining the behavioral characteristics of the consumers that expressed preference for grass-fed beef products.

The majority of respondents (54%) preferred the grass-fed beef steak over conventional beef based solely on the information from the visual evaluation. After the taste and palatability section, this proportion was reduced to 37%. These results were consistent with the findings from previous research (Gwin, et al., 2012, Umberger, et al., 2002). The visual and taste evaluation showed that meat texture, tenderness, juiciness and flavor were influential in the consumer's preference for grass-fed beef products, with tenderness being the only relevant attribute from the visual evaluation. "Consumers are more likely to base their choices of beef products on eating

satisfaction than appearance” (Xue, et al., 2010). However, since the consumer did not taste the product while shopping in a store, the visual information might prove to be more relevant during the in-store selection process. The availability of nutritional information showed to be more influential over the consumer’s beef purchase than visual information. The knowledge about nutrient functions had a positive effect over their WTP for grass-fed beef steaks. The findings also explained that consumers that are knowledgeable about the alternative products that contain similar nutrients will have a lower preference and WTP for grass-fed beef products. The effect of the differences in flavor between grass-fed and conventionally produced steaks over the WTP was not statistically significant. Nevertheless, “actual eating satisfaction largely determines how much they are willing to pay for grass-fed beef”(Xue, et al., 2010).

The analysis of the frequency of consumption variable was also determinant of the WTP for grass-fed beef steaks. Among the respondents that expressed preference for grass-fed beef, those that consumed the product 3 or more times a week were willing to pay a premium of \$0.15 per pound compared to those that only ate grass-fed beef once or twice. Animal welfare and the environment did not have a statistically significant effect over the WTP for grass-fed beef products among consumers that preferred grass-fed beef steaks. The analysis of the socio-demographic factors showed that consumers that live with other people (family, etc) were willing to pay \$0.40 per pound more for grass-fed beef products than those that lived alone. Similar to the findings from the Gwin, et al. (2012) study, household size had a negative effect over the WTP for grass-fed beef products. The authors explained that based on these findings, it can be suggested that consumers that live in small households are willing to pay more for grass-fed beef products. The major finding from the study was that providing health and nutritional information about the benefits of grass-fed beef products at the point of sale might increase consumer

acceptance for grass-fed beef products despite the differences perceived during the visual evaluation of the product.

Consumer preferences and willingness-to-pay for grass-fed beef products in the southeastern United States was also analyzed by Clark (2007). A total of 215 consumers from Athens, GA (107) and Clemson, SC (108) were distributed in a total of 29 consumer taste panels. The initial analysis showed that there were no statistically significant differences between the respondents from the two locations. Initially, all the participants completed two consumer surveys. The first one gathered information regarding their purchasing behavior of meat products, attitudes regarding production systems, perceptions of beef attributes, and prior purchasing experience of products with those attributes. Socio-demographic characteristics were also considered in the first survey. The second survey collected information about the consumer's level of knowledge about beef characteristics (nutritional composition) and product preparation. After the two surveys, the respondents participated in a 6-round auction experiment. After a visual or taste evaluation, the consumers expressed their preference by submitting a bid for the product of their choice. The first two rounds included a taste evaluation, the next three rounds included the visual evaluation only, and the final round involved visual and taste evaluation. Similar to the aforementioned two studies (Gwin, et al., 2012, Xue, et al., 2010), the level of information provided about the attributes of each product and its benefits varied each round. The participant evaluated two steaks each round. One of them was obtained from a grass-fed animal and the other was from an animal produced using the conventional feeding system.

The information from the survey was analyzed using principal components analysis and seven factors were identified that could be used to explain the variability among respondents: Production, WTP for sustainable product, Happy Beef, WTP for perceived food safety, WTP for

feed regimen, convenience and preference for beef. The analysis of the ratings from the taste evaluation showed that juiciness, flavor, tenderness and overall acceptability are highly correlated. As a consequence, only the overall acceptability was included for the analysis. Hedonic price analysis was used to identify the consumers that were willing to pay for a grass-fed beef product and a multinomial logit was used to define the characteristics of the consumers that were willing-to-pay a premium for the grass-finished product. Three different premium levels were considered in the willingness to pay analysis: below 17%, between 17% and 50%, and above 50% of the grain-fed beef steak price. These levels were selected based on the findings from previous literature about the premiums needed by the producers to cover the production, processing and marketing of grass-fed beef products.

The findings suggested that steaks that received a high overall acceptability score also received higher premiums, and the sensory evaluation also showed that tenderness was an important valuation factor for the consumer. The amount of marbling was also shown to have a positive effect on the size of the premium for grass-fed beef steaks. Females and respondents that had a higher level of education were willing-to-pay more for grass-finished products. Respondents that had larger families and that were employed full-time are likely to bid less for grass-fed products. The multinomial analysis showed that only the factors convenience and happy beef (animal welfare, etc.) had a statistically significant effect over the WTP for grass-finished beef steaks. Similar to what was expressed in previous studies, “consumers’ bids are affected more by taste and information than anything else” Clark (2007). Respondents that valued natural and organic production practices, as well as those that reported higher income levels, were willing to pay at least a 17% premium for grass-finished products that displayed these attributes. Almost a third (29.30%) of the participants were willing to pay a 17% premium.

The respondents in this segment were characterized by being female, the primary shopper of the household and being part of smaller families. On the other hand, almost 8% of the consumers surveyed were willing to pay a 50% premium; the majority of these participants were located in Athens, GA. The demographic characteristics of the segment of consumers willing to pay a 50% premium were: male, older, the primary shopper of the household and had a small family size. The authors concurred that the display of health attributes along with the grass-fed beef production information are the attributes that persuade the consumer to try the product for the first time. Based on the findings, the authors suggested that producers should look for breeds that have high marbling levels since marbling and tenderness are important and might be crucial to persuade the consumer for repeat-purchases.

The aforementioned studies (Clark, 2007, Fields, et al., 2006, Gwin, et al., 2012, Umberger, et al., 2009, Xue, et al., 2010) covered very specific geographic regions of the US. Lin (2013) conducted an online survey to analyze consumer preferences for grass-fed versus grain-fed beef. A total of 4000 respondents from the four U.S. regions (Northeast, South, West and Midwest) were considered for the analysis. All of the respondents were at least 18 years old and consumed beef as part of their diets. The sample was divided in to two sub-samples: general population and consumers that had eaten grass-fed beef last year (grass-fed beef eaters). Both sub-samples had the same number of participants. The general population included respondents that may or may not have eaten grass-fed beef in the last year. The survey collected information about the frequency of consumption of beef and/or substitute products, frequency of consumption of meals at home or at a restaurant, and socio-demographic characteristics. After the survey, the respondents expressed their preference for grass-fed or grain-fed beef products by rating ten steaks which differed in four attributes: price, source, type of feeding system (grass-fed

or grain-fed) used during production and USDA grade. Each attribute had three levels. The type of production system was determined by the presence (or absence) of the grass-fed beef USDA certification in the description of the product. The three levels for this attribute were: grass-fed beef with USDA certification, grass-fed beef without USDA certification, and grain-fed beef. The three sources of origin were: local, domestic and imported. The levels for the grade attribute were defined in accordance to the USDA grading system: select, choice and prime; and three levels for the price attribute were: \$7.99, \$4.99 and \$2.99 expressed in dollars per pound. The level of utility derived from each attribute was estimated by relating the ratings for each product to the product characteristics in an ordered probit model for each sub-sample. Later, consumers' socio-demographic characteristics were incorporated as interaction terms in the model to account for the influence of consumer's characteristics in the preference for grass-fed beef products.

The analysis of the results showed that the type of the feeding system used during production accounts for almost 30% of the preference rating for the beef product. This result was very similar for both sub-samples. Price (14.1%) and Grade (7.6%) were the factors that contributed the least to the product's preference rating in the general population and grass-fed beef consumer subsamples. Consumers expressed a higher preference for grass-fed beef steaks that had the USDA certification over grain-fed beef steaks or grass-fed beef steaks without certification. The analysis of the source attribute showed that locally or domestically produced beef steaks were preferred over imported steaks. As expected, consumers preferred steaks that had lower prices. Consumers from the west region expressed a higher preference for grass-fed beef products (regardless of the presence of USDA certification) compared to the rest of the regions. According to Lin (2013), the consumer's region is the factor that has the a highest

influence over his preference for grass-fed beef products. Contrary to previous research, the size of the household and income levels did not influence consumers' preferences for grass fed beef.

There appears to be a lack of empirical analysis of the preferences for grass-fed beef at a national level. As aforementioned, previous studies have targeted very specific geographical areas and consequently many of their findings can only be relevant to those or similar areas. This study considers the results of a survey that was implemented nationally to a larger and consequently more representative sample. The information obtained will be analyzed using a mixed logit or random parameters logit model which allows to account for heterogeneous preferences across the population. Previous studies have only considered consumers' demographics and attitudes as explanatory variables. This study also contemplates the inclusion of factors that account for consumer behavior along with the respondents' demographics and attitudes towards grass-fed beef products as predictors of consumer behavior. This study will also estimate consumers' willingness-to-pay for grass-fed beef products which will bring information that can be used by producers and processors to market these products.

CHAPTER 3: DATA AND METHODOLOGY

3.1 Conjoint Analysis

The main objective of this research is to determine consumer preferences for grass-fed beef meat attributes. Conjoint analysis is a multivariate methodology developed to understand consumer preferences toward a service or a product. It is based on the premise that consumers evaluate their preference for a product (real or hypothetical) by combining the separate amounts of value provided by each one of its characteristics (Hair, et al., 2010). That preference is expressed as the utility received by the consumer from a particular product, which is unique to each individual and encompasses the combination and proportion of all the tangible and intangible attributes of that object. Conjoint analysis is supported by Lancaster's (1966) consumer theory that explains that the good by itself does not provide utility to the consumer; the utility is given by the attributes of that good. Utility can be defined as the overall preference or total worth of a product which is the sum of what the product parts are worth, also known as part-worths (Hair, et al., 2010).

One of the assumptions in conjoint analysis is that respondents react differently to varying combinations of attribute levels (such as different features, prices, or countries of origin) (Hair, et al., 2010). The respondent is asked to evaluate product profiles composed of multiple characteristics (attributes) of interest at different levels. This evaluation implies that the respondent considers all the attributes simultaneously and makes trade-offs between the different characteristics of the products in order to state his preference. Once the overall preference evaluations are stated, either by ranking or rating, they are used to estimate the utility from each product combination and the part-worths of the different attribute levels. The overall preference along with the part-worth utilities can be used to estimate the product attributes that are important and the levels that are preferred (Orme, 2006).

Hair, et al. (2010) explains that in order to define the total utility of an object, it is necessary to represent the respondent's judgment process accurately. The first step is to define the attributes and the levels that influence preference and choice. Once the attributes and levels to be analyzed are selected, they are used to create possible product profiles that will be evaluated by the respondent. For example, if a product has four attributes with four levels each, 64 ($4 \times 4 \times 4 \times 4$) product profiles (stimuli) could be created. A stimulus is the combination of a specific set of levels for each attribute to be evaluated (Hair, et al., 2010, Hill, 2012). A full factorial design includes all the possible combinations of the attributes and levels (Orme, 2006). The full factorial design of the previous example will include 64 product profiles. Nevertheless, the evaluation of a large number of profiles will have a negative effect on the quality of the data due to respondent fatigue.

Since a large number of stimuli leads to respondent's fatigue, it is common to use a fractional factorial design because it reduces the number of profiles to be evaluated. Hensher, et al. (2005) and Hair, et al. (2010) explain that the objective of a fractional factorial design is to reduce the number of combinations while still maintaining orthogonality among the levels and their respective part-worths. Orthogonality is a mathematical constraint that implies zero correlation between the attributes, which means that all the attributes are independent from each other. In a fractional factorial design, a level associated to an attribute can be modified without affecting another level.

Having determined the number of profiles, these can be presented to the respondent to be evaluated. Ranking or rating scales can be used to measure consumer preference. In a ranking scale, the respondent will express his preference by ranking the different profiles in order from most preferred to least preferred. For example, in a 9 point ranking scale, the respondent will

indicate 1 for the most preferred or 9 for the least preferred. In rating or Likert scales, the consumer can express his preference by rating each product for example in a 1 to 5 scale, with 1 meaning “I will definitely not buy this product” and 5 “I will definitely buy this product”. Hair, et al. (2010) explains that rating scales are very versatile and can be easily administered in any setting. One of the drawbacks is that if respondents are not really engaged in the selection process, their ratings might provide little differentiation among the profiles. In the early years of conjoint analysis, the product profiles were presented in cards with a written description of the attributes of each product. Thanks to the advancement of technology, actual photographs or even product prototypes can be included to reduce ambiguity between the profiles (Hill, 2012) and to motivate the respondent’s participation. The use of computers and the internet have benefitted the implementation of conjoint analysis because it increases the number of potential respondents and expedites the data collection process.

The collected preference information is used as a basis to estimate the part-worth utilities for each level. In its most basic form, part-worth utilities can be estimated using an ordinary least squares regression model with the rankings or ratings as the dependent variable. The independent variables are the levels of the attributes expressed as categorical variables (Hill, 2012). Once the part-worth values are estimated, the part-worth utility coefficients can be used to obtain the relative importance that each attribute has in determining total utility and therefore the preference of a product. Each part-worth coefficient expresses the contribution of a particular level of an attribute to the total utility of a product when that level is present. The relative importance of an attribute can be defined as the weight that the consumer places on each attribute when selecting a product during the buying process (Hill, 2012). The relative importance of a factor is calculated by dividing the range of an attribute (the difference between the highest and

lowest values) by the sum of the ranges of all the attributes (Hair, et al., 2010). The result is expressed as a percentage; attributes with higher percentages have greater importance. The total utility of a product is calculated by adding up the part-worth utilities of the combination of its attribute levels. This will provide insight about the respondent's preference for a product whether or not the product was actually present in the study (Orme, 2006).

There are three basic conjoint analysis methodologies that can be used in conjoint analysis: traditional (CA), adaptive (ACA) and choice-based conjoint (CBC) analysis. The selection of the methodology to be used will depend on the number of attributes, level of analysis, types of profiles presented and the collection format (Hair, et al., 2010). The traditional conjoint has been the preferred method for conjoint analysis for decades (Orme, 2006). The respondent is presented with a full profile that displays one level for each attribute. The product profiles are presented in cards one at a time to be ranked or rated (Hair, et al., 2010). Since each profile is defined in terms of a level per attribute, this methodology allows to obtain information about the trade-offs between attributes; however, interactions between attributes can be estimated on a limited basis. Interactions are better measured by choice-based analysis (Orme, 2006). Several authors suggest that the number of attributes to be analyzed using this methodology should be limited to 6 to reduce information overload in the respondent (Green and Srinivasan, 1978, Hair, et al., 2010). Since all the characteristics are presented, the respondent may tend to simplify the process by focusing on those that he considers important. Orme (2006) explains that this simplification strategy should not be considered harmful because it can resemble the buyer's selection process under real circumstances.

Adaptive conjoint analysis (ACA) was developed with the objective of incorporating a large number of attributes in the analysis. The number of attributes that can be analyzed

increases to 30, even though ACA studies typically involve 8 to 15 attributes (Orme, 2006). This methodology uses the information from the respondent to select the relevant attributes that will be incorporated in the profiles to be evaluated. The first section of the ACA employs a two-step self-explicated approach, where the respondent is asked to rank the attribute levels according to his preference and then rate the level of importance of each attribute. This information is used in the second section to create partial profiles that display only the attributes that were regarded as important. These product combinations are tailored to each respondent to ensure that the presented profiles have the attributes that are relevant and meaningful in his or her selection process (Orme, 2006). The profiles are presented in pairs to the respondent, who expresses his or her preference in a rating scale. The pair-wise comparison provides information about the series of trade-offs that the participant makes to select one of the presented products. The ACA methodology is especially useful in high-involvement product categories where the consumer considers each one of the attributes of a product before making a decision (Orme, 2006). The involvement of the respondent in the selection of the product profiles allows the inclusion of more attributes in the analysis. Nevertheless, one of the limitations of this methodology is its format. ACA generally relies on the use of computers to generate the partial profiles for each participant, whereas any format can be used in the data collection for the CA and CBC methods.

Choice-based analysis was created with the objective of mimicking the actual purchasing process in a competitive setting (Orme, 2006). The consumer is asked to select a product from a given set of products called a choice set. Each product is presented in a full profile format and the opt-out, or “no purchase” option, is also included as part of the choice set. The number of profiles present in each choice set may vary. The addition of the opt-out or “no purchase” option adds more realism to the selection process because the consumer may decide not to buy any of

the products if his preferred combination of attributes is not found in the set. The CA method, on the other hand, assumes that the respondent's preference will always be assigned only among the products evaluated (Hair, et al., 2010). The no purchase option also allows for the establishment of options that would never be chosen in a real market setting (Boever, et al., 2011).

Even though in both approaches, CA and CBC, the respondent is asked to rate or rank full-profile combinations, the evaluation process changes. In the traditional approach, the respondent ranks each full-profile combination individually, whereas in the CBC analysis, the respondent is asked to choose his preferred among a specific set of combinations. The latter better resembles what the consumer faces when deciding to purchase a product at a grocery store. The profiles used in choice-based analysis are generally obtained from a fractional factorial design which means that only the combinations that are relevant for the decision maker are evaluated. The traditional approach is more information intensive because the respondent evaluates a larger number of combinations since each level of every attribute needs to be present.

According to Louviere, et al. (2010) CA is based on conjoint measurement (CM) theory, whereas random utility theory (RUT) is the basis for CBC. Conjoint measurement theory was originally developed to analyze the changes in the behavior of sets of numbers due to the manipulation of different factor levels. On the other hand, RUT, the basis for CBC, is deeply rooted on the theory of choice behavior proposed by McFadden (1974) and takes inter-linked behaviors into account (Louviere, et al., 2010). RUT and CBC is a more holistic approach since it considers the different stages of the decision making process. There is always a feasible alternative in the choice set, including the opt-out option. The respondent always picks one alternative that expresses his or her preference. In contrast, in CM theory and CA, the respondent can be invited to evaluate several alternatives and he or she might not be interested in any of

them or they are simply infeasible for the respondent. For example, in CA a respondent can be invited to evaluate (rate or rank) several luxury cars even though the participant might not afford to purchase any of them, making the ranking or rating information meaningless when trying to explain choice behavior. Louviere, et al. (2010) suggests that CA could be used to identify and model the processes that individuals use to form preferences, but should not be considered to compare or analyze preferences; whereas, CBC is a discrete choice methodology that better resembles consumer behavior because it takes into consideration random components that account for all the unidentified factors that affect the selection process.

The CA and ACA methods provide part-worth information at the individual level and use a main-effects model, which means that the contribution to the utilities of all the levels are measured in a *ceteris-paribus* (everything-else equal) context, without the inclusion of attribute interactions (Orme, 2006). In the choice-based approach, once the respondent selects one of the combinations from each choice set, the information can be analyzed at the disaggregate level (individual) or can be aggregated across segments (or homogeneous groups) to estimate the part-worth utilities for each level of each attribute and the interaction terms (Hair, et al., 2010). The contribution of each level can be used to estimate the relative importance of each attribute in the selection process. The adequacy of each methodology can be assessed by considering the number of attributes to be analyzed, level of analysis (individual or groups), types of profiles presented (full or partial), data collection format, and model form (interest in interactions) (Hair, et al., 2010). According to Orme (2006), the choice-based conjoint approach has become the most widely used conjoint approach due to its ability to mimic the selection process in a competitive setting but this characteristic should not be the only one considered when selecting a method. The choice-based approach was considered in this analysis because it allows us to better estimate

the importance of each attribute for the consumer because different levels and attributes are analyzed simultaneously.

3.1.1 Defining Attributes and Levels

Conjoint analysis was developed to understand consumers' preference for a product or service that has a particular combination of attributes. The total utility of a product or service is used to measure its value and is a concept that represents the subjective judgment of preference of each individual (Hair, et al., 2010). Each attribute and the associated levels contribute to the total utility or overall preference of the product (Ladd and Suvannunt, 1976). Therefore, the selection of the attributes and their levels is a crucial step in the design of a conjoint experiment. US consumer perceptions of beef quality are becoming more heterogeneous; credence attributes such as: "grass-fed", "natural", "country of origin", among others are influencing their preference for beef products (Loureiro and Umberger, 2007). The main objective of this research is to estimate consumers' preference for grass-fed beef; therefore, the type of production system is an attribute that is of particular interest for this study. Martin and Rogers (2004) explain that there is an increasing interest in forage-fed beef. The display of information regarding the production system used can influence the consumer's preference and willingness to pay for beef meat. Umberger, et al. (2009) found that the display of information about the production system increased the probability that the consumer will be willing to pay more for grass fed beef. Several authors have found that the production system (grass-finished or grain-finished) affects the sensory characteristics and acceptability of beef meat products (Cox, et al., 2006, Kerth, et al., 2007, Razminowicz, et al., 2006). Leheska, et al. (2008) reported that the production system affects the color and nutrient composition of beef products. Grass-fed beef products had fat that was more yellow in color than the grain-fed products. Using objective and subjective methods,

Priolo, et al. (2001) found that the grass-fed beef meat was darker in color than the meat from animals finished on grain. Loureiro and Umberger (2007) found that the certification of USDA food safety inspection was the most valuable attribute compared to country-of-origin labeling, traceability and tenderness. Three types of beef products were considered for the analysis of grass-fed beef with USDA certification, grass-fed beef without USDA certification, and grain-fed beef. USDA certification was considered to analyze if the presence of the USDA certification seal influences the consumer decision process.

Mennecke, et al. (2007) determined that country of origin is an attribute that influences consumer preferences for grass-fed beef. Umberger, et al. (2002) showed that U.S. consumers can differentiate between the flavors of domestic corn-fed (USDA Select) steaks and imported grass-fed (qualifying as USDA Select) steaks and are willing to pay a premium for the product that they prefer. Killinger, et al. (2004) found that domestic grain-fed beef had higher acceptability than grass-fed beef among consumers from San Francisco and Chicago. Toler, et al. (2009) explains that consumers prefer to allocate their money towards local farmers over non-local farmers and a group of consumers prefers to pay a premium for “local” products due to the perceived benefits of inherent characteristics such as freshness, safety, etc. Onozaka and Mcfadden (2011) compared the effects of sustainable production claims against location claims and found that the latter are more valued by the consumer. Three levels: local, domestic and imported were included in the study to account for the influence of the source attribute in the selection process.

Bowling, et al. (1977) compared forage-fed and grain-fed carcasses of identical USDA quality grade and found that grain-fed beef had twice as much subcutaneous fat. Leheska, et al. (2008) and Daley, et al. (2010) found that grass-fed beef products are considered lean products

because they have lower total fat contents. Scollan, et al. (2006) explained that the type and proportion of fatty acids differs between grain-fed and grass-fed beef products. The USDA beef quality system was used to account for all the differences such as marbling, perceived fat content and color. Select, Prime and Choice were the three levels considered in the analysis.

Price is an attribute that has a dual role in the consumer evaluation of preference among product alternatives (Völckner, 2008). The sacrifice effect of price can be defined as the consumer's evaluation of the amount of money available and the portion that he will use (sacrifice) to satisfy a specific need. The informational effect is given by the premise that price conveys information about the quality of a product in the consumers' mind. Higher prices indicate higher quality, which leads to an increased perceived utility and vice versa (Völckner, 2008). The prevalence of the sacrifice or the informational effect of price will vary depending on the product and market analyzed. The average retail price for beef was 4.44 USD/lb. in 2011. This value increased to 4.65 USD/lb. the first four months of 2012 (USDA and ERS, 2013). In 2011, boneless rib-eye steak prices ranged from 6.46 USD/lb. to 9.06 USD/lb. nationally. The lowest price was reported in the Southeast 2.68 USD/lb. whereas the highest price was recorded in the Northeast 21.32 USD/lb. (USDA and AMS, 2013). The price levels selected for the analysis were 2.99 USD/lb., 4.99 USD/lb. and 7.99 USD/lb.

Product type, source, grade, and price were the four attributes considered for the analysis, each one of them with three levels. Hair, et al. (2010) and Orme (2006) emphasize that special attention needs to be paid in the selection of the attributes to be included in an analysis. A large number of attributes and levels can lead to information overload, and on the other hand it is important to include all the attributes that are relevant to elicit consumer preference. Gao and Schroeder (2009) conducted different choice-based experiments to analyze the impact of the

number of attributes on the willingness-to-pay (WTP) for beef products. As additional information on food attributes was presented the WTP had significant changes. Four three-level attributes: type, source, grade and price (Table 2) were considered to be relevant for the consumer to express his preference among beef products.

Table 2. Choice Experiment Attributes and Levels

Attributes	Levels
Type	Grass-fed beef with USDA certification Grass-fed beef without USDA certification Grain-fed beef
Source	Local Domestic Imported
Grade	Select Choice Prime
Price	\$2.99/lb. \$4.99/lb. \$7.99/lb.

3.2 Experimental Design and Survey

Once the number of attributes and the respective levels are determined, they are used to define the experimental design and survey to be used. Hair, et al. (2010) explains that in the past, personal interviews were the preferred data collection method for conjoint analysis since they allow the interviewer to explain the sometimes more difficult tasks to the respondent. Later improvements increased the feasibility of the implementation of conjoint analysis through the mail (pencil and paper). Nevertheless, mail surveys are affected by low response rates and the lack of interest or motivation by the respondents. The use of computers and the internet have

greatly simplified the implementation of conjoint analysis. The use of computers has increased the feasibility of administration of full profiles and even adaptive conjoint designs can be easily implemented (Hair, et al., 2010). The same author explains that the use of the internet has also improved the reliability and validity of the designs.

The survey used in this study was implemented through the internet and was administered by Mrops, a global marketing research firm that maintains a representative household panel for the United States. The questionnaire was developed by the research team associated with the grant from this project. Geographic region, number of children under 18 years old, household size, age of respondent, education, ethnicity, and gender were the criteria considered in order to obtain a representative sample of respondents. First, the consumer was presented with five statements regarding cattle production and was asked to select the statement that best described “grass-fed beef” production for him. Then, the consumer was asked his frequency of consumption of grass-fed beef, grain-fed beef, chicken, pork and seafood. Next, the respondents that expressed that they had eaten grass-fed beef were asked to indicate, from the last 10 times they ate grass-fed beef, how many of those 10 times it was eaten at home or at a restaurant.

The consumers that had eaten grass-fed beef were also asked to complete a set of multiple choice questions about their preferred place of purchase, cut of meat, commonly used source of information about food and source of information about grass-fed beef specifically. Similar questions were asked to the consumers that indicated that ate grain-fed beef, with the exception of the one regarding the source of grass-fed beef information. All the respondents were asked to express their agreement or disagreement, in a 6-point Likert scale, with 10 statements

about the differences between grass-fed and grain-fed beef, production practices and the healthiness of the product.

The next section was the conjoint experiment. First, information about the definition about grass-fed beef and grass-fed beef with USDA certification was presented. The source attribute was also explained to the respondent. For this study, local means animals produced and processed within 200 miles of where the meat is sold. Domestic means that the animals were produced and processed in the continental United States, but not necessarily within 200 miles of where the meat is sold. Imported means that the meat was obtained from animals that were produced and the meat was processed outside the continental United States. The grade attribute was also explained to the respondent in order to facilitate the selection process. In order to explain this attribute, three hypothetical pictures were listed. Each one of them depicted one of the three categories in the USDA beef grade system: Select, Choice and Prime. It was also explained that differences in grade are determined by the amount of “marbling” found in the meat, which reflects the amount of fat in the meat (i.e., white tissue seen in the meat). A full description of the definitions presented to the respondent can be found in the Appendix B.

These definitions were used as an introduction for the choice experiment section. As aforementioned, four three-level attributes were considered for the analysis. A full profile design would require a total of 81 stimuli ($3 \times 3 \times 3 \times 3$) to be evaluated. However, the evaluation of 81 profiles over the internet would be realistically difficult and the quality of the responses could be affected by respondent fatigue. The number of profiles to be presented was reduced by using a fractional factorial design; 9 product profiles were selected. The description of the 9 products that were considered in the analysis can be found in Appendix B. These 9 products were

randomly divided into three groups (choice sets) to facilitate the selection process and to analyze the potential trade-offs between the attributes.

After reading the definitions, the participant was presented with 3 hypothetical sets of beef steaks to compare. Each choice set had three pictures of steaks with their respective descriptions and the “no purchase” option. The respondent was asked to choose his preferred steak from each set, but he also had the option of opting out by not purchasing any of them. The respondent was requested to take into consideration the attributes: type, grade, source and price for his decision and it was also emphasized that his selection would reduce the amount of money that he would have available to spend on other food. The next section included a set of questions focused on the consumer lifestyle, beliefs and attitudes about foods. The survey ended with a set of demographic questions where the respondent was asked to give information regarding his marital status, number of children, race, ethnic group and income.

The survey was administered online in May 2012 and a total of 4000 responses were obtained from the entire U.S. The 4000 responses were from two groups of similar sizes. The first group was from the general population, comprised of people that had eaten beef in the last year and may or may not have eaten grass-fed beef in the last year. The second group was comprised of people that indicated that they had eaten grass-fed beef in the last year. This division was made with the objective of analyzing the perception of the value of the credence attributes of grass-fed beef by the two groups: general population (that might have had the product during the last year) and consumers that ate grass-fed beef recently. The part-worths from each attribute and respective levels served as a basis to calculate the utility of each product, which served as an indicator to reflect the consumer attitudes towards grass-fed beef products. The product information along with the demographic information were used to identify the

interactions that were relevant to express preference. The analysis of the relationship between consumer lifestyle, attitudes and beliefs towards foods, and the perceived utility of each attribute allowed us to define descriptors that can characterize the potential grass-fed beef consumer.

3.3 Discrete Choice Models: The Mixed Logit Model

Conjoint analysis was used to estimate consumer preferences in this study since it is the preferred statistical analysis technique to quantify consumer's preferences for goods and services (Mennecke, et al., 2007). The choice-based approach was used in this research since it is considered the conjoint methodology that better resembles the selection process of the consumer in the market (Hair, et al., 2010, Orme, 2006). Lancaster (1966) consumer theory and McFadden (1986) random utility theory are considered the foundation for discrete-choice theory (Hill, 2012). It was Lancaster (1966) who proposed that the consumer derives the utility of goods or services from their properties or characteristics. McFadden (1986) states that consumers' behavior in the market is the result of the maximization of utility. Consumer preferences have a random component which is the result of changes in perceptions, attitudes and other factors that cannot be measured. Since there is incomplete information about all the characteristics that influence the consumer's decision process, the random utility model (RUM) separates total utility in two parts (Boever, et al., 2011, McFadden, 1986). The first part is comprised by the deterministic component (V_{ij}) and the second is the error, random or stochastic component (ε_{ij}). Utility can be expressed as:

$$U_{ij} = V_{ij} + \varepsilon_{ij} , \quad j = 1, \dots, J \quad (1)$$

where U_{ij} represents the utility of the i^{th} consumer from choosing the j^{th} product. The V_{ij} term represents all the characteristics and attributes that can be measured that affect the utility of the product. The stochastic term (ε_{ij}) reflects the idiosyncrasies or behaviors particular to each

individual that affect their decision process (McFadden, 1974). The utility of each alternative is affected by the characteristics (attributes) of that alternative (x_{ij}) and by some attributes of the consumer (s_i). Thus, equation (1) can be expressed as:

$$U_{ij} = V(x_{ij}, s_j) + \varepsilon(x_{ij}, s_j) \quad (2)$$

Based on this equation, the characteristics of the error term (ε_{ij}), such as its distribution, depend on the specification of the nonstochastic portion of the equation. Specifically, the error term will be defined relative to the methodology selected to represent a particular choice situation (Train, 2009). In random utility models, each alternative provides a different level of utility, and the decision maker chooses the alternative with the highest level of utility (Train, 2009). This behavior can be expressed as:

$$U_{ij} > U_{ik} , \forall j \neq k \quad (3)$$

where k represents an alternative product. In this case, the individual will choose alternative j , given that this alternative has a higher utility than k . Since an individual's total utility cannot be observed, the individual's choice can be used as a measure of the individual's preference. The individual's choice can be expressed in probabilistic terms. The probability that individual i will choose the j^{th} alternative from a given choice set can be represented as:

$$\begin{aligned} P_{ij} &= \text{Prob}(U_{ij} > U_{ik} \quad \forall j \neq k) \\ P_{ij} &= \text{Prob}(V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik} \quad \forall j \neq k) \\ P_{ij} &= \text{Prob}(\varepsilon_{ik} - \varepsilon_{ij} < V_{ij} - V_{ik} \quad \forall j \neq k) \end{aligned} \quad (4)$$

The joint density for the random error vector $\varepsilon'_i = (\varepsilon_{i1}, \dots, \varepsilon_{ij})$ is denoted $f(\varepsilon_i)$. Train (2009) explains that the cumulative probability from equation (4) can be described using the joint density for the random error as:

$$P_{ij} = \int_{\varepsilon} I(\varepsilon_{ik} - \varepsilon_{ij} < V_{ij} - V_{ik} \quad \forall j \neq k) f(\varepsilon_i) d\varepsilon_i \quad (5)$$

where $I(\cdot)$ can take the value of 1 if the product is chosen or 0 otherwise. This integral depends on the density of the random component $f(\varepsilon_i)$ of the utility. The different assumptions about the density of the random component will influence the selection of the discrete model to be used. Logit models specify the cumulative distribution function of the logistic distribution, whereas probit models use the standard normal; both functions are symmetric around zero (Cameron and Trivedi, 2010).

There are different variations of the logistic and probit models that can be implemented depending on the type of research and the design to be used. The multinomial logit (MNL), conditional logit (CL) and nested logit (NL) are widely used to analyze discrete choice models with more than two outcomes. The MNL and the CL are based on the premise that the probability of choosing one alternative over a second one is not affected by adding or omitting additional alternatives, which is called the Independence of Irrelevant Alternatives (IIA) (Boever, et al., 2011). The multinomial logit model (MNL) is applied when the choice depends on the respondent's characteristics but not on the attributes of the choices (Wooldridge, 2010). The conditional logit considers the effect of alternative-specific attributes to explain the choice made by an individual (Boever, et al., 2011, Train, 2009). Nested logit models are used when the alternatives can be separated into subsets, where the IIA assumption holds between the alternatives within the same set, but not among alternatives from different sets (Train, 2009).

The conditional logit with interactions (CLI), also called random parameters logit or mixed logit, relaxes the IIA assumption and considers alternative-specific and individual-specific variables to estimate the probability of a choice (Boever, et al., 2011). The CLI model allows to account for heterogeneity across the population and differences across alternatives (Hill, 2012). The integral from equation (5) takes a closed form for conditional and nested logit models,

whereas it has an open form for probit and CLI and is estimated using maximum likelihood through simulation (Cameron and Trivedi, 2010, Train, 2009).

Since the deterministic component of the utility is the one that can be measured, the V_{ij} component represents an individual's preferences influencing the selection of alternative x given attributes s . The deterministic component can be expressed as a linear function that encompasses the partial contribution of unknown parameters.

$$v(x_{ij}, s_j) = \beta_1 v^1(x, s) + \dots + \beta_n v^n(x, s) \quad (6)$$

It can be assumed that the i^{th} individual from a population ($i=1, \dots, I$) has to choose a product between a given set of j alternatives ($j=1, \dots, J$) where each of them is described by a x_j number of attributes. The random utility for that particular individual can be expressed using equations (1) and (6) as:

$$U_{ij} = \beta x_{ij} + \varepsilon_{ij} \quad (7)$$

The probability that the i^{th} individual will choose the j^{th} alternative from a given choice set given by equations (4) and (5) can be represented as:

$$P_{ij} = \text{Prob}(\varepsilon_{ik} - \varepsilon_{ij} < \beta x_{ij} - \beta x_{ik} \quad \forall j \neq k) \quad (8)$$

Similar to Hill (2012), assuming that the error terms are independently identically distributed, and considering a Weibull distribution in which the scale parameter is equal to 1, equation (8) can be expressed as:

$$P_{ij} = \frac{\exp(\beta' x_{ij})}{\sum_{k=1}^J \exp(\beta' x_{ik})} \quad (9)$$

Equation (9) is the representation of McFadden's (1974) conditional logit model. According to Hensher, et al. (2005), the conditional logit model should always be used as a starting point for the analysis of discrete choice experiments as a way to check for possible data errors and to make sure that the parameter estimates signs are statistically significant and

consistent with theory. Train (2009) and Cameron and Trivedi (2010) explain that the CL is more flexible than the MNL, and the same results from MNL can be obtained using CL by making minor adjustments during the data entry process.

3.3.1 Conditional Logit Model with Interactions

The conditional logit model with interactions (CLI), also known as the mixed logit, is a combination of the multinomial logit and conditional logit models (Boever, et al., 2011). The CLI model is less restrictive since it relaxes the IIA property and the assumption of preference homogeneity across the population. The incorporation of individual-specific characteristics as interaction terms allows one to account for preference heterogeneity (Boever, et al., 2011). The CLI model considers the effects of alternative-specific attributes and individual-specific characteristics as explanatory variables. As aforementioned, it can be assumed that the i^{th} individual from a population ($i=1, \dots, I$) has to choose a product between a given set of j alternatives ($j=1, \dots, J$) in each of t choice situations ($t=1, \dots, T$). According to Hensher, et al. (2005), the utility associated with each alternative j by each individual in each choice situation can be expressed as:

$$U_{ijt} = \beta_i' x_{ijt} + \varepsilon_{ijt} \quad (10)$$

where x_{ijt} is the full vector of explanatory variables, which includes the alternative-specific, individual-specific characteristics (such as demographics) and the descriptors of the choice set and the selection in each choice situation t . The ε_{ijt} is the error term. Since β_i and ε_{ijt} are not observed, these are considered random components. According to Hensher, et al. (2005) and similar to Hill (2012), ε_{ijt} is assumed to be independent and identically distributed (IID) extreme value type 1 across alternatives, individuals and choice sets. This assumption is restrictive and does not allow for the error components of different alternatives to be correlated. This

assumption can be considered in the utility function by introducing additional stochastic components through β_i in the utility function, with the benefit that these elements will allow us to account for heteroskedasticity and correlations across alternatives (Hensher, et al., 2005).

Thus, β_i can be stated as:

$$\beta_i = \beta + \alpha z_i + \eta_i \quad (11)$$

where η_i is a random term and its distribution depends on the underlying parameters of the distribution and z_i is observed data and comprises the variables that account for the individual-specific characteristics. From equation (11) and based on the assumptions of the model, β_i may contain individual specific constants, η_i may vary across choices, and additionally, may induce correlation across choices; the ε term is IID with zero mean and does not depend on the parameters or data (Hill, 2012). The mixed logit model assumes a general distribution for η_i which can be a normal, log-normal, uniform or triangular (Hensher, et al., 2005). The density of η_i is given by the function $f(\eta_i/\Omega)$, where the elements of Ω are the underlying parameters of the distribution of β_i . Given that the remaining part of the error term is IID, and for a specific value of η_i , the conditional probability of choice j by an individual i is given by (Hensher, et al., 2005)

$$L_{ij}(\beta_i|x_i, \eta_i) = \frac{\exp(\beta_i' x_{ij})}{\sum_j \exp(\beta_i' x_{ij})} \quad (12)$$

Equation (12) represents the expression of the multinomial logit model but with the provision that the information from η_i is known for each individual. The information from η_i (and z_i) influences the alternative chosen. Therefore, the choice probability is conditional on the additional information defined by η_i (Hensher, et al., 2005). The unconditional probability is given by the expected value of the logit probability across all the possible values of β_i , which is estimated by the integration of all these values weighted by the density of β_i . The unconditional probability is given by:

$$P_{ij}(x_i, z_i, \Omega) = \int_{\beta_i} L_{ij}(\beta_i|x_i, \eta_i)f(\eta_i|\Omega)d\eta_i \quad (13)$$

where η_i is the random vector that introduces the variation in β_i , and it accounts for the variation in the integral. Models using this form are called mixed logit, or random parameters logit, because the choice probability P_{ij} results from a mixture of logits using f as the mixing distribution (Hill, 2012). Because of this specification, the probabilities of the model do not hold the IIA assumption and different substitution patterns may be obtained depending on the specification of f . Since in this model the β_i estimates are allowed to vary across individuals, each estimated β_i associated to an attribute will have a mean and a standard deviation (Hensher, et al., 2005). Statistically significant values of the standard deviations from the β_i estimates will be evidence of the presence of preference heterogeneity in the population.

The selection of the distribution of f is made by trying to approximate real behavior. There are several functional forms that can be used to specify the mixing distribution for the random parameters, with the normal, log-normal, triangular, and uniform being the most commonly used. Each one of them has advantages and disadvantages, with either signs or length of the tails being the major sources of deficiencies. The normal distribution is symmetric around the mean and allows for sign changes along the distribution. This might pose a problem for variables such as price that are considered to have a specific sign, negative in most cases. The lognormal distribution avoids this problem because it uses the central limit theorem and is especially useful if a parameter is restricted to be non-negative. Hensher, et al. (2005), explains that the lognormal typically has long right-tails which can lead to large “unreasonable” willingness to pay values. The uniform distribution with a (0,1) bound is sensible especially when dummy variables are used. The triangular distribution avoids large values and wrong signs

by constraining the distribution of the parameter to equal the mean (Hill, 2012), a peak at the mean and linearly dropping off at both sides.

Hole (2007) explains that in a sequence of choices and for a given value of β_i the choice probability from equation (12) can be expressed as:

$$S_i(\beta_i) = \prod_{t=1}^T L_{ij(i,t)t}(\beta_{ij}) \quad (14)$$

where $j_{(i,t)}$ explains the alternative j chosen by individual i on a choice situation t . The unconditional probability from equation (13) in a sequence of choices is:

$$P_i = \int_{\beta_i} S_i(\beta_i|x_i, \eta_i) f(\eta_i|\Omega) d\eta_i \quad (15)$$

The integrals from equations (13) and (15) do not have a closed form; therefore, the coefficients are estimated by using simulations. Hensher, et al. (2005) states that for a given value of the parameters (Ω) and the observed variables z_i a value for β_i is drawn from the distribution selected. This draw is used to estimate the logit probability L_{ij} value from equation (12). This process is repeated for many draws and the mean of the resulting $L_{ij}(\beta_{ij})$ is taken as an approximate choice probability (Hensher, et al., 2005, Hole, 2007):

$$SP_j = \frac{1}{R} \sum_{r=1}^R L_{ij}(\beta_{ir}|x_i, \eta_{ir}) \quad (16)$$

where R is the number of draws ($r = 1 \dots R$) of β_{ir} , β_{ir} represents the r^{th} draw, and SP_j is the simulated probability that alternative j is chosen by an individual. Simulations using random-draws or Halton draws can be made to obtain the approximate choice probability from the integral. Hensher, et al. (2005) states that approximations obtained through the use of Halton draws are more accurate than those obtained through pseudo-random sequences. Train (2000) explains that the superior performance of Halton draws is due to two reasons: first, Halton sequences are designed to give an even coverage over the domain of the mixing distribution, which leads to less variation over simulated probabilities because the draws are evenly spread for

each observation. Second, the simulated probabilities become negatively correlated over observations because each new draw tends to fill the empty spaces on the domain. This negative correlation between the simulated probabilities over observations reduces the variance in the log-likelihood function.

3.4 Factor Analysis

The information about consumer lifestyle, beliefs and attitudes about food from the survey was analyzed using factor analysis. Factor analysis is a multivariate technique that allows one to define the underlying structure among the variables in the analysis (Hair, et al., 2010). Each factor represents a group of variables that are highly inter-correlated and defines an underlying dimension within the data. The factors obtained from the factor analysis represent different dimensions of the consumer's behavior, beliefs and attitudes. These factors were included as interaction variables in the discrete-choice model to analyze the influence of these dimensions over the consumer's preference for grass-fed beef products.

Factor rotation was performed in order to obtain simpler and more meaningful factors. In unrotated factor solutions, the first factor accounts for most of the variance and tends to be a general factor because almost all the variables have significant loadings, and the succeeding factors are obtained based on the residual variance. In factor rotation, the reference axes of the factors are rotated around their origin. The objective of the rotation is to redistribute the variance from the initial factors to the remaining factors in order to obtain a simpler and theoretically meaningful factor pattern (Hair, et al., 2010). There are two types of factor rotation that can be applied: oblique and orthogonal. Orthogonal factor rotation considers a 90 degree angle between the reference axes of the factors, which implies that the factors remain uncorrelated throughout the rotation. Oblique rotation allows for correlations between the factors since the angle between the reference axes needs not to be at 90 degrees (Bharad, 2010). All the rotation methods pursue

to simplify the factor matrix to facilitate interpretation. The columns of the matrix represent the factors and each row has the loading of each variable with respect to the corresponding factor. The VARIMAX procedure is a very popular orthogonal factor rotation method and its objective is to simplify the number of factors on the matrix. This simplification is “achieved by maximizing the sum of variances of the required loadings of the factor matrix” (Hair, et al., 2010). VARIMAX rotation was used for this study since it is widely used in research and provides a clear separation between factors, which facilitates the interpretation of the effect of the consumer’s behavioral and attitudinal dimensions to be considered in the analysis.

CHAPTER 4: RESULTS

One of the objectives of this study was to describe the characteristics of grass-fed beef consumers in the United States based on socio-demographic, attitudinal and behavioral information. Gender, marital status, number of children, education and annual household income were described using means, standard deviations and frequencies. The variables race, Hispanic origin and the region in which the respondent resides were described as frequencies. The summary of the demographics of the respondents are presented in Table 3. Of the 2000 respondents that ate grass-fed beef in the past year (2011), the average respondent was 47 years old and 55% were females. Previous studies (Clark, 2007, Fields, et al., 2006) reported similar results in which highly educated females were more likely to eat and pay more for grass-fed beef products.

The majority of respondents were married (57.1%) with no children under 18 years of age (68.1%). About one quarter of the respondents (26.8%) indicated that they had one or two children in the household. Previous literature (Gwin, et al., 2012, Xue, et al., 2010) suggests that consumers that live in small households are willing to pay more for grass-fed beef products. On average, the respondents indicated having at least an Associate's degree and 47.1 percent reported having a Bachelor's or Post-graduate degree. The majority (20%) of respondents reported an annual household income level between \$50,000 and \$74,999 and 40 percent of the respondents reported earning less than \$49,999.00 and 20 percent reported earning

The racial composition of the sample was 82 percent white, 8.2 percent black, 4.4 percent Asian, almost 1 percent Native American, less than 0.5 percent Hawaiian and 4.1 percent chose not to specify their race. Additionally, less than 10 percent of the respondents indicated having Hispanic origin. The majority of the respondents resided in the South (33.1%), while the

Table 3. Summary Statistics of the Demographic Characteristics of the Respondents

	Ate GFB Last Year				General Population				U.S. Census Bureau	
	Mean	S.D.	N	Freq.(%)	Mean	S.D.	N	Freq.(%)	Mean	Freq. (%)
Gender	0.455	0.498			0.417	0.493				
Male			910	45.50			833	41.65		48.67
Female			1090	54.50			1167	58.35		51.33
Age	46.93	16.18			48.24	19.79			37.6	
Marital Status (Married = 1; 0 = Otherwise)	0.571	0.495			0.516	0.499				
Married			1142	57.10			1032	51.60		53.20
Single			527	26.35			561	28.05		27.70
Widowed			72	3.60			122	6.10		6.1
Divorced			233	11.65			253	12.65		10.7
Separated			26	1.30			32	1.60		2.3
Number of children under 18 years old	0.559	0.968			0.47	0.905				
0 = No Children			1363	68.15			1463	73.15		56.67
1 child			303	15.15			260	13.00		18.27
2 children			233	11.65			184	9.20		16.30
3 children			67	3.35			68	3.40		6.29
4 children			21	1.05			17	0.85		2.47
5 or more			13	0.65			8	0.40		
Education	5.051	1.410			4.974	1.416				
1 = Grade school			4	0.20			4	0.20		4.02
2 = Some high school			36	1.80			27	1.35		8.18
3 = High School diploma			273	13.65			325	16.25		29.54
4 = Some college			518	25.90			539	26.95		19.61
5 = Associate's Degree			227	11.35			187	9.35		9.37
6 = Bachelor's Degree			595	29.75			602	30.10		18.73
7 = Post Graduate Degree			347	17.35			316	15.80		10.19

(Table 3 continued)

	Ate GFB Last Year				General Population				U.S. Census Bureau	
	Mean	S.D.	N	Freq.(%)	Mean	S.D.	N	Freq.(%)	Mean	Freq. (%)
Race										
White/Caucasian			1643	82.15			1629	81.45		77.66
Black /African American			165	8.25			173	8.65		13.17
Asian			88	4.40			108	5.40		5.26
Pacific Islander			7	0.35			4	0.20		0.23
Native American			15	0.75			10	0.50		1.24
Other group			61	3.05			60	3.00		2.45
Unknown			21	1.05			16	0.80		
Hispanic Origin										
Yes			171	8.55			137	6.85		14.95
No			1812	90.60			1846	92.30		
Unknown			17	0.85			17	0.85		
Region										
Midwest			482	24.10			440	22.00		21.35
Northeast			372	18.60			371	18.55		18.11
South			662	33.10			705	35.25		37.28
West			484	24.20			484	24.20		23.26
Income Level	5.941	2.349			5.608	2.407				
1 = Less than \$10,000			81	4.05			121	6.05		7.60
2 = \$10,000 - \$14,999			74	3.70			74	3.70		5.40
3 = \$15,000 - \$24,999			156	7.80			191	9.55		10.80
4 = \$25,000 - \$34,999			213	10.65			239	11.95		10.30
5 = \$35,000 - \$49,999			291	14.55			340	17.00		13.60
6 = \$50,000 - \$74,999			386	19.30			368	18.40		17.90
7 = \$75,000 - \$99,999			301	15.05			256	12.80		11.90
8 = \$100,000 - \$149,999			260	13.00			203	10.15		12.70
9 = \$150,000 - \$199,999			90	4.50			74	3.70		4.90
10 = \$200,000 or more			63	3.15			47	2.35		5.00
11 = Unknown			85	4.25			87	4.35		

proportion of respondents from the Midwest and the West was similar (24.1% and 24.2% respectively).

The demographics of the 2000 respondents from the general population is presented in Table 3 along with the information for grass-fed beef consumers. The average respondent in the general population was 48.24 years old. In the sample, 58.35 percent of the participants were female and 41.65 percent were male. Females were the largest proportion in both samples. The proportion of females in the general population was 4 percent larger than the amount found for the grass-fed beef consumers group. On average, respondents from the group that ate grass-fed beef in the last year were younger than those in the general population. Nearly two thirds (73.15%) of general population indicated having no children and 25.6 percent of the respondents in this group had between one and three children under the age of 18 in their households. Almost 55 percent of the respondents in the general population had at least an Associate's degree.

The majority of respondents (almost 20%) in both groups, general population and among grass-fed beef consumers, reported an annual household income between \$50,000.00 and \$74,999.00. These values are comparable to the mean (\$73,767.00) and median (\$52,250.00) annual income reported by the U.S. Census Bureau (2013) for 2013. A total of 29 percent of the respondents in the general population reported annual incomes above \$75,000 which can be explained by the larger proportion of respondents with a college degree. The racial makeup for the general population was 81.4 percent white, 8.6 percent black, 5.4 percent Asian, 0.5 percent Native American, 0.2 percent Hawaiian and almost 3 percent expressed that their race was not among those listed. In reference to Hispanic origin, only 6.85 percent expressed coming from Hispanic descent. The proportion of respondents with Hispanic origin is below the 14.95 percent reported by the U.S. Census Bureau for 2012 (14.77 percent) and 2013 (14.95%).

All the U.S. regions were represented in the general population, the majority of the respondents (35.25%) resided in the South, 24.20% in the West, and 22% in the Midwest. A smaller proportion (18.55%) of respondents in the general population lived in the northeastern states. In both cases, general population and grass-fed beef consumers, the minority of respondents resided in the northeast region of the U.S. The percentages of grass-fed beef consumers and general population respondents residing in each one of the four U.S. regions are very close to those reported by the U.S. Census Bureau for 2013.

The values reported by the U.S. Census Bureau for 2013 were used to compare the demographic characteristics of respondents for general population and grass-fed beef consumers. The proportions of females in the general population (58.35 percent) and grass-fed beef consumers (54.50 percent) are above the amount reported by the U.S. Census Bureau (51.33 percent). The average age in both samples, general population (48.24 years old) and grass-fed beef consumers (46.93 years old), was above the average age (37.6 years old) reported. In both groups, the proportions of participants that indicated having no children were above the value (56.67%) stated by the U.S. Census Bureau. The percentages of respondents in the grass-fed beef consumers and general population that indicated having at least some college education were above those reported for 2013. These values suggest that the distribution of respondents based on their education level may be skewed.

The meaning of the term “grass-fed beef” for the consumer is shown in Table 4. The majority of consumers in both groups, general population and grass-fed beef consumers, associate the term “grass-fed beef” with cattle that are raised and grazed on open pasture. Less than 10 percent of the respondents that indicated that they have eaten grass-fed beef before indicated that they associate grass-fed beef production with cattle that are never fed grains.

Table 4. Meaning of “Grass-Fed Beef” for the Consumer

Statement	Grass-Fed Beef Consumer	General Population Eaten Grass-Fed Beef	
		Yes	No
Cattle that are raised and grazed on open pasture	55.3%	53.1%	50.9%
Cattle that are finished on grass, but not necessarily raised on a pasture.	16.4%	17.0%	20.1%
Cattle that are raised organically.	6.8%	5.5%	5.1%
Cattle that are raised naturally.	13.6%	15.5%	13.8%
Cattle that are never fed grains.	8.0%	8.9%	10.2%

The frequency of consumption of meat and seafood is shown in Table 5. On average, the respondents from the general population eat beef once a week, same as the consumers in the grass-fed beef eaters group. Almost half of the grass-fed beef consumers reported that they eat beef at least twice a week and when inquired about grass-fed beef, they expressed that they consume it more frequently at home than at a restaurant. Respondents in the general population and among the grass-fed beef consumers indicated that chicken was the meat most often consumed. Almost 59 percent of the respondents from the general population reported that they had eaten grass-fed beef the past year. Home was the preferred location to consume either grass-fed or grain-fed beef products. Participants in the grass-fed beef consumers group indicated that on average they eat beef once a week. Consumers that reported having eaten grass-fed beef often consume it as steaks. On the other hand, all the participants often consumed grain-fed beef as hamburgers.

4.1 Results from Random Parameters Logit Model for Grass-fed Beef Eaters

The following random parameters logit model was estimated for both groups of participants, those that consumed grass-fed beef last year and general population:

$$U_{ijt} = \beta_0 + \beta_1 Price_{ijt} + \beta_2 GfUsda_{ijt} + \beta_3 GfNoUsda_{ijt} + \beta_4 Local_{ijt} + \beta_5 Domestic_{ijt} + \beta_6 Select_{ijt} + \beta_3 Choice_{ijt} + \sum_1^k \beta_k X_{ijk} + \varepsilon_{ijt} \quad (17)$$

Table 5. Summary of Respondents' Meat Consumption

	Ate GFB Last Year				General Population			
	Mean	S.D.	N	Freq.(%)	Mean	S.D.	N	Freq.(%)
Frequency of consumption of Beef	3.286	1.093			3.193	1.097		
1 = 1-11 times a year			158	7.9			163	8.15
2 = 1-3 times a month			323	16.15			382	19.10
3 = Once a week			501	25.05			539	26.95
4 = 2-3 times a week			825	41.25			738	36.90
5 = More than 4 times a week			193	9.65			178	8.90
Consumed grass-fed beef last year			2000	100.0			1178	58.90
In the last 10 times you ate meat or seafood								
Grass-fed beef	2.287	1.725			1.413	1.713		
Grain-fed beef	1.886	1.433			2.316	1.776		
Chicken	3.063	1.638			3.473	1.847		
Pork	1.269	1.017			1.332	1.081		
Seafood	1.493	1.296			1.466	1.346		
In the last 10 times you ate grass-fed beef								
Home	6.468	3.262			6.331	3.382		
Restaurant	3.532	3.262			3.669	3.382		
Cuts of grass-fed beef often consumed	2.282	1.435			2.299	1.435		
Steak			943	51.59			611	51.04
Roast			156	8.53			97	8.1
Ribs			25	1.37			21	1.75
Hamburger			679	37.14			455	38.01
Beef cubes			25	1.37			13	1.09
In the last 10 times you ate grain-fed beef								
Home	5.853	2.843			6.171	2.903		
Restaurant	4.147	2.843			3.829	2.903		
Cuts of grain-fed beef often consumed	2.586	1.436			2.721	1.431		
Steak			656	40.52			615	36.96
Roast			154	9.51			135	8.11
Ribs			35	2.16			33	1.98
Hamburger			753	46.51			861	51.74
Beef cubes			21	1.30			20	1.20

where $i = 1, \dots, N$ represents the number of respondents; j = number of alternatives in the choice set J (3 alternatives and the opt-out option); t = number of choice occasions; and X_{ijk} represents a set of k interaction terms between respondent's characteristics and product attributes (Hill, 2012). The alternative specific β_0 is a dummy variable that indicates either alternative A, B or C was chosen instead of the opt-out option D. Three price levels were selected: \$2.99/lb. \$4.99/lb. and \$7.99/lb.

The levels of the attributes type, source and grade were assigned using effects coding. In effects coding, levels coded 1 or -1 indicate the level appearance and 0 otherwise. The use of dummy variables implies a correlation between the effects of the level and the intercept, whereas with effects coding, the effects of each level are uncorrelated with the intercept (Bech and Gyrd-Hansen, 2005). The value for the reference level was obtained from the negative sum of the estimated coefficients. The variables GfUsda and GfNoUsda define the levels for the attribute type, where GfUsda = 1 and GfNoUsda = 0 represent grass-fed beef with USDA certification; GfUsda = 0 and GfNoUsda = 1 represent grass-fed beef without USDA certification; and GfUsda = -1 and GfNoUsda = -1 represent grain-fed beef. The variables Local and Domestic define the levels for the attribute Origin or source of the product. Local = 1 and Domestic = 0 indicate that the steak came from an animal locally raised; Local = 0 and Domestic = 1 indicate that the steak was domestically produced, and Local = -1 and Domestic = -1 represent imported products. The grade of the steak was defined by the variables Select and Choice, where Select = 1 and Choice = 0 represent Select beef steaks; Select = 0 and Choice = 1 for Choice beef steaks; and Select = -1 and Choice = -1 represent Prime beef steaks.

As it was explained in the literature, different distributional forms can be assumed for the explanatory variables in a random parameters model (Hensher, et al., 2005, Hole, 2007, Train,

2009). All the variables were assumed to follow a normal distribution with the exception of price. The price variable was fixed in order to avoid positive coefficients due to the preference heterogeneity (Hill, 2012). The random parameters logit model was estimated using 2000 Halton draws which were estimated using STATA® version 13.1. Means and standard deviations were estimated for the normally distributed explanatory variables. Statistically significant standard deviations indicate the presence of heterogeneous preferences in the sample for that attribute.

The estimated coefficients from the random parameters logit model for respondents that consumed grass-fed beef last year are shown on Table 6. The model is statistically significant at the 0.01 critical level as shown by the likelihood ratio test. The null hypothesis that all the estimated coefficients are equal to zero is rejected since the chi-squared value of 676.79 is larger than the critical value of chi-squared with 8 degrees of freedom. The attribute levels: grain-fed beef, imported and prime were considered the reference levels and were estimated using the Delta method. The alternative specific constant labelled “Alternative” is positive and statistically significant which indicates that the respondents received a higher utility level from choosing any of the three alternatives than from the no purchase option. The price coefficient is negative and statistically significant; as expected, an increase in price decreases consumer utility. All the “type of beef meat” coefficients are statistically significant at the 0.01 level of significance. The signs and values of the coefficients indicate that grass-fed beef steaks with USDA certification were preferred; however, steaks from grain-fed animals were the least preferred. Grass-fed beef steaks with the USDA certification are preferred over those that came from grass-fed animals that did not have the certification; nevertheless, heterogeneous preferences exist across the population sample.

All the estimates for the source attribute are statistically significant at the 0.01 level of significance and the respondent's utility for imported steaks is negative. Domestically and locally produced beef steaks have a positive effect on respondents' utility, and are preferred over

Table 6. Estimates from Random Parameters Logit Model for Grass-Fed Beef Consumers

Coefficient		Estimates	Std. Err.
Alternative	Mean	5.1161***	0.2760
	Std. Dev.	2.8886***	0.2254
Price	Mean	-0.3542***	0.0196
	Std. Dev.	0.3809***	0.0233
Type			
Grass fed beef with USDA Certification	Mean	0.6766***	0.0378
	Std. Dev.	0.5281***	0.0537
Grass fed beef without USDA Certification	Mean	-0.1510***	0.0387
	Std. Dev.	0.4115***	0.0758
Grain fed beef	Mean	-0.5256***	0.0393
	Std. Dev.	N/A	N/A
Source			
Local	Mean	0.2928***	0.0352
	Std. Dev.	0.5361***	0.0667
Domestic	Mean	0.3416***	0.0346
	Std. Dev.	0.1022	0.2719
Imported	Mean	-0.6344***	0.0424
	Std. Dev.	N/A	N/A
Grade			
Select	Mean	-0.3328***	0.0579
	Std. Dev.	-0.0061 ^a	0.0691
Choice	Mean	0.4970***	0.1037
	Std. Dev.	0.0033	0.1203
Prime	Mean	-0.1642***	0.0553
	Std. Dev.	N/A	N/A
Log likelihood		-6914.01	
Chi squared (8)		676.79	
Prob > Chi squared		0.000	

Notes: Number of respondents: N=1996. Number of Observations = 23,952 (1996 respondents x 3 sets x 4 choices)

*, **, ***. Denotes significance levels at $\alpha = 0.10$, 0.05, and 0.01 percent, respectively

^a The sign of the estimated standard deviations is irrelevant: interpret them as being positive (STATA)

^b Standard errors for "omitted" levels in the effects coding were calculated using the Delta method.

imported which has a negative effect on utility. The estimated coefficients for grade (Select, Choice and Prime) were statistically significant for all levels. Choice steaks had a positive effect on utility and are the preferred steaks. The grades Select and Prime had a negative effect on respondent's utility, with Prime steaks being the least preferred. From the analysis of the standard deviation estimates, it can be concluded that consumers showed heterogeneous preferences for Grass-fed beef with and without USDA certification and for locally produced steaks. There was not preference heterogeneity in the population for the Grade attribute.

The relative importance of each attribute was estimated in order to understand the contribution of that particular attribute level to the total utility of the product. As aforementioned, the relative importance is calculated by the difference between the highest and the lowest estimated coefficient for each attribute divided by the ranges across all the attributes (Hair, et al., 2010, Hill, 2012). For example, the relative importance (R.I.) for the attribute Type was estimated using equation (18).

$$R.I._{Type} = \frac{\beta_{GfUsda} - \beta_{Grainfed}}{(\beta_{GfUsda} - \beta_{Grainfed}) + (\beta_{Local} - \beta_{Imported}) + (\beta_{Price(7.99)} - \beta_{Price(2.99)})} \quad (18)$$

where the β 's represent the estimated coefficients for each level and the 7.99 and 2.99 represent the highest and lowest price in dollars per pound for beef steaks. The relative importance of each attribute can be found in Figure 4.

Price was the most important attribute to the respondents with 37 percent relative importance. This indicates that price is the attribute that has the highest influence on consumer's choice. The type of beef meat was the second in importance with 25 percent relative importance. Source was in third place with 20 percent relative importance. Grade with 17 percent was the attribute of least importance among the four analyzed product attributes. Even though grade had the smallest relative value, its effect over consumer's choice cannot be ignored.

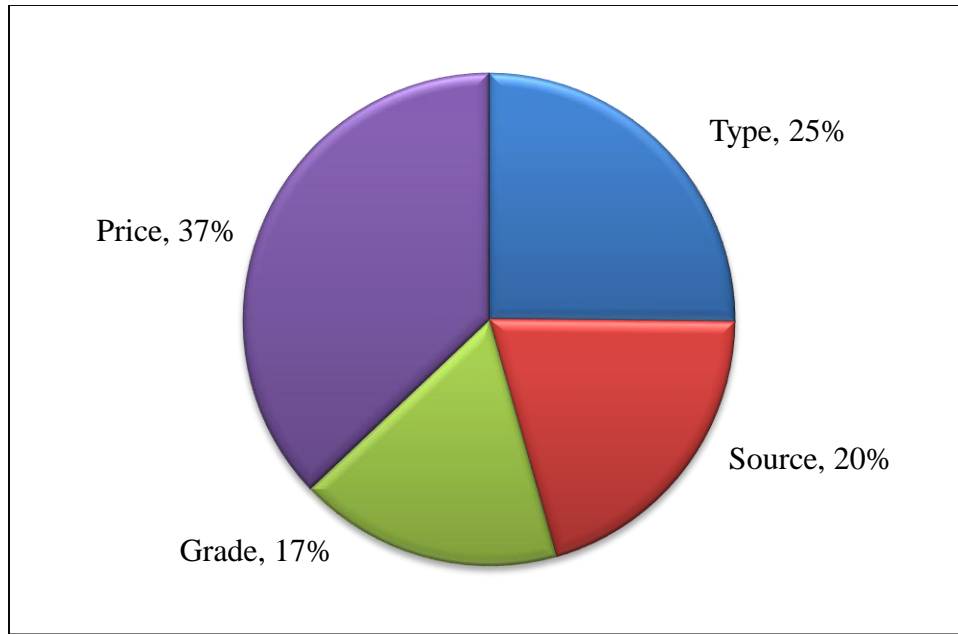


Figure 4. Relative Importance of Grass Fed Beef Attributes for Grass Fed Beef Consumers

The estimates from the random parameters logit model indicate the positive or negative effect that the attributes had on consumer utility. The marginal willingness-to-pay was estimated in order to quantify the effect of each attribute. Marginal willingness-to-pay (WTP) for each attribute was calculated as the negative ratio of the coefficient for each attribute divided by the price coefficient as expressed in equation (19).

$$WTP_{Attribute} = -\frac{\beta_{Attribute}}{\beta_{Price}} \quad (19)$$

The WTP is expressed in dollars per pound and represents the dollar amount that the respondent is willing to pay to obtain the specific beef meat attribute. The estimated marginal WTP for each attribute is shown in Table 7. Overall, consumers preferred grass-fed beef steaks with USDA certification over the rest of steaks presented. The marginal willingness-to-pay revealed that respondents placed a greater value on steaks that came from an animal that was grass-fed and that were certified by the USDA. Respondents valued grass-fed steaks without USDA certification and grain-fed steaks less as indicated by their negative WTP. The presence

of the seal of USDA certification in a grass-fed beef product may positively influence the consumer's decision to purchase a product. The findings suggest that the majority of respondents view the USDA certification system as a way to differentiate the product and it is a desirable attribute for which they are willing to pay more.

Table 7. Marginal Willingness to Pay for Grass Fed Beef Meat Attributes from Random Parameters Logit Model for Grass-fed Beef Consumers

Attribute Level	Estimates	Std. Err.	[95% Conf. Interval]
Type			
Grass fed beef with USDA certification	1.91***	0.1013	[1.7116 to 2.1087]
Grass fed beef without USDA cert.	-0.43***	0.1071	[-0.6361 to -0.2162]
Grain fed beef	-1.48***	0.1145	[-1.7083 to -1.2596]
Source			
Local	0.83***	0.1023	[0.6262 to 1.0271]
Domestic	0.96***	0.0948	[0.7785 to 1.1503]
Imported	-1.79***	0.1210	[-2.0282 to -1.5540]
Grade			
Select	-0.94***	0.1726	[-1.2778 to -0.6012]
Choice	1.40***	0.3063	[0.8029 to 2.0037]
Prime	-0.46***	0.1599	[-0.7771 to -0.1505]

Note: The confidence intervals were estimated using the Delta method.

*, **, ***. Denotes significance levels at $\alpha = 0.10, 0.05$, and 0.01 percent, respectively

Consumers preferred domestically and locally produced steaks and were willing to pay more for steaks produced in the U.S. than for imported products. Consumers did not value imported steaks highly as indicated by the large negative value. Overall, respondents preferred Choice steaks over Select and Prime. Participants did not value Select steaks as shown by the large negative marginal WTP value of \$0.94 per pound. It may be argued that consumers prefer steaks that have marbling but they are also cautious about steaks that have more fat such as in the case of Prime. It may be argued that since the majority of participants were married females and the average age was 46.9 years old, they are interested in buying products that have the “right” amount of fat. Consumers are not looking for a lean beef product; they recognize that marbling is

also important in the palatability and overall acceptability of the product. But, at the same time the presence of fat in the steak may dissuade some of them from buying the product.

Respondents showed heterogeneous preferences for the attributes: grass-fed beef with and without USDA certification, grain-fed beef and local. Consumer preferences for domestically produced beef steaks did not vary in the population. Likewise, the Grade attribute showed homogeneous preferences among the consumers; the perceived utility of each level of the attribute Grade did not vary across individuals. Different interactions between the respondents' socioeconomic, demographic and geographic characteristics and the product attributes were included in the model to understand the sources of heterogeneity (Appendix C.1).

The interactions between gender, age, income levels between 100 thousand and 150 thousand dollars per year and the attributes type and local were statistically significant. The statistically significant interactions were included in the random parameters logit model and the model was estimated using 2000 Halton draws. The results are shown in Table 8. The model is statistically significant with a chi-squared statistic of 678.15 which is larger than the critical value for chi-squared with 8 degrees of freedom. The log likelihood for the random parameters logit model with interactions is -6881.19 which is substantially higher than the -6914.01 for the random parameters logit model initially presented. Cameron and Trivedi (2010) explain that the model with higher log likelihood value should be preferred. Therefore, the random parameters logit model with interactions should be selected, which indicates that the inclusion of interactions provides a better fit for the data.

The interaction between “female” and “type” revealed that female consumers have a positive utility for grass-fed beef steaks with USDA certification and for steaks that are locally produced. The interaction between age and type indicated that older consumers have a positive

Table 8. Estimates from Random Parameters Logit Model with Interactions for Grass-Fed Beef Consumers

Coefficient		Estimates	Std. Err.
Alternative	Mean	5.1442***	0.2739
	Std. Dev.	2.9055***	0.2257
Price	Mean	-0.3572***	0.0197
	Std. Dev.	0.3844***	0.0226
Type			
Grass fed beef with USDA Certification	Mean	0.3168***	0.0896
	Std. Dev.	0.5122***	0.0468
Grass fed beef without USDA Certification	Mean	0.2706***	0.0924
	Std. Dev.	0.4106***	0.0687
Grain fed beef	Mean	-0.5874***	0.1098 ^b
	Std. Dev.	N/A	N/A
Source			
Local	Mean	-0.0308	0.0973
	Std. Dev.	0.5484***	0.0630
Domestic	Mean	0.3412***	0.0333
	Std. Dev.	-0.0020 ^a	0.1997
Imported	Mean	-0.3103***	0.0984
	Std. Dev.	N/A	N/A
Grade			
Select	Mean	-0.3310***	0.0579
	Std. Dev.	-0.0047 ^a	0.0691
Choice	Mean	0.5005***	0.1037
	Std. Dev.	0.0037	0.1209
Prime	Mean	-0.1694***	0.0554
	Std. Dev.	N/A	N/A
Female*GFB with USDA certification		0.2583***	0.0518
Age*GFB with USDA certification		0.0043***	0.0015
Income 100K-149.9K*GFB with USDA cert.		0.1926***	0.0750
Female*GFB without USDA certification		-0.0724	0.0543
Age*GFB without USDA certification		-0.0084***	0.0017
Income 100K-149.9K*GFB without USDA ce.		-0.0104	0.0797
Female*Local		0.1875***	0.0577
Age*Local		0.0047***	0.0018
Income 100K-150K*Local		0.0763	0.0848
Log likelihood		-6881.19	
Chi squared (8)		678.15	
Prob > Chi squared		0.000	

Notes: Number of respondents: N=1996. Number of Observations = 23,952 (1996 respondents x 3 sets x 4 choices)

*, **, ***. Denotes significance levels at $\alpha = 0.10, 0.05$, and 0.01 percent, respectively

^a The sign of the estimated standard deviations is irrelevant: interpret them as being positive (STATA)

^b Standard errors for “omitted” levels in the effects coding were calculated using the Delta method.

utility for grass-fed beef steaks with USDA certification but a negative utility for steaks from grass-fed animals that do not have the certification. Households with annual income levels between 100 thousand and 149.9 thousand dollars prefer grass-fed beef steaks with USDA certification. The display of the USDA certification has a positive effect over the consumers' perceived utility of the product.

The interaction between female and local is positive and statistically significant, indicating that females prefer steaks that were locally produced. The interaction between local and age is also positive indicating that older respondents prefer locally produced steaks. Regional dummy variables were also considered for the analysis. Four dummy variables were created to represent the four regions in the U.S.: Northeast, Midwest, South and West and the interactions were estimated. Nevertheless, all these coefficients were not statistically significant.

The marginal WTP values for both random parameters logit models (with and without interactions) for grass-fed beef eaters are presented in Table 9. In the random parameters logit model with interactions, the marginal WTP for grass-fed beef steaks with and without USDA certification was positive at \$0.89 and \$0.76 per pound respectively. Both random parameters logit models indicate a strong preference for grass-fed beef steaks with USDA certification versus non-certified grass-fed beef steaks. Furthermore, the model with interactions shows that when comparing between grass-fed beef steaks, respondents are willing to pay 17% more for steaks that display the USDA certification.

In terms of origin, domestically produced steaks are preferred and the consumer is willing to pay \$0.96 more per pound for these steaks. Imported steaks have a negative marginal WTP of \$0.87 per pound, indicating consumers' non-preference for imports. Consumers valued Choice steaks over Select and Prime. In both models, respondents are willing to pay \$1.40 more per

pound for steaks graded as Choice. Prime steaks were the least preferred. This finding might be due to the fact that nowadays consumers are more health conscious and the consumption of beef products rich in fat is usually associated with high cholesterol.

Table 9. Marginal Willingness to Pay for Grass Fed Beef Meat Attributes from Random Parameters Logit Models for Grass Fed Beef Consumers

Attribute Level	Random Parameters Logit Model	
	Without Interactions	With Interactions
Type		
Grass fed beef with USDA certification	1.91*** [1.71 to 2.11]	0.89*** [0.40 to 1.37]
Grass fed beef without USDA cert.	-0.43*** [-0.64 to -0.22]	0.76*** [0.24 to 1.27]
Grain fed beef	-1.48*** [-1.71 to -1.26]	-1.64*** [-2.24 to -1.04]
Source		
Local	0.83*** [0.63 to 1.03]	-0.09 [-0.62 to 0.45]
Domestic	0.96*** [0.78 to 1.15]	0.96*** [0.78 to 1.13]
Imported	-1.79*** [-2.03 to -1.55]	-0.87*** [-1.40 to -0.33]
Grade		
Select	-0.94*** [-1.28 to -0.60]	-0.92*** [-1.26 to -0.59]
Choice	1.40*** [0.80 to 2.00]	1.40*** [0.80 to 2.00]
Prime	-0.46*** [-0.78 to -0.15]	-0.47*** [-0.79 to -0.16]

Note: The confidence intervals were estimated using the Delta method.

*, **, ***. Denotes significance levels at $\alpha = 0.10, 0.05$, and 0.01 percent, respectively

The results from both models reveal similar findings. The type and local attributes revealed heterogeneous preferences. Interaction terms revealed that females preferred grass-fed beef steaks and locally produced steaks. Female preferences for USDA certified steaks might be because the consumer perceives the USDA certification as a way to assure the quality of the product. The preference for locally produced steaks can be explained due to the fact that meat is

a perishable product and as such it requires to be carefully handled. The monitoring of temperature is especially important during storage. Consumer preferences for local and domestic steaks may be understood as consumers' confidence in the U.S. beef industry as compared to meat products from other countries. Both models showed that respondents preferred steaks graded as Choice, which indicates that despite the belief that grass-fed beef products are usually considered lean, the consumer prefers products that have an adequate fat content because the amount of marbling present in the steak also affects the overall acceptability and palatability of the product.

The region in which the respondent resided did not influence the preference for grass-fed or grain-fed beef steaks. The level of education and number of children present in the household did not have a statistically significant effect over the selection of the products, which differs from the findings reported in previous studies (Fields, et al., 2006, Gwin, et al., 2012). This difference might be explained because these studies considered respondents from very specific geographical regions or that purchase at a specific store.

4.2 Results from Random Parameters Logit Model for General Population

The random parameters logit model expressed in equation (17) was also used for the analysis of the survey results from the general population. The random parameters logit model for the general population was estimated using 2000 Halton draws, and the results can be found in Table 10. The model is statistically significant at the 0.01 critical level as shown by the likelihood ratio test. The null hypothesis that all the estimated coefficients are equal to zero is rejected since the chi-squared value of 1033.26 is larger than the critical value of chi-squared with 8 degrees of freedom. The attribute levels grain-fed beef, imported and prime were considered reference levels and were estimated using the Delta method. The alternative specific constant "Alternative" is positive and statistically significant, indicating that participants

Table 10. Estimates from Random Parameters Logit Model for General Population

Coefficient		Estimates	Std. Err.
Alternative	Mean	6.6190***	0.3423
	Std. Dev.	3.8036***	0.2708
Price	Mean	-0.5415***	0.0267
	Std. Dev.	0.4788***	0.0273
Type			
Grass fed beef with USDA Certification	Mean	0.6159***	0.0410
	Std. Dev.	0.6155***	0.0480
Grass fed beef with USDA Certification	Mean	-0.2188***	0.0400
	Std. Dev.	0.4857***	0.0665
Grain fed beef	Mean	-0.3971***	0.0404 ^b
	Std. Dev.	N/A	N/A
Source			
Local	Mean	0.2233***	0.0365
	Std. Dev.	0.4407***	0.0770
Domestic	Mean	0.4137***	0.0371
	Std. Dev.	-0.0037 ^a	0.1254
Imported	Mean	-0.6371***	0.0442
	Std. Dev.	N/A	N/A
Grade			
Select	Mean	-0.2328***	0.0588
	Std. Dev.	0.0041	0.0853
Choice	Mean	0.3341***	0.1040
	Std. Dev.	0.0162	0.1537
Prime	Mean	-0.1013*	0.0558
	Std. Dev.	N/A	N/A
Log likelihood		-6753.44	
Chi squared (8)		1033.26	
Prob > Chi squared		0.000	

Notes: Number of respondents: N=1996. Number of Observations = 23,952 (1996 respondents x 3 sets x 4 choices)

*, **, ***. Denotes significance levels at $\alpha = 0.10$, 0.05, and 0.01 percent, respectively

^a The sign of the estimated standard deviations is irrelevant: interpret them as being positive (STATA)

^b Standard errors for “omitted” levels in the effects coding were calculated using the Delta method.

received greater utility from the steaks presented as choices A, B or C than from the no purchase option. As expected, the estimated coefficient for price is negative and statistically significant at the 0.05 level. The estimated standard deviations for the attributes/levels grass-fed beef with and

without USDA certification and local are statistically significant suggesting heterogeneous preferences in the general population for these attributes.

All the coefficients for the different levels of the attributes type, source and grade were statistically significant. On average, consumers from the general population sample prefer grass-fed beef steaks with USDA certification, either locally or domestically produced. Choice steaks were preferred over Prime and Select. The coefficients for grass-fed beef without USDA certification and grain-fed beef were negative and statistically significant, grain-fed beef steaks were the least preferred. Based on this information, it can be said that the display of the USDA certification might increase the likelihood of purchasing steaks with this characteristic. The coefficients for local and domestic were positive and statistically significant, indicating that on average consumers prefer steaks from the U.S. The coefficient for imported steaks was negative and statistically significant. The estimated coefficients for Select and Prime steaks were both negative and statistically significant at the 0.01 and 0.1 critical levels, respectively.

For the general population, the relative importance of each attribute was calculated using the estimated coefficients from the random parameters logit model estimated using equation (18). Measures of the relative importance of grass-fed beef attributes for the general population are shown in Figure 5. Price was the most important attribute to participants, with 57 percent relative importance. This indicates that price is the attribute that had the most influence on consumer choice. Source was the second most-important at 22 percent closely followed by Type at 21 percent relative importance. Grade, with 12 percent relative importance, was the least influential attribute of the 4 analyzed on consumer choice. This could be due to consumers' perception that grass-fed beef products are generally considered leaner. Previous studies suggest

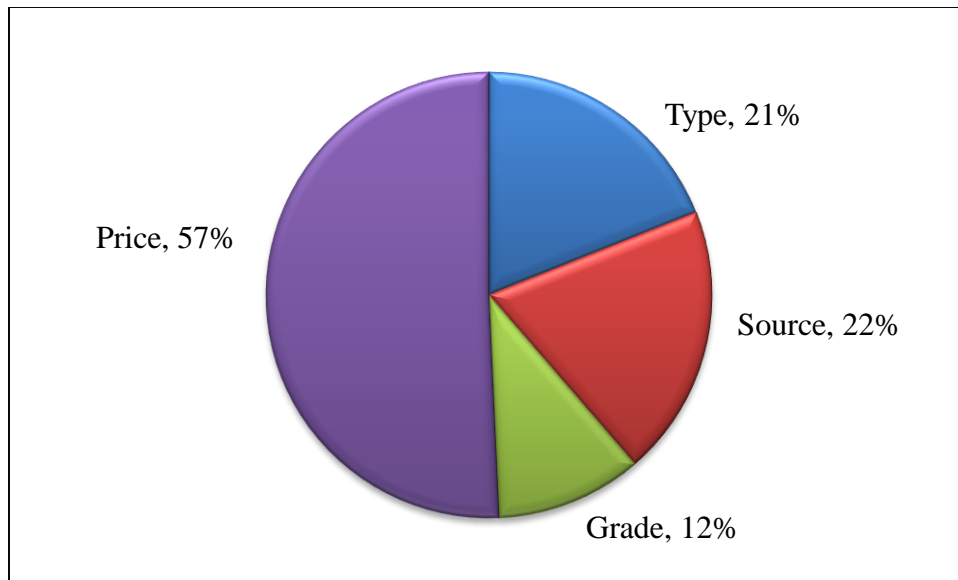


Figure 5. Relative Importance of Grass Fed Beef Attributes for the General Population

that grass-fed beef products have a lower fat content and a more desirable lipid profile than grain-fed beef products (Daley, et al., 2010, Leheska, et al., 2008). The relatively low importance of the Grade attribute might be interpreted as the consumer's lack of knowledge about the benefits attributed to the fat composition of grass-fed beef products.

The general population sample is comprised of respondents that eat meat or seafood regularly and might have eaten grass-fed beef before or not. Participants from the general population place a higher relative importance (57%) on the price attribute than those in the grass-fed beef consumers group. This suggests that price may be considered one of the most important factors for the consumer's decision to purchase the product the first time or not. The relative importance of the attribute source is almost the same for both groups with 22 percent and 20 percent relative importance for grass-fed beef consumers and general population, respectively. Overall, the origin of the product is the third most important attribute that influences consumer's choice. Consumers from the general population group place less importance on the type and grade attributes than those in the grass-fed beef consumers sample. This could indicate that the

attributes grade and type bring information that can help the consumer that has had grass-fed beef before differentiate among grass-fed beef products. Grade had the lowest relative importance value in both groups, indicating that grade was the attribute with the least influence over the respondents' choice.

As mentioned before, consumers showed heterogeneous preferences for grass-fed beef with and without USDA certification and for locally produced steaks. Select interactions were included in the model to analyze the sources of heterogeneous preferences in general population, which was estimated using 2000 Halton draws. Female, age, presence of children under 18 years old in the household, race and different income levels were found to be statistically significant interaction terms with the attributes. The estimated coefficients for this model are shown in Table 11. The random parameters logit model with interactions is statistically significant with a chi-squared statistic of 1031.82, which is larger than the critical value for chi-squared with 8 degrees of freedom. The log likelihood for the random parameters logit model with interactions is -6705.63, which is substantially higher than the -6753.44 for the random parameters logit model initially presented. Cameron and Trivedi (2010) explain that the model with higher log likelihood value should be preferred. Therefore, the random parameters logit model with interactions should be preferred, which indicates that the inclusion of interactions provides a better fit for the data.

The interaction between female and type revealed that female consumers have a positive utility for grass-fed beef steaks with USDA certification. The interaction between white and type was negative and statistically significant at the 5 percent level, indicating that Caucasian consumers do not prefer grass-fed beef steaks that have the USDA certification. The interaction between Age and grass-fed beef without certification was negative, indicating that older

Table 11. Estimates from Random Parameters Logit Model with Interactions for General Population

Coefficient		Estimates	Std. Err.
Alternative	Mean	6.6466***	0.3437
	Std. Dev.	3.8168***	0.2713
Price	Mean	-0.5459***	0.0269
	Std. Dev.	0.4819***	0.0274
Type			
Grass fed beef with USDA Certification	Mean	0.6193***	0.1185
	Std. Dev.	0.5945***	0.0484
Grass fed beef without USDA Certification	Mean	0.0312	0.1205
	Std. Dev.	0.4727***	0.0678
Grain fed beef	Mean	-0.6504***	0.1432 ^b
	Std. Dev.	N/A	N/A
Source			
Local	Mean	-0.1351	0.1188
	Std. Dev.	0.4496***	0.0765
Domestic	Mean	0.4161***	0.0374
	Std. Dev.	-0.0064 ^a	0.1027
Imported	Mean	-0.2810**	0.1203
	Std. Dev.	N/A	N/A
Grade			
Select	Mean	-.2318***	0.0591
	Std. Dev.	0.0070	0.0887
Choice	Mean	0.3395***	0.1044
	Std. Dev.	0.0146	0.1601
Prime	Mean	-0.1077***	0.0560
	Std. Dev.	N/A	N/A
Female*GFB with USDA certification		0.3372***	0.0575
Age*GFB with USDA certification		-0.0004	0.0018
Children*GFB with USDA certification		0.0831	0.0658
White*GFB with USDA certification		-0.1629**	0.0729
Income 35K-74.9K*GFB with USDA cert		-0.0383	0.0639
Income 75K-99.9K*GFB with USDA cert		-0.0153	0.0891
Income 100K-149.9K*GFB with USDA cert		0.0046	0.0968
Female*GFB without USDA certification		-0.0629	0.0583
Age*GFB without USDA certification		-0.0075***	0.0018
Children*GFB without USDA certification		0.1085	0.0671
White*GFB without USDA certification		0.0985	0.0757
Income 35K-74.9K*GFB without USDA cert		0.0335	0.0654
Income 75K-99.9K*GFB without USDA cert		0.1576*	0.0004
Income 100K-149.9K*GFB without USDA cert		-0.0373	0.0996
Female*Local		0.2271***	0.0592
Age*Local		0.0041**	0.0018
Children*Local		0.0267	0.0674
White*Local		0.0856	0.0752

(Table 11 continued)

Coefficient	Estimates	Std. Err.
Income 35K-74.9K*Local	-0.0974	0.0660
Income 75K-99.9K*Local	-0.0428	0.0916
Income 100K-149.9K*Local	0.0102	0.1010
Log likelihood	-6705.63	
Chi squared (8)	1031.82	
Prob > Chi squared	0.000	

Notes: Number of respondents: N=1996. Number of Observations = 23,952 (1996 respondents x 3 sets x 4 choices)

*, **, ***. Denotes significance levels at $\alpha = 0.10$, 0.05, and 0.01 percent, respectively

^a The sign of the estimated standard deviations is irrelevant: interpret them as being positive (STATA)

^b Standard errors for “omitted” levels in the effects coding were calculated using the Delta method.

consumers do not prefer grass-fed beef steaks that were not certified by the USDA. On the other hand, older consumers prefer locally produced steaks, which was evidenced by the positive and statistically significant coefficient for this interaction. For the different income levels, only the interaction between income levels from 75 thousand to 99.9 thousand dollars per year with grass-fed beef without USDA certification was statistically significant. This suggests that consumers within this income level prefer grass-fed beef steaks that do not have the USDA certification.

The estimates from the random parameters models with and without interactions provide some insight on the positive or negative effect of the attributes on consumer utility. However, the marginal WTP was calculated to quantify those effects. The marginal WTP values for both random parameters logit models with and without interactions are shown in Table 12. In both models, consumers indicated a greater value for grass-fed beef steaks with USDA certification versus grass-fed beef steaks without the certification and grain-fed beef steaks. Overall, respondents from the general population sample are willing to pay \$1.13 more for grass-fed beef steaks with USDA certification. Grain-fed beef steaks had a negative marginal WTP of \$0.73 and \$1.19 per pound for the models without and with interactions, respectively.

Table 12. Marginal Willingness to Pay for Grass Fed Beef Meat Attributes from Random Parameters Logit Models for the General Population

Attribute Level	Random Parameters Logit Model	
	Without Interactions	With Interactions
Type		
Grass fed beef with USDA certification	1.13*** [1.02 to 1.26]	1.13*** [0.72 to 1.55]
Grass fed beef without USDA cert.	-0.41*** [-0.54 to -0.27]	0.06 [-0.38 to 0.49]
Grain fed beef	-0.73*** [-0.87 to -0.59]	-1.19*** [-1.71 to -0.68]
Source		
Local	0.41*** [0.28 to 0.54]	-0.25 [-0.67 to 0.18]
Domestic	0.76*** [0.63 to 0.89]	0.76*** [0.63 to 0.89]
Imported	-1.17*** [-1.32 to -1.02]	-0.51** [-0.94 to -0.08]
Grade		
Select	-0.43*** [-0.65 to -0.21]	-0.42*** [-0.64 to -0.21]
Choice	0.62*** [0.24 to 1.00]	0.62*** [0.24 to 1.00]
Prime	-0.19* [-0.39 to -0.02]	-0.19* [-0.40 to 0.01]

Note: The confidence intervals were estimated using the Delta method.

*, **, ***. Denotes significance levels at $\alpha = 0.10, 0.05$, and 0.01 percent, respectively

Consumers valued beef steaks that were domestically produced over imported steaks. The marginal WTP for domestic steaks is \$0.76 per pound, whereas imported steaks had a negative marginal WTP of \$1.17 and \$0.51 per pound for each model. Consumers' marginal WTP estimates for locally produced steaks and grass-fed beef steaks without USDA certification were not statistically significant. The marginal WTP estimates for the levels Select, Choice and Prime were statistically significant and the same values in both models. Consumers valued Choice steaks more than Prime and Select steaks and were willing to pay \$0.62 more per pound for Choice steaks. Prime steaks and Select steaks had a negative marginal WTP of \$0.19 and \$0.42

per pound respectively. However, consumers valued Prime steaks more than Select steaks as indicated by a greater negative value for Select steaks. Consumers expressed their least preference for steaks that had the smallest amount of fat.

Overall, the results from both random parameters logit models for the general population revealed that consumers in this group placed the greatest importance on the price attribute. Respondents preferred grass-fed beef steaks with USDA certification over grain-fed or grass-fed beef steaks that did not have the certification. Female consumers preferred Grass-fed beef steaks with USDA certification and steaks that were locally produced. Overall, consumers preferred grass-fed beef steaks with USDA certification. Consumers valued imported steaks less as indicated by the negative and statistically significant WTP values from both models. Interactions between gender, age and type and local showed possible sources for the preference heterogeneity in the general population. Older consumers' preference for domestically produced steaks might be due to the consumers' confidence in the U.S. beef industry. In the past, problems such as BSE (Bovine Spongiform Encephalopathy) have influenced consumer to become more cautious about imported products as well as the cattle production systems outside the U.S.

The interaction between race and grass-fed beef with USDA certification indicated that Caucasian consumers do not prefer grass-fed steaks with USDA certification. However, the coefficient of the interaction between Caucasian and grass-fed beef steaks without USDA certification was not statistically significant. No evidence was found of the effect of the interaction terms between the annual household income levels and the origin of the product. Even though Grade was the attribute that has the least importance in the consumers' selection, the WTP analysis showed that consumers value Choice steaks over Prime and Select steaks, and

Prime is preferred between the latter two. This indicates that consumers value the amount of marbling present in the steak.

4.3 Factor Analysis Results for General Population and Grass-fed Beef Consumers

In one section of the survey, all the respondents were asked to express their disagreement or agreement with 27 statements regarding consumers' lifestyle, beliefs and attitude towards food, in a 6-point Likert scale. The participants were asked to indicate the responses that best reflected their opinion, where 6 indicated strongly agree, and 1 strongly disagree. All the 27 statements can be found in question number 9 of the survey in the Appendix A. These responses were analyzed using principal component analysis in order to identify common dimensions among the respondents' lifestyle, beliefs, and attitudes toward food.

The VARIMAX orthogonal rotation procedure was implemented to obtain simpler and meaningful factors for general population and grass-fed beef consumers. The use of factor rotation also allowed to eliminate cross-loadings in which variables have significant loadings in more than one factor. Only variables with factor loadings higher than 0.5 were considered for each dimension. Factor loadings of 0.3 or 0.4 are considered minimal (Hair, et al., 2010). The five factors identified for grass-fed beef consumers are displayed in Table 13. The last column shows the unique variance of the variable, which is the portion of the variance that is independent from any correlation with other variables (Bharad, 2010, Hair, et al., 2010). From the analysis of the 27 statements, a total of five and six factors were identified for grass-fed beef consumers and the general population, respectively. Each factor was labelled according to the description of the behavioral or attitudinal statements that are contained in it.

The first factor contains five statements related to the importance that the consumer places in the nutritional components of the food products as a way to differentiate the products he will regularly consume. This factor was labeled "nutrition". The second factor set contains

three statements and was labeled “convenience” since it is characterized by the respondent’s affinity to use semi-elaborated or ready-to-eat food products. The third dimension was labelled “Price sensitivity” because it contains attitudinal statements regarding the respondents’ sensitivity to changes in prices and the preference for coupons and promotions. “Novelty” is the fourth dimension since all the statements that are contained in this factor are characterized by inquiring on the consumers’ level of curiosity for food products, and his willingness to try new products. The fifth factor was labelled “Food procurement” and contains two behavioral questions regarding the time spent by the respondent when planning for meals and shopping for food.

Table 13. Rotated Factor Loadings and Unique Variances for Grass Fed Beef Consumers

Variable	Factor1 Nutrition	Factor2 Convenience	Factor3 Price Sensitivity	Factor4 Novelty	Factor5 Food Procurement	Uniqueness
Q9_1				0.8048		0.3108
Q9_2				0.6670		0.3504
Q9_3				0.7475		0.3771
Q9_6	0.588					0.4803
Q9_7			0.8088			0.3283
Q9_8			0.6341			0.5258
Q9_9			0.8242			0.3001
Q9_10		0.8500				0.2728
Q9_12		0.7791				0.3703
Q9_13		0.7066				0.4091
Q9_18	0.6587					0.5295
Q9_23					0.8576	0.209
Q9_24					0.8628	0.2066
Q9_25	0.6559					0.3893
Q9_26	0.8098					0.3095
Q9_27	0.7648					0.3655

Note: Blanks represent loading factors below 0.5.

The six factors identified for general population are shown in Table 14. Dimensions 2, 3 and 4 were common among grass-fed beef consumers and general population. The first factor (Nutrition) for Grass-fed beef consumers is almost similar to the one found for the general

population, with the caveat that the statement from Q9_18 (I avoid salty foods) was not included due to its low factor loading. An additional factor (sixth) was found among the respondents for the general population. The sixth factor was labelled sustainability because this dimension includes statements that emphasize the consumers' interest for sustainability and the protection of the environment. The inclusion of sustainability for general population indicates that sustainability is a relevant issue for consumers that may have consumed grass-fed beef before or not when selecting food products

Table 14. Rotated Factor Loadings and Unique Variances for General Population

Variable	Factor1 Nutrition	Factor2 Convenience	Factor3 Price Sensitivity	Factor4 Novelty	Factor5 Food Procurement	Factor6 Sustainability	Uniqueness
Q9_1				0.8385			0.2614
Q9_2				0.7265			0.3132
Q9_3				0.6894			0.3976
Q9_6	0.5514						0.4363
Q9_7			0.8093				0.3161
Q9_8			0.5985				0.5531
Q9_9			0.8314				0.2841
Q9_10		0.8482					0.2683
Q9_12		0.7789					0.3617
Q9_13		0.6908					0.426
Q9_14						0.6214	0.4684
Q9_20						0.7933	0.3317
Q9_21						0.7715	0.2821
Q9_23					0.8369		0.2392
Q9_24					0.8137		0.2587
Q9_25	0.7184						0.3485
Q9_26	0.8182						0.2795
Q9_27	0.788						0.3139

Note: Blanks represent loading factors below 0.5.

The ratings from the statements were aggregated and averaged for each factor creating a response range of 1-6 for each factor. The ratings for each factor were categorized in three parts. Factor values less or equal to 2 were considered low scores for that factor. This indicates that the

respondent mostly disagrees with the statements on this factor. Factor values above 2 but less or equal to 4 were considered neutral scores for that factor which indicates that the respondent neither agrees nor disagrees with the statements. Factor values over 4 were considered high indicating that overall the participants agree with the statements in this factor. Dummy variables were created to differentiate the effects of high and low factor scores over the consumers' choice.

These values were incorporated as interaction terms in the random parameters logit models to analyze the influence of the consumer's behavioral and attitudinal characteristics over their choice for grass-fed beef. Only the dummy variables that identified high or low values for the factors were included in the interactions. Therefore, neutral level was considered as the reference level. As aforementioned, the random parameters logit models revealed heterogeneous preferences for the attributes type and local. The interaction terms between type, local, and the relevant factors (rated high and neutral) were incorporated in the random parameters logit models for general population and grass-fed beef consumers. Both models were estimated using 2000 Halton draws.

4.4 Results from Random Parameters Logit Model Including Attitudinal and Behavioral Factors for Grass-fed Beef Consumers

Initially, the individual effect of each one of the five factors that represented the grass-fed beef consumers' attitudinal and behavioral characteristics over consumer choice was analyzed by including the factors as alternative specific constants in the random parameters model (Results in the Appendix C.3). Of the five factors relevant to grass-fed beef consumers, only convenience and novelty had a statistically significant influence over the respondent's choice for grass-fed beef products. Therefore, interaction terms between type, local and novelty and convenience (scored as high and neutral) were incorporated in the random parameters logit model and the coefficients for these interactions can be found in Table 15. The model for grass-fed beef

Table 15. Estimates from Random Parameters Logit Model with Consumer's Attitudinal and Behavioral Factor Interactions for Grass Fed Beef Consumers

Coefficient		Estimates	Std. Err.
Alternative	Mean	5.2032***	0.2763
	Std. Dev.	2.9284***	0.2274
Price	Mean	-0.3643***	0.0198
	Std. Dev.	0.3864***	0.0227
Type	Mean	0.6299***	0.0467
	Std. Dev.	0.5083***	0.0469
Grass fed beef with USDA Certification	Mean	-0.1575***	0.0462
	Std. Dev.	0.4082***	0.0685
Grass fed beef without USDA Certification	Mean	-0.4724***	0.0519 ^b
	Std. Dev.	N/A	N/A
Grain fed beef	Mean	0.2559***	0.0472
	Std. Dev.	0.5222***	0.0640
Source	Mean	0.3558***	0.0336
	Std. Dev.	-0.0061 ^a	0.3355
Local	Mean	-0.6118***	0.0524
	Std. Dev.	N/A	N/A
Domestic	Mean	-0.3178***	0.0581
	Std. Dev.	-0.0058 ^a	0.0696
Imported	Mean	0.4789***	0.1040
	Std. Dev.	0.0018	0.1216
Grade	Mean	-0.1611***	0.0555
	Std. Dev.	N/A	N/A
Select	Mean	-0.2393***	0.0699
	Std. Dev.	0.2782***	0.0647
Choice	Mean	0.1151**	0.0545
	Std. Dev.	-0.0900	0.1171
Prime	Mean	-0.0994	0.0735
	Std. Dev.	0.0629	0.0677
Convenience High*GFB with USDA certification		0.0677	0.0573
Convenience Low*GFB with USDA certification		-0.3149**	0.1268
Novelty High*GFB with USDA certification		-0.2360***	0.0754
Novelty Low*GFB with USDA certification		0.3882***	0.0745
Convenience High*GFB without USDA cert.		-0.0143	0.0600
Convenience Low*GFB without USDA cert.		0.0051	0.1335
Novelty High*GFB without USDA certification			
Novelty Low*GFB without USDA certification			
Convenience High*Local			
Convenience Low*Local			
Novelty High*Local			
Novelty Low*Local			
Log likelihood	-6865.26		
Chi squared (8)	679.53		
Prob > Chi squared	0.000		

Notes: Number of respondents: N=1996. Number of Observations = 23,952 (1996 respondents x 3 sets x 4 choices)

*, **, ***. Denotes significance levels at $\alpha = 0.10, 0.05$, and 0.01 percent, respectively

^a The sign of the estimated standard deviations is irrelevant: interpret them as being positive (STATA)

^b Standard errors for "omitted" levels in the effects coding were calculated using the Delta method.

consumers that includes the interactions with the factors convenience and novelty is statistically significant as indicated by the likelihood ratio test. The chi-squared statistic of 679.53 is greater than the critical value for chi-squared with 8 degrees of freedom; therefore, the null hypothesis that all the coefficients are equal to zero is rejected. The log likelihood value for the model that includes the interactions with the attitudinal and behavioral factors (-6865.26) is higher than the log likelihood value from the random parameters model for grass-fed beef consumers that includes interactions with demographics and socioeconomic characteristics (- 6881.19). Therefore, it can be concluded that the inclusion of the interactions with the respondents' ratings in the factors convenience and novelty can bring additional information to identify the sources of preference heterogeneity among participants.

Similarly to what was found in the previous models, grass-fed beef steaks with USDA certification were preferred over grass-fed beef steaks without the certification or grain-fed beef steaks. Domestically produced steaks were preferred over local or imported beef steaks. Choice was the most preferred grade of steaks. The coefficient of the interaction between convenience (High and Low) and grass-fed beef with USDA certification was statistically significant. The coefficient was positive (negative) when the convenience value was high (low), indicating that consumers that use fresh foods and avoid the use of semi-elaborated food products prefer grass-fed beef steaks with USDA certification. In contrast, consumers that prefer ready-to-eat or that value the benefit of using pre-made mixes as a way to save time in the kitchen do not prefer grass-fed beef steaks with USDA certification. The interaction between high scores in novelty and grass-fed beef with USDA certification was positive and statistically significant, whereas the interaction between lower scores in novelty and grass-fed beef without certification was negative. Respondents that like to try new food products prefer grass-fed beef steaks with USDA

certification. On the other hand, participants that are hesitant to try new foods showed a disutility for grass fed beef products without the USDA certification.

The coefficient for the interaction between high values in the convenience factor and local was negative and the coefficient for low convenience values and local was positive. Consumers that prefer to save their time in the kitchen by including ready-to-eat foods, or semi-elaborated food products do not prefer locally produced steaks. Locally produced steaks are preferred by consumers that value fresh food and that are very selective of the ingredients and procedures used to prepare their foods. One of the most important findings from this model is that consumers that value convenience (in terms of reduced time in the kitchen) are less likely to purchase grass-fed beef steaks with USDA certification. Consumers willing to try grass-fed beef products value the presence of the USDA certification, probably as a way to assure the quality of the product.

4.5 Results from Random Parameters Logit Model Including Attitudinal and Behavioral Factors for General Population

As previously mentioned, six factors were identified that summarized the attitudinal and behavioral characteristics of the consumers in the general population sample. Initially, the individual effect of each one of the six factors over consumer choice was analyzed by including the factors as alternative specific constants in the random parameters model (Results in the Appendix C.4). From the six factors, only sustainability and novelty had a statistically significant influence over the respondent's choice for grass-fed beef products. Therefore, interaction terms between type, local, and sustainability and novelty were incorporated in the random parameters logit model and the coefficients for these interactions are shown in Table 16.

The model for the general population that includes the interactions with the factors novelty and sustainability is statistically significant as indicated by the likelihood ratio test. The

Table 16. Estimates from Random Parameters Logit Model with Consumer's Attitudinal and Behavioral Factor Interactions for General Population

Coefficient		Estimates	Std. Err.
Alternative	Mean	6.5791***	0.3396
	Std. Dev.	3.7864***	0.2702
Price	Mean	-0.5387***	0.0265
	Std. Dev.	0.4730***	0.0271
Type			
Grass fed beef with USDA Certification	Mean	0.5408***	0.0511
	Std. Dev.	0.5855***	0.0481
Grass fed beef without USDA Certification	Mean	-0.2944***	0.0519
	Std. Dev.	0.4585***	0.0680
Grain fed beef	Mean	-0.2464***	0.0531 ^b
	Std. Dev.	N/A	N/A
Source			
Local	Mean	0.1894***	0.0484
	Std. Dev.	0.4318***	0.0770
Domestic	Mean	0.4105***	0.0371
	Std. Dev.	-0.0059 ^a	0.1261
Imported	Mean	-0.5999***	0.0538
	Std. Dev.	N/A	N/A
Grade			
Select	Mean	-0.2362***	0.0589
	Std. Dev.	0.0042	0.0885
Choice	Mean	0.3442***	0.1039
	Std. Dev.	0.0191	0.1578
Prime	Mean	-0.1081***	0.0558
	Std. Dev.	N/A	N/A
Novelty High*GFB with USDA certification		-0.0716	0.0600
Novelty Low*GFB with USDA certification		-0.0091	0.1134
Sustainability High*GFB with USDA certification		0.3515***	0.0615
Sustainability Low*GFB with USDA certification		-0.2941**	0.1167
Novelty High*GFB without USDA certification		0.1372**	0.0612
Novelty Low*GFB without USDA certification		0.0236	0.1142
Sustainability High*GFB without USDA cert.		0.1203*	0.0625
Sustainability Low*GFB without USDA cert.		-0.1944*	0.1172
Novelty High* Local		-0.0855	0.0613
Novelty Low* Local		0.1334	0.1178
Sustainability High* Local		0.1427**	0.0631
Sustainability Low* Local		0.0529	0.1183
Log likelihood		-6707.64	
Chi squared (8)		1005.70	
Prob > Chi squared		0.000	

Notes: Number of respondents: N=1996. Number of Observations = 23,952 (1996 respondents x 3 sets x 4 choices)

*, **, ***. Denotes significance levels at $\alpha = 0.10, 0.05$, and 0.01 percent, respectively

^a The sign of the estimated standard deviations is irrelevant: interpret them as being positive (STATA)

^b Standard errors for "omitted" levels in the effects coding were calculated using the Delta method.

chi-squared statistic of 1005.70 is greater than the critical value for chi-squared with 8 degrees of freedom; therefore the null hypothesis that all the coefficients are equal to zero is rejected. The log likelihood value for the model that includes the interactions with the attitudinal and behavioral factors (-6707.64) is slightly lower than the log likelihood value from the random parameters model for grass-fed beef consumers that includes interactions with demographics and socioeconomic characteristics (-6705.63). Nevertheless, since it was found that the ratings in sustainability and convenience influence consumer choice, the inclusion of these interactions might bring additional information to identify the sources of preference heterogeneity among participants.

The findings regarding the steaks attributes were very similar to those indicated in the previous models. Grass-fed beef steaks with USDA certification were preferred over grass-fed beef steaks without the certification or grain-fed beef steaks. Domestically produced steaks were preferred over local or imported beef steaks. Choice was the most preferred grade of steaks. Consumer attitude towards sustainability affects the likelihood of selecting grass-fed beef steaks with USDA certification. The interaction coefficients between high (low) scores in sustainability and grass-fed beef with or without certification were positive (negative) and statistically significant. This indicates that respondents who value the use of sustainable food production practices and the use of recyclable packaging materials expressed a higher utility for grass-fed beef steaks, with the grass-fed beef steaks with USDA certification being the most preferred.

The coefficient of the interaction between high scores in sustainability and local was positive and statistically significant. As expected, consumers that pay more attention to the sustainability surrounding the products that they consume are more likely to buy locally produced beef steaks. For the novelty factor, only the interaction between high scores in novelty

and grass-fed beef steaks without USDA certification was positive and statistically significant. Respondents that enjoy trying new products are more likely to purchase grass-fed beef steaks without the USDA certification.

The findings from this model suggest that sustainability is a factor that can motivate the consumer to purchase grass-fed beef products. Consumers that are interested in food sustainability received a higher utility from locally produced steaks over imported ones. Since the consumer's level of interest in sustainability can have a positive effect on the likelihood of purchase of grass-fed beef steaks with USDA certification, producers and retailers could consider the inclusion of information regarding the use of sustainable practices in grass-fed beef production as a way to promote their products to new consumers.

The marginal willingness to pay for the random parameters logit models with attitudinal and behavioral factor interactions for both groups (grass-fed beef consumers and general population) are shown in Table 17. Overall, respondents place more value on grass-fed beef steaks with USDA certification than on steaks without certification or from grain-fed animals. On average, respondents from the grass-fed beef consumers group are willing to pay more for each one of the product attributes than respondents from the general population sample. Grass-fed beef consumers are willing to pay \$1.73 more per pound for grass-fed beef with USDA certification, whereas on average, respondents from the general population are willing to pay \$1.00 more per pound for the same steak.

Consumers from both groups value domestically produced steaks. Imported steaks have a negative marginal willingness to pay in both groups, indicating that consumers do not value imported steaks. Choice steaks are valued by both groups; however, consumers in the general population are willing to pay half (\$0.63) of the amount that grass-fed beef consumers are

Table 17. Marginal Willingness to pay for Grass Fed Beef Meat Attributes from Random Parameters Logit Models Including Behavioral and Attitudinal Factor Interactions

Attribute Level	Grass-fed Beef Consumers	General Population
Type		
Grass fed beef with USDA certification	1.73*** [1.49 to 1.96]	1.00*** [0.83 to 1.16]
Grass fed beef without USDA cert.	-0.43*** [-0.67 to -0.18]	-0.54*** [-0.73 to -0.37]
Grain fed beef	-1.29*** [-1.57 to -1.02]	-0.46*** [-0.64 to -0.26]
Source		
Local	0.70*** [0.44 to 0.95]	0.35*** [0.18 to 0.53]
Domestic	0.97*** [0.80 to 1.14]	0.76*** [0.63 to 0.89]
Imported	-1.67*** [-1.95 to -1.40]	-1.11*** [-1.30 to -0.92]
Grade		
Select	-0.87*** [-1.20 to -0.54]	-0.44*** [-0.65 to -0.22]
Choice	1.31*** [0.73 to 1.90]	0.63*** [0.25 to 1.02]
Prime	-0.44*** [-0.75 to -0.14]	-0.20* [-0.41 to -0.004]

Note: The confidence intervals were estimated using the Delta method.

*, **, ***. Denotes significance levels at $\alpha = 0.10, 0.05$, and 0.01 percent, respectively

willing to pay for this attribute. Select steaks had a negative marginal willingness to pay of \$0.87 and \$0.44 for grass-fed beef consumers and the general population respectively, indicating that respondents do not value steaks that have low marbling. Since grass-fed beef consumers know the product from previous experience, they are aware that the low fat content in grass-fed beef products has a negative effect over the palatability and tenderness of the product.

Overall, it can be concluded that consumers that have eaten grass-fed beef during the last year are willing to pay more for grass-fed beef steaks that have the USDA certification.

Respondents that have consumed grass-fed beef before are more discriminant and place more value on to the different characteristics of the products. Consumers in both groups value the amount of marbling present in the steak, and Choice steaks are preferred. Since grass-fed beef products have on average less fat content, consumers that have eaten grass-fed beef before are aware of this fact and place more value on the amount of marbling present in the product.

CHAPTER 5: CONCLUSIONS

5.1 Summary

The primary purpose of this research was to determine consumer preferences for attributes present in grass-fed beef products. A national consumer survey was administered online in May 2012. The target population was consumers who had consumed beef meat in the past year and who were at least 18 years of age. A total of 4000 surveys were completed where respondents evaluated three sets of three hypothetical beef steaks. Each set also included an opt-out (no-purchase) option. Information regarding the consumers' lifestyle, belief and attitudes towards food along with their demographic and socioeconomic information was requested. The respondents were divided into two main groups of similar sizes. The grass-fed beef consumers group was comprised of respondents who had consumed grass-fed beef the past year. The rest of the 2000 respondents were included in the general population group. On average, participants in the grass-fed beef consumers group were female, white, 46.93 years old and almost half of them had a Bachelor's or Post-graduate degree. The majority of participants in this group were married, with no children and their average annual income was between \$35,000.00 and \$49,999.00. The four U.S. regions were represented in the sample, with the respondents from the South being the majority at a 33%. Only 8.55% of the respondents indicated Hispanic origin. The majority of grass-fed beef consumers (75.95%) reported that they eat beef at least once a week. The steak is the cut preferred for grass-fed beef and it is frequently consumed at home.

In the general population, the average participant was female and 48.24 years of age. A little over a half of them (51%) indicated that were married and almost three quarters of the respondents indicated that there were no children in the household. On average, participants had at least an Associate's degree with an annual income between \$35,000.00 and \$49,999.00. The majority of respondents were white (81%) and resided in the southern states. Around 60% of

participants in the general population sample indicated that they consumed grass-fed beef the past year; and on average they consume beef at least once a week. On average, grass-fed beef steaks were consumed more often than grass-fed beef ribs, hamburgers or cubes by all the participants. Whereas grain-fed beef hamburgers were consumed more often than grain-fed beef steaks, ribs or cubes. When looking at the last 10 times that any meat or seafood product was consumed, the respondents in the grass-fed consumers (general population) group reported that they ate grass-fed beef more (less) often than grain-fed beef. Based on the analysis of the consumers' understanding of the term "grass-fed beef", it can be said that there is an over-reporting of the consumption of grass-fed beef. For the majority of respondents (more than 50%), cattle that are raised and grazed on open pastures are considered grass-fed beef. But, less than 10% of the respondents indicated that cattle that are never fed grains are considered grass-fed beef. The respondents associate the idea of cattle grazing on pastures to grass-fed beef production, but in reality the majority of the cattle that is raised on pastures will go to a feedlot to be finished with grain.

5.2 Procedures

The conditional logit model is usually considered the starting point for discrete choice analysis. The conditional logit model assumes that there is homogeneity in consumer preferences. The random parameters logit relaxes the IIA assumption and allows the detection of heterogeneity in the population. The random parameters logit model was selected because one of the objectives of the study was to investigate the potential differences that the product attributes can have over consumer preferences. The random parameters logit (RPL) model gives the researcher the flexibility to assign the distribution pattern for the explanatory variables. Since the interest of this study was to identify the positive or negative effect of each variable over consumer choice, the normal distribution was selected.

The random parameters logit model was estimated for both groups (general population and grass-fed beef consumers). Initially, only the product attributes were considered as explanatory variables in order to determine the relative importance of each one of the product characteristics in the consumer's choice. Preference heterogeneity was found among the respondents for the attributes type (grass-fed beef with and without USDA certification) and local. Therefore, the respondents' characteristics were also incorporated in the analysis. Later, consumers' demographic and socioeconomic characteristics and geographic location were included as interactions in the model to identify the possible sources of heterogeneity. The analysis of the log likelihood values revealed that the random parameters models that included the interaction variables did a better job fitting the data.

Factor analysis was used to identify the dimensions of the consumer's behavior, beliefs and attitudes toward food. The consumers' scores on these factors were included as interaction variables in the discrete-choice model to analyze the influence of these dimensions over the consumer's preference for grass-fed beef products. The analysis of the log likelihood values revealed that the random parameters models that included the consumers' attitudinal and behavioral interaction variables did a good job fitting the data. The inclusion of demographic, attitudinal and behavioral variables provided a better understanding about how the consumers value the different attributes of the grass-fed beef products. Also, it provides information about the profile of the consumer that is more likely to purchase grass-fed beef products.

5.3 Findings

5.3.1 Grass-fed Beef Consumers

Overall, price was the most important attribute to grass-fed beef consumers. The results from the models suggest that grass-fed is preferred over grain-fed beef, with grass-fed beef with USDA certification being the most preferred. Steaks produced in the U.S. are preferred over

imported, and when considering grade, Choice steaks are preferred. These differences were also expressed in their marginal willingness to pay values, indicating that consumers are willing to pay \$1.91 more per pound of grass-fed beef steak with USDA certification. Respondents were willing to pay \$1.40 more per pound for Choice steaks and almost one dollar (\$0.96) more per pound for steaks domestically produced. Consumers in this group valued more the amount of marbling present in the steak than its origin. Since all the grass-fed beef consumers had already eaten grass-fed beef, this difference can be explained due to the fact that consumer is more interested in a grass-fed beef steak with the adequate amount of marbling. The amount of marbling present in the cut of meat has a direct influence over the palatability and juiciness of the product. Overall, grass-fed beef products have less fat than grain-fed beef products. The low fat content has a negative influence over the tenderness and juiciness of the product. At the same time, the amount of fat present in the Prime steaks might dissuade some of them from buying the product.

The random parameters model that included the interactions with the consumers' demographic characteristics showed that the USDA certification is a determinant factor for women when purchasing grass-fed beef steaks. Female consumers prefer grass-fed beef steaks with the USDA certification but have a negative utility for steaks without USDA certification regardless of whether they come from grass-fed or grain-fed animals. The USDA certification was also a determinant factor for older consumers. Older respondents had a greater preference for grass-fed beef steaks with USDA certification. The absence of it provided a negative utility for them. Older and female consumers indicated strong preferences for locally produced steaks. This could indicate that female and older consumers are confident and value the U.S. beef production system and the USDA certification brings an extra assurance of the quality of the

product. The ideal grass-fed beef product for females and older consumers would be a steak produced in the U.S. with the USDA certification. The USDA certification is the attribute for which they are willing to pay the most (\$1.91 more per pound).

From the factor analysis, five common dimensions were identified among the respondents' lifestyle, beliefs and attitudes toward food for grass-fed beef consumers. The five factors were labelled nutrition, convenience, price sensitivity, novelty and food procurement. All the factors were included in the preliminary analysis, but only convenience and novelty had a statistically significant influence over consumer choice. The factor nutrition did not have a statistically significant influence over consumer choice. Respondents that scored high on the nutrition factor value lower calorie foods, are weight conscious and frequently read the nutrition labels when buying a food product. The estimate for the interaction between the alternative specific constant and the nutrition factor was negative, but not statistically significant. It can be hypothesized that consumers that are weight conscious are less likely to purchase any of the products offered.

The interactions of convenience and novelty with type and local were statistically significant. Respondents that scored low (high) on the convenience dimension were more (less) likely to purchase grass-fed beef with USDA certification. Consumers that scored low (high) on the convenience dimension were more (less) likely to purchase locally produced steaks. The convenience dimension dealt with the amount of time that the consumer is willing to spend preparing his food and the use of fresh products. Respondents that scored high in this dimension value the use of ready-to-eat meals and prefer to use mixes and semi-elaborated products that save time in the kitchen. These findings suggest that grass-fed beef steak consumers are very selective at the moment of choosing their food products and the preparation of their foods.

Consumers that pay special attention to the ingredients they use in the kitchen are more likely to buy grass-fed beef products. Locally produced steaks are also preferred for these consumers. The novelty factor indicates the willingness of the respondent to try new food products. High scores in novelty correspond to respondents that can be considered food enthusiasts, or are simply curious about new foods. The analysis revealed that consumers that are willing to try new products are more likely to buy grass-fed beef with USDA certification. On the other hand, grass-fed beef consumers that are hesitant to try new food products receive a disutility from grass-fed beef steaks without USDA certification. Since all the respondents have already consumed grass-fed beef before, it can be said that they are more selective and recognize that grass-fed beef steaks demand time and special attention during their preparation in the kitchen. The marginal WTP analysis showed that grass-fed beef consumers were willing to pay more for grass-fed beef steaks with USDA certification. Consumers also value steaks produced in the U.S. more than imported steaks.

5.3.2 General Population

Price was the most important attribute for consumers in the general population group. Consumers in the general population place a higher importance on price (57%) than grass-fed beef consumers when selecting a product. It suggests that given the importance of price for the general population, this factor is the most determinant for a consumer's decision to purchase the product for the first time. On average, the origin of the product is considered more important than the production system for these respondents. The basic random parameters model (no interactions) showed that grass-fed beef with USDA certification was preferred over grain fed-beef or grass-fed beef steaks without certification. The analysis of the attributes source and grade revealed that domestic and Choice steaks were preferred, similar to the findings for grass-fed

beef consumers. The model showed preference heterogeneity across the respondents for grass-fed beef with and without USDA certification and for local.

Grass-fed beef with USDA certification had the highest marginal WTP value at \$1.13 per pound. Grass fed beef consumers placed a higher value (\$1.91 per pound) for a steak with similar characteristics. The respondents from both groups expressed that Domestic and Choice steaks were the most preferred levels of each attribute. However, on average, consumers in the general population indicated lower WTP's for domestic and Choice steaks than grass-fed beef consumers. This suggests that consumers that have consumed the product before place a higher value on the different attributes of the product. Previous experience is a determinant factor when evaluating the price of a grass-fed beef product.

Price was the most important attribute to respondents in both groups, general population and grass-fed beef consumers. Lin (2013), on the other hand, found that the type of feeding system had the most influence in consumer's choice. This difference can be explained due to the methodologies used for each study. In Lin's study (2013), the respondents were asked to rate 10 steaks individually. The present study was analyzed using a choice-based model in which the respondent was asked to select a product from a set of products based on his preference. Choice-based models are preferred because they can better simulate the actual purchasing process in a competitive setting (Orme, 2006). Louviere, et al. (2010) explains that choice-based models are better suited to explain preferences because they are based on consumer behavior theory. CBC models are more versatile because they take into consideration a random component that allows them to account for the different stages of the decision making process. Ranking and rating scales, commonly used in traditional conjoint analysis, are more restrictive and they generally consider only the final outcome of the decision making process.

The general population valued the origin of the product more than the Grade of the product. On the other hand, grass-fed beef consumers valued Grade over origin. Clark (2007) found that the amount of marbling has a positive effect over the premium that the consumer is willing to pay for grass-fed beef products. This suggests that the amount of marbling is very important for a consumer that had the product before, which means the amount of marbling influences the repeat purchase of the product. This suggests that consumers that are likely to buy the product for the first time might not pay much attention to the marbling of the product. But since the amount of marbling influences the overall palatability of the product, first-time buyers that acquire a product with low levels of marbling might be discouraged to buy it again because they might be dissatisfied after tasting it due to its low juiciness and palatability. In terms of origin, respondents from both groups preferred domestically or locally produced steaks over imported. This finding was also reported by Lin (2013).

The random parameters model that included the interaction with the consumers' demographic and socioeconomic characteristics revealed that Females are more likely to purchase grass-fed beef steaks with USDA certification. Locally produced steaks were also preferred by female consumers. These findings resemble the results for grass-fed beef consumers. In general, female consumers expressed preference for steaks produced in the U.S. with the USDA certification, which indicates the confidence that female consumers have on the U.S. beef production industry and the USDA certification for grass-fed beef. These findings are consistent with the results found by Clark (2007) and Fields, et al. (2006) in which females expressed a higher utility for grass-fed beef products. Older consumers prefer locally produced steaks and perceive a disutility from grass-fed beef steaks that do not have the certification.

Older consumers value locally produced beef steaks but they prefer not to buy grass-fed beef steaks without the USDA certification.

The factor analysis identified six common dimensions among the respondents' lifestyle, beliefs and attitudes toward food for general population. The five factors found for grass-fed beef consumers were also identified for general population, with sustainability as the additional factor. Based on the findings from the preliminary analysis, only convenience and sustainability had a statistically significant influence over the respondent's choice. Nutrition did not have a statistically significant influence over the respondents' choice. This finding is similar for both groups, grass-fed beef consumers and general population. The estimate for the interaction between the alternative specific constant and the nutrition factor was negative, but not statistically significant. The consumer's interest in weight management or leaner food products does not affect his choice for grass-fed or grain-fed beef products. Previous research (Duckett, et al., 2009) has shown that grass-fed beef has less total fat with greater contents of Omega-3 fatty acids, B-vitamins, and vitamins E and A (beta carotene) than grain-fed beef. Xue, et al. (2010) found that the consumer's awareness about the health and nutritional benefits of grass-fed beef products increases the consumer's preference and marginal willingness-to-pay. Therefore, it can be hypothesized that the consumer is not aware of these characteristics when selecting a beef product. Xue, et al. (2010) found that the display of information about the benefits of grass-fed beef products at the point of sale increases their preference among consumers.

Some of the interactions between novelty and sustainability with type and local were statistically significant. Respondents that scored high (low) on sustainability were more (less) likely to purchase grass-fed beef in general regardless of the USDA certification. Consumers that scored high on sustainability were more likely to purchase locally produced steaks. Consumers

that scored high in sustainability value the use of recycling materials in their food products, and are willing to change or try food products obtained from environmentally friendly production systems. Consumers that care for sustainability issues are more likely to purchase locally produced grass-fed beef products. This finding suggests that the sustainability component could be included as a characteristic to promote the product to new consumers. Clark (2007), Gwin, et al. (2012) and Umberger, et al. (2009) also found that information about animal welfare and sustainability can have a positive effect over the consumer's willingness-to-pay for grass-fed beef products. Retailers can identify groups of consumers interested in sustainability as potential market niches for domestically produced grass-fed beef products.

The comparison between the marginal WTPs from grass-fed beef consumers and general population shows that on average, grass-fed beef consumers place more value on the attributes of the grass-fed beef steaks. Choice steaks are valued by both groups, nevertheless grass-fed beef consumers are willing to pay more (almost double) for them. The differences in the marginal WTPs for the grade attribute across the groups suggest that the amount of marbling is more valued by consumers that have already consumed the product. Domestically produced steaks were valued over imported steaks by both groups of participants, which indicates a clear preference and confidence on the U.S. beef industry.

5.4 Implications

This research contributes to the literature on consumers' preferences for grass-fed beef products. U.S. per capita beef consumption has been steadily declining during the last 10 years as shown in Figure 1. Consumers are more aware of the risks and benefits of their food choices and therefore pay more attention to what they eat, as well as the practices involved in the production of their foods. Producers, processors and retailers have seen the introduction of quality differentiated beef products as a way to open and develop new niche markets for their products.

In general, grass-fed beef products have been considered healthier alternatives by the consumer due to the overall low fat content and because their high levels of omega-3s and 6s. Even though there is a disconnection between the consumer's meaning of grass-fed beef production and the actual characteristics of this production system, the consumer prefers grass-fed beef over grain-fed beef products. But there are other attributes, such as origin and physical characteristics that the consumer also considers when selecting a meat product. The USDA has also introduced a certification system for grass-fed beef as a way to provide differentiation for these products. The findings of this study suggest that there is a clear preference for grass-fed beef products with USDA certification. Females, who are usually the primary grocery shopper in the household, expressed a clear preference for grass-fed beef products with USDA certification. This is consistent with the results from the studies by Clark (2007) and Fields, et al. (2006). Products with these characteristics were also preferred by older consumers. Overall, the USDA certification is characteristic that increases the consumer's perceived utility of the product. The results showed that consumers value grass-fed beef products with the USDA certification over those that were not certified. Therefore, it would be beneficial for the industry to motivate producers using this production system to participate in the certification program.

Consumer preference for domestic or local products over imported was a clear expression of their confidence in the U.S. beef production industry. The willingness to pay revealed a strong preference for Choice steaks, whereas Select steaks were the least preferred. Since grass-fed beef has a low fat content when compared to grain-fed beef, producers should focus on using breeds that can provide the amount of marbling and fat desired by the consumer.

The analysis also showed that sustainability, novelty and convenience are consumer's attitudinal and behavioral characteristics that affect their choice for grass-fed beef products.

Retailers might consider incorporating the benefits for the environment of grass-fed beef production in their promotional campaigns as a way to attract potential new consumers. The consumer interest for sustainability and willingness to try new products can be used to segment consumers and identify potential market niches for grass-fed beef products.

The convenience factor indicated that respondents view grass-fed beef products as products that require more preparation-time in the kitchen. Retailers and processors might consider including grass-fed beef products in ready-to-eat meals as a way to attract consumers that are looking for food products that can save them time in the kitchen. Nutrition, or the consumer's interest in food composition and weight control did not affect their choice for beef products. Overall, the findings of this study suggest that the consumer expressed strong preference for grass-fed beef products. The USDA certification is valued by the consumer and certified grass-fed beef products are preferred over grass-fed beef products without certification. U.S. grass-fed beef products were valued over imported products.

5.5 Limitations and Future Research

The consumers' misperception about grass-fed beef production led to an over reporting in the frequency of consumption of grass-fed beef products. Prior to the conjoint analysis, the participants were exposed to information regarding the actual characteristics of the grass-fed production system, which may have reduced the prior misperception of the consumer and influenced their answers in benefit of the grass-fed beef products. Participants evaluated each product based on the visual information provided by the picture of the product and the description of its characteristics. Participants did not have physical contact with or taste the product, which might have influenced their purchasing decision. The survey was administered online which limited our sample to respondents that had internet access.

From the survey, it was clear that there is a disconnection between the actual meaning and what the consumer understands as “grass-fed beef” production. Future research should consider the level of knowledge that the consumer has about grass-fed production systems before and after participating in the survey. Tasting could also be included as part of the sample evaluation process. The survey could also be administered via mail, phone and in person to reach a larger population and to gather the information and preferences from a representative sample of the U.S. population.

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**APPENDIX A: GRASS-FED BEEF SURVEY – STUDY OF CONSUMER ATTITUDES
AND CONSUMPTION BEHAVIOR OF FORAGE FED BEEF**

PN: Group number=10; n=2000

US respondents 18 or older that have eaten grass fed beef in the past year

S1>18 and S7=yes

PN: Group number=20; n=2000

US respondents 18 or older who eat any type of beef

S1>18 and S4=codes 2-6

S1. Please indicate your age. <min 16><max 99> (Type in a whole number)

S2. What is your gender? (Select One)

Male

Female

S3. Please indicate the highest level of education you have completed. (Select One)

Grade School

Some High School

Graduated High School

Some College-no degree

Graduated College –Associate’s Degree (2 years)

Graduated College- Bachelor’s Degree (4 years)

Post Graduate Degree

S4. How often do you eat beef? (Select One)

Never

1-11 times per year

1-3 times a month

Once a week

2-3 times a week

More than 4 times a week

S6. Which of the following statements best describes what the term “grass-fed beef” mean to you?
(Select one)

<Randomize>

Cattle that are raised and grazed on open pasture

Cattle that are finished on grass, but not necessarily raised on a pasture

Cattle that are raised organically

Cattle that are raised naturally

Cattle that are never fed grains

PN: Show the text below with S7.

Please use the following definitions in responding to the remaining questions on this survey.

Grain fed beef is the most common way beef is produced in the United States. It means that animals are fed a grain-based feed (primarily corn) in a feedlot during the final 90 - 180 days before slaughter.

Grass fed beef means that cattle are fed grass and forage for the lifetime of the animal, with the exception of milk consumed prior to weaning. Animals are not fed grain or grain byproducts and must have continuous access to pasture during the growing season.

S7. Have you eaten grass fed beef in the past year? (Select one)

Yes

No

Term if: S1 <18 years old or

Term if: Group number=10 and S7=No or

Term if: Group number=20 and S4=Never

S8. Based on your answers to the previous questions, you qualify for our survey.

1. To the best of your memory, of the last 10 times you ate any kind of meat or seafood, how often did you eat? (Please enter a number for each item) <min 0><max 10>

Times ate grass fed beef _____

Times ate grain fed beef _____

Times ate chicken _____

Times ate pork _____

Times ate seafood _____

Last 10 Occasions I ate meat or seafood (PN: Must add to 10)

Ask if: Q1 "Grass fed beef">0

2a. To the best of your memory, of the last 10 times you ate grass fed beef, how often did you eat it at home versus at a restaurant? (Please enter a number for each item) <min 0><max 10>

Times ate grass fed beef at home _____

Times ate grass fed beef at a restaurant _____

Last 10 Occasions I ate beef (PN: Must add to 10)

Ask if: Q1 "Grass fed beef">0

2b. To the best of your memory, when you ate grass fed beef at home, which of the following best describes where you purchase the beef most often? (Select one)

PN: add a button with Grass-fed beef definition

Locally owned grocery store

National grocery chain – Ex: Albertson, Kroger, Super Value, Winn Dixie, Safeway Giant Eagle

Supercenter grocery store – Ex: Walmart, Target
Club store - Ex: Sams, Costco
Natural food stores- Ex: Whole Foods
Internet or mail – Ex: Omaha Steaks, Local Grass Fed Producer website
Specialty meat shop
Directly from the producer/processor location
Other, please specify

Ask if: Q1 “Grass fed beef”>0

3. Which cuts of grass fed beef do you eat most often? (Select one)

PN: add a button with grass-fed beef definition
Steak
Roast
Ribs
Hamburger
Beef Cubes

Ask if: Q1 “Grass fed beef”>0

4a. Where do you typically get information about foods that you eat? (Select all that apply)

Television shows about food
News stories about food
Book about foods/cook books
Food magazines
The internet
Other, please specify

Ask if: Q1 “Grass fed beef”>0

4b. Where did you learn about grass fed beef? (Select all that apply)

Television shows about food
News stories about food
Book about foods/cook books
Food magazines
The internet
Heard about it from a friend
Just part of my culture
Other, please specify

Ask if: Q1 “Grass fed beef”>0

5. To the best of your memory, of the last 10 times you ate grass fed beef, how often were you sure it was 100% grass fed? (Please enter a number for each item) <min 0><max 10>

PN: add button for Grass Fed Beef Definition

Times ate beef I knew was 100% grass fed _____

Times ate beef I didn’t know how it was produced _____

Last 10 Occasions I ate beef

(PN: Must add to 10)

The questions that follow request information about your consumption and attitudes regarding grain fed beef. Please use the following definition when considering your responses:

Grain fed beef is the most common way beef is produced in the United States. It means that animals are fed a grain-based beef (primarily corn) in a feedlot during the final 90 – 180 days before slaughter.

Ask if: Q1 “Grain fed beef”>0

- 6a. To the best of your memory, of the last 10 times you ate grain fed beef, how often did you eat it at home versus at a restaurant? (Please enter a number for each item) <min 0><max 10>

Times ate grain fed beef at home _____

Times ate grain fed beef at a restaurant _____

Last 10 Occasions I ate beef

(PN: Must add to 10)

Ask if: Q1 “Grain fed beef”>0

- 6b. To the best of your memory, when you ate grain fed beef at home, which of the following best describes where you purchase the beef most often? (Select one)

Locally owned grocery store

National grocery chain – Ex: Albertson, Kroger, Super Value, Winn Dixie, Safeway Giant Eagle

Supercenter grocery store – Ex: Walmart, Target

Club store- Ex: Sams, Costco

Natural food stores- Ex: Whole Foods

Internet or mail – Ex: Omaha Steaks, Local Grass Fed Producer website

Specialty meat shop

Directly from the producer/processor location

Other, please specify

Ask if: Q1 “Grain fed beef”>0

7. Which cuts of grain fed beef do you eat most often? (Select one)

Steak

Roast

Ribs

Hamburger

Beef Cubes

PN: Ask all respondents

8. Please read the following statements carefully and indicate the response that best reflects your opinion, where 6 indicates strongly agree and 1 indicates strongly disagree.

[BANNER]

1= Strongly disagree

2

3

4

5

6= Strongly agree

[STATEMENTS] <RANDOM>

There are no real nutritional differences between grass-fed and grain-fed beef

Grass-fed beef is healthier for people to eat than grain-fed beef

Grass-fed beef is produced in a more environmentally friendly way than grain-fed beef

Grass-fed beef is produced without antibiotics

Grass-fed beef is produced in a way that is better for the animal's welfare

Grass-fed beef tastes different from grain-fed beef

Grass-fed beef tastes better than grain fed-beef

Grass-fed beef is produced locally

Grass-fed beef is more tender and juicier than grain-fed beef

Grass-fed beef has "healthier" fat than grain-fed beef

Grain fed beef is the most common way beef is produced in the United States. It means that animals are fed a grain-based feed (primarily corn) in a feedlot during the final 90 - 180 days before slaughter.

Grass fed beef means that cattle are fed grass and forage for the lifetime of the animal, with the exception of milk consumed prior to weaning. Animals are not fed grain or grain byproducts and must have continuous access to pasture during the growing season.

***** Insert Conjoint Instructions and Design here *****

Consumer lifestyle, beliefs, and attitudes – client only

9. Please read the following statements carefully and indicate the response that best reflect your opinion, where a 6 indicates strongly agree and 1 indicates strongly disagree.

[BANNER]

1= Strongly disagree

2

3

4

5

6 = Strongly agree

[STATEMENTS] <RANDOM>

- Q9_1 I am the kind of person who would try any new product once.
- Q9_2 When I see a new product on the shelf, I often buy it just to see what it's like.
- Q9_3 I like the challenge of doing something I have never done before.
- Q9_4 I have at least one meal away from home per day.
- Q9_5 Information about food ingredients is important.
- Q9_6 I always read and compare food nutrition labels when buying food.
- Q9_7 I notice when prices on food I buy change.
- Q9_8 I look for coupons in the newspaper and plan to take advantage of them when I go shopping.
- Q9_9 I find myself checking prices in the grocery store even for small items.
- Q9_10 I use a lot of ready-to-eat foods in my household.
- Q9_11 Fresh whole foods account for a large part of the food products I use in my household.
- Q9_12 Frozen foods account for a large part of the food products I use in my household.
- Q9_13 I use a lot of mixes, for instance, baking mixes and powdered soups.
- Q9_14 I try to avoid food products with food additives.
- Q9_15 I exercise regularly.
- Q9_16 I often eat fresh fruits and vegetables.
- Q9_17 I eat red meat only in moderation.
- Q9_18 I avoid salty foods.
- Q9_19 I have regular medical check-ups.
- Q9_20 I prefer using products with recyclable packaging.
- Q9_21 I have switched food products for ecologically-friendly reasons.
- Q9_22 I try to balance my time between work and my private life.
- Q9_23 Planning for meals takes quite a bit of my time.
- Q9_24 Shopping for food takes quite a bit of my time.
- Q9_25 I eat diet foods at least one meal a day.
- Q9_26 I buy lower calorie foods.
- Q9_27 I am careful about eating certain foods and beverages to control my weight.

Demographics

D1. In which state of the U.S. do you live? (Select one)
[PN: insert state drop down list]

D2. What is your current marital status? (Select one)
Married
Single
Widowed
Divorced
Separated

D3. How many children under the age of 18 years are living in the home with you? (Select one)

0

1

2

3

4

5 or more

D4a. In which of the following groups would you place yourself? (Select one)

White or Caucasian

Black or African American

Asian

Pacific Islander

Native American or American Indian

Some other group

Prefer not to answer

D4b. Are you of Hispanic or Latino origin? (Select one)

Yes

No

Prefer not to answer

Ask If: D4b = yes

D4c. Which of the following best describes you? (Select one)

Moved to the United States with parents before you were a teenager

Born in the United States, but your parents were born in another country

Both you and your parents were born in the United States

Ask If: D4b = yes

D4d. Which of the following best describes your families' origins? (Select one)

Central America

North America

South America

Europe

Other, please specify

Ask If: D4a = Asian or Pacific Islander

D4e. Which of the following best describes you? (Select one)

Moved to the United States with parents before you were a teenager

Born in the United States, but your parents were born in another country

Both you and your parents were born in the United States

Ask If: D4a = Asian or Pacific Islander

D4d. Which of the following best describes you families' origins? (Select all that apply)

- China
- Japan
- Korea
- Southeast Asia
- Pacific Islander
- Other, please specify

D5. Which of the following best describes your annual income? (Select one)

- Less than \$10,000
- \$10,000- \$14,999
- \$15,000 - \$24,999
- \$25,000 - \$34,999
- \$35,000 - \$49,999
- \$50,000 - \$74,999
- \$75,000 - \$99,000
- \$100,000 - \$149,999
- \$150,000 - \$199,999
- \$200,000 or more
- Prefer not to answer

APPENDIX B: CONJOINT ANALYSIS – INSTRUCCIONES AND DESIGN

Product types:

Please take some time to review the information below and when you are finished proceed to the next screen.

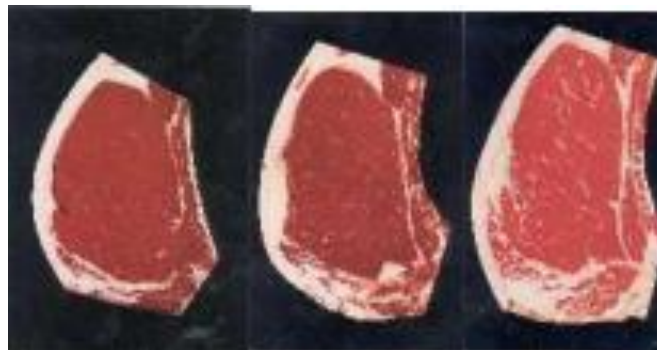
- Grain fed beef refers to the most common way beef is produced in the United States. Animals are fed a grain-based feed (primarily corn) in a feedlot during the final 120-160 days before slaughter.
- Grass fed beef means that cattle are fed only grass and other forage for their entire lifetime, with the exception of milk consumed prior to weaning. Animals are not fed grain or grain byproducts and must have continuous access to pasture during the growing season.
- Grass fed USDA means beef is produced under an auditing program provided by the United States Department of Agriculture (USDA), which certifies that cattle labeled as grass fed strictly adhere to the definition provided above. The program is voluntary and the cattle producer must pay a fee to participate.
- Grass fed without USDA means the beef is produced without the USDA certification. Adherence to the definition provided above is based solely on the reputation of the cattle producer.

Source:

- Local means the animals were produced and processed within 200 miles of where the meat is sold.
- Domestic means the animals were produced and processed in the continental United States, but not necessarily within 200 miles of where the meat is sold.
- Imported means animals were produced and processed outside the continental United States.

Grade:

Three grades appear in the hypothetical products listed in the upcoming screens – Prime, Choice and Select. Differences in grade are determined by the amount of “marbling” found in the meat, which reflects the amount of fat in the meat (i.e., white tissue seen in the meat). The following photographs show Select, Choice and Prime grades.



Select

Choice

Prime

I. Choice Experiment Section

In the questions that follow, you will be given 3 hypothetical sets of beef steaks to compare. All steaks are identical except for product type, source of production, grade and price. Imagine you are choosing one of the three steaks as they are presented, but keep in mind you also have the option of not purchasing either steak. Please be sure to take into account the product type, the product's source of production, the product's grade, and the price when making your choice. Remember that any purchase will reduce your income available to buy other products for you or your family.

PN: Randomly select 3 cards without replacement from the first 9 listed in the conjoint rating section and arrange into 3 sets. Present each set sequentially to the respondent until all three sets have been evaluated. Be sure to provide the respondent with a choice of not purchasing either card within each set.

Choice Set 1

Product A	Product B	Product C	I would not purchase either product
Product Type: Grass fed with USDA certification Source: Local USDA Grade: Prime Price: \$7.99 per pound	Product Type: Grass fed without USDA certification Source: Import USDA Grade: Prime Price: \$4.99 per pound	Product Type: Grain fed Source: Local USDA Grade: Select Price: \$4.99 per pound	

Which product would you purchase: Product A, Product B, Product C, or no purchase?

Choice Set 2

Product A	Product B	Product C	I would not purchase either product
Product Type: Grass fed without USDA certification Source: Domestic USDA Grade: Select Price: \$7.99 per pound	Product Type: Grass fed with USDA certification Source: Import USDA Grade: Select Price: \$2.99 per pound	Product Type: Grain fed Source: Domestic USDA Grade: Prime Price: \$2.99 per pound	

Which product would you purchase: Product A, Product B, Product C, or no purchase?

Choice Set 3

Product A	Product B	Product C	I would not purchase either product
Product Type: Grain fed Source: Import USDA Grade: Choice Price: \$7.99 per pound	Product Type: Grass fed with USDA certification Source: Domestic USDA Grade: Choice Price: \$4.99 per pound	Product Type: Grass fed without USDA certification Source: Local USDA Grade: Choice Price: \$2.99 per pound	

Which product would you purchase: Product A, Product B, Product C, or no purchase?

APPENDIX C: ESTIMATES FROM RANDOM PARAMETERS LOGIT MODELS WITH ALTERNATIVE SPECIFIC INTERACTIONS

Table C.1. Estimates from Random Parameters Logit Model with Alternative Specific Demographic Interactions for Grass Fed Beef Consumers

Coefficient		Estimates	Std. Err.
Alternative	Mean	6.4637***	0.6409
	Std. Dev.	2.7962***	0.2209
Price	Mean	-0.3566***	0.0197
	Std. Dev.	0.3852***	0.0233
Type			
Grass fed beef with USDA Certification	Mean	0.6802***	0.0377
	Std. Dev.	0.5271***	0.0524
Grass fed beef without USDA Certification	Mean	-0.1541***	0.0379
	Std. Dev.	-0.4185*** ^a	0.0741
Grain fed beef	Mean	-0.5261***	0.0391 ^b
	Std. Dev.	N/A	N/A
Source			
Local	Mean	0.2946***	0.0353
	Std. Dev.	0.5408***	0.0659
Domestic	Mean	0.3419***	0.0344
	Std. Dev.	0.0864	0.2848
Imported	Mean	-0.6364***	0.0426
	Std. Dev.	N/A	N/A
Grade			
Select	Mean	-0.3316***	0.0579
	Std. Dev.	-0.0044 ^a	0.0695
Choice	Mean	0.4933***	0.1036
	Std. Dev.	0.0004	0.1208
Prime	Mean	-0.1617***	0.0553
	Std. Dev.	N/A	N/A
Female*ab		-0.9823***	0.2342
Age*ab		-0.0229***	0.0077
Married*ab		-0.1052	0.2497
Children under 18 years of age*ab		0.3004	0.2651
College Degree*ab		0.1004	0.2378
White*ab		0.0495	0.3087
Hispanic*ab		-0.4218	0.4131
Midwest*ab		0.0298	0.3503
South*ab		-0.2745	0.3268
West*ab		-0.0837	0.3490
Income 35K-74.9K*ab		0.3313	0.2831
Income 75K-99.9K*ab		0.0995	0.3662
Income 100K-149.9K*ab		0.9177**	0.4140
Income 150K and up*ab		0.3094	0.4941

(Table C.1. continued)

Coefficient	Estimates	Std. Err.
Log likelihood	-6895.44	
Chi squared (8)	661.41	
Prob > Chi squared	0.000	

Notes: Number of respondents: N=1996. Number of Observations = 23,952 (1996 respondents x 3 sets x 4 choices)

*, **, ***. Denotes significance levels at $\alpha = 0.10, 0.05$, and 0.01percent, respectively

ab Denotes the alternative specific constant "Alternative"

^a The sign of the estimated standard deviations is irrelevant: interpret them as being positive (STATA)

^b Standard errors for "omitted" levels in the effects coding were calculated using the Delta method.

Table C.2. Estimates from Random Parameters Logit Model with Alternative Specific Demographic Interactions for General Population

Coefficient		Estimates	Std. Err.
Alternative	Mean	7.2788***	0.7594
	Std. Dev.	3.6032***	0.2621
Price	Mean	-0.5436***	0.0268
	Std. Dev.	0.4804***	0.0271
Type			
Grass fed beef with USDA Certification	Mean	0.6181***	0.0410
	Std. Dev.	0.6188***	0.0481
Grass fed beef without USDA Certification	Mean	-0.2199***	0.0400
	Std. Dev.	0.4885***	0.0665
Grain fed beef	Mean	-0.3982***	0.0405 ^b
	Std. Dev.	N/A	N/A
Source			
Local	Mean	0.2243***	0.0365
	Std. Dev.	0.4460***	0.0763
Domestic	Mean	0.4156***	0.0373
	Std. Dev.	-0.0139 ^a	0.1241
Imported	Mean	-0.6399***	0.0443
	Std. Dev.	N/A	N/A
Grade			
Select	Mean	-0.2344***	0.0590
	Std. Dev.	0.0055	0.0864
Choice	Mean	0.3376***	0.1042
	Std. Dev.	0.0264	0.1545
Prime	Mean	-0.1032***	0.0559
	Std. Dev.	N/A	N/A
Female*ab		-1.2442***	0.2931
Age*ab		-0.0419***	0.0092
Married*ab		0.2922	0.3115
Children under 18 years of age*ab		1.4351***	0.3774
College Degree*ab		0.1261	0.2841
White*ab		1.0992***	0.3671
Hispanic*ab		0.1214	0.6127
Midwest*ab		0.2488	0.4333
South*ab		0.0583	0.3920
West*ab		0.0672	0.4219
Income 35K-74.9K*ab		0.6563**	0.3291
Income 75K-99.9K*ab		1.1685**	0.4964
Income 100K-149.9K*ab		1.0901**	0.5419
Income 150K and up*ab		0.9395	0.6895
Log likelihood	-6705.69		
Chi squared (8)	975.87		
Prob > Chi squared	0.000		

Notes: Number of respondents: N=1996. Number of Observations = 23,952 (1996 respondents x 3 sets x 4 choices)

*, **, ***. Denotes significance levels at $\alpha = 0.10, 0.05$, and 0.01 percent, respectively

ab Denotes the alternative specific constant “Alternative”

^a The sign of the estimated standard deviations is irrelevant: interpret them as being positive (STATA)

^b Standard errors for “omitted” levels in the effects coding were calculated using the Delta method.

Table C.3. Estimates from Random Parameters Logit Model with Alternative Specific Behavioral and Attitudinal Factor Interactions for Grass Fed Beef Consumers

Coefficient		Estimates	Std. Err.
Alternative	Mean	2.7233***	0.6943
	Std. Dev.	2.8028***	0.2194
Price	Mean	-0.3584***	0.0198
	Std. Dev.	0.3888***	0.0233
Type			
Grass fed beef with USDA Certification	Mean	0.6839***	0.0376
	Std. Dev.	0.5263***	0.0536
Grass fed beef without USDA Certification	Mean	-0.1569***	0.0382
	Std. Dev.	0.4236***	0.0731
Grain fed beef	Mean	-0.5270***	0.0394 ^b
	Std. Dev.	N/A	N/A
Source			
Local	Mean	0.2957***	0.0354
	Std. Dev.	0.5446***	0.0654
Domestic	Mean	0.3419***	0.0345
	Std. Dev.	-0.0818 ^a	0.3150
Imported	Mean	-0.6376***	0.0426
	Std. Dev.	N/A	N/A
Grade			
Select	Mean	-0.3324***	0.0580
	Std. Dev.	-0.0039 ^a	0.0703
Choice	Mean	0.4933***	0.1037
	Std. Dev.	-0.0013 ^a	0.1224
Prime	Mean	-0.1609***	0.0553
	Std. Dev.	N/A	N/A
Nutrition*ab		-0.0498	0.1167
Convenience*ab		0.5596***	0.1055
Price Sensitivity*ab		0.1038	0.1120
Novelty*ab		0.2148*	0.1202
Food Procurement*ab		-0.1276	0.1010
Log likelihood		-6893.68	
Chi squared (8)		671.19	
Prob > Chi squared		0.000	

Notes: Number of respondents: N=1996. Number of Observations = 23,952 (1996 respondents x 3 sets x 4 choices)

*, **, ***. Denotes significance levels at $\alpha = 0.10, 0.05$, and 0.01 percent, respectively

ab Denotes the alternative specific constant "Alternative"

^a The sign of the estimated standard deviations is irrelevant: interpret them as being positive (STATA)

^b Standard errors for "omitted" levels in the effects coding were calculated using the Delta method.

Table C.4. Estimates from Random Parameters Logit Model with Alternative Specific Behavioral and Attitudinal Factor Interactions for General Population

Coefficient		Estimates	Std. Err.
Alternative	Mean	4.3557***	0.8834
	Std. Dev.	3.6930***	0.2703
Price	Mean	-0.5441***	0.0269
	Std. Dev.	0.4814***	0.0272
Type			
Grass fed beef with USDA Certification	Mean	0.6190***	0.0411
	Std. Dev.	0.6152***	0.0480
Grass fed beef without USDA Certification	Mean	-0.2208***	0.0401
	Std. Dev.	0.4885***	0.0664
Grain fed beef	Mean	-0.3982***	0.0405 ^b
	Std. Dev.	N/A	N/A
Source			
Local	Mean	0.2242***	0.0365
	Std. Dev.	0.4451***	0.0767
Domestic	Mean	0.4148***	0.0372
	Std. Dev.	0.0065	0.1242
Imported	Mean	-0.6390***	0.0442
	Std. Dev.	N/A	N/A
Grade			
Select	Mean	-0.2344***	0.0590
	Std. Dev.	-0.0002 ^a	0.0856
Choice	Mean	0.3369***	0.1042
	Std. Dev.	0.0151	0.1548
Prime	Mean	-0.1025*	0.0559
	Std. Dev.	N/A	N/A
Nutrition*ab		-0.0238	0.1458
Convenience*ab		0.1400	0.1312
Price Sensitivity*ab		0.0552	0.1428
Novelty*ab		1.0046***	0.1555
Food Procurement*ab		-0.1118	0.1326
Sustainability*ab		-0.4535***	0.1536
Log likelihood	-6722.79		
Chi squared (8)	998.08		
Prob > Chi squared	0.000		

Notes: Number of respondents: N=1996. Number of Observations = 23,952 (1996 respondents x 3 sets x 4 choices)

*, **, ***. Denotes significance levels at $\alpha = 0.10, 0.05$, and 0.01 percent, respectively

ab Denotes the alternative specific constant "Alternative"

^a The sign of the estimated standard deviations is irrelevant: interpret them as being positive (STATA)

^b Standard errors for "omitted" levels in the effects coding were calculated using the Delta method.

VITA

Franklin F. Vaca Moran was born in Quito, Ecuador. Franklin attended the Escuela Agrícola Panamericana (Pan-American School of Agriculture) Zamorano University in Honduras, where he graduated from the Agronomist program in 2000, and received the degree of Agricultural Engineer (BS) majoring in Food Technology in 2001. During his last year at Zamorano University, Franklin was awarded the Food for Progress Scholarship. In 2002, Franklin continued his education at Hamline University, where he obtained a Master of Arts in Management in 2004. Franklin returned to Ecuador where he worked as Production and Quality Control Manager for Sociedad Industrial Reli. In 2007, Franklin worked as the Executive Assistant to the President at Zamorano University in Honduras. In the summer of 2009, Franklin entered the doctoral program at the Department of Agricultural Economics and Agribusiness at Louisiana State University. Franklin worked under the mentorship of Dr. R. Wes Harrison and he is scheduled to graduate in the fall of 2014.