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An analysis of consumer preferences for grass-fed versus grain-fed beef

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ABSTRACT

As a consequence of the growing concerns about human health and the environment, consumers are becoming more interested in grass-fed beef than conventional grain-fed beef. Therefore, the study of consumers' preferences toward grass-fed versus grain-fed beef steak is the focus of research. In this study, 2,000 respondents who indicated they have eaten grass fed beef in the past year were surveyed, and 2,000 respondents that represent a national sample of the general population were surveyed. Conjoint analysis is utilized to analyze the preference of consumers. Participants are presented ten hypothetical beef steaks to rate. All steaks are identical excluding their product type, source of production, grade and price. Respondents were asked to rate each product from 1 to 10. Results show that for both grass-fed beef eaters and the general population, the target market has a higher demand for local prime grass-fed beef with a USDA certification with a relatively lower price. Consumers who live in the western region of the U.S. tend to prefer grass-fed beef with a USDA certification relative to other regions of the United States.

The research also suggests among the four attributes, product type is the most essential attribute, followed by source as the second most important attribute for both groups. The highest utility rank for grass-fed eaters comes from the combination of grass-fed beef with USDA certification, local, prime, and $2.99 per pound; for general population, the highest utility rank is the combination of grass-fed product with USDA certification, local, choice, and $2.99 per pound. These results will help to reallocate input and resources as well as target and develop a market for grass-fed beef.

Limitations of this research still exist because more interaction effects should be studied. Future research may focus on an increased number of consumer characteristics in order to provide an improved assessments of the market potential for grass-fed beef.

CHAPTER 1 INTRODUCTION

1.1 Background

The beef industry plays a vital role in the United States food sector (Mintert, 2007). Table 1-1 shows cash receipts in 2011 for five commodities including corn, cattle and calves, dairy products, soybeans, and broilers. Cattle and calves, as shown in the table, received the second most cash receipts of all US agricultural commodities (USDA, 2011). As shown in Table 1-2, although the retail value of beef, as well as cattle and calf production, has increased from 2002 to 2011, beef consumption and production have trended downward since 2002 (USDA, 2011).

Table 1-1 Cash Received For Each Category in the U.S.

Top Five Agriculture Commodities	Farm Receipts 1000 dollars	Farm Receipts Percent of U.S
Corn	63,974,136	17.1
Cattle and calves	62,925,466	16.8
Dairy products	39,532,545	10.6
Soybeans	37,574,197	10.0
Broilers	23,172,674	6.2
All commodities	374,251,708	

(Source: http://www.ers.usda.gov/StateFacts/US.HTM)

Moreover, Figure 1-1 shows that demand for beef, which can be revealed by the retail choice demand index, has decreased from 1981 to 1998. Caswell (1998) suggests this downward trend is associated with consumers' concern for grain-fed beef for health, quality, nutritional content, and the safety of foods, as well as a growing demand for intangible attributes such as animal welfare and adverse environmental impacts associated with production and marketing of beef. Roughly 80% of the beef consumed in the U.S. is grain-finished with approximately 20% of the beef market being composed of either grass-fed, natural or organic beef (Mathews, 2013).

Therefore, grass-fed beef represents only a small share of the total U.S. beef market (Rinehart, 2006). This study examines the growth potential of the grass-fed beef market.

Table 1-2 U.S Cattle, Calf and Beef Industry, 2002-2011 (billion)

Beef Industry Retail Value		Beef Consumption		Cattle & Calf production		Beef Production	
2002	$60	2002	27.9	2002	27.1	2002	27.09
2003	$63	2003	27.0	2003	32.1	2003	26.24
2004	$70	2004	27.8	2004	34.8	2004	24.55
2005	$71	2005	27.8	2005	36.6	2005	24.68
2006	$71	2006	28.1	2006	35.6	2006	26.15
2007	$74	2007	28.1	2007	36.0	2007	26.42
2008	$76	2008	27.3	2008	35.6	2008	26.56
2009	$73	2009	26.8	2009	32.0	2009	26.07
2010	$74	2010	26.4	2010	37.0	2010	26.41
2011	$79	2011	25.6	2011	45.2	2011	26.29

(Source: USDA data
http://www.ers.usda.gov/topics/animal-products/cattle-beef/statistics-information.aspx)
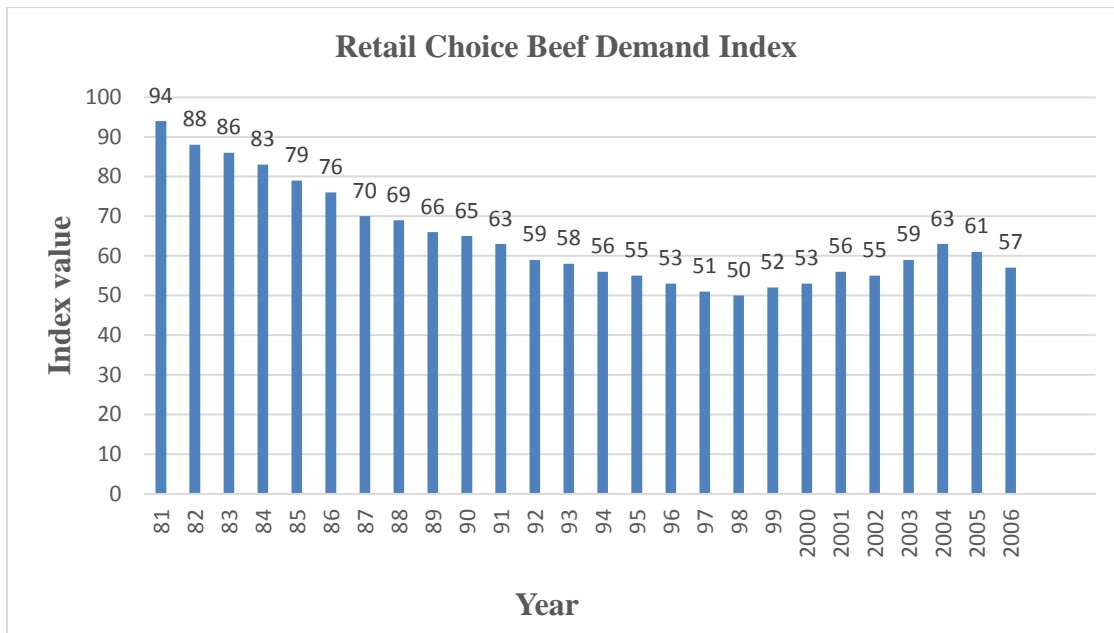

Figure 1-1 Retail choice demand index for beef industry, 1981-2006.

(Source: USDA, Department of Commerce & K-State Research Price Deflated By CPI, 1980 =100 for Beef Demand Index)

1.2 Problem Statement

Yearlings in the United States are typically fed grass, forage, hay and some feed supplements, until they have reached approximately a year old with a weight of 700 to 800 pounds. Calves then will undergo a "finishing" period with high concentrate diets in concentrated feeding operations (feedlots) to reach the weight at which they are to be sold to harvest plants (usually at an average of 1200 to 1300 pounds). However, some advocate point out that this process is not in accordance with animal welfare, environmental issue, and healthy issues. Therefore, grass-fed beef has been sought as a new approach in the market (Gomez, 2000), which means that cattle are fed grass and forage for the lifetime of the animal, with the exception of milk consumed prior to weaning. The diet is 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. Hay, haylage, baleage, silage, crop residue without grain, and other sources may also be included as acceptable feed sources (Mccluskey, 2005).

Routine mineral and vitamin supplementation may also be included in the feeding regimen. However, if the animal is accidentally exposed 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 exposure including the amount, the frequency, and the supplements provided. According to the American Grass-fed Association (http://www.americangrassfed.org), grass-fed products are the livestock or meat "from ruminants, including cattle, bison, goats and sheep, as those food products from animals that have eaten

nothing but their mother's milk and fresh grass or grass-type hay from birth to harvest – all their lives".

Some of the consumers mistakenly regard grass-fed beef as organic or natural beef. Grass-fed beef is not necessarily produced in a way that meets the same standard as organic beef. However, on the other hand, organic beef is not necessarily finished on just forages or grass. Organic beef indicates that cattle have been raised through approved methods that integrate cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity (Worthington, 2011). Therefore, synthetic fertilizers, antibiotics, irradiation, and genetic engineering may not be used in any aspect of the production process. Natural beef requires that three conditions are met: (1) the product must be minimally processed, (2) the product cannot contain any artificial ingredients and (3) the product cannot contain any preservatives. Unfortunately, the USDA has no specific restriction on management practices during the life of the animal. Hence, cattle may be finished on grain (Boland and Schroder, 2000).

With growing concern about the link between health and diet consumption has shifted to grass-fed, organic or natural foods rather than conventionally produced foods (Worthington, 2011; American Grass-fed Association, 2007). Because several studies have linked beef demand to health concerns such as fat content, several additional health claims have been reported for forage-fed beef: 62% lower in fat content than grain-fed beef, 65% lower in saturated fat than grass-fed beef, and greater concentrations of omega-3 fatty acids, and conjugated linoleic acid (CLAs) (Umberger, 2005). The omega-3 fatty acids and CLA's had been previously measured

by food chemists so the statement of greater levels of these nutrients in the forage-fed beef could be verified.

Boetel and Liu (2003) found that ''increased food health concerns about fat and cholesterol have resulted in a 6% reduction in the consumption of beef per capita per quarter since 1987''. Kinnucan (1997) also found that health information related to cholesterol had a significantly larger effect than relative price elasticity on beef demand. In Conner's study (2008), large majorities (between 82%–93%) of respondents rated the attributes of humanely raised, environmentally friendly, and produced antibiotics free or hormones free as being fairy or to some extent important, and approximately 80% agreed with the idea that grain-fed beef products are healthier for consumers. Difficulties identifying and accessing grain-fed products were commonly mentioned barriers to purchase (Conner and Oppenheim, 2008). Besides, animal waste is also used as a natural fertilizer, accordingly, grass-fed beef is regarded as environmentally friendly. In addition, grass finished animals are generally believed to be treated more humanely because they are allowed to roam freely on pastureland.

Since grass-fed beef has gained increasing attention, more research should be conducted to develop a clear, focused beef marketing plan. However, currently, there is no clear beef marketing plan to connect producers and consumers. Hence, the research is crucial for providing marketing information to producers of both grass-fed beef and grain-fed beef. Furthermore, by providing statistical data that represents consumer preferences for the product, the study will offer variable information for producers to develop. The objectives of this research include: study the perceptions that consumers have regarding grass-fed beef products versus grain-fed beef products; determine the level of interest consumers have in receiving information about the

product type, source, grade and price of grass-fed beef versus grain-fed; estimate the relative

importance for each level of each attribute; determine how consumers' rating differs according to

demographic characteristics; help to target and develop a market for grass-fed beef.

CHAPTER 2 REVIEW OF LITERATURE

This chapter introduces empirical research and achievements of previous studies. The first section provides insight into studies that focus on factors that influence consumers' preference toward grass-fed and grain-fed beef. Moreover, research using conjoin t analysis are reviewed in the second section of the chapter.

2.1 Factors Influencing Consumers' Preference toward Grass-Fed Beef and Grain-Fed Beef

Numerous studies have been focused on factors impacting consumers' preference and demand toward beef products. Xue *et al.* (2010) found that consumers' nutrition knowledge, beef consumption behavior, health conditions, and household size have significant impact on consumers' preference and demand for grass-fed beef. Xue *et al.* (2010) also found that palatability attributes play a central role in determining consumers' preferences and demand for grass-fed beef. The ability to inform consumers about grass-fed beef has a direct effect on product price. The more nutritional knowledge consumers acquire, the more they are willing to pay for grass-fed beef. Furthermore, the education and gender of consumers can have either a positive or negative effect on their preference and demand. Several models including OLS and Tobit regressions were employed to create a baseline for the analysis of consumers' willingness to pay. Using cluster analysis, a common market analysis technique, researchers could sort consumers with similarities into groups, enhancing producer and retail initiatives to target product development, promotional messages, and price points (Lyford, 2010).

Ziehl (2004) analyzed consumers' segments based on their interest and willingness to pay with the same method for various natural beef products. Ziehl (2004) not only found that

consumers stated importance and interest in attributes such as natural production practices, grass-fed, traceability, and tested for Mad Cow Disease influence their willingness to pay a premium for natural beef, but also found there are different segments that are significant in size, identifiable and with distinct interests in the production practices of natural beef. Ziehl (2005) found that consumers who have previously purchased natural beef or occasionally bought meat at alternative markets (not supermarkets) were more willing to pay a premium for natural products. Consumers indicated importance and interest in attributes such as natural and forage-fed production practices, traceability, and tested for Mad Cow Disease also affect their decision to pay a premium for natural, regionally produced beef.

In 2003, the Leopold Center and the Business Analysis Laboratory of Iowa State University conducted an internet-based study concentrating on pasture-raised beef and dairy products. They studied various consumer perceptions toward the factors influencing the production of pasture-raised beef and dairy products. Results revealed that a majority of respondents understood that pasture-raised beef and dairy products refer to cattle that were raised or grazed in pastures (Pirog, 2004). Furthermore, consumers regard freshness, taste, quality, appearance, and value of the food products as the most important attributes when they purchased fresh/frozen beef or dairy products. Nutrition is another important factor to which consumers will pay attention. More than 50% of the respondents were aware or somewhat aware of the perceived benefits of pasture-raised beef and dairy products. Consumer respondents placed extensive importance on selecting food products that disclose the food safety record of the processor and the presence of additives in the food. However, they did not place as much

importance on the place and the way the food was grown, the size of the farm, the size of the company that produced the food product, as well as whether the product was organically grown.

Exploiting conjoint analysis, Mennecke and Townsend (2007) found that region of origin is the most fundamental decision characteristics among all groups of consumers; followed by animal breed, traceability, animal feed, and beef quality. Alternatively, cost of cut, use of growth promoters，farm ownership, and guaranteed tenderness were least important factors. Results for animal science undergraduates are similar to the aggregate results, except that these students paid more attention to the beef quality at the expense of traceability and the nonuse of growth promoters, whereas business students emphasize on region of origin, traceability and cost (Mennecke, 2007).

The ideal steak for the national sample is from a locally produced, Choice Angus fed a mixture of grain and forage that is traceable to the farm of origin. If the product were not produced locally, respondents have indicated that their preferred production states are, in order from most to least preferred: Iowa, Texas, Nebraska, and Kansas. The authors also interpreted whether educating the consumer will help influence purchasing decisions in terms of type of cut, quality, and marbling definitions. Results revealed that animal science students demonstrated they were more knowledgeable about intrinsic cues for quality. In turn, they were apparently more likely than business student counterparts to use understanding of these and other features to make informed decision about which cut to purchase.

2.2 Consumers' Preference toward Grass-fed and Grain-fed Beef

In Umberger (2002), 23% of consumers preferred grass-fed beef over grain-fed beef and were willing to pay an average of $1.36 more per pound. Thilmany (2003) also found consumer

segments preferring and willing to pay more for grass-fed or "natural" beef, respectively. Results demonstrated that most consumers believed that grass-raised products were healthier, more environmentally friendly, and better for animal welfare than conventional-raised products and thus were willing to purchase these grass-fed products (David and Diana, 2008). However, the sample was fairly diverse in its demographic attributes, and the types of shoppers in the grocery store were certainly different from the shoppers, therefore, these findings cannot be generalized to other populations.

King *et al.* (2010) examined the ability to directly market a product like beef to the consumer and the result of increased opportunities that strengthened relationships between vendor and buyer. When a direct market chain is created and is strategically implemented, buyers are able to understand their food source. They do not have the indirect relationship that they do with larger food retailers that do not promote the farmer/rancher that raised the beef. Consumers interested in this market may believe that local products are fresher or free of harmful chemicals. Other consumers gain non-monetary satisfaction, a greater sense of community, and the belief that buying local is helping the environment, small farmers, and the local economy as it engages in direct interaction with producers (Evans, *et al.* 2010). Often, marketing initiatives are started with a supply chain that fits the business. In the case of local food systems, direct supply chains are vital to success. The ability to effectively market local beef products which are in many cases, priced higher than similar products in local retail stores, is linked to product information and relationships with the customer. More specifically, a systematic link from farm to patron encourages greater commercial interaction between the two parties. In a niche market such as forage-fed beef or locally grown foods, differentiation and relationships are critical for achieving

success. Some research focuses primarily on differing aspects of consumer preference and how these aspects influence demand among different segments of the population (Gillesipie, 1998).

In a segmentation analysis of supermarket consumers, Mangaraj and Senauer (2001) found three distinct segments: Mid-Americans (motivated by price and value), sophisticated (concerned with quality and service), and time-pressed convenience seekers (with young children and little time). Carlson, Kinsey, and Nadau (2002) conducted a similar analysis of where consumers purchased food (including away from home) and found a segment that varied significantly by demographics, but the research did not consider food attitudes and they could not be able to prove the way they distinguished the segments. In a study measuring produce food-safety preferences, Baker and Crosbie (1993) found three segments, one concerned with pesticide use, one concerned with the level of damage to produce (the majority of respondents) and one primarily concerned with price and quality. Baker and Burnham (2001) conducted a similar study in 2000 considering genetically modified foods, and again found three segments. The three clusters—brand buyers, safety seekers and price pickers—were motivated by different concerns, attitudes toward risk, and knowledge of GMO's, but had demographics that were very similar to each other, indicating that demographics are not effective market-segmentation factors. Therefore, noticeably clarified sections and demographics with highly distinguished characters need to be formed in the research (Paul, 2001).

2.3 Conjoint Analysis

2.3.1 History of Conjoint Analysis

The earliest conjoint analysis published in the *Journal of Mathematical Psychology* is a seminar research conducted by Luce and Tukey (1964). They piloted fundamental measurement

using axiomatic approaches. The idea was to obtain ordered metric-scale data from rank-order response data and a set of factorial designed stimuli. Later, some psychometricians like Carroll (1969), Kruskal (1965) and Young (1969), who developed numerous nonmetric models for computing part-worths from respondents' preference orderings across multi-attributed stimuli such as descriptions of products or services, made great contributions utilizing this theory. In the late 60s, Green *et al.* (1967) started running numerous experiments with the Monanova program and published a paper in 1969. Later, Green and Rao (1971) published the first marketing journal article on conjoint analysis, followed by a two-attribute at a time trade-off model investigated by Johnson (1974), and Westwood *et al.* (2001).

2.3.2 Application of Conjoint Analysis

With development of conjoint analysis method, several studies have employed conjoint analysis to examine buyers' preferences. Utilizing conjoint analysis, Halbrendt, Wirth, and Vaughn (1991) determined the utility values for nine different hybrid striped based products. The authors also added variables and attributes to allow for inter-industry comparisons. Anderson and Bettencourt (1991) applied the conjoint approach to model preferences in the New England market for fresh and frozen salmon. Huang and Fu (1995) examined individual consumer preferences for various Chinese sausage attributes. Yoo and Ohta (1995) utilized conjoint analysis to determine the optimal pricing and product planning for automobiles. Gan and Luzar (1996) exploited conjoint analysis to the problem of waterfowl hunting in Louisiana. They built ordered logit model to estimate willingness to pay for recreation experience attributes. Harrison, Ozayan, and Meyers (1998) focused on analyzing the acceptance of two value-added seafood products derived from crawfish minced meat. In another study, conjoint analysis investigated the

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preferences of restaurant managers for two intermediate minced based seafood products in the southern region of the United States (Harrison *et al*., 2002).

There are three steps in conjoint analysis. The first step in designing a conjoint study is to determine a series of attributes and corresponding attribute's levels to characterize the competitive domain. The second step is to construct an experimental design and a survey to collect the conjoint data. Often, researchers use focus groups, in-depth consumer interviews and internal corporate expertise to frame the sets of attributes and levels guiding the rest of the study. In an actual credit-card suppliers study, researchers used a set of 12 attributes with two to six levels of attribute, for a total of 35 levels of characteristics. However, the total number of possible combinations of levels is 186,623. Conjoint analysts make extensive use of orthogonal arrays and other types of fractional factorial designs to reduce the number of stimulus descriptions (Addelman, 1962). Therefore, a respondent receives simply a small fraction of the total number of combinations. In this paper we conducted fractional factorial designs, which reduces respondents burdens to rate all of the products. Green and Krieger (1996) utilized a hybrid conjoint design. Each respondent was inquired to consider merely eight profile descriptions drawn from sixty-four profiles. Researchers may prepare prop cards in this kind of study. After the respondent sorts the prop cards in terms of preference, each card is rated on a 0 to 100 likelihood of acquisition scale. In small conjoint studies, respondents typically sort the prop cards into four to eight ordered categories before they give likelihood of purchase ratings for each separate profile within each category. The third step is to choose an appropriate composition model and estimate consumers' part-worth utilities. Part-worth utilities are decomposed from the total utility of a multidimensional product for each attribute of the product

(Harrison, 1998). Using conjoint analysis, which can provide a technique for measuring and evaluating the relative importance of each characteristic of a hypothetical product, part-worth utilities are calculated to obtain the preferred combination of product characteristics for specific market (Harrison, *et al.*, 2001). Consumers' preferences will be collected after part-worth utilities are calculated. Harrison (1998) indicated that part-worth values can be estimated in a way that linear regression and mean deviation dummy variable coding is employed. Therefore, models indicated in Chapter Three will be utilized to estimate the part-worth utilities for both grass-fed and grain-fed product.

CHAPTER 3 THEORETICAL FRAMEWORK AND METHODOLOGY

The conceptual framework of the article involves the theory of consumer demand, where utility is maximized. This chapter first presents several essential, economic theories connected to consumers' demands and preferences for novel goods; followed by the theoretical framework and a discussion of methodology of the conjoint analysis, and the ordered probit model.

3.1 Demand

The theory of consumer behavior has been formulated entirely in terms of consumer preferences, and utility is observed merely as a way to describe preference. The consumer demand function for commodities will, in general, depend on the prices of all commodities and income (Lankasta, 2008). Demand is contingent upon consumers' willingness and ability to purchase different quantities of products and services at different prices during a specific time period (Wetzstein, 2005). A change in demand refers to a shift in the demand curve. The factors causing demand to shift are: 1) changes in a person's income, 2) consumers preferences, and 3) prices of related goods. Quantity demanded, on the other hand, refers to the number of units of products that consumers are willing and able to afford to buy at a given price (Lankasta, 2008). The difference in a change in demand and a change in quantity demanded is that a change in demand is a shift in the demand curve while the change in quantity demanded is a movement along a given demand curve (Verbeke, 2001). The Law of Demand depicts the relationship between price and quantity demanded as being an inverse relationship (Krinksky, 1986). Graphically, the relationship between prices and quantities demanded for products can be illustrated through the use of demand curves. Since the connection between quantity demanded

and price varies inversely the demand curve will have negative slope when graphed (Lankasta, 2008). However, while demand functions represent the quantity demanded at a certain price, the equations also serve as marginal value curves because products will only be consumed to the point where marginal benefits equate to marginal costs (Champ, Boyle, and Brown, 2003). Demand functions can be modeled as below:

$$Q\ (P) = a - bP \tag{3-1}$$

where quantity is a function of price as well as the dependent variable. In this equation, a is the x-intercept term or quantity intercept where the price of the commodity equals zero, b is the slope, or the change in quantity given a change in P, and P is the price of the good in question. As shown from the negative value of b, as long as the Law of Demand holds, quantity and price will always move inversely of one another (Champ, Boyle, and Brown, 2003).

3.2 Conjoint Analysis

Conjoint analysis is one of the most widely used marketing research methods for analyzing consumer trade-offs and evaluating survey responses concerning preferences and intentions to buy. Besides, conjoint analysis is employed for simulating how consumers might react to changes in current products or to new products introduced into an existing competitive array (Johnson, 1987). The basic idea of conjoint analysis is dealing with the question why consumers choose one product or commodity instead of the others. The method addressed the trade-off between A and B when option A is better than option B on attribute 1 while B is better than A on attribute 2, and various extensions of these conflicts. In addition, the method provides a technique for measuring and evaluating the relative importance of the individual characteristics

of a product; at the same time, the method provides a means to determine the preferred combination of product characteristics (Green, 2001).

3.2.1 Determining the Attributes and Levels

According to Harrison (2005), conjoint analysis studies have sought to estimate respondents' preference for a group of attributes associated with a recreational site or activity. In order to identify products' attributes and associated levels, Louviere (1988) recommends the use of unstructured focus group interviews combined with a series of semi-structured, open-ended questions. First, product type is identified as one of the most important attributes (Seim, 2006). Katja (2004) presented a model of entry with endogenous product-type choices. These choices are formalized as the outcomes of a game of incomplete information in which rivals' differentiated products have non-uniform competitive effects on firms' profits. Second, price is identified as another most central attributes (Fields, *et al.* 2006). Erickson *et al.* (1985) stated the role of price in multi-attribute product evaluations. The price consumers pay for a product results in a reduction of their wealth, which represents the "price as a constraint" (Lancaster, 1966). Later, Olson (1974), Wheatley and Chiu (1977) used price to convey information to the consumer about product quality, which gives price the character of a product attribute. The role of price can extend even further if subjective beliefs about price levels are dealt with. Regression methods were used to sort out the various price effects. In addition, source (Herring, *et al.*, 2007) is another main attribute. Using a double-hurdle probit analysis, Mabiso *et al.* (2005) conducted studies on country of origin labeling and found that consumer preference for locally produced beef also positively affected the likelihood to support MCOOL. Mabiso concluded depending on different markets and places, price varies from \$2.99 to \$7.99 per pound. Moreover, the grade of

the product was considered and discussed because grade can be observed in almost every grocery store (Ward, *et al.* 2008).

According to their preference for each level, four attributes including product type, grade, source and price were determined. Product type consists of three levels: grass-fed beef with USDA certification, grass-fed beef without USDA certification and grain-fed beef. Grade consists of three levels including select, choice and prime. Source consists of three levels including local, domestic and prime. Price consists of three levels including $2.99 per pound, $4.99 per pound and $7.99 per pound. Therefore, the preferences for the selected attributes were tested for the beef product (Carlsson, Frykblom and Lagerkvist 2007).

3.2.2 Constructing Experimental Design and Survey

Constructing an experimental design and a survey to collect the conjoint data is the second step in the study. Generally, there are four ways to conduct the survey: mail, in-person interviews, phone, and internet survey. Mail surveys are the most used method in past years. However, they usually suffer from low completion rates and response bias because of the lack of motivation of the respondents. In-person interviews can also create some human biases based on social desirability. Phone surveys generally need the contact information, such as private cell-phone number, home phone number, which are not easy to obtain (Glasow, 2005).

The survey used in this study was administered by MROPs, which is a professional marketing research firm that maintains a national representative household panel for the United States. The questionnaire was developed by the research team associated with the grant that funded this project, and the survey data is collected via the internet. In this study, respondents were selected in such a way that it comprises a nationally representative sample across a section

of consumers by geographic region, number of children under 18 years old, household size, age of respondent, education, income, ethnicity and gender. Consumers were initially questioned about how often they eat beef, chicken, pork and seafood, followed by how often the respondents eat at home or at a restaurant. In addition, participants were presented ten hypothetical beef steaks to compare. All steaks are identical except for their product type, source of production, grade and price. Respondents were enquired to decide which of the ten steaks they prefer and to rate each product from 1-10, where a 1 indicates most preferred and a 10 indicates the least preferred. Since we are interested whether general population would prefer grain-fed beef to grass-fed beef product while grass-fed beef eaters would prefer grass-fed beef to grain-fed beef product, a total of 4,000 responses were received and divided into two groups, general population and grass-fed beef eaters,. Gathered information can be categorized into the following groups of inquiries: consumer attitudes towards beef product (utility), product information (product type of beef, source, grade and price, etc.), demographic information (in which area consumers live: Northeast, South, West or Midwest), marital status (currently married, single or divorce/widow/separate), number of children in the household, race or annual income. Interaction effects are also detected in our research. As previously mentioned, four three-level attributes are presented. Consequently, a full profile approach will involve 81(3×3×3×3) for the beef product. However, rating 81 product profiles on internet is not an easy task. In order to solve this problem, the number of treatments was reduced using a mixed ten confounded design, which is presented in the Appendix (Harrison, 2005).

3.2.3 Choosing a Model

Choosing an appropriate composition model and estimate consumers' part-worth utilities is the third step. The conceptual model is based on the theory of consumer demand, where utility is maximized. A consumer's utility is assumed to be a linear function of selected product attributes. An ordered probit model is generally used when the dependent variables are ordinal (Long, 1997). There are two main advantages for ordered probit model. Frist, the ordered probit model provides a solution to the problem of heteroskedasticicity, which occurs when a regression model is used to analyze a categorical dependent variable; and second, maximum likelihood estimates are, under general conditions and consistent (Hamath *et al*., 1997). The ordered Probit model assumes the following relationship between an interval rating scale (i.e., IR scale), and utility (U_i^*):

$$y_i = 0, \text{ if } y_i^* \leq \mu_0,$$

$$y_i = 1, \text{ if } \mu_0 < y_i^* \leq \mu_1,$$

$$y_i = 2, \text{ if } \mu_1 < y_i^* \leq \mu_2, \qquad\qquad (3\text{-}2)$$

$$.$$

$$.$$

$$.$$

$$y_i = J, \text{ if } \mu_{j\text{-}1} \leq y_i^* \leq \mu_{j+1}$$

Where μ is an unknown "threshold" that determine the ordinal intervals of the scale, and all other variables are as previously defined. Since the μ is an unrestricted parameter, no significance to the unit distances associated with the discrete values of the scale (Harrison *et al.* 2004). Ordered Probit assumes ε_i normally distributed with zero mean, but sets δ^2 equal to one, in which the

restriction proves necessary because all values of U_i^* are assumed to be censored in the OP model (Long, 1997).

All continuous utility functions of the general form is given as

$$U_{ij} = \sum_{j=1}^{3} \alpha_j + \beta_1 x_1 + \gamma_{2\alpha} x_{2a} + \gamma_{2b} x_{2b}$$

$$+ \gamma_{3a} x_{3a} + \gamma_{3b} x_{3b} + \gamma_{2a3a} x_{2a} x_{3a} + \gamma_{2a3b} x_{2a} x_{3b}$$

$$+ \gamma_{2b3a} x_{2b} x_{3a} + \gamma_{2b3b} x_{2b} x_{3b+\varepsilon_{ij}} \tag{3-3}$$

where α_j are alternative specific constants; x_1 is a continuous product type attribute; x_{2a}, x_{2b}, x_{3a}, and x_{3b} denote dummy variables corresponding to the levels in attributes; x_2 and x_3, β_K and γ_K represent true utility parameters. In addition, U_{ij} symbolizes the estimated utility function. The attribute vector X contains a series of dummy variables defined as follows: First, X_1=1 and X_2=0 representing the grass-fed beef with USDA certification; X_1=0 and X_2=1 representing the grass-fed beef without USDA certification; X_1=-1 and X_2=-1 representing the grain-fed beef; Next, X_3=1 and X_4=0 representing the local beef; X_3 =0 and X_4=1 representing the domestic beef; X_3=-1 and X_4=-1 representing the import beef; In addition, X_5=1 and X_6=0 representing the select beef; X_5=0 and X_6=1 represent the choice beef; X_5=-1 and X_6=-1 representing the prime beef; Finally, X_7=1 and X_8=0 representing the steak product with \$2.99 per pound; X_7=0 and X_8=1 represent beef steak product at \$4.99 per pound; X_7=-1 and X_8=-1 representing beef steak product costing \$7.99 per pound.

CHAPTER 4 PROCEDURES FOR DATA COLLECTION AND RESULTS

In order to present and discuss the results of the study, we discuss frequency distribution of the socioeconomic and demographic characteristics from the survey, followed by an analysis of the ordered probit results. Moreover, the study evaluates the effects of interaction terms between demographic variables, as well as the relative importance of each attribute related to beef-steak production and utility rank (Candice and Clark, 2007).

4.1 Frequency Distribution of the Socioeconomic and Demographic Characteristics of Survey Respondents

Table 4-1 presents distributions of the socioeconomic and demographic characteristics from the survey to understand nature of the variables, which are qualitative. Respondents consist of two classifications, grass-fed beef consumers and the general population. Results demonstrate the highest number of responses comes from the south region for both groups: 662 and 705, respectively. Among all the samples, Non-Hispanics account for 90.6% of grass-fed beef consumers and 92.3% of the general population. In terms of the race, white respondents comprise the greatest proportion, 82.2% of grass-fed beef and 81.5% of general population, respectively. Additionally, most respondents have no children at their household, and earn from $35,000 to $79,000.

4.2 Ordered Probit Results

When a variable is ordinal, its categories can be ranked from low to high. Sometimes, the dependent variable cannot be observed. Therefore, an ordered probit (OP) model is necessary to get the part-worth utilities.

Table 4-1 Frequency Distribution of the Demographic Characteristics of Survey Respondents

Characteristic	Category(n=4000)	Grass-fed Beef Eaters		General Population	
		Frequency	Percent	Frequency	Percent
Geographic Regions	Northeast	372	0.186	371	0.186
	South	662	0.331	705	0.353
	West	484	0.242	484	0.242
	Midwest	482	0.241	440	0.220
Hispanic	Hispanic/Latino origin	171	0.086	137	0.069
	Non-Hispanic origin	1812	0.906	1846	0.923
	Unknown	17	0.0086	17	0.009
Race	White/Caucasian	1643	0.822	1629	0.815
	Black	165	0.082	173	0.087
	Asian	88	0.044	108	0.054
	Pacific Islander	7	0.004	4	0.002
	Native American	15	0.008	10	0.005
	Other groups	61	0.031	60	0.030
	Unknown	21	0.011	16	0.008
Marital Status	Currently Married	1142	0.571	1032	0.516
	Single	331	0.166	561	0.281
	Divorced/Widowed/ Separate	527	0.264	407	0.204
Number of Children Under 18 Years Old	No children	1363	0.682	1463	0.732
	One child	303	0.152	260	0.130
	Two children	233	0.117	184	0.092
	Three children	67	0.034	68	0.034
	Four or more	34	0.018	25	0.013
Income	Under $10,000	81	0.041	121	0.061
	$10,000-$14,999	74	0.037	74	0.037
	$15,000-$24,999	156	0.078	191	0.096
	$25,000-$34,999	213	0.107	239	0.120
	$35,000-$74,999	677	0.339	708	0.354
	$75,000-$99,999	301	0.151	256	0.128
	$100,00-$149,999	260	0.130	203	0.102
	$150,000-$199,999	90	0.045	74	0.037
	$200,000 or more	63	0.032	47	0.024
	Unknown	85	0.043	87	0.044

4.2.1 Consumer Preference towards Grass-fed and Grain-fed Beef Steaks

Participants were presented 10 hypothetical beef-steak products to rate on a scale from one to ten, where a one indicates the most preferred and a ten indicates the least preferred. Rating points were inverted to the new variable (RERATING) to obtain a preference scale of utility. Attribute levels and demographic information are used as independent variables. Since these independent variables are categorical, dummy variables are created for each category and are used to estimate the effects of the categorical variables in standard regression models. One category from each of the variables is used as the base category and left out of the model. Hence, the dummy variables take on values of either one or zero, where X=1 when the attribute is present and X=0 when not. Moreover, consumers are asked to score ten beef products from one to ten, where one represents the most preferred and ten represents the least preferred.

4.2.2 Estimation of Part-Worth Utilities

In conjoint analysis, customers' total utility for a product is a function of their part-worth utilities. To determine consumers' total utility for a product, part-worth utilities for each product attribute must be estimated using ordered probit model and mean deviation dummy variable coding. The part-worth estimates relate the preference rating to combinations of various attribute levels (Harrison, 1998). Table 4-2 presents the ordered probit part-worth estimates for beef steak product for both groups, where utility is the dependent variable and product characteristics are the independent variables. According to the US Census Bureau, respondents from both groups can be divided into four geographic subsets: respondents living in the Northeast, Midwest, West and South.

As mentioned above, the general model used to estimate utility is described as:

Utility= β_0 + β_1GrasswithUSDA + β_2GrasswithoutUSDA + β_3Local + β_4Domestic + β_5Select +

β_6Chocie + β_7\$2.99 + β_8\$4.99 + β_9Northeast + β_{10}South+ β_{11}West + β_{12}Single +

β_{13}DivoceWidowSeparate + β_{14}Nchild2 + β_{15}Nchild3 + β_{16}Nchild4 + β_{17}Nchild5 +

β_{18}Black + β_{19}Asian + β_{20}Pacific + β_{21}Native + β_{22}Others + β_{23}Unknown +

β_{24}Nonhispanic + β_{25}Hisunknown + β_{26}income2 + β_{27}income3 + β_{28}income4 +

β_{29}income5 + β_{30}income6 + β_{31}income7 + β_{32}income8 + β_{33}income9 + β_{34}income10 + ε_i

(4-1)

where *Utility* is the dependent variable measuring consumers' preference toward grass-fed beef

and grain-fed beef, β_0, the constant, equals to the mean rerating for the sample; β_1 through β_{34} are

the estimated part worth values and represent a change in the mean rerating given a unit change

in the associated explanatory variables, holding all other variables constant. For both groups, first,

GrasswithUSDA=1 and *GrasswithoutUSDA*=0 represent the grass-fed beef with USDA

certification; *GrasswithUSDA*=0 and *GrasswithoutUSDA* =1 represent the grass-fed beef without

USDA certification; *GrasswithUSDA* =-1 and *GrasswithoutUSDA*=-1 represent the grain-fed

beef; second, l*ocal*=1 and domestic=0 represent beef-steak produced locally; local =0 and

domestic =1 represent the beef-steak produced domestically; local =-1 and domestic=-1 represent

beef-steak that is imported from a foreign country; third, select=1 and choice =0 represent the

select beef; select=0 and choice=1 represent the choice beef; select=-1 and choice=-1 represent

the prime beef; finally, \$2.99=1 and \$4.99=0 represent the steak product with \$2.99 per pound;

\$2.99 =0 and \$4.99=1 represent the steak product with \$4.99 per pound; \$2.99=-1 and \$4.99=-1

represent the steak product with \$7.99 per pound. One thing should be noticed that ε_i is the error

term. This type of coding yields part-worth estimates that represent deviations from the overall mean preference rating. Besides, more categorical variables are created below in Table 4-2.

Another important aspect is the part-worth values were estimated using an ordered probit model. A t-test is used to test the null hypothesis that the part-worth estimate for each attribute level is not statistically different from zero. Results for both groups are discussed separately.

For grass-fed eaters, the log likelihood statistic shows that the model was significant at greater than the 99 percent level, indicating the part-worth estimates are jointly different from zero. The coefficient for grass-fed beef steaks with USDA certification is positive and significant, while the coefficient for grass-fed beef steaks without USDA certification is negative and significant (Table 4-3A), indicating that grass-fed consumers' preference will increase toward grass-fed beef steaks with USDA certification relative to grain-fed beef, while the preference these consumers will decrease for grass-fed beef steaks without USDA certification relative to the grain-fed beef steaks. The relative effect of each attribute level on grass-fed consumers' preference rating can be determined by comparing the part-worth utilities. The highest contribution to customers' preferences come from grass-fed beef with USDA certification with a part-worth utility of 0.341 and the lowest come from beef steaks that are imported, with a part-worth utility of -0.235 on buyers' preference for grass-fed preferred population. Results are expected and show grass-fed shoppers tend to purchase grass-fed products with a guarantee rather than those which are either not guaranteed or fed with grain, indicating the target market for grass-fed consumers has a higher demand for a grass-fed beef with USDA certification and the lowest demand for grain-fed beef steaks.

Table 4-2 Categorical Variables and Coding.

Variables	Code	
	1	0
Northeast	People live in the Northeast	Otherwise
South	People live in the South	Otherwise
West	People live in the West	Otherwise
NonHispanic	NonHispanic Origin	Otherwise
Hisunknown	Unknown Region	Otherwise
Black	Black or African American	Otherwise
Asian	Asian	Otherwise
Pacific	Pacific Islanders	Otherwise
Native	Native American	Otherwise
Others	Other groups	Otherwise
Unknown	Unknown Groups	Otherwise
Single	People who never get married	Otherwise
DivorceWidowSeparate	People who are divorced or widowed or separated	Otherwise
Nchild2	1 child in the household	Otherwise
Nchild3	2 children in the household	Otherwise
Nchild4	3 children in the household	Otherwise
Nchild5	4 or more children in household	Otherwise
Income2	$10,000-$14,999	Otherwise
Income3	$15,000-$24,999	Otherwise
Income4	$25,000-$34,999	Otherwise
Income5	$35,000-$74,999	Otherwise
Income 6	$75,000-$99,999	Otherwise
Income 7	$100,000 - $149,999	Otherwise
Income 8	$150,000 - $199,999	Otherwise
Income 9	$20,0000 or more	Otherwise
Income 10	Unknown	Otherwise

The coefficients of beef steaks that are produced locally and domestically were significant and positive, while significant and negative for beef steaks that are imported from foreign countries (Table 4-3A), suggesting that grass-fed consumers have a higher preference toward beef steaks that are produced locally and domestically, as compared to beef steaks that are imported. Grass-fed beef eaters have a lower preference for imported beef than local beef. Part-

worth utilities reveal that the target market has comparatively higher demand for a local products. However, even though the local product is the most preferred, the average respondent still has a relatively strong preference for domestic products and prefers domestic products to imported products.

Coefficients of Choice and Prime were significant and positive; while negative and significant for select beef steaks, showing grass-fed eaters prefer choice and prime beef steaks as compared to select beef steaks. Although prime is shown to be the most favored product, grass-fed beef eaters still have a high demand for choice. Coefficients of beef steaks with prices of $2.99 and $4.99 per pound are positive and significant. This means when comparing beef steaks with higher price to those with lower prices, the lower priced products will be more attractive to overall consumers. Therefore, combination between variables should be detected in later analysis.

For the general population, the log likelihood statistic shows that the model was significant at greater than the 99 percent level, indicating the part-worth estimates are jointly different from zero. The coefficient of grass-fed beef steaks with USDA certification was positive and significant, and the coefficient of grass-fed beef steaks without USDA certification was negative and significant (Table 4-3B), indicating that the general population's preference will increase for grass-fed beef steaks with USDA certification relative to the omitted grain-fed beef, while preference will decrease toward grass-fed beef steaks without USDA certification relative to the grain-fed beef steaks. The highest contribution to customers' preference still comes from grass-fed beef with USDA with a part-worth utility of 0.237. Different with grass-fed beef eaters, the lowest comes from Grass-fed beef steaks without USDA certification, with a part-worth utility of -0.149 of respondents' preference. Results show the general population prefers grass-fed product

Table 4-3A Ordered Probit Part-Worth Estimates of Beefsteaks Products for Grass-fed Eaters

Attribute	Coefficient		μ	Std. Err.	RI
Constant		μ_0	-1.236^{***} (-98.88)	0.0125	
GrassUSDA	0.341^{***} (31.14)	μ_1	-0.937^{***} (-86.10)	0.0109	29.6%
GrasswoUSDA	-0.106^{***} (-9.76)	μ_2	-0.634^{***} (-63.4)	0.0108	
Grainfed	-0.235^{***} (-21.56)			0.0109	
Local	0.208^{***} (19.11)	μ_3	-0.375^{***} (-37.5)	0.0109	28.7%
Domestic	0.142^{***} (13.11)	μ_4	-0.094^{***} (-9.40)	0.0108	
Import	-0.350^{***} (-31.82)			0.0110	
Select	-0.086^{***} (-7.96)	μ_5	0.275^{***} (27.5)	0.0107	7.6%
Choice	0.024^{***} (2.16)	μ_6	0.549^{***} (54.9)	0.0109	
Prime	0.062^{***} (5.74)			0.0108	
\$2.99	0.124^{***} (11.46)	μ_7	0.888^{***} (88.8)	0.0108	16.4%
\$4.99	0.072^{***} (6.66)	μ_8	1.293^{***} (99.46)	0.0109	
\$7.99	-0.196^{***} (-17.98)			0.0109	
Log Likelihood				-39931.86	
Number of Observation				18000	
LR chi2(34)				2399.99	
Prob>chi(2)				0.0000	
Pseudo R2				0.0285	

The coding for questions measuring respondent's level of satisfaction is reversed in order to measure their preference toward grass-fed beef and grain-fed beef.

*: Significant at 0.10 level; **: significant at 0.05 level; ***:significant at 0.01 level.

Table 4-3B Ordered Probit Part-Worth Estimates of Beefsteaks Products for General Population

	Coefficient	μ	Std. Err.	RI
Constant	-1.263*** (-132.9)		0.0095	
Grass fed with USDA	0.237*** (20.61)	-0.095*** (8.637)	0.0115	29.3%
Grass fed without USDA	-0.149*** (-12.96)	-0.655*** (65.5)	0.0115	
Grain Fed	-0.088*** (-7.72)		0.0114	
Local	0.097*** (8.43)	-0.378*** (41.15)	0.0115	19.2%
Domestic	0.059*** (5.13)	-0.093*** (8.455)	0.0115	
Import	-0.156*** (-13.68)		0.0114	
Select	-0.112*** (-9.74)	0.278*** (30.89)	0.0115	15.2%
Choice	0.088*** (7.72)	0.555*** (61.7)	0.0114	
Prime	0.025*** (2.17)		0.0115	
$2.99	0.154*** (13.51)	0.888*** (80.72)	0.0114	14.1%
$4.99	-0.039*** (-3.29)	1.270*** (97.69)	0.0115	
$7.99	-0.115*** (10.09)		0.0114	
Log Likelihood		-28264.071		
Number of Observation		18000		
LR chi2(34)		1054.18		
Prob>chi(2)		0.0000		
Pseudo R2		0.0183		

The coding for questions measuring respondent's level of satisfaction is reversed in order to measure their preference toward grass-fed beef and grain-fed beef.

∗: Significant at 0.10 level;   ∗∗: significant at 0.05 level;   ∗∗∗: significant at 0.01 level.

with a guarantee rather than those are either not guaranteed or fed with grain, indicating the target market for the general population also has a higher demand for grass-fed beef with USDA certification and the lowest demand for grass-fed beef steaks without USDA certification.

Similar to the results of grass-fed beef eaters, the coefficients of beef steaks that are produced locally and domestically were also significant and positive, while significant and negative for beef steaks that are imported from foreign countries for the general population (Table 4-3B). Results are similar for grade, except that choice is shown to be the most favored product. However, the general population still has a higher need for prime.

Coefficients of beef steaks with $2.99 a pound is still positive and significant, relative to steaks with $7.99 a pound; while price with $4.99 is shown to be negative and significant for general population. Price with $7.99 is found to have the lowest part-worth utilities. For the region information, coefficient of west is positive and insignificant, while negative and insignificant for the southern region, relative to the omitted Midwest variable.

4.2.3 Ordered Probit Results of Interaction Terms of Beef Products for Grass-fed Eaters and General Population

After producing results from the first model, a second model was needed to account for the interaction effects between demographic information and product information. Results were presented in Table 4-3A, mentioned below, the general model used to estimate utility is described as:

Utility= β_0 + β_1GrassUSDA + β_2GrasswithoutUSDA + β_3Local + β_4Domestic + β_5Select +

β_6Chocie + $\beta_7$$2.99 + $\beta_8$$4.99 + β_9South × GrassUSDA + β_{10}Northeast × GrassUSDA +

β_{11}West × GrassUSDA + β_{12}South × GrasswithoutUSDA + β_{13}Northeeast ×

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GrasswithoutUSDA + β_{14} West × GrasswithoutUSDA + β_{15}South × Local + β_{16}Northeast × Local + β_{17}West × Local + β_{15}South × Domestic + β_{16}Northeast × Domestic + β_{17}West × Domestic + β_{18}South × Select + β_{19}Northeast × Select + β_{20}West × Select + β_{21}South × Choice + β_{22}Northeast × Choice + β_{23}West × Choice + β_{24}South × \$2.99 + β_{25}Northeast × \$2.99 + β_{26}West × \$2.99 + β_{27}South × \$4.99 + β_{28}Northeast × \$4.99 + β_{29}West × \$4.99 + β_{30}Single × GrassUSDA + β_{31}Single × GrasswithoutUSDA + β_{32}Nchild2 × GrassUSDA+ β_{33}Nchild3 × GrassUSDA+ β_{34}Nchild4 × GrassUSDA + β_{35}Nchild5 × GrassUSDA + β_{36}Nchild2 × GrasswithoutUSDA + β_{37}Nchild3 × GrasswithoutUSDA + β_{38}Nchild4 × GrasswithoutUSDA + β_{39}Nchild5 × GrasswithoutUSDA + β_{40}Black × GrassUSDA + β_{41}Asican × GrassUSDA + β_{42}Pacific × GrassUSDA + β_{43}Native × GrassUSDA + β_{44}Others × GrassUSDA + β_{45} Unknown × GrassUSDA + β_{46}Black × GrasswithoutUSDA + β_{47}Asican × GrasswithoutUSDA + β_{48}Pacifi × GrasswithoutUSDA + β_{49}Native × GrasswithoutUSDA + β_{50}Others × GrasswithoutUSDA + β_{51}Unknown × GrasswithoutUSDA + ε_i (4-2)

where β_9 through β_{51} are the estimated part worth values of interaction term representing a change in the mean utility for the beef steak product, given a unit change in the associated explanatory variables, holding all other variables constant. In Table 4-4A, product information still have either positive, or negative significant effect on utility of the products. People living in the west have both insignificant higher preferences towards grass-fed beef with USDA certification and grass-fed beef without USDA certification, compared with those who live in the Midwest. In addition, residents in the northeast have a slightly lower preference towards both

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two products. Simultaneously, preference for individuals living in the south is higher towards grass-fed beef with USDA, while lower towards grass-fed beef without USDA certification. On the other hand, inhabitants living in the northeast area have a lower preference towards local product compared with those who live in the Midwest.

Besides, residents living in the south prefers to purchase domestic product, compared with those who live in the Midwest, while residents living in the west xinjizhu1989@gmail.com towards select product compared with those who live in the Midwest. Moreover, citizens living in the south have a lower preference towards local product and a higher preference towards select product, relative to citizens living in the Midwest. In addition, preference for individuals living in the west proves higher preference towards local product and an insignificantly lower preference towards domestic product, relative to those who live in the Midwest. Relative to persons living in the Midwest, those who reside in the northeast have an insignificant lower preference towards domestic product and an insignificantly higher preference towards domestic product. Compared with those who live in the Midwest, residents from various areas are all indifferent with choice products and products at $4.99 per pound.

Furthermore, people residing in the west have a significant lower preference towards products with products with $2.99, compared with people living in the Midwest.

Additionally, grass-fed eaters who said they had never been married have a significantly higher preference toward grass-fed beef steaks without USDA certification, as compared to those who are married. However, for those who have been divorced or separated, they have a significantly higher preference toward grass-fed beef with USDA certification while significantly

lower preference toward grass-fed steak without USDA certification, when compared to people who are married.

Furthermore, results demonstrate that the number of children in the household is not a considerable factor for consumers' preference toward beef product, regardless of whether it is grass-fed steak with or without USDA Certification. Similarly, race does not have extensive influence on products' utility. Interestingly, Pacific island residents have slightly higher preference toward both grass-fed steak with USDA certification and without USDA certification, relatively to Caucasians. Besides, Native Americans have slightly higher preference toward grass-fed steak with USDA certification while they prefer less toward grass-fed steak without USDA certification, relatively to Caucasian. Moreover, Blacks and Asians have lower preference for both products, compared with Caucasian.

The Hispanic interaction variable was expected to have a significant and positive impact. Unlike most U.S. consumers, Hispanic consumers were expected to have a stronger preference for grass-fed beef relative to non-Hispanic consumers, since pasture-based production systems are almost exclusively used in Latin American countries. For example, Argentina and Brazil are two of the world's largest grass-fed beef exporters (USDA 2001). Inexpensive pastureland and a year-round grass supply provide advantages to pursue grass-fed production in many Latin American countries such as Mexico, Venezuela, Uruguay, and Paraguay (Myers 1980; Place 2001; USDA 1997). People from the countries that rely on grass-feeding are likely to be accustomed to the sensory attributes of grass-fed beef. Thus, while the unique visual appearance and taste of grass-fed beef seem to limit the market for grass-fed beef among U.S. mainstream consumers, it appears reasonable to hypothesize that people from Latin American countries that

rely on grass-feeding practices have potential preferences for grass-fed beef to conventionally produced beef. Furthermore, the U.S. Hispanic population has been rapidly growing for decades and is currently the largest ethnic minority in the U.S. At the same time, the fast-growing Hispanic population represents an increasingly important market in the total U.S. food market (Humphreys 2006). Hispanic consumers are known to be heavy beef eaters and meat accounts for a greater portion of their annual food expenditure than other ethnicities (BLS/CEX 2005a). With significant consumption of beef and potential preferences for grass-fed beef, the fast-growing Hispanic population may constitute a potential promising market for grass-fed beef. However, the Hispanic interaction variable is not significant in the model. Hence, the hypothesis of stronger preferences for grass-fed beef among the Hispanic population is rejected based on the results of this study. This may be associated with a bias in the household panel used in the study, which more likely composed of acculturated Hispanics.

In addition, residents who earn $150,000-$199,999 prefer grass-fed beef with USDA certification, compared with consumers who earn $10,000- $14,999. Individuals who earn higher tend to prefer more to grass-fed steak with USDA certification. However, income seems not to have a significant impact on steak without USDA certification, although higher income consumers tend to consume less toward steak without USDA certification. In Table 4-4 B, for general population, except for product type, all the other product information have significant impact either positive or negative on utility of the products. Consumers living in different regions are overall indifferent about whether the steak are grass-fed with USDA certification or not. In addition, compared to those who are currently married, consumers who have already divorced or separated still prefer more towards grass-fed steak with USDA certification, while

Table 4-4A Ordered Probit Results of Interaction Terms of Beef Products for Grass-fed Eaters

Variable	Coefficient	Std. Err.
GrassUSDA	0.442*** (7.48)	0.0590
GrasswithoutUSDA	-0.158*** (-2.70)	0.0585
Grainfed	-0.284*** (-4.83)	0.0588
Local	0.206*** (18.58)	0.0111
Domestic	0.137*** (12.39)	0.0111
Import	-0.343*** (-32.36)	0.0106
Select	-0.085*** (-7.71)	0.0110
Choice	0.024*** (2.18)	0.0111
Prime	0.061*** (5.59)	0.0111
$2.99	0.125*** (11.27)	0.0111
$4.99	0.072*** (6.57)	0.0111
$7.99	-0.197*** (-18.24)	0.0108
South $\times$ GrassUSDA	0.030 (1.72)	0.0176
Northeast$\times$ GrassUSDA	-0.036 (-1.7)	0.0211
West$\times$GrassUSDA	0.059*** (3.02)	0.0194
South $\times$ GrasswithoutUSDA	-0.037*** (-2.11)	0.0175
Northeast$\times$ GrasswithoutUSDA	-0.021 (-0.99)	0.0210
West$\times$GrasswithoutUSDA	0.042*** (2.20)	0.0193
South$\times$Local	-0.007 (-0.40)	0.0173
Northeast$\times$Local	-0.060*** (-2.88)	0.0209

Table 4-4A Continued

Variable	Coefficient	Std. Err.
West×Local	0.0185 (0.97)	0.0191
South×Domestic	0.0377*** (2.18)	0.0173
Northeast×Domestic	-0.0395 (-1.90)	0.0208
West×Domestic	-0.0289 (-1.51)	0.0191
South×Select	0.0025 (0.14)	0.0173
Northeast×Select	0.0269 (1.29)	0.0208
West×Select	-0.038*** (-1.98)	0.0191
South×Choice	-0.006 (-0.33)	0.0174
Northeast ×Choice	0.0003 (0.01)	0.0209
West×Choice	0.0082 (0.42)	0.0192
South×$2.99	0.0014 (0.08)	0.0173
Northeast ×$2.99	0.0003 (0.01)	0.0209
West×$2.99	-0.039*** (-2.02)	0.0191
South×$4.99	-0.006 (-0.36)	0.0173
Northeast ×$4.99	0.00016 (0.01)	0.0208
West ×$4.99	0.0005 (0.03)	0.0191
Single×GrassUSDA	-0.019 (-1.08)	0.0181
Single×GrasswithoutUSDA	0.041*** (2.30)	0.0180
Divorce×GrasswithUSDA	0.064*** (3.15)	0.0204
Divorce×GrasswithoutUSDA	-0.046*** (-2.28)	0.0203

Table 4-4A Continued

Variable	Coefficient	Std. Err.
Number of 2 children×GrassUSDA	-0.006 (-0.20)	0.0313
Number of 3 children×GrassUSDA	0.018 (0.54)	0.0335
Number of 4 children×GrassUSDA	-0.077 (-1.49)	0.05140
Number of 5 children×GrassUSDA	0.051 (0.74)	0.0690
Number of 2 children×GraswithoutsUSDA	0.044 (1.42)	0.0312
Number of 3 children×GrasswithoutUSDA	0.040 (1.21)	0.0334
Number of 4 children×GrasswithoutUSDA	0.012 (0.24)	0.0512
Number of 5 children×GrasswithoutUSDA	-0.081 (-1.17)	0.0689
Black×GrassUSDA	-0.0512 (-1.02)	0.0503
Asian×GrassUSDA	-0.062 (-1.07)	0.0581
Pacific×GrassUSDA	0.284 (1.73)	0.1639
Native Indiana×GrassUSDA	0.129 (1.12)	0.1156
Others×GrassUSDA	-0.094 (-1.44)	0.0653
Unknown×GrassUSDA	-0.135 (-1.38)	0.0981
Black×GrasswithoutUSDA	-0.075 (-1.50)	0.0499
Asian×GrasswithoutUSDA	0.0407 (0.71)	0.0576
Pacific×GrasswithoutUSDA	0.014[**] (0.09)	0.1605
Native Indiana×GrassUSDA	-0.108 (-0.95)	0.1144
Others×GrassUSDA	0.032 (0.50)	0.0649
Unknown×GrassUSDA	-0.055 (0.57)	0.0975

Table 4-4A Continued		
Variable	Coefficient	Std. Err.
Hispanic×GrassUSDA	-0.028 (0.58)	0.0485
Hisunknown×GrassUSDA	0.069 (0.86)	0.0805
Hispanic×GrasswithoutUSDA	-0.017 (-0.35)	0.0483
Hisunknown×GrassUSDA	-0.007 (-0.09)	0.0802
$15,000-$24,999×GrassUSDA	-0.171*** (-3.21)	0.0533
$25,000-$34,999×GrassUSDA	-0.015 (-0.40)	0.0380
$35,000-$74,999×GrassUSDA	-0.049 (-1.49)	0.0328
$75,000-$99,999×GrassUSDA	0.035 (1.70)	0.0199
$100,000 - $149,999×GrassUSDA	0.016 (0.57)	0.0289
$150,000 - $199,999×GrassUSDA	0.074*** (2.40)	0.0308
$200,000 or more×GrassUSDA	0.073 (1.50)	0.0490
Unknown×GrassUSDA	0.077 (1.36)	0.0570
$15,000-$24,999×GrasswithoutUSDA	0.088 (1.65)	0.0534
$25,000-$34,999×GrasswithoutUSDA	0.0338 (0.89)	0.0379
$35,000-$74,999×GrasswithoutUSDA	-0.006 (-0.18)	0.0328
$75,000-$99,999×GrasswithoutUSDA	-0.00006 (-0.00)	0.0199
$100,000-$149,999×GrasswithoutUSDA	-0.018 (-0.62)	0.0287
$150,000 - $199,999×GrasswithoutUSDA	-0.013 (-0.43)	0.0307
$200,000 or more×GrasswithoutUSDA	-0.047 (-0.96)	0.0490
Unknown×GrasswithoutUSDA	-0.065 (-1.14)	0.0570

Table 4-4B Ordered Probit Results of Interaction terms of beef products for General Population

Variable	Coefficient	Std. Err.
GrassUSDA	0.115	0.0927
	(1.25)	
GrasswithoutUSDA	0.038	0.0901
	(0.42)	
Grainfed	-0.153	0.0915
	(-1.67)	
Local	0.097***	0.0118
	(8.20)	
Domestic	0.058***	0.0118
	(4.95)	
Import	-0.155***	0.0118
	(-13.14)	
Select	-0.110***	0.0119
	(-9.25)	
Choice	0.087***	0.0117
	(7.44)	
Prime	-0.023	0.0118
	(-1.95)	
$2.99	0.150***	0.0118
	(12.79)	
$4.99	-0.039***	0.0118
	(-3.32)	
$7.99	-0.111***	0.0118
	(-9.41)	
South × GrassUSDA	-0.017	0.0181
	(-0.92)	
Northeast× GrassUSDA	0.029	0.0223
	(1.32)	
West×GrassUSDA	0.030	0.0206
	(1.44)	
South × GrasswithoutUSDA	-0.024***	0.0184
	(-1.33)	
Northeast× GrasswithoutUSDA	0.022	0.0225
	(0.97)	
West×GrasswithoutU SDA	0.008	0.0209
	(0.37)	
South×Local	-0.009	0.0180
	(-0.55)	
Northeast×Local	-0.033	0.0222
	(-1.48)	

Table 4-4B Continued

Variable	Coefficient	Std. Err.
West×Local	0.0183 (0.09)	0.0203
South×Domestic	0.006*** (0.32)	0.0181
Northeast×Domestic	0.007 (0.30)	0.0222
West×Domestic	0.005 (0.24)	0.0203
South×Select	-0.0114 (-0.63)	0.0182
Northeast×Select	0.0312 (1.44)	0.0222
West×Select	-0.018 (-0.90)	0.0204
South×Choice	-0.005 (-0.30)	0.0179
Northeast ×Choice	-0.015 (-0.68)	0.0222
West×Choice	0.0017 (0.08)	0.0202
South×$2.99	0.015 (0.81)	0.0179
Northeast ×$2.99	-0.015 (-0.66)	0.0221
West×$2.99	-0.0034*** (-0.17)	0.0202
South×$4.99	0.0117 (0.64)	0.0181
Northeast ×$4.99	-0.0036 (-0.16)	0.0223
West ×$4.99	-0.0197 (-0.97)	0.0203
Single×GrassUSDA	0.0123 (0.67)	0.0184
Single×GrasswithoutUSDA	0.024 (1.27)	0.0186
Divorce×GrasswithUSDA	0.064*** (3.15)	0.0204
Divorce×GrasswithoutUSDA	-0.012*** (-0.61)	0.0201

Table 4-4B Continued

Variable	Coefficient	Std. Err.
Number of 2 children×GrassUSDA	0.0672 (1.86)	0.0362
Number of 3 children×GrassUSDA	0.044 (1.11)	0.0398
Number of 4 children×GrassUSDA	0.068 (1.22)	0.0552
Number of 5 children×GrassUSDA	-0.172 (-2.02)	0.0853
Number of 2 children×GraswithoutsUSDA	-0.066 (-1.80)	0.0365
Number of 3 children×GrasswithoutUSDA	-0.037 (-0.93)	0.0402
Number of 4 children×GrasswithoutUSDA	0.005 (0.09)	0.0557
Number of 5 children×GrasswithoutUSDA	0.147 (1.73)	0.0849
Black×GrassUSDA	0.025 (0.33)	0.0773
Asian×GrassUSDA	0.027 (0.30)	0.0934
Pacific×GrassUSDA	-0.075 (-0.37)	0.2044
Native Indiana×GrassUSDA	-0.283 (-1.66)	0.1699
Others×GrassUSDA	0.039 (0.36)	0.1073
Unknown×GrassUSDA	-0.135 (-1.38)	0.0981
Black×GrasswithoutUSDA	-0.095 (-1.28)	0.0742
Asian×GrasswithoutUSDA	-0.129 (-1.42)	0.0909
Pacific×GrasswithoutUSDA	0.065 (0.32)	0.2039
Native Indiana×GrasswithoutUSDA	0.009 (0.05)	0.1681
Others×GrasswithoutUSDA	-0.074 (-0.70)	0.1057
Unknown×GrasswithoutUSDA	0.336 (0.75)	0.4466
Hispanic×GrassUSDA	0.0853 (1.46)	0.0586

Table 4-4B Continued

Variable	Coefficient	Std. Err.
Hisunknown×GrassUSDA	-0.146 (-1.46)	0.1001
Hispanic×GrasswithoutUSDA	-0.028 (-0.47)	0.0593
Hisunknown×GrasswithoutUSDA	0.069 (0.68)	0.1012
$15,000-$24,999×GrassUSDA	-0.025 (-0.45)	0.0559
$25,000-$34,999×GrassUSDA	0.006 (0.14)	0.0373
$35,000-$74,999×GrassUSDA	0.056 (1.69)	0.0328
$75,000-$99,999×GrassUSDA	0.021 (0.91)	0.0223
$100,000 - $149,999×GrassUSDA	-0.007 (-0.21)	0.0330
$150,000 - $199,999×GrassUSDA	-0.0006 (-0.02)	0.0360
$200,000 or more×GrassUSDA	-0.055 (-1.00)	0.0552
Unknown×GrassUSDA	0.075 (1.12)	0.0673
$15,000-$24,999×GrasswithoutUSDA	0.037 (0.66)	0.0558
$25,000-$34,999×GrassUSDA	0.0591 (1.57)	0.0377
$35,000-$74,999×GrassUSDA	-0.0318 (-0.94)	0.0338
$75,000-$99,999×GrassUSDA	0.0302 (-0.94)	0.0338
$100,000 - $149,999×GrassUSDA	0.0302 (1.30)	0.0232
$150,000 - $199,999×GrassUSDA	0.0272 (0.81)	0.0334
$200,000 or more×GrassUSDA	0.004 (0.11)	0.0364
Unknown×GrassUSDA	-0.143*** (-2.08)	0.0687

prefer less towards grass-fed steak without USDA certification. Moreover, the number of children in the household and income do not affect consumers' preference considerably.

Overall, the interaction term shows grass-fed beef buyers living in the west have a positive and significant impact on grass-fed beef steak as compared to those who live in the Midwest, indicating the target market of grass-fed beef steak with USDA certification has a potentially high demand for grass-fed eaters who live in the west region. On the other hand, consumers who are divorced or separated seem to have a higher demand for grass-fed steak with USDA certification. Moreover, higher income households are more likely to consume grass-fed beef with USDA certification. Results also can be found similar to the general population group except for most of the interaction terms are found to be insignificant.

4.3 Measure of the Relative Importance of Product Attributes

Given each of the 10 possible attribute-level combinations, the utility values for the OP model are simulated by calculating the probability of occurrence for each value of the interval rating (IR) scale. The simulated utility is equal to the scale value associated with the highest probability of occurrence. Relative importance weights are calculated in a manner described by Halbrendt, Wirth, and Vaughn (1991). First, the highest and the lowest part-worth utilities are determined for each attribute. The difference between the highest and lowest part-worth establishes the utility range for the attribute. Once a range for each attributes has been determined, the relative importance of the ith attribute proves to be calculated as follows:

$$RI_\text{i} = x = \frac{\text{Utility Range}}{\sum Utility\ Range\ Attributes} \times 100 \qquad (4\text{-}3)$$

where RI_i is defined as the relative importance measuring for the ith attribute (Harrison, 2005). As shown in Table 4-3, the most important attribute demonstrates to be product type,

contributing over 29.7 % to the preference rating for the beef steak product. Source shows to be the second most important, with a contribution of 29.2%. Similarly, for the general population, product type appears to be the most important attribute, contributing to 29.2% to the preference rating for the beef steak product. Source is the least important with a contribution of 19.17%. In the contrast, grade proves to be the second most important attribute, with a contribution of 7.6% for the grass-fed eaters and $15.2% for the general population. These results indicate that product type is the most important characteristic in beef steak products for grass-fed beef eaters, which should not be surprising given that these products are entirely unknown to the buyer. This result also demonstrates the importance of developing beef steak products that have a better grade. Even though source shows to be a second most important attribute, it still plays an important role and remains a significant factor. Moreover, the potential buyers' preference for a local or domestic product shows to be high.

4.4 Calculation of Total Utility

The additional decision model was used to find the market's overall utility for specific product profiles since interaction effects were found to be insignificant; hence allowing for a ranking of the products tested by conjoint analysis. The total utility for each profile is calculated using the OLS part-worth estimates. The following formula is used:

$$U_{ijk} = G + \sum W_{ijk} \qquad (4\text{-}4)$$

Where U_{ijk} is the total utility for the product profile defined by the attribute combination given by levels ijk. G is the overall mean preference rating given by the OLS intercept, and $\sum W_{ijk}$ is

the summation of all part-worth utilities associated with the product profile defined by levels ijk. The market's rankings of the beef-steak are presented in Table 4-5.

Overall, the objective of this study is to investigate the market potential for a variety of beef-steak products. Consequently, a combination of the beef-steak products will be chosen.

The rankings show the most preferred of the beef steak product is a grass-fed beef steak with USDA certification, and with a local source, a prime grade, and a price of $2.99 per pound. And it is clear that the top five rankings belong to those products with a grass-fed beef, certification and an import source. These imply grass-fed beef eaters will favor grass-fed beef products over imported products. Higher prices tend to have a larger impact on grass-fed consumers' preference. The lowest utility comes from the combination of grain fed beef, for a import source, select grade beef costing $7.99 per pound. For the general population, the highest utility comes from the combination of grass-fed beef with USDA certification, local origins, a choice grade and a price of $2.99 per pound, while the lowest utility comes from the combination of grass-fed beef without USDA certification, for an import source, a select grade worth $7.99 per pound. This suggests consumers, no matter whether they are grass-fed beef eaters or general population, prefer to purchase beef steak products with USDA certification.

Table 4-5 Estimated Utility Rankings for the Beef-steak Product

Product Type		Source				Grade			Price			Rank	
Grasswith hUSDA	Grasswithou otUSDA	Grain	Local	Domestic	Import	Select	Choice	Prime	$2.99	$4.99	$7.99	Grass eaters	General Pop
X			X					X	X			1	3
X			X				X		X			2	1
X			X					X		X		3	10
X				X				X	X			4	4
X			X				X			X		5	5
X				X			X		X			6	2
X				X				X		X		7	12
X			X			X			X			8	6
X				X			X			X		9	7
X			X			X				X		10	21
X				X		X			X			11	8
X				X		X				X		12	24
X			X					X			X	13	16
X			X				X				X	14	11
X				X				X			X	15	18
X				X			X				X	16	13
	X		X					X	X			17	26
X			X			X					X	18	28
	X		X				X		X			19	19
	X		X					X	X		X	20	49
	X			X				X	X	X		21	29
X				X		X					X	22	30
	X		X				X			X		23	38
X					X			X	X			24	14

Table 4-5 Continued

Product Type		Source				Grade			Price			Rank	
Grasswit hUSDA	Grasswithou otUSDA	Grain	Local	Domestic	Import	Select	Choice	Prime	$2.99	$4.99	$7.99	Grass eaters	General Pop
	X			X				X	X			25	53
		X	X					X	X			26	20
	X			X			X		X			27	22
X					X		X		X			28	9
	X		X			X			X			29	41
	X			X			X			X		30	43
X					X			X		X		31	31
		X	X				X		X			32	15
		X	X					X		X		33	39
X					X		X			X		34	25
	X		X			X				X		35	64
		X		X				X	X			36	23
	X			X		X			X			37	45
		X	X				X			X		38	32
		X		X			X		X			39	17
X					X	X			X			40	27
		X		X				X			X	41	55
		X		X				X		X		42	44
	X			X		X				X		43	66
		X	X			X			X			44	34
		X		X			X			X		45	35
X					X	X				X		46	50
	X		X					X			X	47	57
		X	X			X				X		48	58
		X		X		X				X		49	36

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Table 4-5 Continued

| Product Type | | Source | | | | Grade | | | Price | | | Rank | |
GrasswithUSDA	GrasswithoutUSDA	Grain	Local	Domestic	Import	Select	Choice	Prime	$2.99	$4.99	$7.99	Grass eaters	General Pop
	X		X				X				X	50	51
	X			X				X			X	51	60
		X		X	X					X		52	61
	X			X			X				X	53	54
X					X		X				X	54	40
		X	X				X				X	55	52
X					X	X					X	56	33
	X		X			X					X	57	72
		X	X				X				X	58	42
	X			X		X					X	59	73
	X				X			X	X			60	56
		X		X			X				X	61	46
	X				X			X		X		62	74
X					X	X					X	63	59
	X				X		X			X		64	47
		X	X			X					X	65	65
	X				X		X			X		66	67
		X		X		X					X	67	68
		X			X			X	X			68	48
	X				X	X			X			69	70
		X			X		X		X			70	37
		X			X			X		X		71	69
	X				X	X				X		72	79
		X			X		X			X		73	62
		X			X	X				X		74	63

Table 4-5 Continued

Product Type		Source				Grade			Price			Rank	
Grasswit hUSDA	Grasswithou otUSDA	Grain	Local	Domestic	Import	Select	Choice	Prime	$2.99	$4.99	$7.99	Grass eaters	General Pop
	X				X			X			X	75	77
		X			X	X				X		76	78
	X				X		X				X	77	75
		X			X			X			X	78	76
	X				X	X					X	79	81
		X			X		X				X	80	71
		X			X	X					X	81	80

[a] The highest estimated total utility is assigned a ranking of 1, and the lowest utility is assigned a ranking of 81. [b] A particular combination of X's defines a hypothetical produc

CHAPTER 5 CONCLUSION AND SUMMARY

As a result of the growing concerns about human and environmental health and the nutritional content and safety of food, consumers pay more attention to the production methods of their foods. These factors have motivated many consumers to purchase organic and natural food products.

As the World Health Organization pointed out, the "overuse and misuse of antibiotics in food animals" is a major source of antibiotic-resistant bacteria that are affecting humans (WHO, 1998). Usage of antibiotics in grain-fed beef is more than in grass-fed beef, and the consumption of such beef has the potential to cause numerous health problems (Jayson, 2009). In addition, grass-fed beef product produces omega-3s and 6s, which are essential fats because human beings have to obtain the fats from food, hence grass-fed beef is healthier than grain-fed beef. Consequently, a clear market strategy should be made to recognize the preference consumers have regarding grass-fed beef products versus grain-fed beef products. However, currently no clear consensus regarding the specifics of that plan has been made. Samples in some of the articles are fairly diverse in its their demographic attributes (Jayson, 2005). Furthermore, the types of shoppers in the grocery store are certainly different from the co-op shoppers, hence these findings cannot be generalized to other populations. Therefore, most of the consumers and producers are left to obtain the information of consumer preference toward grass-fed beef versus grain-fed beef independently. This lack of access to information is the impetus of our research. The objectives of this research include: study the perceptions that consumers have regarding grass-fed beef products versus grain-fed beef products; determine the level of interest consumers have in receiving information about the product type, source, grade and price of grass-fed beef

versus grain-fed; estimate the relative importance for each level of each attribute; determine how consumers' rating differs according to demographic characteristics; help to target and develop a market for grass-fed beef.

Conjoint analysis is utilized in this study. Four attributes, including product type, source, grade and price, are determined and corresponding attribute's levels are specified. There are three levels for each attribute. Product type includes grass-fed steak with USDA Certification, grass-fed steak without USDA Certification, and grain-fed steak; source includes local, domestic, and import; grade includes select, choice, and prime; while price includes $2.99, $4.99, and $7.99.

In order to collect the conjoint data, a nationally administered survey was distributed and asked questions about consumers' attitudes towards grain-fed beef and grass-fed beef. The respondents are selected so that they comprise a nationally representative sample with respect to geographic region, number of children under 18 years old, household size, age of respondent, education, income, ethnicity and gender. Consumers were initially asked how often they eat beef, chicken, pork and seafood. Followed by questions asking how many times they eat at home or at a restaurant. In addition, participants were presented ten hypothetical beef steaks to compare. All steaks are identical except for their product type, source of production, grade and price. Respondents were asked to decide which of the ten steaks they prefer and to rate each product from 1-10, where a one indicates most preferred and a ten indicates the least preferred. Next, they were asked about their consumer lifestyle, beliefs and attitudes.

A total of 4,000 responses, divided into two groups (grass-fed beef eaters and general population), were received. The information collected from the survey can be categorized as one

of the following: consumer attitudes towards beef product (utility); sample information (product type of beef); source; grade and price, etc.; demographic information, in which area consumers live (Northeast, South, West or Midwest); marital status (currently married, single or divorce/widow/separated); number of children in the household, race, annual income. Interaction effects are also detected in our research. As previously mentioned, four three-level attributes are presented. Therefore, a full profile approach will involve 81 ($3\times3\times3\times3$) profiles for the beef product. However, rating all 81 profiles for respondents on the internet is not an easy task. To resolve this problem, the number of treatments was reduced using a mixed ten confounded design. Distributions of the socioeconomic and demographic characteristics from the survey are presented. An Ordered Probit model is utilized to estimate part-worth utilities. Dummy variables are employed, and the attribute level is expressed by combination of the two attributes.

Results for both groups show that respondents are likely to purchase grass-fed product with a USDA guarantee, rather than those that are not. Grain fed beef is also predicted to be less demand than Grass fed, this indicates that consumers have preference for a grass-fed beef with USDA certification relative to grain-fed beef steaks. However, data from the USDA (2009) show consumers are still most likely to purchase grain-fed beef products. This may be caused by the high price of grass-fed products. The other reason may be because consumers are not aware of type of beef product they are facing and what production methods are used in that production of that beef product. In addition, results also show a higher preference toward beef steaks that are produced locally and domestically, compared to beef steaks that are imported. Consumers prefer choice and prime beef steaks compared to select beef steaks. On the other hand, they tend to

purchase choice and prime beef steaks as compared to select beef steaks. Compared to higher priced beef steaks, lower priced steaks will be more preferred by those consumers.

Individuals who live in the West prefer more grass-fed beef both with and without USDA certification than those living in other regions. They also prefer more domestic product than people living in other regions. Simultaneously, they display a lower preference to low-priced products, relative to other regions. The number of the children in the household and household income are not shown to be very important factors influencing demand. Therefore, region seems to influence the consumers' preference most.

This study also revealed, among the four attributes, product type is the most important attribute and source is the second most important attribute for both groups. The top five utility rank for grass-fed eaters is the combinations of (1) grass-fed beef with USDA certification, local, prime, $2.99; (2) grass-fed beef with USDA certification, local, choice, $2.99; (3) grass-fed beef with USDA certification, local, prime, $4.99; (4) grass-fed beef with USDA certification, domestic, prime, $2.99; (5) grass-fed with USDA, local, choice, $4.99. For general population, the top five utility rank is (1) grass-fed with USDA certification, local, choice, $2.99; (2) grass-fed with USDA certification, domestic, choice, $2.99; (3) grass-fed with USDA certification, local, prime, $2.99; (4) grass-fed with USDA certification, domestic, prime, $2.99; (5) grass-fed with USDA certification, local, choice, $4.99. These results have the potential to assist in the construction of a market strategy.

There are limitations to this research because, first, informing respondents about beef cattle production methods may have led to biases favoring grass-fed. That said, these results may indicate that consumers' knowledge about cattle production methods would lead to increase in

the demand for grass-fed beef. Second, respondents were not able to sample the actual product, which may also lead to biased opinion. Third, the research employed an internet survey method, which may not be able to obtain email addresses for the specific groups we are trying to reach. Future research should be focused on informing respondents about beef cattle production methods, and if the situation allows, actual sample products should be prepared for respondents tasting. In addition, a combination of internet, mail and phone survey should be considered for future method to obtain the data. What is more, sample should be selected representatively to avoid bias.

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APPENDIX A: 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
    Changes 4/18
    Changes 5/4
    Changes 5/7

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" means 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 this question and 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 S1<18 or S4=Never or S7=No or
 Term if: Group number=20 and S1<18 or S4=Never

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 to10)

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>**
PN: add a button with the Grass fed beef definition

 # 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 and Q2a>0 for # of times ate at home

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 the 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 the 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)
 PN: add a button with the Grass fed beef definition
    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 feed (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 and Q6a>0 for # of times ate at home

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.

APPENDIX B: CONJOINT DESIGN FOR BEEF SURVEY

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 hav continuous access to pasture during the growing season.

Grass fed USDA means the 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 w/o 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.
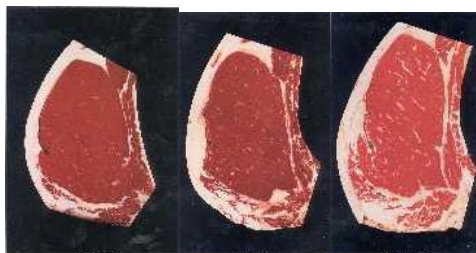Source:
Local means the animals were produced and processed within 200 miles of where the meat is sold.

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 the 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 prime, choice and select grades.

Select Choice   Prime
Conjoint Rating Section – All 10 products on the same screen and randomize ordering.
In the question that follows, you are given 10 hypothetical beef steaks to compare. All steaks are identical except for product type, source of production, grade and price. Imagine you are trying to decide which of the 10 steaks listed below you prefer. Please review each of the beef steaks taking into account the product type, the product's source of production, the product's grade, and the price.   Please rate each product from 1-10, where a 1 indicates most preferred and a 10 indicates the least preferred. Ties are okay.

PN: Product numbering is for client only.

	Product 1	Product 2
Product Type:	Grass fed with USDA Cert	Grass fed without USDA Cert
Source:	Local	Domestic
USDA Grade:	Prime	Select
Price:	$7.99 per pound	$7.99 per pound

    Rating   Rating

	Product 3	Product 4
Product Type:	Grain fed beef steak	Grass fed with USDA Cert
Source:	Import	Domestic
USDA Grade:	Choice	Choice
Price:	$7.99 per pound	$4.99 per pounds

    Rating   Rating

	Product 5	Product 6
Product Type:	Grass fed without USDA Cert	Grain fed
Source:	Import	Local
USDA Grade:	Prime	Select
Price:	$4.99 per pound	$4.99 per pound

    Rating   Rating

	Product 7	Product 8
Product Type:	Grass fed with USDA Cert	Grass fed without USDA Cert
Source:	Import	Local
USDA Grade:	Select	Choice
Price:	$2.99 per pound	$2.99 per pound

    Rating   Rating

    Product 9   Product 10 (Holdout - Not for choice experiment)

Product Type: Grain fed	Grass fed without USDA Cert
Source: Domestic	Import
USDA Grade: Prime	Select
Price: $2.99 per pound	$2.99 per pound
Rating	Rating

II. 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 two 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 and 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.

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>
I am the kind of person who would try any new product once.
When I see a new product on the shelf, I often buy it just to see what it's like.
I like the challenge of doing something I have never done before.
I have at least one meal away from home per day.
Information about food ingredients is important.
I always read and compare food nutrition labels when buying food.
I notice when prices on food I buy change.
I look for coupons in the newspaper and plan to take advantage of them when I go shopping.
I find myself checking prices in the grocery store even for small items.
I use a lot of ready-to-eat foods in my household.
Fresh whole foods account for a large part of the food products I use in my household.

Frozen foods account for a large part of the food products I use in my household.
I use a lot of mixes, for instance, baking mixes and powdered soups.
I try to avoid food products with food additives.
I exercise regularly.
I often eat fresh fruits and vegetables.
I eat red meat only in moderation.
I avoid salty foods.
I have regular medical check-ups.
I prefer using products with recyclable packaging.
I have switched food products for ecologically-friendly reasons.
I try to balance my time between work and my private life.
Planning for meals takes quite a bit of my time.
Shopping for food takes quite a bit of my time.
I eat diet foods at least one meal a day.
I buy lower calorie foods.
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 you 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

VITA

Bo Lin graduated in 2010 from Chinese Academy of Agricultural Sciences in China. She received a degree in Master of Sciences in Agriculture. Ms. Bo is currently a graduate student at the Department of Agricultural Economics & Agribusiness, and she is scheduled to graduate in the summer of 2013.