EFFECTS OF ADDITIONAL QUALITY ATTRIBUTES ON CONSUMER WILLINGNESS-TO-PAY FOR FOOD LABELS

by

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B.A., Harbin Engineering University, China, 1998
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AN ABSTRACT OF A DISSERTATION

Submitted in partial fulfillment of the requirements for the degree

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Abstract

Contingent valuation (CV), choice experiment (CE) and experimental auction (EA) or the combinations of the three methods are often used by researchers to elicit consumer willingness to pay for food attributes (food label). The main concern about these approaches is that different quality attributes of food are assumed independent.

The problem of the independence assumption of a food attribute is that one attribute can signal information about another attribute or could be a proxy of overall product quality. In addition, in surveys consumers tend to be forced to focus on the limited attribute information that are presented by researchers, whereas in the real world, consumers have various sources of food quality information. The limited attributes provided in a survey may lead respondents to allocate their budgets to those limited attributes rather than allocate their budgets to a larger number of product attributes to truly reveal their preferences.

The main objective of this study is to reveal the marginal impacts of additional food quality attributes on consumer WTP for food labels.

Surveys containing a series of online CEs were collected to investigate the effects of additional beef steak attributes on consumer WTP in two different US markets. Both surveys included the same four questionnaires. Two questionnaires test the effect of additional attributes when no cue attributes are provided to the respondents, while the other two questionnaires test the effect of additional attributes when cue attributes are also presented. Every questionnaire contains two CEs, with the second CE having one more attribute than the first.

Random parameters logit models are estimated for each CE in the four questionnaires with survey results from both samples, resulting in 16 sets of estimations altogether. The models with the different survey samples reveal consistent results regarding changes in WTP with more attributes added to the CEs. Consumer WTP for the most important attributes in the CE decreases when the number of attributes increases from three to four, while the WTP for the most important attributes increases when the number of attribute increase from four to five. The changes in the WTP for attributes depend on their relationships with the newly added attributes to the CEs and the number of attributes in CEs.

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CHAPTER 1 - INTRODUCTION

A variety of factors are causing consumer food preferences to evolve. The declining proportion of food expenditure relative to household income, more knowledge about the effect of food consumption on human health, increasing awareness of food-born disease such as BSE and bird flu, and increasing concerns about the environment, are driving consumer demand for foods that are healthier, safer, more palatable and environmentally or animal friendly (Caswell and Mojduszka, 1996; Krystallis and Chryssohoidis, 2005; Roosen, 2003; Schroeder, Marsh and Mintert, 2000). Product quality can be categorized into search, experience and credence attributes: Search attributes such as product colors can often be determined by consumers before purchasing; experience attributes, such as tastes, can be judged after a product is purchased and used by consumers; and credence attributes such as the nutritional level and safety cannot be observed by consumers either at purchase or after purchase (Nelson 1970, 1974 and Darby and Karni, 1973). As most attributes relating to food quality are credence or experience attributes, consumers can not use their purchasing power to reveal their true demand for those attributes without additional food quality information. Producers are reluctant to provide higher quality food attributes that require higher production cost if there is no way to capture the added value associated with increased product quality.

Because consumers have relatively sufficient information on search attributes, the market functions well for those attributes. For experience attributes, the problem of asymmetric information exists. Though this issue can be reduced by consumers' repeated purchases and the communication between informed and uninformed consumers, the transaction cost of acquiring quality information is high. And the effects of those mechanisms depend on the efficiency of information exchange among consumers and consumer loyalty to firms producing higher quality products. As for credence attributes, no practicable ways exist for consumers to obtain information on the food quality by themselves. Without additional food quality signals, the market for credence attributes is inefficient (Caswell and Mojduszka, 1996).

The asymmetric information problem in the market of experience and credence attributes can be solved by transforming experience and credence attributes into search attributes. Food labeling is one means to signal food quality to satisfy consumers' information needs, thus

improving market efficiency. Though food labeling is not perfect for transferring quality information to the market (Caswell and Mojduszka, 1996; Crespi and Marette, 2003), it is increasingly used by both food companies as well as governments. Mandatory and voluntary labels are two forms of food labeling. Under a mandatory labeling program, governments establish the rules and guidelines of labeling and all the companies covered by the program are required to follow the guidelines to label their products. In a voluntary labeling program, companies have the right to label or not label their product. However, as long as they choose to label their products, they must follow the guidelines and make sure the labeled products satisfy certain government or private standards (Golan, Kuchler and Mitchell, 2005).

Because different consumers have different perceptions of the same food label and different food companies are impacted differently by a label policy, it is almost impossible to have a policy that satisfies all the members of society. Many issues exist with regard to labeling or not labeling certain food quality attributes including whether the labeling policy should be mandatory or voluntary (Crespi and Marette, 2005; Golan, Kuchler and Mitchell, 2000). To determine whether and how a policy should be implemented, economists make use of welfare analysis of the policy of interest. Welfare analysis may consider the effect of policy on both supply and demand, including how the labeling program would affect the cost of production and how consumers respond to the label on food products, thus the net welfare effect of the policy is determined (Lusk and Anderson, 2004; Brester, Marsh and Atwood, 2004; Lubben, 2005). In addition, if food companies believe that the cost of labeling their products can be offset by increased demand for labeled products, and bring them more profit, they may voluntarily choose to label their products without a mandatory government labeling policy.

Consumer willingness-to-pay (WTP) for certain food quality attributes is an important indicator of consumer response to food labels and a determinant of the change in the demand under a food labeling program. The estimated WTP can be used as an input or proxy of demand change in the welfare analysis of food policy and provide useful information for food companies to make decisions on food labeling programs. As a result, besides the study on the impact of food labeling on the production cost, accurately eliciting consumers' WTP for food labels is very important.

Contingent valuation (CV), choice experiment (CE) and experimental auction (EA) or the combinations of the three methods are most often used by researchers to elicit consumer

willingness to pay for product attributes. In the CV method, respondents are provided with detailed information on products and then are asked if they would like to pay a certain amount of money for the new products (referendum CV) or how much they would like to pay for the new products (open-ended approaches). CE is also called stated preference (SP) method or choice-base conjoint analysis. In the CE method, products are described as bundles of several attributes varying in levels and respondents are asked to choose among those alternatives. Econometric models are used to estimate consumer willingness to pay for a specific attribute (Louviere, Hensher and Swait, 2000; Lusk and Hudson, 2004). In EA, consumers bid to exchange their endowed product for a product which has new attributes or they can bid directly on several competing goods. Willingness to pay for the products can be elicited from consumer bids (Lusk and Hudson, 2004).

Economists and market researchers have used these methods extensively to elicit consumer WTP for food labels on attributes such as tenderness of beef, country of origin of meat and vegetables, organic foods and foods containing genetically modified organisms (GMO). The main pitfall in these studies is that different quality attributes of food are assumed independent when eliciting WTP. That is, in CV or EA methods the alternatives for respondents to make choices or bid only differ in prices and one or a few quality attributes of researcher interest, lacking information on other food quality attributes and no interaction between attributes can be investigated. For instance, to estimate consumer WTP for country of origin label (COOL) under CV or EA, respondents are asked to choose between foods with or without COOL or bid for products with or without a label, no other information on safety, nutritional level, etc. on those products is provided. In CE, respondents make choices from the alternatives which differ in numerous quality attributes, but consumer WTP for one attribute has no effect on WTP for the other attributes in most studies. This is because consumer utility functions are assumed to be linear in quality attributes. For example, if a consumer's marginal WTP for tenderness in beef is $0.30 and WTP for COOL is $0.20, consumer's WTP for tenderness and COOL is just the sum of the WTP for the two attributes separately or $0.50.

Two basic relationships exist between quality attributes. In the first case, one attribute is a cue to other attributes or overall quality. For instance, country-of-origin, and organic labels may signal the information or perceptions about food safety or be treated as a sign of overall product quality (Strutton and Pelton, 1993; Maheswaran, 1994). In the second case, one attribute

does not necessarily signal any information on the other attributes. For example, tenderness cannot provide any safety information or nutritional information about a product.

In the first case, because one attribute (attribute A) is a cue to another attribute (attribute B) or could be a proxy of overall product quality, we would expect that an interaction between attribute A and attribute B exists. As attribute B is revealed, attribute A may, to some extent, lose its power of signaling product quality and consumers may put less value on attribute A. Thus, in WTP estimation, the assumption of the independence of quality attributes may not be proper.

Even in the second case, the interaction between food attributes may still exist. That is, in surveys (CV, CE and EA), consumers tend to be forced to focus on the limited attribute information provided to them, while in the real world, consumers have various sources to obtain food quality information (experience, friends, media). If consumers maximize their utilities subject to their budget constrains by choosing the optimal attribute bundles (Lancaster 1972), the limited attributes provided in a survey may lead respondents to allocate their budgets to those limited attributes rather than allocate their budgets to a larger number of product attributes as they actually do in reality. Therefore, we may over-estimate the amount they would be willing to pay for the label compared to what they actually would pay in the real world. The independence assumption in current WTP estimation methods may partially explain the frequently high value of WTP for food labels on certain attributes.

Similar to the relationships between different goods in traditional demand analysis, quality attributes could be complements or substitutes for each other. By complements we mean that the appearance of one attribute enhances consumer WTP for the other attribute: consumers are willing to pay more for one attribute after the other attribute is revealed. By substitutes, we mean that the appearance of one attribute reduces consumer WTP for the other attribute: consumers are less willing to pay for one attribute after the other attribute is revealed.

Objective

Consumer WTP for food attributes is a major proxy of measuring the demand of food products using labels to reveal food attributes. These changes in demand are very important in welfare analysis and food industry food labeling decisions. A clear view of how additional food quality attributes affect consumer WTP for labels on cue attribute and independent attributes will

help economists to better understand their welfare analysis of food label policy using WTPs from published studies as well as enhance producer ability to make more appropriate decisions on launching labeling programs based on current WTP estimates.

The main objective of this study is to reveal the marginal impacts of additional food quality information on consumer WTP for food labels.

To accomplish the primary objective, we will conduct several surveys to investigate the changes in consumer WTP for certain food labels as more information on food quality attributes are provided to respondents. Because of the two types of the relationships between food attributes (cue or independence), we will choose two sets of attributes. One set of attributes includes a cue attribute and several other independent attributes and the other set of attributes only have independent attributes.

The specific hypotheses are:

1. With more information on food safety and other quality attributes disclosed, consumers tend to decrease their WTP for a particular food attribute if this attribute is a cue or proxy for other quality attributes.
2. In the case where one attribute A is not a cue for the other attributes, as more information on food quality attributes are added, WTP for the attribute A changes. If the added attributes are substitutes for attribute A, then WTP for attribute A decreases. If the added attributes are complements for attribute A, then WTP for attribute A increases.

CHAPTER 2 - LITERATURE REVIEW

The first part of the literature review will focus on the classification of and the relationship between food quality attributes. Previous studies of consumer perceptions and WTP for COOL and other food attributes will comprise the main body of the literature review. From the literature review, we want to gain relevant information to help us choose a proper survey method, econometric models and food quality attributes used in our analysis.

Food Quality Attributes and Classifications

In an objective way, food quality can be defined as an intrinsic property of food which meets a pre-standard requirement. In this way food quality can be determined by nutritional properties, hygienic properties, organoleptic properties, and functional properties of the food (Abalaka, 1999). With consumer involvement, food quality can be described by a bundle of characteristics, both objective and subjective, that satisfy consumer requirements (Schröder). Those characteristics can be categorized as intrinsic attributes and extrinsic attributes. Intrinsic attributes are those attributes that are an integral and inseparable part of the physical products. Extrinsic attributes are not physical components of the product and can be assigned after the production process (Kirmani and Rao).

Schröder classified intrinsic attributes based on physical, chemical, microbiological and production process characteristics into product-focused attributes and process-focused attributes. Product-focused attributes include composition, contaminants and performance attributes. Food composition attributes focus on the nutritional content of foods including dietary fuels, dietary fiber, nutrients bioactive compounds and chemical additions. Contaminant attributes refer to whether foods are contaminated by pests, microorganisms, chemicals and foreign matter. Performance attributes mainly tell about how foods perform in accordance to certain quality criteria, including sensory, shelf life, food safety, performance in use as well as weight and measures. The process-focused attributes are divided into service and provenance attributes. Service attributes tell about predictability, versatility, stock control, availability and product support of the food. Provenance attributes are about where and how foods are produced including the origin of the food and the production system. Caswell, Noelke and Mojduszka classified intrinsic attributes mainly according to the aspects of food functionality, including

safety, nutrition, sensory/organoleptic and value/function attributes. Since the production process is an inseparable part of food, they also include process attributes as a group of intrinsic quality attributes.

The extrinsic attributes of food can be defined from two dimensions, test/measurement indicators and cues (Caswell, Noelke and Mojduszka, 2002). Test/measurement indicators include quality management systems, certification, and records. Cues include prices, brand name, manufacture name, packaging and warranty.

Based on whether one attribute provides any information about other attributes and overall product quality, relationships between food attributes can be classified as independence or cues. Though extrinsic attributes are not integrated with the physical products, most studies show that extrinsic attributes are cues for intrinsic attributes and perceived product quality (Miyazaki, Grewal and Goodstein 2005; Brucks, Zeithaml and Naylor 2000). The relationship between intrinsic attributes is relatively difficult to determine. From a scientific perspective, any change in one intrinsic attribute may relate to changes in other attributes. The production system, including climates, breeds, production technology/method, traceability, place of origin and etc. determine the physical, chemical or even macromolecular structure of food (Composition and contaminants attributes) and therefore determine the performance of foods in sensory, shelf life, characteristic in use and safety aspects. From consumer perspectives, a clear and definite dichotomy of the independent and cue attributes is difficult, because this relationship depends on consumer scientific knowledge and perceptions about the food production system. For example, beef flavor and tenderness of meat is mainly affected by the mixture of fat with lean muscle in a cut of meat, an expert in meat scientist will know this relationship better than other people. On the other hand, most consumers can link provenance or process attributes to composition and performance attributes--organically produced products are normally perceived safer, healthier than their conventional counterparts and country of origin of product is seen as an indicator of product safety, freshness and overall quality. Based on most consumer studies, provenance/process attributes can be treated as cues of other intrinsic attributes, and other intrinsic attributes can be seen as independent.

Food attributes could also be categorized into search, experience and credence attributes based on the information environment when consumers make purchase decisions. Search attributes can be judged before consumer buy foods, experience attributes can be evaluated only

after the products have been purchased and used, while credence attributes cannot be evaluated even after the product have been used. Most intrinsic attributes of foods are credence attributes and intrinsic search attributes are limited, including color, appearance, softness, shape smell and others, most are sensory/organoleptic attributes. The number of intrinsic experience attributes is also small, including taste, tenderness, freshness, performance in use and etc. In contrast, most extrinsic attributes are search attributes, including price, brand and store name, certification and so on (Caswell, Noelke and Mojduszka, 2000).

An attribute can shift between search, experience and credence attribute by means of labeling, package, taste test, etc. (Grolleau and Caswell, 2005). For example, current Nutrition Labels provide most of the information on nutrients of foods, thus transfer credence nutritional attributes into search attributes. By using opaque package, search attributes such as color and smell can be transformed into credence attributes. And experience attributes such as flavor and tenderness could be transformed into search attributes by free taste before purchase (Grolleau and Caswell, 2005).

At present, consumers are demanding more information about food quality. Because most intrinsic attributes that determine the quality of foods are credence, it's very difficult for consumers to judge food quality at purchase, resulting in an imperfect market of food quality. More concerns are on converting credence attributes into search attributes.

The third classification of food attributes is based on consumer preferences for attributes. If consumers have same ranking on one attribute, the attribute is said to be vertically differentiated, whereas an attribute is horizontally differentiated, if consumers have different rankings on one attribute (Caswell, Noelke and Mojduszka, 2000). For example, food safety attributes are vertically differentiated, because consumers will always choose safer foods if two products are the same in all other aspects. However, some sensory attributes such as color, appearance and taste are horizontally differentiated, because consumers have heterogeneous preference for those attributes. Whether an attributes is vertically or horizontally differentiated is more an empirical issue rather than a theoretical problem. Normally the more important is one attribute in a consumer's utility function, the more likely the attribute to be vertically differentiated. Attributes which are related to food safety and health are more likely to be vertically differentiated.

Combining all the aspects of food attributes regarding intrinsic and extrinsic, cue and independent, search, experience and credence, as well as vertically and horizontally differentiated, we can summarize the major food quality attributes according to Schröder and Caswell, Noelke and Mojduszka studies. Figure 2.1 shows that intrinsic attributes include product-focused attributes and process-focused attributes. All the product-focused attributes are independent while process-focused attributes are cue attributes of product-focused attributes and overall food quality. Composition and contamination attributes are more likely to be vertically differentiated whereas performance attribute and process-focused attributes are horizontally differentiated. Most intrinsic attributes are credence attributes including safety attributes, nutrition attributes, province attributes and some of the value function attributes. Search (single stared) and experience (double stared) attributes only appear in performance attributes which include sensory/organoleptic attributes and value/function attributes. All extrinsic attributes are cue attributes, and most of them are horizontally differentiated. Only price, reputation and warranty are vertically differentiated attributes, because all consumers will prefer products with low price, good reputation and long warranty (Figure 2.2). Caswell, Noelke and Mojduszka classified irradiation and fumigation as food safety attributes and quality management systems and country of origin as extrinsic attributes. This classification is arguable. First, all other food safety attributes are about physical food product, while irradiation and fumigation is more likely a method used in food production process. In addition, unlike price, brand name and other extrinsic attributes, both quality management systems and country of origin are permanent and inseparable from physical product. Therefore, it is more reasonable to classify those two attributes into province attributes.

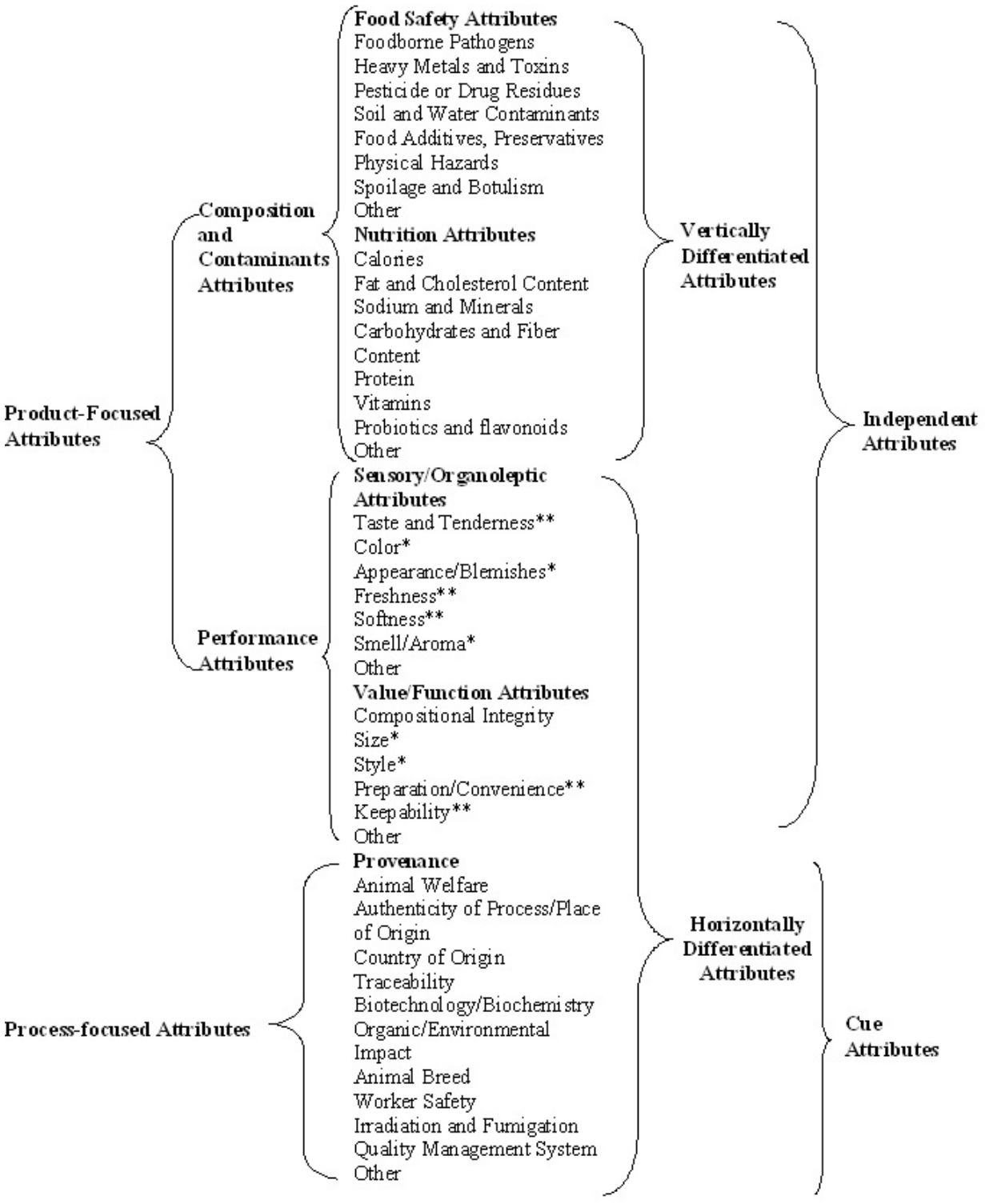

Figure 2.1 Intrinsic Quality Attributes

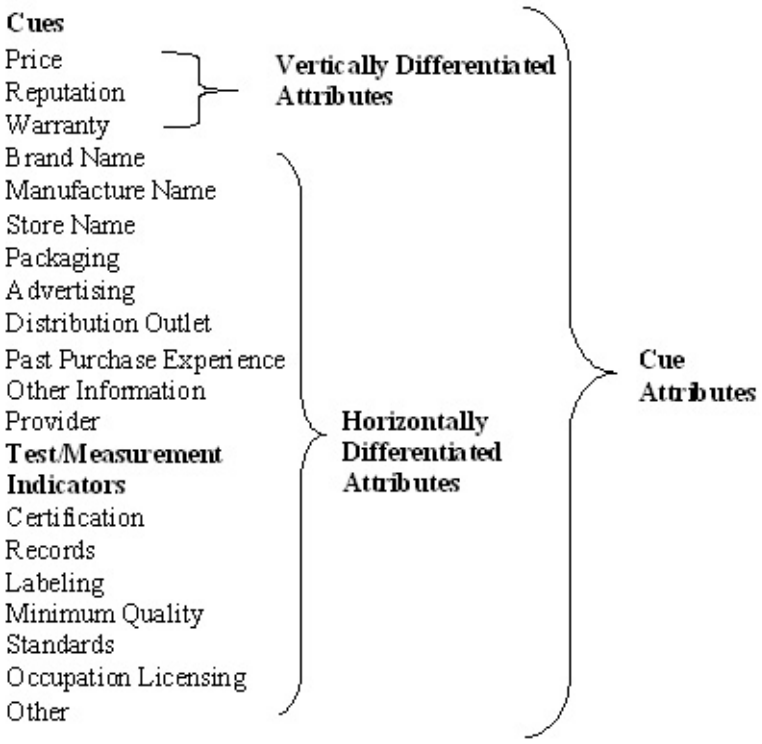

Figure 2.2 Extrinsic Quality Attributes

Consumer Perception of Various Food Attributes

Because most intrinsic attributes are credence, and the number of them is huge, it is not economically possible to reveal all the information through labeling due to the cost of test, record tracking and certifying as required by a labeling process. Market researchers and economists are trying to decide which quality attributes are important to consumers and how much consumers want to pay for them in order to provide information to firms who consider providing value-added products or labeling the attributes of their product. Also, consumer perception and WTP for food attributes are important to economists who conduct welfare analysis of food labeling. Numerous studies have examined consumer perceptions and WTP for various foods attributes: both product-focused and process-focused attributes. Product-focused attributes include tenderness, fat percentage, and leanness. Process-focused attributes include organic, eco-friendly, country-of-origin, reduced or no pesticides, growth hormones and antibiotics used in production, irradiation, and genetically or non-genetically modified. The results of these studies vary, but most of the studies show that consumers are likely to purchase and willing to pay more for foods that possess "good" attributes such as tender, organic produced, non-genetically modified and local or country-of-origin labeled.

A vast literature exist assessing consumer valuation of a variety of food products. Rather than review the massive literature in this area, the literature review here will only focus on studies relating consumer attitudes and WTP for hormone-free, country-of-origin and genetically or non-genetically modified food. Hormone-free production is a process-focused attribute and is closely related to food safety issues. GM technology can be considered as both contaminants attribute (food contained GM ingredients) and process attribute (food produced using GM technology or food produce from animal feed with GM crops) and consumers always related GM foods to health and safety problems. COOL is a process attributes and most study shows that consumers closely related it to food safety, freshness and overall food quality. Those three attributes cover most aspects of food quality including food safety, nutrition, and provenance. From the literature review, we want to have an overview of consumer attitudes toward food attributes and get information on survey methods and econometric models used in those studies.

Consumers Attitudes toward Hormone-treated or Hormone-free Foods

Synthetic growth hormones are widely used in milk and livestock production because they reduce cost of production. However, consumer concern regarding the long-term effect of hormone on human health has been increasing concomitant with more food safety issues related to food-born diseases. Not surprisingly, studies show that most consumer perceptions of growth-hormones in food production are negative, and they tend to pay less for products grown using growth-hormones. Various techniques are used in studies on consumer perceptions and WTP for hormone-free or hormone-treated products, including experimental auctions and choice experiments. The most studied foods are milk and beef. In addition country-of-origin and GMO are two frequently used attributes besides growth-hormones in choice experiments.

Fox et al. (1994)

Using the Vickrey experimental auction, Fox et al. studied consumer willingness to accept milk from cows treated with bST (bovine somatotropin) in Iowa, Arkansas, Massachusetts, Urban Californian and rural California from July 1992 to March 1993. Fifteen undergraduate students participated in one of five auctions where there were 20 repeated trials in each. Participants were asked to bid for prices to exchange their endowed milk produced by typical dairy cows for milk produced from cows that received bST. In the first 10 trials, no information on bST was provided, and thereafter detailed description of bST was provided to participants. Results showed that all the bidding prices increased from trial 1 to trial 10, especially prices in urban California and Massachusetts, implying that participants were trying to avoid bST milk. From between trial 10 and 11, the mean bid fell except in Iowa. The reduced bid indicated that the impact of information on participant behavior which assured that bST milk was very similar to regular milk. Overall, most participants (60%) were willing to pay $0.25 or less to avoid bST milk. A niche market may exist for bST-free market as some participants especially those in Massachusetts would pay more that $1.00 to avoid bST milk.

Fox (1995)

Using the data from the same experimental auction, Fox analyzed the effects of participant's previous knowledge, information and demographic characteristics on consumer attitudes toward bST milk. The econometric analysis was based on Heckman's (1976, 1979) two-stage estimation procedure, in which a probit model was first estimated using full sample, and then OLS model was estimate for the sub-sample data where all bids were positive. The

probit result using the first bid showed that participant attitude towards genetic engineering/biotechnology had the most impact on the probability of bidding for milk without bST. However, the negative coefficient of food safety concern was unexpected because increased food safety concerns are likely to increase participant bids for normal milk. The second-stage OLS estimation indicated that concern for animal welfare increase bids for "normal" milk. Also, the results did not show any evidence that prior knowledge of bST affected participant probabilities of choices and bids at either stage. The model used the averages of three-trial stable bids before and after bST information to investigate the effect of information on participant behavior. Results implied that females were more likely positively affected by the information on bST, and tended to bid more than males. Participant safety concerns, prior knowledge of bST and region where they lived had significant impacts on bids. In addition, likelihood ratio tests indicated that great regional differences in participants bidding behaviors in both milk selection and bidding prices.

Wang et al. (1997)

Wang et al. used a two-limit Tobit model to estimated consumers' WTP for rBST-free milk using survey data collected from 702 Vermont households in 1995. Their results showed that 50.6% consumers would like to pay a premium up to 40 cents for rBST-free milk, 12.0% were willing to pay a premium up to 41 cents or more and 37.4% were not willing to pay any premium. The estimation of the two-limit Tobit model implied that consumers who have negative impression of rBST milk tend to pay more for rBST-free milk; females, higher income had positive impacts while education level had negative impact on consumer WTP for rBST-free milk; urban consumers were more likely to pay more for rBST-free milk, and age didn't had significant impact on consumers' WTP.

Alfnes and Rickertsen (2003)

Alfnes and Rickertsen conducted ten sessions of second-price auctions in Norway with total 106 participant to investigate consumer WTP for Norwegian, Irish, U.S. hormone-free and U.S. hormone-treated rib-eye steaks. In each session, six trials were conducted and participants were allowed to taste the steak after the third trial. Participants were also given endowments to reduce the possibility that they bid lower prices in order not to take beef home for the sake of convenience. Norwegian and U.S. hormone-treated beef was used as endowments in five of ten sessions respectively. Results showed that domestic hormone free beef (Norwegian) received

the highest prices, followed by Irish hormone-free, U.S. hormone free and U.S. hormone treated beef. The bids increase over trials at a decreasing rate, reflecting the learning behavior of participants of the auction market mechanism. On average, participants would pay NOK 9.88, NOK 2.48 more and NOK 11.99 less for domestic, Irish and U.S. hormone-treated beef than U.S. hormone-free beef. The differences between one product and other alternatives were lower when the product was used as a base product and the differences between alternatives was not affected by the base product if none of the compared alternatives was base product. Taste of products did not significantly affect WTP differences between U.S. hormone-free beef and other alternatives except Irish beef. Most of the participants (72%) prefer U.S. hormone-free to hormone-treated beef, 10% prefer hormone-treated beef and 18% were indifferent between those two, suggesting heterogeneous preferences among consumers.

Alfnes (2004)

Using choice experiment survey data of 1066 individuals in five regions of Norway, Alfnes investigated consumer preferences for beef from Norway, Sweden, Ireland, the USA and Botswana. Mixed logit models were used in the paper to capture the "random taste variation, unrestricted substitution patterns and correlations in unobserved factors over time". Their results showed that, on average domestic beef (Norway) was the most preferred followed by beef from Sweden, Ireland, the USA and Botswana. Irish and U.S. hormone-free beef were perceived almost identical while U.S. hormone-free beef was preferred to U.S. hormone-treated beef. The average marginal willingness to pay for Swedish, Irish, US hormone-free, Botswanan and US hormone-treated beef were -34,-59,-66,-110 and -246 NOK compared to Norwegian beef. Large differences existed in consumers attitudes toward country of origin and hormone status of beef. Country of origin is important for beef bought form grocery stores while not for beef in restaurants. Females and older people were less likely to purchase imported and hormone-treated beef than males and younger people. Urban residents and those with more trade and abroad experience had higher probability to choose imported beef, while income did not have a significant effect on consumer choice of imported beef. Education positively affected consumer choice of imported hormone-free beef and negatively affected the choice of hormone-treated beef.

Chakraborty (2005)

Chakraborty conducted a mail survey in Kansas which resulted in 700 returned questionnaires to study consumer attitudes toward bST milk and factors that affected consumer choice behavior. Results showed that 70 percent of respondents did not have any knowledge on bST technology, and only 28% had some knowledge. Most respondents (76%) were concerned with potential health risk of bST and 74% preferred labeling bST information in milk and milk products. About 26 percent of respondents were willing to pay a premium for bST-free milk, while 38% would not, with remaining 36% uncertain about their choices. With lower-priced bST-treated milk and higher-priced bST-free milk, 19% of those uncertain respondents choose bST-treated milk while 61% preferred bST-free milk. Overall, 45% of respondents were not willing to pay a premium for bST-free milk, 47% were in favor of bST-free milk and 8% were still not sure about their choices. The results of discrete choice probit model showed that lower education level, less knowledge of bST technology increases the probability of consumers paying a higher price for bST-free milk. Respondent confidence in food labels also increased the probability of willingness to pay a higher price for bST-free milk.

Tonsor et al. (2005)

Tonsor et al. used data from a non-hypothetical choice experiments to investigate consumer perception of beef steak attributes such as hormone-free, GM-free, farm-specific source verification and domestic origin in London, Frankfurt and Paris. Altogether, 248 consumers participated in the experiment in local supermarkets. In the choice experiment, each consumer was asked to choose one of five beef steaks of which varied in 4 price levels. The results showed that consumers in EU were concerned with the use of hormone and GM crops in cattle production. Less than 9% of respondents were willing to buy typical USDA Choice beef, while more than 20% choose USDA Choice No Hormone or GM beef when all beef steaks had the same prices. Paris consumers were more concerned with source verification of beef: in most cases, Domestic Source Verified beef was chosen by more than 40% of participants. Compared to French consumers, consumers in England and Germany were more likely to purchase U.S. beef and were more concerned about hormone and GM attributes of beef. A random parameters logit model was used to estimate consumer willingness to pay for each attribute and analyze the effect of demographic characteristics on consumer choice behavior. The estimated WTP for USDA Choice No Hormone beef were $7.13/lb, $8.27/lb and $1.01/lb for consumers in London, Frankfurt and Paris respectively. Average consumer WTP for GM-free beef steak were $2.64/lb,

$4.25/lb and $2.27/lb respectively for Paris, Frankfurt and London consumers. However, only the premium for Paris consumer was significantly different from zero. Premiums of Domestic Typical steak relative to USDA Choice No Hormones or GMs steak were $2.07/lb and $5.96/lb respectively for London and Paris consumers, while Frankfurt consumers would like to pay $3.74/lb more for USDA Choice No Hormones or GMs steak. None of those premiums were significantly different from zero at 5 percent level. Premiums for source verification attribute were $4.88/lb, $1.47/lb and $5.75/lb respectively for London, Frankfurt and Paris consumers. All the premiums were significantly different from zero at 10% level. Income, gender and education significantly affect consumer choices of the USDA Choice No Hormones or GMs, Domestic Typical and Domestic Source Verified steaks in all three locations. In addition, consumers' preferences of beef were heterogeneous not only across countries but also within each country.

Consumer Perception of Country-of-Origin Label

Many studies on country-of-origin labeling related to product evaluations show that country-of-origin could be a signal of product qualities and thus affect consumer choice (Maheswaran, 1994; Haucapet, Wey and Barmbold, 1997; Strutton and Pelton, 1993; Cai, Cude and Swagler, 2004). However, studies on U.S. consumer willingness to pay for foods with country-of-origin label are limited. The first survey is conducted by Schupp and Gillespie in 1999 to estimate Louisiana household reactions to country-of-origin labeling of fresh and frozen beef. And the most recent one is a survey carried out by Mabiso et al, which estimated consumer willingness- to-pay for fresh apples and tomatoes in late 2003 and early 2004. Those studies find similar results that food safety, freshness and quality are the main reasons that consumers chose U.S. products. However the percentage of consumers that supported "Certified U.S." foods and the amount of premium that consumers would like to pay for COOL vary in different studies.

Schupp and Gillespie (2001)

Schupp and Gillespie conducted a mail survey of 2000 randomly selected households in Louisiana located in four rural and four urban areas. The returned surveys were 381 (19.1%), which result in 337 useful questionnaires. The questionnaires were designed based on Dillman (1978) procedures. About 93 percent of respondents would like the beef in grocery stores to have country-of-origin labels and around 88 percent of respondents preferred restaurants to label

the country-of-origin of beef used in the meal. Nearly 86 percent of respondents rated U.S. beef better than imported beef primarily because the expected higher qualities of U.S. beef. Food safety and potential disease carried by imported beef were the other two main reasons that they considered U.S. beef superior to imported beef. A binomial probit model was used to analyze characteristics that could influence consumer attitudes toward COOL. Consumers who preferred domestic durable products and those who thought U.S. beef was safer and had higher quality were more interested in COOL of beef in both grocery stores and restaurants. Income was not a significant factor that affected household decisions to choose U.S. beef, possibly due to the high percentage of higher income households in the samples. Males and households with a single head or with children were less interested in COOL than others.

Loureiro and Umberger (2003)

Schupp and Gillespie's research only studied consumer attitudes toward country-of-origin labeling without eliciting consumer WTP. Realizing this drawback, Loureiro and Umberger surveyed 243 Colorado consumers in eight supermarkets located in Denver, Fort Collins and Boulder during spring 2002 to estimate consumer WTP for COOL. Consumers in the survey were randomly selected by asking every third consumer entering the store. The survey asked respondents about their purchasing behavior, attitude toward beef, desirable attributes of beef, food safety concerns and the premium WTP for "Certified U.S. Beef", "Certified U.S. Beef" steak" and "Certified U.S. Beef" hamburger". The amount of money they would be willing to spend to support the COOL program was also asked. Probit models were estimated for beef, beef steak, and beef hamburger respectively to determine the factors that affected consumer preferences and willingness to pay for COOL. The results showed that on average, surveyed consumers would be willing to pay a premium of 38% and 58% for "Certified U.S." steak and hamburger respectively. In addition, they would be willing to spend about $184 per household annually to support mandatory COOL program. Females, consumers with higher education, primary shoppers in the household as well as those who were concerned about food quality and safety preferred mandatory COOL compared to their counterparts. Similar to Schupp and Gillespie's results, consumers with higher income and those who had children were less interested in paying a premium for COOL. Their explanation for the negative marginal effect of higher income was that wealthier consumers had more confidence in the safety of meats they

consumed, because they can afford more expensive foods which were considered to be safer and have higher quality.

Umberger et al. (2003)

Umberger et al. extended Loureiro and Umberger's study by combining contingent valuation approach and experimental auction to estimate consumer WTP for COOL allowing consumers to visually examine real steak products. In June and July of 2002, 273 randomly selected and screened consumers in Chicago and Denver participated in the study. Consumers were first requested to complete a survey on their preference for country-of-origin labeled steak and hamburger over an unlabeled counterpart and their WTP for these products. Thereafter, consumers participated in a random n^{th} price auction in which the participant submitted sealed bids for each product in the experiment simultaneously, and those whose biding prices were higher than the randomly drawn n^{th} highest price of each product win the products. New York Strip steaks wrapped in styrofoam packages identical in size, color, marbling and external fat were used in the auction. However, one steak was labeled with "USA Guaranteed: Born and Raised in the U.S.A" and the other was without label.

The survey results showed that 75% of consumers preferred products with origin labels and 22% were indifferent between the label and unlabeled products. Seventy-three percent of the consumers were willing to pay a premium for COOL, and the premium for labeled steak and hamburger were 11% and 24% respectively. Twenty-six percent of the participants were not willing to pay a premium for country-of-origin labels. The experimental results showed that 69% of the consumers in the auction were willing to pay a premium for the U.S. labeled steak, and the average premium was about 19%. Consumers in Chicago were willing to pay a premium as high as 23% for the U.S. labeled steak compared to the 14% premium paid by Denver consumers. About 7% of the consumers did not prefer the labeled steak and 24% of the consumers showed indifference between the labeled and unlabeled steaks. The major reasons that consumers preferred COOL were: "food safety concerns about imported beef, a preference for labeling source and origin information, a strong desire to support U.S. products, and beliefs that U.S. beef was of higher quality." The results of the logit model indicated that consumers that were more concerned about freshness, source assurance, locally raised cattle and COOL and those who preferred not to purchase beef in supermarkets were more likely to pay a premium for

USA Guaranteed labeled steaks. Consumers with higher income and with higher preference for organic or natural product were less interested in COOL.

Loureiro and Umberger (2005)

Previous studies were conducted regionally and had relatively small sample size. In spring 2003 Loureiro and Umberger mailed surveys to 5000 households in the continental United States and received 632 (12.6%) completed returned surveys. Besides fewer minorities and older ages, the sample was consistent with U.S. Census data in terms of gender, education, income, children per household and household size. Binary logit model and random effects logit model were estimated to explore the effect of demographic variables and consumers' food safety perceptions on the WTP for each product. The results showed that only 30% of consumers were willing to pay a 5% premium for COOL meat products. The average premiums were about 2.5% for labeled chicken and pork and about 2.9% for labeled beef. As the premium for the country-of-origin labeled products increased, consumers are less likely to pay for COOL, implying a negative price-quantity relationship. Demographic variables affect consumer WTP for COOL for all meats products in the same direction; however the effects were different in scale for products. Income had a significant positive marginal effect on consumer WTP for COOL of beef and pork. Older, higher educated and male consumers had less desire to pay for COOL. Food safety and freshness of meat were the two most important reasons that consumer chose "Certified U.S." meats products. With regard to the agency that consumer trusted the most to certify COOL, approximated 60% preferred USDA/AMS inspection service. Nearly 39% of respondents preferred government to pay the COOL-related certification costs and 36.2% agreed to pay the costs through higher meat price.

Mabiso et al. (2005)

Mabiso et al. tested consumer willingness- to-pay for fresh apples and tomatoes with country-of-origin labels. Data were colleted in December 2003 and January 2004 using both questionnaires and Vickrey experimental auction methods. A total of 335 shoppers in three different cities in three states (Florida, Georgia and Michigan) were surveyed which resulted in 311 usable observations. The sample had more female, higher educated and higher income consumers compared to the U.S. census. A double hurdle probit model was applied to estimate the effects of demographic characteristics on consumer WTP for COOL. Approximately 79% of the respondents were willing to pay a premium for "Grown in the U.S." labeled apples and 72%

of the respondents for labeled tomatoes. Premiums for labeled products were $0.49 for apples and $0.48 for tomatoes. Statistical analysis showed that the premiums were equivalent, which indicated that consumer WTP for COOL was not product specific for apple and tomatoes. Results from the double hurdle probit model indicated that older and wealthier people had less WTP for COOL and consumers in different cities had different levels of WTP for COOL. Quality perception of food as well as consumer trust in government agencies significantly influenced consumer decisions in the choice for COOL, while food safety concerns were more important when consumers were asked to decide the amount of money they were willing to pay for labeled products.

Consumer Attitudes toward GMO Labels

In general, consumer attitudes towards GMO foods are negative and consumers in various countries have different perceptions of GMO foods. Most studies show that consumers are willing to pay to know the information about GM in their foods when particularly asked about it. And a majority of consumers would not accept GMO foods (Hallman et al., 2003). However, GMO is not the most important characteristic of foods that consumers are concerned about (Cormick, 2005). If GMO foods could provide more beneficial characteristics, consumer rejection of GMO foods declined and their WTP for GMO foods increased. Current researchers pay more attention to how the beneficial attributes of GMO foods affect consumer attitudes toward or WTP for GMO foods (Hu et al., 2004; Lusk et al., 2004), and consumer perceptions of GMO foods in different countries (Lusk et al., 2003; Chern et al., 2002).

Chern et al. (2002)

Using stated preference methods, Chern et al. compared consumer attitudes and WTP for GMO vegetable oil and salmon in Norway, U.S., Japan and Taiwan. Their surveys on students indicated that most students in the four countries supported mandatory GMO labeling. Students in Taiwan were mostly concerned about the risk related to GMO foods, followed by Japan, Norway and U.S. However, the estimated premiums for non-GM vegetable oil were the highest for students in Norway and lowest for students in Taiwan, with American and Japanese students in between. They also completed pilot telephone surveys of 200 respondents in Norway and 256 respondents in the U.S. Results reinforced the findings inform the student surveys. Consumers in both countries supported mandatory GMO labeling and consumers in the U.S. were less

concerned about GMO foods than Norwegian consumers. The premium for non-GM salmon paid by Norwegian consumers was much higher than that by U.S. consumers (67% vs 54%). The relatively high premium for non-GM foods, as the author pointed out, might due to the small sample size and the stated preference method used in the study. Experimental auctions were suggested for further research.

Hallman et al. (2003)

Hallman et al. conducted a national telephone survey of 1201 U.S. households from February 2003 to April 2003. Their results showed more than half of respondents (54%) read food labels frequently, and most (78%) respondents were satisfied with current information on food labels. When GMO label was not mentioned, less than 1% of those who wanted to see more information on food labels listed GMO information as information they would like to see on food labels. However, when respondents were asked about their attitude toward GMO labels, 94% of them agreed that they would like to see GMO information on food labels. This phenomenon partially indicated that research questions reinforced consumer attention to the information of the research's interests. Majority of Americans did not have good knowledge of GMO foods, and did not realize that GMO foods had been sold in the market. Only 12% of respondents had ever read or heard frequently about genetic engineering and biotechnology, and 25% of respondents did not believe that GMO products were available in supermarket. Consumers had different attitudes for plant-based and animal-based GMO foods: 49% of respondents would like to accept plant-based GMO foods while the approval rate for animal-based GMO food was only 27%. Consumer rejection of GMO foods was reduced if those foods could bring certain benefits to consumers or the environment. Among those respondents who rejected GMO foods initially, 44% would buy GMO foods if the foods were produced with less use of pesticide than conventional food. Environment friendly production processes, less fat, and better taste of GMO foods were the other factors that changed opponents' minds to purchase GMO foods. Price did not play an important role in consumer choices regarding GMO foods. Demographic characteristics affected consumer perception of GMO foods. Females, old people and those with low level of education were more likely to reject GMO foods. Respondents who preferred natural and healthy foods, who had purchased organic food in the past were less likely to approve GMO foods. In addition, respondent perceptions about GMO foods could be easily influenced by the wording. Biotechnology received the most positive response while genetic

modification gave the most negative impression to respondents. The same question different in wording resulted in 21% difference in respondents reaction to GMO foods.

Lusk et al. (2003)

In 2000 Lusk et al. conducted several mail surveys in France, Germany, the United Kingdom and the United State to investigate consumer perceptions of beef from the cattle fed with genetically modified corn or raised with growth hormones in different countries. Choice experiment methods were used in the surveys where consumers were asked to choose between two rib-eye steaks with different levels of prices, taste attributes such as tenderness and marbling and the use or non-use of GM corn and growth hormones in live cattle production. Multinomial logit models and random parameter logit models which accounted for the heterogeneous preference among consumers were estimated. Results showed that consumers in different countries evaluated the attributes differently. Consumers in France were willing to pay a much higher premium ($9.94) for beef from cattle not raised with growth hormones than consumers in U.S. ($8.12), Germany ($7.29) and the United Kingdom ($7.39). However, consumers in France ($9.32), Germany ($7.64) and the United Kingdom ($6.31) showed similar evaluation of beef from animals fed with GM corn in contrast to consumers in U.S. ($3.31). Price and tenderness have more impact on the choice of U.S. consumers than that of European consumers. Respondents in France and Germany each had relatively homogeneous preferences for steak attributes. Consumers in U.K and U.S, however, showed heterogeneous preferences for steak tenderness and growth hormones.

Hossain et al. (2003)

Hossain et al. estimated a logit model with 992 observations obtained from a national telephone survey in 2001 to analyze the effect of product attributes on consumer acceptance of GMO. The basic scenario where GMO foods did not have any beneficial attributes was compared with the other three scenarios where GMO fruits and vegetables could bring better taste, extend product shelf life and reduce product price. Their results showed consumer acceptance of GMO foods increased as genetic modification technology could bring them direct benefits. When there were no beneficial attributes related to GMO fruits and vegetables, only 49 percent of respondents accept GMO products, in contrast to the acceptance rate of 71%, 62% and 74% respectively, when GMO could give better taste, increase shelf life and reduce the price of fruits and vegetables. The acceptance of GMO foods was primarily driven by consumer attitudes

towards government, scientists, biotechnology companies and their knowledge of science. Demographic characteristics were correlated with consumer attitudes toward GMO foods and the benefits of GMO foods. Male, white and middle-aged consumers were more likely to accept GMO products. In addition, no relationship between religion of consumers and their acceptance of GMO foods was found, which indicated that the debate on biotechnology was just risks and benefits, rather than a moral or ethical problem. The drawback of this study was that they did not elicit consumer willingness to pay for beneficial attributes incorporated in GMO products and the trade off between those benefits.

Tegene et al. (2003) Huffman (2003)

These two papers were based on the same experimental auction of vegetable oil, tortilla chips and russet potatoes. Tegene, Huffman and other researchers investigated the impact of positive, neutral and negative information on consumer willingness to pay for GMO label foods. The experiment involved 172 individuals, and 42% claimed to have certain knowledge about genetic modification technology. The information on GMO food was categorized from environmental group perspective (negative), agricultural biotechnology industry perspective (positive) and independent, third party perspective (neutral). In each category, the information included (a) general information of GM technology, (b) scientific impact, (c) human impact, (d) financial impact and (e) environmental impact of GM technology. During the auction, participants were randomly exposed to one of the six information packages, which included information from (1) industry prospective, (2) environmental perspective, (3) industry and environmental perspective, (4) industry and third party perspective, (5) environmental and third party perspective and (6) all three perspective. Results showed that consumers tended to pay 14% less to GM labeled foods than non labeled one. Information from environmental group perspective enlarged the difference between bid prices for labeled and unlabeled product while information from biotech industry perspective reduced the difference. The negative GM information did not dominate positive information: when information from both environmental group and biotech industry perspectives were provided, the difference between the bid prices for GM labeled and unlabeled commodities declined to -0.18 compared to -0.41 when only information from environmental group perspective was received by consumers. “Being out of market” was defined in the studies as a participant bid for a GM labeled product by at least one-third lower than the bid for unlabeled product. A probit model was used to study the effect of

information and individual characteristics on the probability of participants being out of market. Information from environmental perspectives increased the possibility that a consumer was out of the market for GM foods while information from the biotech industry and third party perspectives reduced the probability of a consumer being out of the market of GM foods. In addition, when the information from all three perspectives was received by participants, the impact of independent third party information almost offset the negative impact of the environmental group perspective. Demographic characteristics such as education, gender, household income and marital status did not have a significant effect on individual bidding, and consumers who claimed that they had knowledge on GM technology before the experiment had much higher possibility not to buy GM foods. Further studies, as authors realized, need to focus on the consumers' attitude to GM foods that had special beneficial attributes and how the "wording" of the label affected consumer willingness to pay for biotech foods.

Lusk et al. (2004)

Similar to Tegene et al. and Huffman's studies, Lusk et al. investigated the impact of information, especially, potential benefits of genetic biotechnology on consumer willingness to accept (WTA) GMO foods in United State (California, Florida and Texas), England (Reading) and France (Grenoble). In the experimental auctions, participants were divided into several experimental sessions and asked about the compensation needed for them to exchange a chocolate chip cookie containing no GM ingredients for a GM one. In the first 5 rounds of bidding, no beneficial information of GMO foods was provided. From the 6^{th} round of bidding, participants in each session were randomly exposed to one of the three types of beneficial information of GM food production, including an environmental benefit, a health benefit and a world benefit.

Consumer WTA GM foods before and after the beneficial information was compared using unconditional tests (parametric paired t-tests and non-parametric Wilcoxon signed-rank tests) and conditional tests (censored multivariate regression). The unconditional test showed that the environmental benefits of GM production had influenced consumer WTA significantly in all five locations. After the information on the benefits of biotechnology was provided, consumer WTA GM cookies reduced by $0.31, $0.20, $0.02 and $0.03 in Texas, California, Florida and England respectively, while the WTA for GM foods in France increased by $0.51. The increase of French consumer WTA of GM foods indicated that "French consumers initially

held negative attitude toward genetic modified technology and reacted in a manner opposite to that implied by the one-side information statement." Health benefits of GM foods had significant impact on WTA of consumers in Californian, Florida, Texas and England, but did not influence French consumers WTA GM foods. The information that GM production could increase world food supply increased the bids for GM foods in Texas and England significantly but didn't have significant affects on the WTA of French consumers.

The joint tests that all types of information had same impact on consumers' WTA of GM foods were rejected in all five locations. In California, environmental information had a larger effect, while in Florida health benefit had a larger impact. Meanwhile, the hypotheses that the same information had uniform impact on consumer WTA of GM food across location were also rejected. Consumer pre-acceptance of GM food influenced consumer response to the new beneficial information of biotechnology. Individuals who had higher WTA before the information shock reduced their WTA more than individuals with lower initial WTA. This is because consumers who had a higher WTA for GM food initially had more room to reduce their bids after new information was provided. In addition, higher subjective knowledge tended to be related to a smaller change in consumer WTA GM foods, because consumers with higher levels of subjective knowledge placed more weight on their prior information than those with low subjective knowledge.

Hu et al. (2004)

The research was based on the survey to 445 consumers across Canada. Respondents were asked to choose breads with different attributes including GMO ingredients, health benefit and environmental friendly at different price level or not to choose anything. A latent class model was estimate to capture the heterogeneity in respondent preferences. In the latent class model, the number of consumer segments could be endogenously determined. Their results indicated that most respondents were not influenced by the information on GMO ingredients, environmental and health benefits. Less than half of the respondents disagreed that the health and environmental benefits of GMO foods outweighed their corresponding risk. Respondents were separated into 4 segments, including the segments of value-seeking consumer, traditional consumer, fringe consumer and Anti-GM consumer. Consumers' attitude toward GMO and beneficial attributes varied greatly between different consumer segments. Value-seeking consumers and fringe consumers account for 55% of all respondents and were indifferent to GM

ingredients in bread. However, respondents in other consumer groups had a tendency to reject GMO foods regardless of the health and environmental benefits that were associated with GMO food. Respondent age was the most important factor impacting respondent segmentation. Young (younger than 25) and old (older than 67) people were more likely to be value-seeking consumers while other people tended to be either traditional consumers or Anti-GM consumers. As heterogeneous preferences among consumer existed, the author argued that it was not appropriate use to "the average consumer" in the analysis of policy impact.

Onyango and Govindasamy (2005)

In early 2003, Onyango and Govindasamy conducted a mail survey to explore how consumers made trade-offs between potential risks and benefits enhanced in GMO foods. Banana, Cornflakes and Ground beef were used in their stated preference choice experiment. Consumers were willing to pay more for benefits in foods related to direct health, environmental and production-related benefits. In general, respondents had a negative view on GMO foods, and placed more negative value on GMO foods using bacterium and animal-base biotechnology than the foods using own- and plant-based genetic modification. For bananas, 22%, 9% and 5% compensation were required for respondents to accept processes involving animal, bacterium and plant genes and there was 3% premium for bananas grown with less pesticides and chemicals. For cornflakes, respondents needed to be compensated by about 10-37% to accept genetically modified products, and they were willing to pay 5% and 19% for cornflakes using less pesticides and chemicals. With respect to ground beef, there were 3% and 2% premiums respectively for the benefit of antioxidants which can slow down the ageing process and less antibiotics in cow production. Respondents needed to be compensated 20% and 13% respectively to accept the genetic modified beef involving animal or bacterium genes.

In summary, most consumer perceptions of growth-hormones in food production are negative, and they tend to pay more for products grown without growth-hormones. However, compared to other attributes such as COOL, growth-hormone may not be the most important attributes that consumers concern about. Experimental auction and choice experiment are the major approach used in studies on consumer perceptions and WTP for hormone-free or hormone-treated products. Most studies focus on milk and beef and country-of-origin and GMO are two frequently used attributes besides growth-hormones in choice experiments. In addition,

consumer attitudes toward growth-hormone are heterogeneous both across countries and within countries.

All the studies show that consumers have positive impression of products with country-of-origin labels. Average premiums for COOL range from 2.5% to 58%. Most researchers use beef as subject in COOL study and only one study of COOL is about vegetables and fruits. Food safety concerns, product freshness, and food quality are the main reasons that consumers choose COOL products, while support for U.S. products is also a cause for consumers to support produce with COOL. Contingent valuation and experimental auction approaches are the major methods used in estimating consumer WTP. The main drawback of current studies is that country of origin labeling is often the only attribute in the consumer choice sets, thus the trade off between COOL and other quality attributes could not be investigated.

Consumers are inclined to reject GMO foods, and would like to see information on GMO in food labels. The premiums for non-GMO foods range from 14% to 67% if the GMO food does not provide beneficial attributes. With more information about the benefits of GMO products provided to consumers, consumer rejections of GMO food declined and in some case they were more likely to pay a premium for GMO foods. Compared to biotechnology used in animal products, genetic modification technology in plants are more likely to be accepted. EU consumers are more reluctant to accept GMO foods than U.S. consumers, and more compensation is needed in EU in order for consumers there to accept GMO foods. In addition, consumer perceptions of GMO food are not homogeneous even in the same country, and their reactions to the same information on GMO products differ. All the survey methods including CV, SP and EA are used in consumer perception and WTP of GMO foods. However, Hossain et al.'s study is the only one that analyzes the effect of product attributes, especially beneficial attributes of GMO products, on consumer acceptance of GMO. No research on the effect of product attributes on consumer WTP for GMO exists.

In all the studies, logit models are the most commonly used econometric models. Random parameter logit models are used to capture heterogeneous preferences among consumers. Probit models, latent class models and censored multivariate regressions are also used in current studies.

CHAPTER 3 - METHODOLOGY

Theoretical Model

Our model is based on the random utility theory which is widely adopted by researchers in WTP studies. As shown by Adamowicz et al. (1998), consumer utility could be defined by a deterministic component and a random component:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

where U_{ij} is ith individual's utility of consuming alternative j, V_{ij} is the systematic part of the utility function determined by the attributes of alternative j as well as individual i's characteristics, and ε_{ij} is a stochastic part following a certain distribution.

As in most studies, we can assume that individual has a linear random utility function of an alternative's attributes and individual's characteristics:

$$V_{ij} = \sum_{k=1}^{T} \beta_{ik} \cdot x_{ijk} + \sum_{l}^{m} \delta_l \cdot z_{il} \ . \tag{2}$$

where x_{ijk} is the kth attribute of alternative j, and z_{il} is individual i's lth characteristic. β_{ik} and δ_l is the marginal utility of alternative j's kth attribute and individual i's lth characteristic, respectively. T is the number of attributes of alternative j, and m is the number of characteristic of individual i.

Assuming that price is one of the attributes affecting consumer indirect utility, and consumer has homogeneous preference for price, then

$$V_{ij} = \alpha \cdot p_{ij} + \sum_{k=1}^{T} \beta_{ik} \cdot x_{ijk} + \sum_{l=1}^{m} \delta_l \cdot z_{il} \ . \tag{3}$$

And consumer i's random utility function is:

$$U_{ij} = \alpha \cdot p_{ij} + \sum_{k=1}^{T} \beta_{ik} \cdot x_{ijk} + \sum_{l=1}^{m} \delta_l \cdot z_{il} + \varepsilon_{ij} \ . \tag{4}$$

Consumer i's WTP for the kth attribute is the amount of money that he/she would like to pay to stay at his/her previous utility level when the kth attribute changes from one level to another level. Now assume that the kth attribute in alternative j improves from level 0 (without attribute k) to level one (with attribute k), the WTP of consumer i to accept this change is the price premium he/she would like to pay for this change such that the following equality holds:

$$V_{ij}\left(p_{ij}, x_{ijk}^{0} \mid x_{ijh}, z_{il}, h \neq k\right) = V_{ij}\left(p_{ij} + WTP^{k}, x_{ijk}^{1} \mid x_{ijh}, z_{il}, h \neq k\right) \ . \tag{5}$$

Assuming linear indirect utility functions as in equation (3), the equality in (5) can be expressed as:

$$\alpha \cdot p_{ij} + \sum_{\substack{h=1 \\ h \neq k}}^{T} \beta_{ih} \cdot x_{ijh} + \beta_{ik} \cdot x_{ijk}^{0} + \sum_{l=1}^{m} \delta_l \cdot z_{il} = \alpha \cdot (p_{ij} + WTP^k) + \sum_{\substack{h=1 \\ h \neq k}}^{T} \beta_{ih} \cdot x_{ijh} + \beta_{ik} \cdot x_{ijk}^{1} + \sum_{l=1}^{m} \delta_l \cdot z_{il} . \quad (6)$$

Solving for the WTP from equation (6), we get

$$WTP^k = -\frac{\beta_{ik}}{\alpha}(x_{ijk}^{1} - x_{ijk}^{0}) . \quad (7)$$

In equation (7), α is negative in most cases to satisfy a negative price and demand relationship. The sign of β_k depends on consumer perception of attribute x_{ijk}. If attribute k is the quality consumers prefer, β_k should be positive, then $-\frac{\beta_{ik}}{\alpha}(x_{ijk}^{1} - x_{ijk}^{0})$ is bigger than zero, which indicates that consumer would willingly pay a premium for the quality improvement. If attribute k decreases consumer utility, β_k will be negative, then $-\frac{\beta_{ik}}{\alpha}(x_{jk}^{1} - x_{jk}^{0})$ is less than zero, implying that consumer need to be compensated to accept the change in attribute k from status 0 to 1. As a result, for a linear indirect utility and utility function, such as (3) and (4), consumer WTP for kth attribute is the negative ratio of the parameter of kth attribute to the parameter of price: $WTP^k = -\frac{\beta_{ik}}{\alpha}$.

To test the effect of additional attributes on consumer WTP for attribute k in equation (3) and (4), we assume alternative j has additional M-T attributes (M>T). In this case, consumer i's indirect and random utility function can be expressed as:

$$V_{ij}^{*} = \alpha^{*} \cdot p_{ij} + \sum_{k=1}^{T} \beta_{ik}^{*} \cdot x_{ijk} + \sum_{k=T+1}^{M} \beta_{ik}^{*} \cdot x_{ijk} + \sum_{l=1}^{m} \delta_l^{*} \cdot z_{il} \quad (8)$$

$$U_{ij}^{*} = \alpha^{*} \cdot p_{ij} + \sum_{k=1}^{T} \beta_{ik}^{*} \cdot x_{ijk} + \sum_{k=T+1}^{M} \beta_{ik}^{*} \cdot x_{ijk} + \sum_{l=1}^{m} \delta_l^{*} \cdot z_{il} + \varepsilon_{ij} \quad . \quad (9)$$

Equations (8) and (9) imply that with more attributes added to the consumer utility function, the marginal utility of price and attributes change from α to α^{*} and from β_i to β_i^{*}, respectively. In addition, the marginal utilities of consumer i's characteristic changes

from δ to δ^*. With these changes, consumer WTP for attribute k will change from $WTP^k = -\frac{\beta_{ik}}{\alpha}$ to $WTP^{k^*} = -\frac{\beta_{ik}^*}{\alpha^*}$.

If consumer WTP for one attribute x_{ijk} is independent of the other attributes, when more quality attributes such as x_{ijl} are added to consumer utility function, consumer WTP for x_{ijk} will not change, generally: $|(WTP^k = -\frac{\beta_k}{\alpha}) - (WTP^{k^*} = -\frac{\beta_k^*}{\alpha^*})| < \xi$ where ξ is a small positive number. If consumer WTP for attribute x_{ijk} is not independent with other x_{ijl}, then $|WTP^k - WTP^{k^*}| > \xi$, and the relationship (substitutes or complements) between x_{ijk} and x_{ijl} determines which WTP is bigger.

Model Estimation

Depending on the assumption of the distribution of the random component in the random utility function, different alternative econometric model can be estimated. Normally, the random component ε_{ij} is assumed to have a normal distribution or a Gumbel distribution, resulting in different types of probit and logit model, respectively. In our study, we adopt the random parameters logit model or mixed logit model, because this model is highly flexible to allow us to simulate any random utility model. It eliminates the limitation of standard logit model such as homogeneous taste among individuals, restricted substitution pattern between alternatives and lacking the ability to allow the correlation in unobserved factors over time (or across choice sets for one individual). In addition, unlike a probit model, the random parameters logit model does not require a normal distribution of the random component in the utility function, which may result in the difficulty in model estimation when the number of alternatives in a model is larger than four (Train, 2005; Greene 2002).

In a random parameters logit model, coefficients in individual random utility function are decomposed into random parameters and nonrandom parameters. For an attribute that consumers are assumed to have homogeneous preferences, a nonrandom parameter is assigned. For an attribute that we believe there is unobserved heterogeneity among individuals, a random

parameter can be assigned. Particularly, consumer random utility functions like equation (4) can be rewritten as:

$$U_{ij} = \alpha \cdot p_{ij} + \varphi_j^{'} \cdot f_{ij} + \beta_{ij}^{'} \cdot x_{ij} + \delta_j^{'} \cdot z_i + \varepsilon_{ij} = V_{ij} + \varepsilon_{ij} \quad (10),$$

where α is the nonrandom parameter associated with alternative price; φ_j is a vector of nonrandom parameters associated with alternative attributes f_{ij}, for which consumers have homogeneous preference; β_{ij} is a vector of random parameters associated with alternative attributes x_{ij}, for which consumers have heterogeneous preferences; δ_j is a vector of parameters associated with individual specific characteristics z_i. Like traditional multinomial logit model, the stochastic component ε_{ij} is assumed to be identical independent distributed (IID) with a Gumbel distribution which has probability density function (PDF), $f(\varepsilon_{ij}) = \mathrm{e}^{-\varepsilon_{ij}} \cdot \exp(-e^{-\varepsilon_{ij}})$ and cumulative density function (CDF) $F(\varepsilon_{ij}) = \exp(-e^{-\varepsilon_{ij}})$.

In a condition where multiple alternatives exist, the probability consumer i chooses one alternative, such as j is the probability that alternative j can give him/her the maximum utility level. It implies that, $P_{ij}(Y_i = j) = Prob(V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik} \forall k \neq j) = Prob(\varepsilon_{ik} < \varepsilon_{ij} + V_{ij} - V_{ik} \forall k \neq j)$. For a given ε_{ij}, P_{ij} is the cumulate distribution ε_{ik} evaluated at value $\varepsilon_{ij} + V_{ij} - V_{ik}$, which is $\exp(-\exp(-(\varepsilon_{ij} + V_{ij} - V_{ik})))$, according to the cumulative distribution function of ε_{ik}. Because $\varepsilon's$ are assumed to be independent, the cumulative distribution for all $k \neq j$, conditional on ε_{ij}, is the product of all individual cumulative distributions: $P_{ij} \mid \varepsilon_{ij} = \prod_{k \neq j} \mathrm{e}^{-\exp(-(\varepsilon_{ij} + V_{ij} - V_{ik}))}$. The unconditional probability is the integral of the product of ε_{ij}'s conditional probability and its density function over all values, such that

$$P_{ij} = \int_{-\infty}^{+\infty} (P_{ij} \mid \varepsilon_{ij}) \cdot f(\varepsilon_{ij}) d\varepsilon_{ij} = \int_{-\infty}^{+\infty} (\prod_{k \neq j} \mathrm{e}^{-\exp(-(\varepsilon_{ij} + V_{ij} - V_{ik}))}) \mathrm{e}^{-\varepsilon_{ij}} \cdot \exp(-e^{-\varepsilon_{ij}}) d\varepsilon_{ij} \quad (11).$$

As shown in Train (2005), and Louviere, Hensher and Swait (2004), this integral has a closed form

$$P_{ij} = \frac{e^{\mu V_{ij}}}{\sum_{k=1}^{N} e^{\mu V_{ik}}} \quad (12),$$

where μ is the scalar parameter that accounts for the variance of the random component of consumer random utility. Normally, μ could be set to 1. However, if two models estimated using different data sources such as different groups of people are compared, μ should be taken into account (Train, 2005; Swait and Louviere, 1993).

Heterogeneous preference among individuals and correlation across alternatives are introduced through the random parameters in the utility function. In equation (10), assuming alternative j has m number of attributes with random parameter β_{jk}, and consumer utility has a random or nonrandom constant α_j, then β_{ij} can be specified as $\beta_j + \Gamma v_{ij} = \beta_j + \eta_{ij}$ (Hensher, Rose and Greene, 2005). Where $\beta_j = \left[\alpha_j \;\; \beta_{j1} ... \beta_{jk} ... \beta_{jm}\right]'$, accounts for the mean valuation of attribute across individuals, $\Gamma = \begin{bmatrix} a_{j11} & 0 & . & . & . & 0 \\ a_{j12} & a_{j22} & 0 & . & . & . \\ . & . & . & 0 & . & . \\ . & . & . & . & 0 & . \\ . & . & . & . & . & 0 \\ a_{jm1} & a_{jm2} & . & . & . & a_{jmm} \end{bmatrix}$ is a lower triangular matrix, and $v_{ij} = \begin{bmatrix} v_{ij1} \\ v_{ij2} \\ . \\ . \\ . \\ v_{ijm} \end{bmatrix}$ is the random term with mean vector zero and covariance matrix I. The random term Γv_{ij}, or η_i captures the variations in preference across consumers or the correlations over alternatives (attributes). The full covariance matrix of random parameters β_{ij} is $\Sigma = \text{var}(\beta_j + \Gamma v_{ij}) = \Gamma \,\text{var}(v_{ij})\Gamma' = \Gamma\Gamma'$. As a result, the specification of Γ will allow us to have different assumptions of the random parameters, thus the underlying assumption about variation in consumer preferences. For example, if $\Gamma = 0$, then the random parameters change to nonrandom parameters and the model transforms to the traditional multinomial logit mode. If all

the below diagonal elements in Γ are zeros or Γ is a diagonal matrix, then the covariance matrix of random coefficients is also a diagonal matrix-the covariance between random parameter of attributes are all zero. As a result, only the variations in preferences for each attribute across consumers are captured by the model. If Γ is a full lower triangular matrix, then Σ is a full symmetric matrix with nonzero off diagonal elements. In this case, all the nonrandom parameters in the consumer utility function are correlated, and both the heterogeneous preferences across consumers and correlation across attributes (alternatives) can be introduced to the model (Greene, 2002; Train 2005).

Because the assumption of the IID Gumbel distribution of the random ε_{ij} in the utility function does not change, the probability that consumer i chooses alternative j is the same as that in equation (12). However, as a random term v_{ij} is introduced in the random parameter model, the probability is conditional on v_{ij}. So, equation (12) can be rewritten as

$$P_{ij} \mid v_{ij} = \frac{e^{\mu V_{ij}}}{\sum_{k=1}^{N} e^{\mu V_{ik}}} \tag{13},$$

where $V_{ij} = \alpha \cdot p_{ij} + \varphi_j^{'} \cdot f_{ij} + \beta_{ij}^{'} \cdot x_{ij} + \delta^{'} \cdot z_i$, and $\beta_{ij} = \beta_j + \Gamma v_{ij}$. The unconditional probability is the integral of v_{ij} out of the conditional probability:

$$P_{ij} = \int_{-\infty}^{+\infty} \frac{e^{\mu V_{ij}}}{\sum_{k=1}^{N} e^{\mu V_{ik}}} f(v_{ij}) dv_{ij} \tag{14}.$$

The random term v_{ij} can take on different distributions such as normal, lognormal, uniform or triangular, and thus different types of random parameter logit models can be defined. However, (14) is a multiple integral over v_{ij}, which does not have a closed form. In practice, it is approximated by R repeated random draws from the underlying distribution of v_{ij}, and takes the average, such that:

$$\tilde{P}_{ij} = \frac{1}{R} \sum_{1}^{R} \frac{e^{\mu V_{ij}}}{\sum_{k=1}^{N} e^{\mu V_{ik}}} \tag{15}.$$

With L observations, the simulated log likelihood function is

$$LogL_s = \sum_{1}^{L} \frac{1}{R} \sum_{1}^{R} \frac{e^{\mu V_{ij}}}{\sum_{k=1}^{N} e^{\mu V_{ik}}} \quad (16),$$

which can be maximized to estimate the parameters in consumer random utility functions.

A more generalization of the random parameters model is to allow panels in the error term of the random parameters. This is particularly useful in the case where one consumer makes a sequence of choices, or the observations of one consumer are recorded in multiple years. A simple specification is to allow the random parameters to vary over people, but keep constant over choice situations or times for each individual: $\beta_{ijt} = \beta_j + \Gamma(v_{ijt} + \mu_{ij}) = \beta_j + \Gamma\eta_{ijt}$. The conditional probability that a person makes a sequence of choices for each time period $i = [i_1, ..., i_T]$ is the product of the logit formula over time:

$$P_{ij} \mid v_{ijt} = \prod_{1}^{T} \frac{e^{\mu V_{ij}}}{\sum_{k=1}^{N} e^{\mu V_{ik}}} \quad (17).$$

This equation can be plugged in equation (15) to get the simulated unconditional probability (replace $\frac{e^{\mu V_{ij}}}{\sum_{k=1}^{N} e^{\mu V_{ik}}}$ by $\prod_{1}^{T} \frac{e^{\mu V_{ij}}}{\sum_{k=1}^{N} e^{\mu V_{ik}}}$), and then equation (16) to get the simulated log likelihood function. The model then can be estimated.

Using the estimated parameters and covariance matrix from the random parameters logit model, 1,000 parameters can be generated using Krinsky-Robb (1986) bootstrapping procedure. Given those 1,000 parameters, 1,000 point WTP can be calculated for both equation (3) and (8). If the distributions of simulated WTP are normal, standard t-test can be used to compare the means of WTP of two samples assuming no equal variance in the two samples. In the case where the simulated WTP are not normally distributed, the differences in the WTP can be calculated by comparing each of the 1000 WTP from equation (3) with every WTP from equation (8). Thus, 1000*1000=1000000 differences in WTP are obtained. The p-values associated with the one-tailed test that WTP estimated in (3) are significantly bigger or lesser than WTP from equation (8) are calculate by the proportion of the negative/ positive differences in WTP in the total number of differences (1000000) (Lusk and Schroeder, 2004; Poe, Severance-Lossin and Welsh, 1994).

CHAPTER 4 - DATA COLLECTION METHOD

A choice experiment (CE) method is used to collect the data in this study, because this method is consistent with random utility theory and Lancaster's theory of utility maximization. Most importantly, it is easier to add additional quality attributes in a CE than that in CV and EA approaches. Attributes, alternatives, choice sets are three factors than must be determined in a choice experiment. An attribute describes one aspect of an alternative; an alternative is a bundle of attributes; two or more alternative compose a choice set and a number of choice sets compose a choice experiment. In a choice experiment, respondents are asked to choose one alternative from each choice set.

Design of Choice Experiments

Two sets of attributes of beef steak (beef strip lion steak, also known as KC strip) were used to compose the alternatives in choice sets. The first set of attributes included price, "Certified U.S. Product" (COOL), "Guaranteed Tender" (Tenderness), "Guaranteed Lean" (Lean), and "Days before Sell-by Date" (Freshness). This set of attributes were used to test the effects of additional attribute information on consumer willingness to pay in the case that cue attribute ("Certified U.S. Product") existed. The second set of attributes included price, "Guaranteed Tender", "Guaranteed Lean", "Days before Sell-by Date", and "Enhanced Omega-3 Fatty Acids". This set of attributes was used to test the impact of additional information on consumer willingness to pay in the case where no cue attribute existed.

The particular attributes were used in this study because they described substantial aspects of beef steak characteristics and reflected concerns of consumers when they made beef steak purchases. Tenderness was the key determinant of consumer satisfaction of beef (Dransfield, Zamora, and Bayle, 1998; Sivertsen, KubberØd, and Hildrum, 2002). "Day before Sell-buy Date" (Normally used as "Sell by dd-mm-yyyy" on most meat product) was a widely used label on food products that may imply the freshness of product, thus affect consumers' choice decisions. Schroeder et al. (2006) found in consumer surveys in the U.S that freshness was the most often cited product characteristics by consumer that they considered when making beef purchase decisions. Leanness and "Enhanced Omega-3 Fatty Acids" related to consumer health concerns and leanness was rated as one of the most important attributes of beef products

(McCarty, 2006). The selected attributes were weakly correlated from a consumer's perceptive, thus they were suitable to test the hypothesis of independence. In contrast, COOL was a cue attribute that attracted a good deal of public attention. However, most studies showed that the main reasons for consumers to prefer COOL were food safety, overall quality and freshness concerns (i.e. COOL was a signal for several other product attributes).

Four different steak prices were used in the choice experiments ranging from $4.64/lb to $11.50/lb allowing variation to capture the effects of additional attributes. The base price was $6.93/lb, which roughly matched market prices of beef steaks (Average monthly price compiled for USDA-ERS from retail supermarket scanner data). Two higher prices were obtained by increasing the base price with 33% and 66% increments and a lower price was obtained by decreasing the base price by 33%. All other attributes were selected to have two different levels. The two levels of "Certified U.S. Product" vs. not label for origin, "Guaranteed Tender" vs. not guaranteed, "Guaranteed Lean" vs. not guaranteed, and "Enhanced Omega-3 Fatty Acids" vs. not enhanced were the product categories selected. The levels of "Days before Sell-by Date" used were "2 days" and "8 days". The reason for keeping the alternative attributes to only two different levels was to reduce the size of the choice experiments, thus to minimize respondent fatigue when presented with too many choices in a short time. The two sets of attributes used in the choice experiment are shown in Table 4.1 and Table 4.2 and the definition of those attributes as they were presented to respondents were:

Price: The price per pound you would pay for the 12-ounce strip loin steak.

Certified U.S. Product: According to U.S. Department of Agriculture, this steak is certified to be from cattle born, raised, and processed in the United States.

Guaranteed Tender: According to U.S. Department of Agriculture, this steak is guaranteed to be tender.

Guaranteed Lean: According to U.S. Department of Agriculture, this steak is guaranteed to have less than 10% fat, less than 4.5% saturated fat, and less than 0.1% cholesterol.

Days before Sell-by Date: According to U.S. Department of Agriculture, the "Sell-By" date tells the store how long to display the product for sale. Product should be purchased before the date expires. "Days before Sell-by Date" tells you how many days until expiration

Enhanced Omega-3 Fatty Acids: According to U.S. Department of Agriculture, this steak is guaranteed to have more Omega-3 fatty acids than other steaks.

With the attributes and their levels defined, choice experiments were constructed. The first step was to generate a set of alternatives (profile) that could be used to construct a choice experiment. An alternative or profile was a combination of certain attribute levels. For example, in a choice experiment that had three attributes: "Price", "Certified U.S Product" and "Guaranteed Tender" , a combination of levels from all attributes such as [$4.64, Yes, Yes] was an alternative, while a combination only contained the levels from two attributes, such as [$4.64, Yes] was not. This was because in the later case, absence information about "Guaranteed Tender" existed, respondents might or might not interpret the lacking information in the same manner, thus different "choice rules" existed for different respondents. In a choice experiment that consisted of "Price", "Certified U.S Product" and "Guaranteed Tender", the full combination of all attributes levels resulted in 4*2*2=16 alternatives. With one additional attribute, the number of possible combinations increased by 16. For instance, in a choice experiment consisting of additional two attributes each having two levels, the number of total combinations was 16*2*2=64. In this case, the number of alternatives quickly becomes so large that it was not feasible for a respondent to answer a choice experiment that included all the 64 alternatives. We used the orthogonal fractional factorial design to reduce number of alternatives used in our choice experiment. In this case, only the main effects of each attribute estimable was included and the interactions between attributes were ignored. This strategy was plausible, because we assumed consumer random utility functions are linear in product attributes.

To test the impact of additional attribute information on consumer WTP, we constructed a sequence of choice experiments. The first experiment consisted of 3 attributes; the second experiment consisted of 4 attributes, while the third experiment consisted of 5 attributes. This methodology was applied to both sets of attributes (the set of attributes that included a cue attribute, and the set of attributes without a cue attribute). Thus we had six choice experiments in total, with each three based on one set of attributes. The attributes used for different choice experiments are shown in Table 4.3 and Table 4.4.

Because of the complexity associated with a larger number of choice sets in the choice experiment could adversely affect respondent choice decisions (Hensher,2004; Hanley, Wright and Koop,2002), we tried to minimize the impact of the number of choice sets by designing all

three choice experiments with same number of choice sets. In the first step, we generated 3 sets of alternatives with the number of attributes of the alternatives being 3, 4 and 5. The first attribute of the alternatives had 4 levels (1, 2, 3, 4), corresponding to the four prices of the beef steaks. The other attributes of alternatives had 2 levels (0, 1), corresponding to other attributes of the beef steaks. All the alternatives are generated with orthogonal fractional factorial design and the number of alternative were kept the same, although the numbers of attributes vary. As a result, we had 3 sets of alternatives, each set consisted of 8 original alternatives and the number of alternative attributes in each set being 3, 4 and 5, respectively. The designs of all the 3 sets of alternatives had a D-efficiency of 100%. In the second step, the 8 original alternatives in each set were randomly ordered to create 8 pair alternatives (choice sets) altogether with the original alternatives. Because in logit models, only the differences in attributes levels matter, "In general, the fewer non-zero differences or constants, the more precise the confidence interval will be." (Louviere, Hensher and Swait, 2004). The random-ordered alternatives were the ones that have the maximum difference with the original alternatives. In this step, 3 paired alternatives or choice experiment were generated. The last step was to label the numerical attribute levels with corresponding attribute levels in beef steaks. Thus, we had 6 choice experiments in total, three with the set of attributes that included cue attribute and three with the set of attributes without the cue attribute. As in most studies of this type, we added a "none" alternative to each choice sets to make the choice task more realistic as respondents might choose this option when shopping (Lusk, Schroeder, 2004). In addition, we removed the choice sets with a dominant alternative by reordering the randomly ordered alternatives. If a choice set contained a dominant alternative, such as a choice sets that consisted of two alternatives that were same in all attributes, but one had a lower price, the choice set didn't provide any information on consumer choice decisions because respondents would always choose the one with lower price (see Appendix A to Appendix D for final surveys including the choice experiments). Overall, there were 8 choice sets in each choice experiments, and each choice set included three alternatives "Option A", "Option B" and, "Neither A nor B" (None option) for respondent to choose from.

Design of Surveys

To investigate the effects of additional quality attributes on consumer WTP for an attribute, two approaches: Between-subject comparison and within-subject comparison could be

used. In the first approach, respondents are divided into several groups, and different groups take different choice experiments. The number of groups depends on the number of choice experiments, which were 6 in our case. In the within-subject comparison, a respondent answers all the choice experiments designed using a set of attributes. Thus, a respondent will answer all Ai (i=1, 2, 3) or all Bi (i=1, 2, 3) choice experiments. After data are collected for all the six choice experiments, a random parameters logit model can be estimated for each of the choice experiment, and consumer WTP for a specific attribute can be elicited. For instance, 3 WTP for "Certified U.S Product" can be estimated and compared for the first sequence of choice experiments, and 3 WTP for "Guaranteed Tender" can also be estimated and compared for the second sequence of choice experiments. As a result, we can investigate the effect of an additional quality attribute on consumer WTP for a particular attribute.

Problems exist in both Between-subject comparisons and within-subject comparisons. In the first approach we must make the strong assumption that different groups have homogeneous preferences for product attributes. Though the random parameters logit model assumes that consumers in the same group have heterogeneous preferences, it does not mean that different groups have the same or different preferences. In addition, potential problems exist in that the distributions of respondents' characteristics in different groups are not the same (Carlsson, 2001). As a result, we could not tell if the differences in the WTP estimated from different groups of respondents are the effects of additional attributes or the impact of different preferences between consumer groups. Moreover, it is difficult to control for this factor and difficult to argue that homogeneous preferences among consumer groups exist. The within-subject comparison does not have this problem because a consumer answers a set of choice experiments. Another benefit of within-subject comparison is we can have multiple WTP for one attribute estimated from different choice experiments for each consumer, if the number of choice sets in each choice experiment is big enough. The main problem of this approach is that consumers' answers in one choice experiment may be affected by their answer in the other one, which we can call a carry over effects. For example, if consumers realize a sequence of choice experiments (A1-A3 or B1-B3) only differ in the number of attributes, they may try to answer the questions consistently across different choice experiments by going back and forth from one choice experiment to the other one. To avoid this carry over effect, we must control consumer ability to alter answers they have made by using online or phone surveys, in which consumers can not go back to change

their previous answers. The other problem of within-subject comparisons is that respondents are asked to answer a large number of choice questions, which may cause less efficient results due to fatigue of the consumer in processing so much information in one survey. For instance, if a respondent takes a survey that includes choice experiments A1, A2, A3, the total number of choice sets he/she needs to answer is 24, which is larger than the choice set number in choice experiments used by most researchers. Hesnsher (2006) found the number of choice sets in a choice experiment significantly affected the WTP estimation, potentially due to cognitive burden on respondents. Carlsson and Martinsson (2006) also found out that increasing the number of the choice sets in a choice experiment decreased the response rate of the survey, which is also not preferable if it is not feasible to send out a large number of surveys due to research budget constraints.

We adopted means which allowed us to do both Between-subject comparisons and within-subject comparisons. This enabled us to draw more robust conclusions on the impacts of additional attribute information on consumer WTP estimation.

Two of the three choice experiments (A1, A2 and A3 or B1, B2 and B3) were selected to include in one survey to construct a series of surveys. The first survey included choice experiments A1 (B1), and A2 (B2), the second survey included A2 (B2) and A3 (B3). To make the comparisons between results easier, the first choice experiment in the first survey was named A11 (B11), the second choice experiment in the first survey was named A12 (B12), the first choice experiment in the second survey was named A21 (B21), and the second choice experiment in the second survey was named A22 (B22). Altogether, we had four surveys; each survey was composed of two choice experiments. As shown in Table5 and Table6, the letter A (B) indicated whether the choice experiment included the cue attribute, "Certified U.S. Product", the first subscript indicated if the survey was the first or the second survey, and the second subscript indicated if the choice experiment in the survey is the first of second. Questions regarding respondents' demographic characteristics were also asked. To reduce the impact of "carry over effects", or reduce respondent burden by making a large number of choice decisions in a short time, the demographic questions were placed in between the two choice experiments in the survey. The outlines of the surveys were shown in Table 4.5 to Table 4.8. The full questionnaires of survey A1 are shown in Appendix A, and the choice experiment in surveys A2, B1 and B2 are shown in Appendix B to Appendix D.

The four surveys can be sent out to four groups of respondents, and both within-subject and Between-subject comparisons of WTP can be conducted. The within-subject comparison is achieved by comparing the WTP estimated from different choice experiments in one survey.

The Between-subject comparison is achieved by comparing the WTP estimated from different choice experiments in different surveys. For example, if we want to investigate how the consumer WTP for "Certified U.S. Product" changes when the number of attributes increases from three to four, the within-subject comparison is between choice experiment A11 and A12, the Between-subject comparison is between choice experiment A11 and A21. The effect of additional attribute information on consumer WTP for "Guaranteed Tender", "Guaranteed Lean" and so on can also be investigated by using both within and between Subject comparisons in the same way (Table 4.9 and Table 4.10).

Table 4.1 Attributes and Levels Used in Choice Experiment (with Cue Attribute)

Price ($/lb)	Certified U.S. Product	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date
4.64	Yes	Yes	Yes	8
6.93	No	No	No	2
9.22				
11.50				

Table 4.2 Attributes and Levels Used in Choice Experiment (without Cue Attribute)

Price ($/lb)	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date	Enhanced Omega-3 Fatty Acids
4.64	Yes	Yes	8	Yes
6.93	No	No	2	No
9.22				
11.50				

Table 4.3 Choice Experiments Based on the First Set of Attributes (with Cue Attribute)

Choice Experiment	# of Attributes	Attribute				
A1	3	Price	Certified U.S. Product	Guaranteed Tender		
A2	4	Price	Certified U.S. Product	Guaranteed Tender	Guaranteed Lean	
A3	5	Price	Certified U.S. Product	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date

Table 4.4 Choice Experiments Based on the Second Set of Attributes (without Cue Attribute)

Choice Experiment	# of Attributes	Attribute				
B1	3	Price	Guaranteed Tender	Guaranteed Lean		
B2	4	Price	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date	
B3	5	Price	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date	Enhance Omega-3 Fatty Acids

Table 4.5 Outline of the First Survey (A1) with the Cue Attribute

Section 1	Attributes in CE	Price	Choice Experiment A11 Certified U.S. Product	Guaranteed Tender		
Section 2	Demographic, and Shopping Experience Questions					
Section 3	Attributes in CE	Price	Choice Experiment A12 Certified U.S. Product	Guaranteed Tender	Guaranteed Lean	

Table 4.6 Outline of the Second Survey (A2) with the Cue Attribute

			Choice Experiment A21			
Section 1	Attributes in CE	Price	Certified U.S. Product	Guaranteed Tender	Guaranteed Lean	
Section 2	Demographic, and Shopping Experience Questions					
			Choice Experiment A22			
Section 3	Attributes in CE	Price	Certified U.S. Product	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date

Table 4.7 Outline of the First Survey (B1) without the Cue Attribute

			Choice Experiment B11		
Section 1	Attributes in CE	Price	Guaranteed Tender	Guaranteed Lean	
Section 2	Demographic, and Shopping Experience Questions				
			Choice Experiment B12		
Section 3	Attributes in CE	Price	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date

Table 4.8 Outline of the Second Survey (B2) without the Cue Attribute

Section 1			Choice Experiment B21			
	Attributes in CE	Price	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date	
Section 2	Demographic, and Shopping Experience Questions					
Section 3			Choice Experiment B22			
	Attributes in CE	Price	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date	Enhanced Omega-3 Fatty Acids

Table 4.9 Comparisons of WTP with Cue Attribute in Choice Experiments

Attributes	Choice Experiment	Number of Attributes in CE	Comparison Method
Certified U.S. Product	A11	3	Within-subject Comparisons
	A12	4	
	A21	4	
	A22	5	
	A11	3	Between-subject Comparisons
	A21	4	
	A12	4	
	A22	5	
Guaranteed Tender	A11	3	Within-subject Comparisons
	A12	4	
	A21	4	
	A22	5	
	A11	3	Between-subject Comparisons
	A21	4	
	A12	4	
	A22	5	
Guaranteed Lean	A12	4	Within-subject Comparisons
	A22	5	
	A21	4	Between-subject Comparisons
	A22	5	

Table 4.10 Comparisons of WTP without Cue Attribute in Choice Experiments

Attributes	Choice Experiment	Number of Attributes in CE	Comparison Method
Guaranteed Tender	B11	3	Within-subject Comparisons
	B12	4	
	B21	4	
	B22	5	
	B11	3	Between-subject Comparisons
	B21	4	
	B12	4	
	B22	5	
Guaranteed Lean	B11	3	Within-subject Comparisons
	B12	4	
	B21	4	
	B22	5	
	B11	3	Between-subject Comparisons
	B21	4	
	B12	4	
	B22	5	
Days before Sell-by Date	B12	4	Within-subject Comparisons
	B22	5	
	B21	4	Between-subject Comparisons
	B22	5	

CHAPTER 5 - RESULTS

In November, 2006, e-Rewards, Inc. an online-survey company, sent out the surveys to 2200 Chicago residents, each of the four surveys went to 550 respondents in e-Reward's consumer panel through the company's online survey system. Because we were charged for each response, budget constraints forced us to discontinue the survey when 310 surveys were completed. This resulted in 74 completes of A1, 76 completes of A2, 78 completes of B1 and 82 completes of B2. In December, 2006, the surveys were also distributed via email to 3932 faculty members, staff members and graduate students at Kansas State University (K-State), Manhattan, Kansas, each of the four surveys were send out to 983 respondents using the online survey system of surveymonkey.com. This resulted in 211 completes of A1, 187 completes of A2, 198 completes of B1, and 171 completes of B2. Using two distinct locations and populations for the survey helps us to reduce potential problems associated with results being sensitive to the location, hopefully enabling us to generalize our conclusions with more confidence (though we recognize that two replications is certainly not definitive). Table 5.1 reported the summary statistics of basic demographics for the 8 surveys at both Chicago and K-State. Definitions of the variables in the surveys are as follows:

Age: Age in years

Gender: 1=Female; 0=Male

Education: 1=1st through 8th grade; 2=Some high School or high school graduate
3=Some colleage/2 year associate degree;
4=Four year college degree; 5=Master or Ph.D. degree

Marriage: 1=Single; 2=Married; 3=Divorced, widowed or separated

Employment: 1= Employed full time; 2=Employed part time;
3=Unemployed; 4= Student; 5=Retired

# of Adults: Number of adults living in home

# of Children: Number of children living in home

Income: Household annual income level.
1=Under 10,000; 2=10,000 to 24,999…
13=300,000 to 399,999; 14=400,000 and more

For the Chicago sample, ANOVA (Analysis of Variance) showed that the respondents taking survey A2 had a higher education level and fewer children than those who took survey A1 at 5% significant level. The respondents who took survey B2 had a lower education level than those taking survey B1. The null hypothesis of equality of means of all other demographics between respondents taking survey A1 and A2, and B1 and B2 cannot be rejected at 5% significant level. For the K-State sample, ANOVA showed that there were no significant differences in the means of all demographics between respondents who took survey A1 and A2, and B1 and B2, respectively. Compared to the K-State sample, the Chicago sample had older respondents, more females, lower levels of education, less single people, more adults and fewer children at home and higher income level.

Results of Econometric Models

For both the Chicago and K-State samples, eight random parameter logit models are estimated for the eight choice experiments in the surveys, respectively, resulting in 16 models in total. Specifically, the random utility functions of the choice experiments in surveys A1 and A2 are:

$$A11: U_{ij} = b_{ij} + \alpha \cdot p_{ij} + \beta_{i1} \cdot x_{ij1} + \beta_{i2} \cdot x_{ij2} + \varepsilon_{ij}$$
$$A12: U_{ij} = b_{ij} + \alpha \cdot p_{ij} + \beta_{i1} \cdot x_{ij1} + \beta_{i2} \cdot x_{ij2} + \beta_{i3} \cdot x_{ij3} + \varepsilon_{ij}$$
$$A21: U_{ij} = b_{ij} + \alpha \cdot p_{ij} + \beta_{i1} \cdot x_{ij1} + \beta_{i2} \cdot x_{ij2} + \beta_{i3} \cdot x_{ij3} + \varepsilon_{ij}$$
$$A22: U_{ij} = b_{ij} + \alpha \cdot p_{ij} + \beta_{i1} \cdot x_{ij1} + \beta_{i2} \cdot x_{ij2} + \beta_{i3} \cdot x_{ij3} + \beta_{i4} \cdot x_{ij4} + \varepsilon_{ij}$$

where b_{ij} is alternative specified constant, α is the marginal utility of price, $\beta_{i1} - \beta_{i4}$ are marginal utility of attributes $x_{ij1} - x_{ij4}$, respectively and ε_{ij} is random error identically and independently distributed with Gumbel distribution . p_{ij} is alternative *j's* price, $x_{ij1} - x_{ij4}$ are beef steak attributes, such as, "Certified U.S. Product", "Guaranteed Tender", "Guaranteed Lean", and "Days before Sell-by Date", respectively.

The random utility function of the choice experiments in surveys B1 and B2 are:

$$B11: U_{ij} = b_{ij} + \alpha \cdot p_{ij} + \beta_{i1} \cdot q_{ij1} + \beta_{i2} \cdot q_{ij2} + \varepsilon_{ij}$$
$$B12: U_{ij} = b_{ij} + \alpha \cdot p_{ij} + \beta_{i1} \cdot q_{ij1} + \beta_{i2} \cdot q_{ij2} + \beta_{i3} \cdot q_{ij3} + \varepsilon_{ij}$$
$$B21: U_{ij} = b_{ij} + \alpha \cdot p_{ij} + \beta_{i1} \cdot q_{ij1} + \beta_{i2} \cdot q_{ij2} + \beta_{i3} \cdot q_{ij3} + \varepsilon_{ij}$$
$$B22: U_{ij} = b_{ij} + \alpha \cdot p_{ij} + \beta_{i1} \cdot q_{ij1} + \beta_{i2} \cdot q_{ij2} + \beta_{i3} \cdot q_{ij3} + \beta_{i4} \cdot q_{ij4} + \varepsilon_{ij}$$

where $b_{ij}, \beta_{i1} - \beta_{i4}, p_{ij}, \varepsilon_{ij}$ have the same definitions as above, and $q_{ij1} - q_{ij4}$ are beef steak attributes, such as, ", "Guaranteed Tender", "Guaranteed Lean", "Days before Sell-by Date" and "Enhanced Omega-3 Fatty Acids", respectively.

In the estimation, the coefficient on alternative price is a nonrandom parameter. This is because the normal distribution has density on both sides of zero, assuming a normal distribution of the price coefficients implies that some people will have positive price coefficients, which is not consistent with the negative price-demand relationship. In addition, not allowing the price coefficient to vary randomly also assures that WTP estimated for a particular beef attribute is normally distributed (Tonsor et. al., 2005; Lusk, Roosen and Fox, 2003). The coefficients of other beef steak attributes are defined as random parameters with a normal distribution to allow heterogeneous preferences for those attributes across consumers. Because in choice experiments, each respondent makes sequences of choice decisions with several (eight in our case) choice sets, individual preferences are perfectly correlated across the choice sets for a given respondent. It is more appropriate to use a panel data model to allow the correlation among individual preferences in a sequence of choice decisions. As a result, the nonrandom parameters in consumer utility functions are defined as $\beta_{ijt} = \beta_j + \Gamma(v_{ijt} + \mu_{ij})$, where β_j is a vector of average coefficients of beef attributes, v_{ijt} is the random error with independent and identical normal distribution across individual *i*, alternative *j* and choice set *t*, and μ_{ij} is the random error normally distributed over individual *i* and alternative *j*, but not choice sets. The matrix Γ is a full lower triangular matrix which indicates that all the nonrandom parameters are correlated. Thus, both the heterogeneous preferences across consumers and correlation across attributes (alternatives) can be estimated in the models. In a choice experiment with three alternatives in a choice set, the maximum number of alternative specified constants is two. The constants measure the differences in consumer utility levels of those two alternatives compared to the third alternative. If the choice experiments are labeled experiments, such that the first alternative is the "Certified U.S. Product" beef steak and the second is "Guaranteed Tender" steak, with other attributes varying, then two alternative specified constants can be included in the model. The constants will measure the additional utility that "Certified U.S. Product" steak or "Guaranteed Tender" steak gives to consumers in the comparison with the "Neither A nor B" alternative. Our study uses unlabeled choice experiments in that there is no particular beef attributes attached to all "Option A" or

"Option B". Each of these two alternatives is just a combination of a set of beef attributes. The main benefits of using unlabeled alternatives, as mentioned by Hensher, Rose and Greene (2005) are that "they do not require identification and use of all alternatives within the universal set of alternatives" and the IID assumption of the random component in consumer utility function is more likely to be met in an unlabeled choice experiment than in a labeled one. Because in an unlabeled choice experiment, each alternative does not contain a particular attribute, the alternative specified constant in the consumer utility function does not have any meaningful interpretation. We only include one alternative specified constant of the "None "option in the consumer utility function. The constant can measure the difference in consumer utility level when they choose the "None" option in comparison with the other two alternatives. The estimates of the random parameters logit models for the choice experiments in surveys A1 and A2 with both Chicago and K-State samples are reported in Table 5.2 and Table 5.3, respectively. Table 5.4 and Table 5.5 report the estimates of the random parameter logit models for the choice experiments in surveys B1 and B2 with both Chicago and K-State samples, respectively.

The first four rows in Table 5.2-5.5 reported the estimates of means of random parameters in the corresponding models. Row 5 and row 6 reported the estimates of non random parameter of price and the constant for the "None" option. The next 10 rows were the estimates of the diagonal value and off diagonal values in Cholesky matrix Γ, which would give the full covariance matrix of random parameter β_{ij} by $\Sigma = \Gamma\Gamma'$. The last four rows were the standard deviation of random parameter distributions, which were the square roots of diagonal values in Σ. The diagonal values of Σ measured the variations of preferences for beef attributes across respondents. The off diagonal values of Σ measured the correlations between the random parameters, indicating the correlations between consumer preferences for one beef attribute and the other one. For instance, if the covariance between the random parameters of "Certified U.S. Product" and "Guaranteed Tender" was negative, then consumers' choices of the alternative with "Certified U.S. Product" were negatively affected by the presence of the alternative attribute "Guaranteed Tender". However, if the covariance was positive, then the appearance of "Guaranteed Tender" in the product would increase consumer marginal utility (random parameter) of "Certified U.S. Product", thus positively affected consumer choice of the alterative with those two attributes.

For four choice experiments in surveys A1 and A2, with the Chicago sample, all the coefficients of product attributes were different from zero at 5% significance level. The price coefficient was negative and coefficients of other beef attributes were all positive, indicating a downward sloping price-demand relationship and an increasing probability of consumers choosing alternatives with the appearance of other beef quality attributes. For choice experiments A11, A12 and A21, significant heterogeneous preferences for beef steak attributes existed across respondents who completed the corresponding choice experiment. For choice experiment A22, significant heterogeneous preferences for the attributes "Certified U.S. Product" and "Guaranteed Tender" existed across respondents. However, the heterogeneous preferences across respondents were not significant for attributes "Guaranteed Lean" and "Days before Sell-by Date" (Table 5.2). Table 5.6 reports the covariance matrices of random parameters in each model in choice experiments A1i and A2i (i=1-2). The negative covariance between coefficients of "Guaranteed Tender" and "Certified U.S. Product" in choice experiment A11 indicates that the appearance of "Guaranteed Tender" in beef steaks would decrease consumer marginal utility of "Certified U.S. Product". However, this coefficient was not significantly different from zero as the corresponding below diagonal values in Γ were not significant. For other choice experiments, the covariance between the random parameters of most beef attributes were positive, indicating that consumer marginal utility of one beef attribute would positively affect the other beef attributes. The covariance of "Guaranteed Tender" and "Guaranteed Lean", "Guaranteed Tender" and "Days before Sell-by Date", and "Guaranteed Lean" and "Days before Sell-by Date" were negative in choice experiment A22, which implies that the appearance of one beef attribute negatively affected consumer marginal utility of the other corresponding attributes. However, all the covariances between beef attributes might not be significantly different from zero, because all the below diagonal values in Γ were not significant (the significance/insignificance of below diagonal value in Γ might not result in the significance/insignificants of the corresponding values in covariance matrix, because the values in covariance matrix were functions of multiple values in below diagonal matrix Γ).

With the K-State sample, all the coefficients of beef steak attributes were significantly different from zero, except for the coefficient on "Guaranteed Lean" in choice experiments A21 and the coefficients of "Guaranteed Lean" and "Days before Sell-by Date" in choice experiment A22. The estimates of beef attribute had expected sign, with coefficient of "Price" being

negative, and the coefficients of other attributes being positive. The standard deviation of random parameter distributions showed that heterogeneous preferences exist for all beef steak attributes across respondents in all choice experiments (Table 5.3). The covariance matrices of random parameters (Table 5.7) showed that the random parameters of "Certified U.S. Product" and "Guaranteed Tender" were negatively correlated in choice experiments A21 and A22, implying that the presence of one attribute would decrease consumer marginal utility of the other attribute. The covariance of all other beef attributes in all choice experiments were positive, which implies that the presence of one attribute would increase consumer marginal utility of the other attributes. However, most of the below diagonal values in Γ were not significantly different from zero in all choice experiments, indicating that the correlations between random parameters might not be significant. The six significant below diagonal values in Γ were for "Certified U.S. Product" and "Guaranteed Tender" in choice experiment A11, "Certified U.S. Product" and "Guaranteed Lean", "Guaranteed Lean" and "Guaranteed Tender" in choice experiments A12 and A21, and "Days before Sell-by Date" and "Guaranteed Tender" in choice experiments A22. Those significant below diagonal values implied that covariance between corresponding beef attributes might be significantly different.

For four choice experiments in surveys B1 and B2, with the Chicago sample, all the coefficients of product attributes were significantly different from zero, except for the coefficient of "Days before Sell-by Date" in choice experiment B12, B21 and B22, and the coefficient of "Enhance Omega-3 Fatty Acids" in choice experiment B22. Most of the signs of attribute coefficients were as expected, except for the negative sign of "Days before Sell-by Date" in choice experiment B12, however, the coefficient was not statistically significant. Respondents showed heterogeneous preferences for all attributes in choice experiment B11 and B12. Although significant heterogeneous preferences for "Guaranteed Tender" and "Guaranteed Lean" existed in choice experiment B21 and B22, the heterogeneous preferences for "Days before Sell-by Date" and "Enhanced Omega-3 Fatty Acids" were not significant across respondents (Table 5.4). Covariance matrix of random parameters showed that most random parameters had positive relationships-an increase in one random parameter will caused the increase of the other random parameters. However, negative relationships existed between the random parameters of "Guaranteed Tender" and "Guaranteed Lean" in choice experiment B12 and B21, as well as "Days before Sell-by Date" and "Guaranteed Lean" in choice experiment

B12 (Table 5.8). Because most of the below diagonal values in Γ were not significant, it is likely that most of the correlations between random parameters were not significant.

With the K-State sample, just like the Chicago sample, the coefficients of "Guaranteed Tender", "Guaranteed Lean" and "Price" in all choice experiments were significantly different from zero, and the coefficients of "Days before Sell-by Date" and "Enhanced Omega-3 Fatty Acids" were not significant. Except for the negative signs on the coefficients for "Days before Sell-by Date" in choice experiments B21 and B22, all other coefficients had expected signs. The standard deviations of random parameter distributions indicated significant heterogeneous preferences for all beef attributes across respondents in all choice experiments (Table 5.5). The covariance between random parameters of "Guaranteed Tender" and "Guaranteed Lean" were negative in all choice experiments, most of the covariances were likely insignificant except for the covariance in choice experiment B11. Other negative covariance terms were between random parameters of "Guaranteed Tender" and "Days before Sell-by Date" in choice experiment B12, and "Omega-3 Fatty Acids" and "Days before Sell-by Date" in choice experiment B22 (Table 5.9). Similar to the Chicago sample, it was likely that most of the covariances between attributes were not significant, because most to the below diagonal values in Γ were not significant.

Impacts of Additional Attributes on Estimates of Coefficients

The estimates of coefficients in consumer utility function were compared across choice experiment using within and between subject comparisons with both Chicago and K-State samples. It need to pointed out that the direct comparison of the estimates of parameters across choice experiments did not enable us to compare the true preference parameters, because the estimates in the random parameters logit models were confound with the variance of the random term in consumer random utility function and the variance could not be separated from the parameter estimates. In order to compare the estimates from two choice experiments, the relative scale of the variance of the random term in the model must be isolated before we compared the true preference parameters (Swait and Louviere, 1993). However, in our study the models being compared had different number of independent variables (three vs. four and four vs. five) it was difficult to find a perfect solution to pool the data from different experiments and to estimate pooled models. As a result, using hypothetical tests to test the equality of coefficients across

models was not conducted in our study. The estimates of parameters across choice experiments were directly compared by the percentage of change, though the comparisons were not the perfect solution.

With the Chicago sample, after "Guaranteed Lean" was added to the choice experiments from A11 to A12, the coefficients of "Certified U.S Product" , "Guaranteed Tender" and "Price" decreased by 37% ,13% and 7%, respectively (regarding prices, only absolute values of prices are compared). After "Days before Sell-by Date" was added to the choice experiment from A21 to A22, the coefficient of "Certified U.S Product" increased by 17%, while the coefficients of "Guaranteed Tender", "Guaranteed Lean" and "Price" decreased by 0.2%, 21% and 28%, respectively (Figure 5.1). The between-subject comparisons told a different story. After "Guaranteed Lean" was added to the choice experiment from A11 to A21, the coefficient of "Certified U.S Product" decreased by 29%. Whereas, the coefficients of "Guaranteed Tender" and "Price" increased by 6% and 21%, respectively. After "Days before Sell-by Date" was added to the choice experiment from A12 to A22, the coefficients of "Certified U.S Product", "Guaranteed Tender", and "Guaranteed Lean" increased by 30%, 21% and 2%, respectively. The coefficient of "Price" decreased by 6% (Figure 5.2).

With the K-State sample, the within-subject comparisons showed that the coefficient of "Certified U.S. Product" decreased by 23%, while the coefficients of "Guaranteed Tender" and "Price" increased by 29% and 19%, respectively, after the attribute of "Guaranteed Lean" was added to the choice experiments from A11 to A12. After the attribute of "Days before Sell-by Date" was added to the choice experiments from A21 to A22, the coefficients of "Certified U.S. Product" and "Guaranteed Tender" increased by 6% and 3% respectively, and the coefficients of "Guaranteed Lean" and "Price" decreased by 57% and 32%, respectively (Figure 5.3). Between-subject comparisons showed that the coefficients of "Certified U.S. Product" and "Guaranteed Tender" decreased by 32% and 21%, respectively, while the coefficient of "Price" increased by 32% after "Guaranteed Lean" was added to the choice experiments from A12 to A21. All the coefficients of beef attributes decreased after "Days before Sell-buy Date" was added to the choice experiments from A12 to A22, with 7% for "Certified U.S. Product", 37% for "Guaranteed Tender", 77% for "Guaranteed Lean" and 24% for "Price".

For choice experiments in surveys B1 and B2, the within-subject comparisons with Chicago sample showed that all the coefficients of beef attributes increased after "Days before

Sell-by Date" was added to the choice experiment from B11 to B12. The percentages increases in those coefficients were 8% for "Guaranteed Tender", 24% for "Guaranteed Lean" and 26% for "Price". After "Enhanced Omega-3 Fatty Acids" was added to the choice experiments from B21 to B22, coefficients of "Guaranteed Tender", "Guaranteed Lean" and "Price" decreased by 0.5%, 2% and 32%, respectively. While the coefficient of "Days before Sell-by Date" increased by 106% (Figure 5.5). Between-subject comparisons showed different patterns in the change in coefficients between choice experiments B11 and B21. The coefficient of "Guaranteed Tender" decreased by 17% in B21 compared with that in B11. The coefficients of "Guaranteed Lean" and "Price" in B21 increased by 12% and 2%, respectively, in comparison with corresponding coefficients in choice experiment B11. The change in the coefficients were same for within and between Subject comparisons, when "Enhance Omega-3 Fatty Acids" was added to the choice experiments as the 5th beef attributes from B12 to B22. The coefficients of "Guaranteed Tender", "Guaranteed Lean" and "Price" decreased by 24%, 12% and 45%, respectively. And the coefficient of "Days before Sell-by Date" increased by 146%, from a negative vale to a positive value (Figure 5.6).

With the K-State sample, the within-subject comparisons showed that the coefficients of all beef attributes increased after "Days before Sell-by Date" was added to the choice experiment from B11 to B12, with an increase of 6% for "Guaranteed Tender", 19% for "Guaranteed Lean" and 23% for "Price". This change was same as that with Chicago sample. After "Enhance Omega-3 Fatty Acids" was added to the choice experiments from B21 to B22, the coefficients of "Guaranteed Tender", "Guaranteed Lean" and "Price" decreased by 15%, 4% and 18% respectively, while the coefficients of "Days before Sell-by Date" increased by 2% (Figure 5.7). Within-subject comparisons with both Chicago and K-State sample show the same pattern in the change of coefficients across choice experiments. Between-subject comparisons showed that the coefficient of "Guaranteed Tender" decreased by 24%, while the coefficients of "Guaranteed Lean" and "Price" increased by 70% and 24% respectively, after "Days before Sell-by Date" was added to the choice experiments from B11 to B21. The coefficients of "Guaranteed Tender" and "Price" decreased by 39% and 17%, while the coefficients of "Guaranteed Lean" and "Days before Sell-by Date" increased by 38% and 22%, respectively, after "Enhance Omega-3 Fatty Acids" was added to the choice experiments from B12 to B22 (Figure 5.8).

Overall, it was difficult to draw consistent conclusions on the impacts of additional attributes on the coefficient estimates across within and between subject comparisons, and with the Chicago and the K-State samples. The effects of additional attributes on the estimates of coefficients depended on the relationships between the added attributes and the attributes previously existed in the choice experiment. If the new attribute was a substitute for the other attributes, then the coefficients of the other attributes would decrease after the new attributes were added to the experiment. If the new attribute was a complement of the other attributes, the coefficients of the other attributes would increase after the new attribute was presented in the experiment.

The effects of some of new attributes were apparent, because the changes in the coefficients of attributes were consistent across four comparisons by within and between subject comparisons with the Chicago and K-State samples. While the effects of some new attributes were not clear, as the change in the coefficient of other attributes are not consistent across comparisons.

For choice experiments in survey A1 and A2, two consistent conclusions existed. First, the coefficients of "Certified U.S. Product" decreased in within and between subject comparisons, with both Chicago and K-State samples, when "Guaranteed Lean" was added to choice experiments making the number of attributes in the experiment change from 3 to 4. The second consistent result was that the coefficients of "Price" decreased in all cases, when "Days before Sell-by Date" was added to the choice experiments, making the number of attributes in the experiments increase from 4 to 5.

Other changes in the coefficients included: the coefficients of "Guaranteed Tender" decreased twice, and the coefficients of "Price" decreased once in four comparisons when "Guaranteed Lean" was added to choice experiments; the coefficients of "Certified U.S. Product" decreased once, the coefficients of "Guaranteed Tender" decreased twice, and the coefficients of "Guaranteed Lean" increased once in four comparisons when the number of attributes in choice experiments changes from 4 to 5.

Regarding the choice experiments in surveys B1 and B2, the coefficients of "Guaranteed Lean" and "Price" increased in all cases, when number of attributes in the choice experiments changed from 3 to 4 after "Days before Sell-buy Date" was added to the choice experiments. After "Enhance Omega-3 Fatty Acids" was added to the choice experiment, both within and

between subject comparisons with Chicago and K-State samples show that the coefficients of "Guaranteed Tender" and "Price" decreased.

The inconsistent changes in the coefficients across within and between subject comparison with Chicago and K-State samples included: the coefficients of "Guaranteed Tender" decreased twice in four comparisons when the number of attributes in choice experiment increased from 3 to 4 ("Days before Sell-by Date" was added to choice experiments), and the coefficients of "Guaranteed Lean" increased once in four comparisons, when the number of attributes in choice experiment increased from 4 to 5 ("Enhance Omega-3 Fatty Acids" was added to choice experiments).

Impacts of Additional Attributes on WTP Estimates

Another means of evaluating the effect of additional attributes on consumer choice decisions is to compare the WTP estimation across choice experiments. Investigating the effects of additional attributes on WTP is more reasonable compared to simply investigating the effects of additional attributes on the estimated coefficients of attributes. This is because when more attributes are presented in the choice experiments, both the coefficients of product attributes and of price changed, and the mixed effects might be that the new attribute had no impact on consumer choice decisions. In addition, because the WTP were the ratio of the parameters of product attributes and price, they did not confound with the variance of random term in random utility function. The comparisons of WTP across different choice experiment were a better way to investigate the changes in consumer preferences than the direct compassions of the parameters.

A bootstrap method was used to generate 1000 values of coefficients of each beef attribute with the estimated means and variances. Consumer WTP for a beef attribute was calculated by dividing the coefficient of price and the coefficient of the attribute, such as $WTP_k = \frac{\beta_k}{\alpha}$, where β_k was the coefficient of k^{th} attribute of alternative and α was the coefficient of price. With the 1000 values from bootstrap procedure, 1000 WTP could be simulated for each attribute of the beef steaks in every choice experiment. Because the coefficients of beef attributes were assumed to be normally distributed and the coefficient of price was a nonrandom parameter, the ratio of attribute coefficients and price coefficient were normally distributed. As a result, the means of WTP from different choice experiment could be

compared using standard t-test. The total WTP for an alternative was also calculated as the sum of the WTP for every individual attribute in a choice experiment. It measured the amount of dollars that a consumer would be willing to pay for a beef steak which had all the attributes presented in a choice experiment.

Changes in the Value of WTP with Additional Attributes

The means of simulated WTP for each individual attribute and total WTP in each choice experiment were reported in Table 5.10 and Table 5.11. Most of the WTP were significantly different from zero at 5% significance level, except the WTP for "Days before Sell-by Date" in choice experiments A22, B11 and B12 with the K-State sample, the WTP for "Days before Sell-by Date" in choice experiment B21 with the Chicago sample. Most of the WTP were greater than zero, which implied that the consumer would pay a premium for a product possessing those attributes. A comparison of WTP across different beef attributes showed that consumers had highest WTP for "Certified U.S Product", followed by "Guaranteed Tender", "Guaranteed Lean" and "Enhance Omega-3 Fatty Acids". Consumer WTP for "Days before Sell-by Date" was the lowest, and surprisingly, it was negative and significant in choice experiment B22 with the K-State sample, and in choice experiment B12 with the Chicago sample. One possible explanation is that the difference in the levels ("2 days before sell-by date" and "8 days before sell-by date") of "Days before Sell-by Date" were not considered significantly different to respondents, such that respondents just ignored this attribute when they made choice decisions. As a result, consumer choices for beef steak with more "Days before Sell-by Date" depended on the presence of other attributes that consumers were more concerned about.

The within-subject comparisons of WTP were conducted using a t-test with simulated total WTP for alternatives and the WTP for each individual attributes across choice experiments A11 and A12 (B11 and B12) as well as A21 and A22 (B21 and B22). Between-subject comparisons of WTP were across choice experiments A11 and A21 (B11 and B21) as well as A12 and A22 (B12 and B22). The values in Table 5.12 and 5.12 were the differences between means of WTP for beef attributes across choice experiments, calculated by subtracting the mean WTP in the second choice experiment from the mean WTP in the first choice experiment for each corresponding attribute. For instance, the value 1.584 of first row and first column in table 5.12 was calculated by subtracting the mean WTP for "Certified U.S. Product" in choice experiment A12 by that in choice experiment in A11. As a result, it indicates that consumer

WTP for "Certified U.S. Product" decreased by $1.584 after "Guaranteed Lean" was added to choice experiment A12. Results in Table 5.12 showed that consumer WTP for most beef attributes changed significantly, after more attributes were added to choice experiments. However, the changes in the WTP did not monotonically change with the number of attributes in the choice experiment. The changes in the WTP for a certain beef attribute depend on its relationship with the newly added beef attributes to the choice experiment and the presence of other attributes.

With both the Chicago and K-State samples, within and between Subject comparisons showed that consumer WTP for "Certified U.S. Product" decreased when "Guaranteed Lean" was added to the choice experiments making the number of attributes of beef steak change from 3 to 4. While the WTP increased when "Days before Sell-by Date" was added to choice experiments making the number of attributes of beef steak change from 4 to 5. Both changes are statistically significant for the Chicago and K-State samples.

With the Chicago sample, both within and between Subject comparisons gave consistent conclusions on the effect of an additional attribute. That is, the added attribute of "Guaranteed Lean" decreased consumer WTP for "Guaranteed Tender", while adding "Days before Sell-by Date" increased consumer WTP for "Guaranteed Tender". The impact of "Guaranteed Lean" is not statistically significant in the within-subject comparison, and other changes in WTP for "Guaranteed Tender" were significant (0.05 level). In addition, both within and between subject comparisons showed that the WTP for "Guaranteed Lean" increased significantly after "Days before Sell-by Date" was added to choice experiments.

With the K-State sample, within-subject comparisons showed that consumer WTP for "Guaranteed Tender" increased when "Guaranteed Lean" and "Days before Sell-by Date" were added to choice experiments, but only "Days before Sell-by Date" significantly affected the WTP. Between-subject comparisons implied a different result- both "Guaranteed Lean" and "Days before Sell-by Date" significantly decreased consumer WTP for "Guaranteed Tender". In addition, "Days before Sell-by Date" decreased consumer WTP for "Guaranteed Lean", with a significant effect in between-subject comparison.

Regarding the change in the total WTP for alternatives in choice experiment, within-subject comparisons with the Chicago sample showed that the negative effect of "Guaranteed Lean" was not statistically significant, while "Days before Sell-by Date" significantly increased

consumer total WTP. Between-subject comparisons with the Chicago sample showed that "Guaranteed Lean" significantly decreased and "Days before Sell-by Date" significantly increased consumer total WTP for beef steak. The results with the K-State sample implied that "Guarantee Lean" decreased the total WTP for beef steaks, with significant effects in between-subject comparisons, and "Days before Sell-by Date" significantly increased consumer total WTP in within-subject comparisons, and decreased the total WTP in between-subject, with an insignificant effect.

For the choice experiment in survey B1 and B2, "Days before Sell-by Date" significantly decreased consumer WTP for "Guaranteed Tender" with both the Chicago and K-State samples (Table 5.13). "Enhance Omega-3 Fatty Acids" significantly increased consumer WTP for "Guaranteed Tender" with the Chicago sample, while it did not have significant impact on the WTP for "Guaranteed Tender" with the K-State sample. Although WTP for "Guaranteed Lean" was decreased by "Days before Sell-by Date" in within-subject comparison with the Chicago sample, the changes were not significant, and in most cases it was significantly increased by both "Days before Sell-by Date" and "Enhanced Omega-3 Fatty Acids". The comparisons with the K-State sample showed that "Enhanced Omega-3 Fatty Acids" decreased consumer WTP for "Days before Sell-by Date", with a significant effect in between-subject comparison, while the comparison with Chicago sample implied that "Enhance Omega-3 Fatty Acids" significantly increased consumer WTP for "Days before Sell-by Date" in both within and between subject comparisons. Regarding to the total WTP, in most cases, the newly added attributes significantly affected consumer total WTP. "Days before Sell-by Date" significantly decreased consumer total WTP in both within and between subject comparisons with both the Chicago and K-State samples. "Enhance Omega-3 Fatty Acids" significantly increased total WTP with the Chicago sample, and in within-subject comparison with the K-State sample, the negative effect of "Enhance Omega-3 Fatty Acids" on total WTP was not significant in the between-subject comparison with the K-State sample (Table 5.13).

Changes in the Proportion of WTP for Individual Attributes in Total WTP

Analysis of results in Table 5.12 and Table 5.13 showed that in most cases, the additional attributes presented in the choice experiment affected consumer WTP for individual attributes and total WTP - in the total 56 comparisons, only in eight cases the impacts of additional attributes were not statistically significant. Another interesting question was: did the importance

of a particular attribute in the beef steak changes in comparison with other attributes? To answer this question, the proportions of WTP for each individual attribute in the total WTP in each choice experiment were calculated. A larger proportion of the WTP for an individual attribute indicated greater importance of this attribute. Because the large variation of the WTP, some proportion of WTP for individual attributes were negative when calculated with simulated data. So, only mean proportions of individual attributes were calculated as $Wpr = \frac{WTP^k}{Total\ WTP}$.

The results in Table 5.14 and 5.15 were calculated by dividing the means of total WTP by the means of WTP for individual attributes in Table 5.10 and 5.11. The results showed that in the choice experiments in survey A1 and A2, "Certified U.S. Product" was the most important attribute of beef steak - consumer WTP for it accounted for more than 50% of the total WTP 5 out of 8 times. "Guaranteed Tender" and "Guaranteed Lean" were the second and third most import attributes, while "Days before Sell-by Date" was the least important - consumer WTP for this attribute accounted for less than 3% of total WTP for beef steaks (Table 5.14). When "Certified U.S. Product" did not exist in the choice experiments, "Guaranteed Tender" was the most important attributes, the WTP for it accounted for 55% of the total WTP. "Guaranteed Lean" and "Enhanced Omega-3 Fatty Acids" were the second and third important attributes. However, the proportion of WTP for "Enhanced Omega-3 Fatty Acids" in total WTP was less than 10%. "Days before Sell-by Date" was still the least important attribute, with the WTP for it only accounting for less than 1% of total WTP, and it was sometimes negative (Table 5.15).

Within and between subject comparison of the proportion of WTP showed that the proportions of "Certified U.S. Product" decreased by more than 13% with both the Chicago and K-State samples, when "Guaranteed Lean" was added to choice experiments. However, the proportions increased as much as 17.5%, when "Days before Sell-by Date" were added to choice experiments. The proportions of both "Guaranteed Tender" and "Guaranteed Lean" decreased when "Days before Sell-by Date" were added to choice experiment- the decrease in the proportions of "Guaranteed Tender" varied from 2.5% to 5.7%, and the proportions of "Guaranteed lean" decreased from 2.3% to 12% (Table 5.12). In the case of choice experiments in surveys B1 and B2, the proportions of "Guaranteed Tender" decreased when "Days before Sell-by Date" or "Enhanced Omega-3 Fatty Acids" were added to choice experiments. When "Days before Sell-by Date" was added to the choice experiments, the decreases in the

proportions varied from 2.2% to 15.9%, and the decreases varied from 4.8% to 18.4% when "Enhance Omega-3 Fatty Acids" was added to the choice experiments. The proportions of "Guaranteed Lean" increased when "Days before Sell-by Date" was added to choice experiments. Those proportions decreased in the Chicago sample, but increased with the K-State sample, when "Enhance Omega-3 Fatty Acids" was added to the choice experiment. However, the increases in the proportions with the K-State sample were relatively larger (3.7% and 18.3%) compared with the decrease in the proportions with Chicago sample (5.1% and 1.2%). The results of the effects of "Enhanced Omega-3 Fatty Acids" on the proportion of "Days before Sell-by Date" were not consistent between with the Chicago and K-State samples. Results with the K-State sample showed that "Enhanced Omega-3 Fatty Acids" decreased the proportion of "Days before Sell-by Date", while results with the Chicago sample indicated "Enhance Omega-3 Fatty Acids" increased the proportion for "Days before Sell-by Date" (Table 5.13).

Table 5.1 Means and Standard Deviations of Respondent Demographics by Location and Survey

	Chicago				Manhattan			
Variable	A1	A2	B1	B2	A1	A2	B1	B2
Age [c]	43.30[a]	45.46	44.33	46.98	41.30	40.65	40.28	39.75
	(12.10)[b]	(11.91)	(12.30)	(10.62)	(13.62)	(13.27)	(13.06)	(12.51)
Income [d]	6.57	6.30	6.35	5.96	5.20	5.20	5.25	5.19
	(2.35)	(2.12)	(2.36)	(2.27)	(2.50)	(2.44)	(2.48)	(2.53)
# of Adults e	2.01	2.00	1.94	1.99	1.91	1.87	1.88	1.84
	(0.81)	(0.79)	(0.72)	(0.92)	(0.78)	(0.80)	(0.76)	(0.81)
# of Children [f]	0.62	0.30	0.47	0.45	0.52	0.62	0.59	0.56
	(1.01)	(0.69)	(0.83)	(0.77)	(0.91)	(0.99)	(0.96)	(0.97)
Gender [h]								
0	32[g]	27	46	26	132	100	114	90
1	42	49	32	56	79	87	84	81
Education [i]								
1	6	0	0	0	0	0	0	0
2	15	4	1	5	12	13	15	10
3	28	22	19	28	0	1	0	0
4	25	25	32	28	30	27	30	25
5	0	25	26	21	169	146	153	136
Marriage [j]								
1	19	21	19	20	59	52	56	60
2	46	43	49	47	141	130	138	99
3	9	12	10	15	11	5	4	12
Employment [k]								
1	50	59	54	59	142	123	142	116
2	9	3	13	10	16	9	10	13
3	7	1	2	6	0	0	0	1
4	3	0	2	1	47	52	46	37
5	5	3	7	6	6	3	0	4
# of respondents	74	76	78	82	211	187	198	171

[a] Reported statistics of Age, Income, # of Adults and # of Children are mean values.
[b] The numbers in parenthesis are standard deviations.
[c] Age: Age in years
[d] Income: Household annual income level.
1=Under 10,000; 2=10,000 to 24,999…
13=300,000 to 399,999; 14=400,000 and more
[e] # of Adults: Number of adults living in home
[f] # of Children: Number of children living in home
[g] Reported statistics of Gender, Education, Marriage, and Employment are frequency of the variable levels among respondents.
[h] Gender: 1=Female; 0=Male
[i] Education: 1=1st through 8th grade; 2=Some high School or high school graduate;
3=Some colleage/2 year associate degree;
4=Four year college degree; 5=Master or Ph.D. degree
[j] Marriage: 1=Single; 2=Married; 3=Divorced, widowed or separated
[k] Employment: 1= Employed full time; 2=Employed part time;
3=Unemployed; 4= Student; 5=Retired

Table 5.2 Random Parameters Logit Model for Surveys A1 and A2 with Chicago Sample

Choice Experiment	A11	A12	A21	A22
Independent Variable	Coefficient	Coefficient	Coefficient	Coefficient
Certified U.S. Product	3.114	1.976	2.203	2.582
	(0.000)[a]	(0.000)	(0.000)	(0.000)
Guaranteed Tender	1.565	1.357	1.651	1.648
	(0.000)	(0.000)	(0.000)	(0.000)
Guaranteed Lean		0.851	1.094	0.870
		(0.006)	(0.005)	(0.001)
Days before Sell-by Date				0.138
				(0.003)
Price	-0.340	-0.315	-0.411	-0.295
	(0.000)	(0.000)	(0.000)	(0.000)
Constant for the None Option	0.190	0.335	-0.323	1.757
	(0.563)	(0.233)	(0.234)	(0.000)
	Diagonal values in Cholesky matrix, L			
Ns Guaranteed U.S. Product	1.505	1.289	1.466	1.794
	(0.000)	(0.000)	(0.000)	(0.000)
Ns Guaranteed Tender	1.461	1.110	1.359	0.022
	(0.000)	(0.000)	(0.000)	(0.753)
Ns Guaranteed Lean		1.442	1.437	0.442
		(0.000)	(0.000)	(0.296)
Ns Days before Sell-by Date				0.016
				(0.945)
	Below diagonal values in L matrix. V = L*Lt			
Tender : U.S. Product	-0.219	0.320	0.541	0.267
	(0.528)	(0.411)	(0.161)	(0.401)
Lean : U.S. Product		0.114	0.619	0.035
		(0.799)	(0.143)	(0.912)
Lean : Tender		0.325	0.227	-0.082
		(0.469)	(0.525)	(0.852)
Sell-by : U.S. Product				0.097
				(0.086)
Sell-by : Tender				-0.095
				(0.064)
Sell-by : Lean				-0.011
				(0.894)
	Standard deviations of parameter distributions			
Std Guaranteed U.S. Product	1.505	1.289	1.466	1.794
	(0.000)	(0.000)	(0.000)	(0.000)
Std Guaranteed Tender	1.477	1.155	1.462	0.268
	(0.000)	(0.000)	(0.000)	(0.025)
Std Guaranteed Lean		1.483	1.581	0.451
		(0.000)	(0.008)	(0.345)
Std Days before Sell-by Date				0.137
				(0.097)
Log Likelihood	-438.87	-467.81	-457.956	-499.08
# of Obs	74	74	76	76

[a] The number in parenthesis are p-values.

Table 5.3 Random Parameters Logit Model for Survey A1 and A2 with K-State Sample

Choice Experiment	A11	A12	A21	A22
Independent Variable	Coefficient	Coefficient	Coefficient	Coefficient
Certified U.S. Product	2.058	1.594	1.391	1.475
	(0.000)	(0.000)	(0.000)	(0.000)
Guaranteed Tender	0.794	1.028	0.629	0.645
	(0.000)	(0.000)	(0.002)	(0.000)
Guaranteed Lean		0.649	0.342	0.148
		(0.004)	(0.120)	(0.334)
Days before Sell-by Date				0.009
				(0.776)
Price	-0.435	-0.516	-0.574	-0.391
	(0.000)	(0.000)	(0.000	(0.000)
Constant for the None Option	-2.260	-2.656	-3.626	-1.928
	(0.000)	(0.000)	(0.000)	(0.000)
	Diagonal values in Cholesky matrix, L			
Ns Guaranteed U.S. Product	1.834	1.518	1.431	1.453
	(0.000)	(0.000)	(0.000)	(0.000)
Ns Guaranteed Tender	1.351	1.405	1.411	0.970
	(0.000)	(0.000)	(0.000)	(0.000)
Ns Guaranteed Lean		1.759	1.364	0.589
		(0.000)	(0.000)	(0.018)
Ns Days before Sell-by Date				0.159
				(0.000)
	Below diagonal values in L matrix. V = L*Lt			
Tender : U.S. Product	0.778	0.061	-0.072	-0.072
	(0.000)	(0.759)	(0.727)	(0.728)
Lean : U.S. Product		0.493	0.566	0.380
		(0.036)	(0.014)	(0.057)
Lean : Tender		0.608	0.673	0.322
		(0.003)	(0.004)	(0.201)
Sell-by : U.S. Product				0.005
				(0.879)
Sell-by : Tender				0.121
				(0.001)
Sell-by :Lean				-0.004
				(0.940)
	Standard deviations of parameter distributions			
Std Guaranteed U.S. Product	1.834	1.518	1.431	1.453
	(0.000)	(0.000)	(0.000)	(0.000)
Std Guaranteed Tender	1.559	1.406	1.413	0.973
	(0.000)	(0.000)	(0.000)	(0.000)
Std Guaranteed Lean		1.925	1.623	0.771
		(0.000)	(0.000)	(0.005)
Std Days before Sell-by Date				0.200
				(0.000)
Log Likelihood	-1423.94	-1367.52	-1247.43	-1347.67
# of Obs	211	211	187	187

[a] The number in parenthesis are p-values.

Table 5.4 Random Parameters Logit Model for Survey B1 and B2 with Chicago Sample

Choice Experiment	B11	B12	B21	B22
Independent Variable	Coefficient	Coefficient	Coefficient	Coefficient
Guaranteed Tender	2.165	2.347	1.790	1.780
	(0.000)	(0.000)	(0.000)	(0.000)
Guaranteed Lean	0.977	1.209	1.092	1.070
	(0.000)	(0.000)	(0.000)	(0.000)
Days before Sell-by Date		-0.026	0.006	0.012
		(0.705)	(0.903)	(0.802)
Enhanced Omega-3 Fatty Acids				0.294
				(0.220)
Price	-0.456	-0.572	-0.463	-0.317
	(0.000)	(0.000)	(0.000)	(0.000)
Constant for the None Option	-1.832	-2.435	-2.530	-0.858
	(0.000)	(0.000)	(0.000)	(0.000)
	Diagonal values in Cholesky matrix, L			
Ns Guaranteed Tender	1.629	1.074	1.041	1.058
	(0.000)	(0.002)	(0.000)	(0.001)
Ns Guaranteed Lean	1.274	0.842	0.782	0.176
	(0.000)	(0.004)	(0.000)	(0.661)
Ns Days before Sell-by Date		0.226	0.077	0.050
		(0.000)	(0.433)	(0.788)
Ns Enhanced Omega-3 Fatty Acids				0.267
				(0.779)
	Below diagonal values in L matrix. V = L*Lt			
Lean : Tender	0.695	-0.134	-0.092	0.167
	(0.003)	(0.650)	(0.819)	(0.530)
Sell-by : Tender		0.137	0.131	0.104
		(0.075)	(0.013)	(0.049)
Sell-by : Lean		-0.106	0.087	0.083
		(0.178)	(0.182)	(0.556)
Omega-3 : Tender				0.019
				(0.971)
Omega-3 : Lean				0.538
				(0.578)
Omega-3 : Sell-by				-0.612
				(0.472)
	Standard deviations of parameter distributions			
Std Guaranteed Tender	1.629	1.074	1.041	1.058
	(0.000)	(0.002)	(0.000)	(0.001)
Std Guaranteed Lean	1.451	0.852	0.787	0.243
	(0.000)	(0.003)	(0.000)	(0.466)
Std Days before Sell-by Date		0.285	0.176	0.143
		(0.000)	(0.074)	(0.303)
Std Enhanced Omega-3 Fatty Acids				0.858
				(0.470)
Log Likelihood	-506.83	-446.013	-537.95	-592.56
# of Obs	78	78	82	82

[a] The number in parenthesis are p-values.

Table 5.5 Random Parameters Logit Model for Survey B1 and B2 with K-State Sample

Choice Experiment	B11	B12	B21	B22
Independent Variable	Coefficient	Coefficient	Coefficient	Coefficient
Guaranteed Tender	1.648	1.744	1.252	1.068
	(0.000)	(0.000)	(0.000)	(0.000)
Guaranteed Lean	0.463	0.550	0.787	0.756
	(0.001)	(0.001)	(0.000)	(0.000)
Days before Sell-by Date		0.003	-0.055	-0.056
		(0.929)	(0.108)	(0.048)
Enhanced Omega-3 Fatty Acids				0.057
				(0.737)
Price	-0.480	-0.588	-0.594	-0.486
	(0.000)	(0.000)	(0.000)	(0.000)
Constant for the None Option	-2.441	-3.050	-4.545	-3.640
	(0.000)	(0.000)	(0.000)	(0.000)
	Diagonal values in Cholesky matrix, L			
Ns Guaranteed Tender	1.637	1.108	1.112	1.373
	(0.000)	(0.000)	(0.000)	(0.000)
Ns Guaranteed Lean	1.285	1.271	1.231	1.195
	(0.000)	(0.000)	(0.000)	(0.000)
Ns Days before Sell-by Date		0.177	0.223	0.107
		(0.000)	(0.000)	(0.017)
Ns Enhanced Omega-3 Fatty Acids				0.438
				(0.024)
	Below diagonal values in L matrix. V = L*Lt			
Lean : Tender	-0.571	-0.319	-0.013	-0.048
	(0.004)	(0.127)	(0.959)	(0.840)
Sell-by : Tender		-0.055	0.088	0.093
		(0.119)	(0.040)	(0.013)
Sell-by : Lean		0.090	0.028	0.006
		(0.001v	(0.393)	(0.873)
Omega-3 : Tender				0.340
				(0.110)
Omega-3 : Lean				0.478
				(0.013)
Omega-3 : Sell-by				-0.062
				(0.837)
	Standard deviations of parameter distributions			
Std Guaranteed Tender	1.637	1.108	1.112	1.370
	(0.000)	(0.002)	(0.000)	(0.000)
Std Guaranteed Lean	1.406	1.310	1.231	1.20
	(0.000)	(0.000)	(0.000)	(0.000)
Std Days before Sell-by Date		0.206	0.241	0.142
		(0.000)	(0.000)	(0.007)
Std Enhanced Omega-3 Fatty Acids				0.735
				(0.003)
Log Likelihood	-1327.80	-1245.92	-1111.40	-1185.29
# of Obs	198	198	171	171

[a] The number in parenthesis are p-values.

Table 5.6 Covariance Matrices of Random Parameters for Surveys A1 and A2 with Chicago Sample

A11	Certified U.S. Product	Guaranteed Tender
Certified U.S. Product	2.27[a]	-0.33
Guaranteed Tender	-0.33[b]	2.18

A12	Certified U.S. Product	Guaranteed Tender	Guaranteed Lean
Certified U.S. Product	1.66	0.41	0.19
Guaranteed Tender	0.41	1.33	0.41
Guaranteed Lean	0.19	0.41	2.21

A21	Certified U.S. Product	Guaranteed Tender	Guaranteed Lean
Certified U.S. Product	2.15	0.79	0.91
Guaranteed Tender	0.79	2.14	0.64
Guaranteed Lean	0.91	0.64	2.50

A22	Certified U.S. Product	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date
Certified U.S. Product	3.22	0.48	0.06	0.17
Guaranteed Tender	0.48	0.07	0.01	0.02
Guaranteed Lean	0.06	0.01	0.20	0.01
Days before Sell-by Date	0.17	0.02	0.01	0.02

[a] The diagonal values are the variance of random parameters of attributes.
[b] The off-diagonal values are the covariance between random parameters of attributes.

Table 5.7 Covariance Matrices of Random Parameters for Surveys A1 and A2 with K-State Sample

A11	Certified U.S. Product	Guaranteed Tender
Certified U.S. Product	3.36[a]	1.43
Guaranteed Tender	1.43[b]	2.43

A12	Certified U.S. Product	Guaranteed Tender	Guaranteed Lean
Certified U.S. Product	2.30	0.09	0.75
Guaranteed Tender	0.09	1.98	0.88
Guaranteed Lean	0.75	0.88	3.71

A21	Certified U.S. Product	Guaranteed Tender	Guaranteed Lean
Certified U.S. Product	2.05	-0.10	0.81
Guaranteed Tender	-0.10	2.00	0.91
Guaranteed Lean	0.81	0.91	2.63

A22	Certified U.S. Product	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date
Certified U.S. Product	2.11	-0.10	0.55	0.01
Guaranteed Tender	-0.10	0.95	0.29	0.12
Guaranteed Lean	0.55	0.29	0.60	0.04
Days before Sell-by Date	0.01	0.12	0.04	0.04

[a] The diagonal values are the variance of random parameters of attributes.
[b] The off-diagonal values are the covariance between random parameters of attributes.

Table 5.8 Covariance Matrices of Random Parameters for Surveys B1 and B2 with Chicago Sample

B11	Guaranteed Tender	Guaranteed Lean
Guaranteed Tender	2.65[a]	1.13
Guaranteed Lean	1.13[b]	2.11

B12	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date
Guaranteed Tender	1.15	-0.14	0.15
Guaranteed Lean	-0.14	0.73	-0.11
Days before Sell-by Date	0.15	-0.11	0.08

B21	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date
Guaranteed Tender	1.08	-0.10	0.14
Guaranteed Lean	-0.10	0.62	0.06
Days before Sell-by Date	0.14	0.06	0.03

B22	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date	Enhanced Omega-3 Fatty Acids
Guaranteed Tender	1.12	0.18	0.11	0.02
Guaranteed Lean	0.18	0.06	0.03	0.10
Days before Sell-by Date	0.11	0.03	0.02	0.02
Enhanced Omega-3 Fatty Acids	0.02	0.10	0.02	0.74

[a] The diagonal values are the variance of random parameters of attributes.
[b] The off-diagonal values are the covariance between random parameters of attributes.

Table 5.9 Covariance Matrices of Random Parameters for Surveys B1 and B2 with K-State Sample

B11	Guaranteed Tender	Guaranteed Lean
Guaranteed Tender	2.68[a]	-0.93
Guaranteed Lean	-0.93[b]	1.98

B12	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date
Guaranteed Tender	1.23	-0.35	-0.06
Guaranteed Lean	-0.35	1.72	0.13
Days before Sell-by Date	-0.06	0.13	0.04

B21	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date
Guaranteed Tender	1.24	-0.01	0.10
Guaranteed Lean	-0.01	1.52	0.03
Days before Sell-by Date	0.10	0.03	0.06

B22	Guaranteed Tender	Guaranteed Lean	Days before Sell-by Date	Enhanced Omega-3 Fatty Acids
Guaranteed Tender	1.89	-0.07	0.13	0.47
Guaranteed Lean	-0.07	1.43	0.00	0.55
Days before Sell-by Date	0.13	0.00	0.02	0.03
Enhanced Omega-3 Fatty Acids	0.47	0.55	0.03	0.54

[a] The diagonal values are the variance of random parameters of attributes.
[b] The off-diagonal values are the covariance between random parameters of attributes.

Table 5.10 WTP Estimates in Survey A1 and A2

Location	Chicago				Kansas State University			
WTP for…[a]	A11[c]	A12	A21	A22	A11	A12	A21	A22
Certified U.S. Product	9.09*	6.31*	5.26*	9.14*	4.61*	3.03*	2.33*	3.89*
Guaranteed Tender	4.40*	4.40*	3.97*	5.44*	1.67*	1.90*	1.09*	1.48*
Guaranteed Lean		2.47*	2.55*	2.98*		1.14*	0.44*	0.40*
Days before Sell-by Date				0.51*				0.01
Total WTP [b]	13.49*	13.18*	11.78*	18.07*	6.28*	6.07*	3.85*	5.78*

[a] WTP values are derived from models in Table 5.2 and 5.3. WTP values are for 12 oz beef steaks.
[b] Total WTP are the sum of WTP for all individual attribute in each choice experiment.
[c] Report statistics are mean of 1000 simulated WTP estimations.
[*] Values with star are significant different from zero at 5% significance level or lower.

Table 5.11 WTP Estimates in Survey B1 and B2

Location	Chicago				Kansas State University			
WTP for…[a]	B11[c]	B12	B21	B22	B11	B12	B21	B22
Guaranteed Tender	4.61*	4.06*	3.89*	5.86*	3.38*	2.89*	2.06*	2.07*
Guaranteed Lean	2.13*	2.10*	2.41*	3.42*	0.94*	1.02*	1.35*	1.66*
Days before Sell-by Date		-0.04*	0.01	0.06*		0.004	-0.10	-0.12*
Enhance Omega-3 Fatty Acids				0.98*				0.12*
Total WTP [b]	6.74*	6.12*	6.31*	10.32*	4.32*	3.91*	3.31*	3.74*

[a] WTP values are derived from models in Table 5.2 and 5.3. WTP values are for 12 oz beef steaks.
[b] Total WTP are the sum of WTP for all individual attribute in each choice experiment.
[c] Report statistics are mean of 1000 simulated WTP estimations.
[*] Values with star are significant different from zero at 5% significance level or lower.

Table 5.12 Within and Between Subject Comparisons of WTP Estimates in Survey A

Location	Chicago				Kansas State University			
Type of Comparison	Within Subject		Between Subject		Within Subject		Between Subject	
Choice Experiment	A11-A12	A21-A22	A11-A21	A12-A22	A11-A12	A21-A22	A11-A21	A12-A22
Certified U.S. Product	2.779[c]	-3.881	3.832	-2.828	1.584	-1.564	2.281	-0.867
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Guaranteed Tender	0.006	-1.470	0.430	-1.045	-0.233	-0.396	0.581	0.418
	(0.975)	(0.000)	(0.014)	(0.000)	(0.104)	(0.000)	(0.000)	(0.000)
Guaranteed Lean		-0.429		-0.507		0.043		0.746
		(0.001)		(0.002)		(0.697)		(0.000)
Total WTP	0.311	-6.291	1.711	-4.891	0.210	-1.928	2.424	0.286
	(0.338)	(0.000)	(0.000)	(0.000)	(0.486)	(0.000)	(0.000)	(0.315)

[a] The numbers in parenthesis are p-values.

[b] The numbers are means of difference of WTP between different choice experiments.

[c] The values are calculate by subtracting WTP for attribute in second choice experiment from WTP for attribute in the first choice experiment. Positive value indicates WTP decrease after additional attribute added to the second choice experiment and negative value indicates WTP increase.

Table 5.13 Within and Between Subject Comparisons of WTP Estimates in Survey B

Location	Chicago				Kansas State University			
Type of Comparison	Within Subject		Between Subject		Within Subject		Between Subject	
Choice Experiment	B11-B12	B21-B22	B11-B21	B12-B22	B11-B12	B21-B22	B11-B21	B12-B22
Guaranteed Tender	0.557[c]	-1.977	0.727	-1.808	0.490	-0.013	1.318	0.815
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.902)	(0.000)	(0.328)
Guaranteed Lean	0.030	-1.003	-0.287	-1.320	-0.078	-0.313	-0.403	-0.639
	(0.783)	(0.000)	(0.012)	(0.000)	(0.503)	(0.002)	(0.000)	(0.000)
Days before Sell-by Date		-0.054		-0.098		0.023		0.124
		(0.003)		(0.000)		(0.142)		(0.000)
Total WTP	0.622	-4.013	0.431	-4.204	0.409	-0.427	1.012	0.176
	(0.002)	(0.000)	(0.040)	(0.000)	(0.003)	(0.020)	(0.000)	(0.328)

[a] The numbers in parenthesis are p-values.
[b] The numbers are means of differences of WTP between different choice experiments.
[c] The values are calculate by subtracting WTP for attribute in second choice experiment from WTP for attribute in the first choice experiment. Positive value indicates WTP decrease after additional attribute added to the second choice experiment and negative value indicates WTP increase.

Table 5.14 Proportion of WTP for Individual Attributes in the Total WTP for All Attributes in Choice Experiments-Survey A

Location	Chicago				Kansas State University			
Choice Experiments	A11	A12	A21	A22	A11	A12	A21	A22
Certified U.S. Product	67.4%a	47.9%	44.6%	50.6%	73.5%	49.9%	60.4%	67.3%
Guaranteed Tender	32.6%	33.4%	33.7%	30.1%	26.5%	31.3%	28.2%	25.6%
Guaranteed Lean		18.8%	21.7%	16.5%		18.8%	11.4%	6.8%
Days before Sell-by Date				2.8%				0.2%

[a] The number are calculated by dividing total WTP by WTP for individual attributes in Table 5.12.

Table 5.15 Proportion of WTP for Individual Attributes in the Total WTP for All Attributes in Choice Experiments-Survey B

Location	Chicago				Kansas State University			
Choice Experiment	B11	B12	B21	B22	B11	B12	B21	B22
Guaranteed Tender	68.4%	66.3%	61.6%	56.8%	78.2%	73.9%	62.3%	55.5%
Guaranteed Lean	31.6%	34.3	38.2%	33.1%	21.8%	26.1%	40.7%	44.4%
Days before Sell-by Date		-0.6%	0.2%	0.6%		0.1%	-2.9%	-3.2%
Enhance Omega-3 Fatty				9.5%				3.3%

[a] The number are calculated by dividing total WTP by WTP for individual attributes in Table 5.13.

Table 5.16 With and Between Subject Comparisons of Proportion of WTP for Individual Attributes in the Total WTP for All Attributes in Choice Experiments-Survey A

Location	Chicago				Kansas State University			
Type of Comparison	Within Subject		Between Subject		Within Subject		Between Subject	
Choice Experiment	A11-A12	A21-A22	A11-A21	A12-A22	A11-A12	A21-A22	A11-A21	A12-A22
Certified U.S. Product	19.5%	-5.9%	22.7%	-2.7%	23.6%	-6.9%	13.0%	-17.5%
Guaranteed Tender	-0.7%	3.6%	-1.1%	3.2%	-4.8%	2.5%	-1.6%	5.7%
Guaranteed Lean		5.2%		2.3%		4.5%		12.0%

[a] The numbers are calculate by subtracting the proportion of WTP for attribute in second choice experiment from the proportion of WTP for attribute in the first choice experiment in Table 5.14.
[b] The values are not percentage change in the proportions of WTP, they are real changes in the proportions of WTP across different choice experiment.

Table 5.17 Within and Between Subject Comparisons of Proportion of WTP for Individual Attributes in the Total WTP for All Attributes in Choice Experiments-Survey B

Location	Chicago				Kansas State University			
Type of Comparison	Within Subject		Between Subject		Within Subject		Between Subject	
Choice Experiment	B11-B12	B21-B22	B11-B21	B12-B22	B11-B12	B21-B22	B11-B21	B12-B22
Guaranteed Tender	2.1%	4.8%	6.8%	9.5%	4.3%	6.8%	15.9%	18.4%
Guaranteed Lean	-2.7%	5.1%	-6.7%	1.2%	-4.3%	-3.7%	-18.9%	-18.3%
Days before Sell-by Date		-0.4%		-1.2%		0.3%		3.3%

[a] The numbers are calculate by subtracting the proportion of WTP for attribute in second choice experiment from the proportion of WTP for attribute in the first choice experiment in Table 5.15.
[b] The values are not percentage change in the proportions of WTP, they are real changes in the proportions of WTP across different choice experiment.

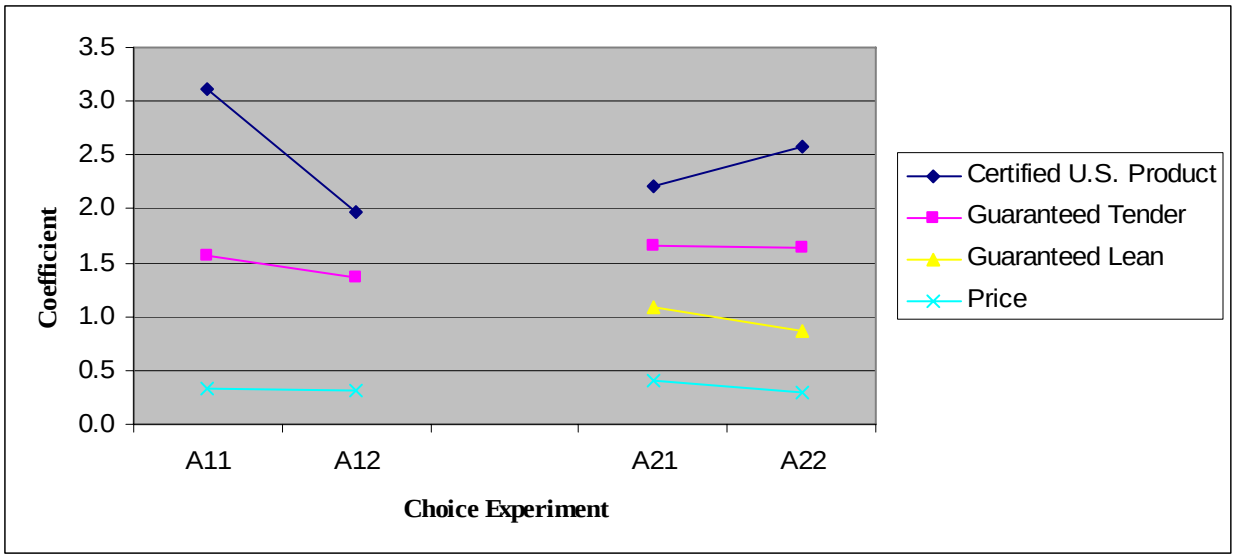

Figure 5.1 Within-subject Comparisons of Coefficients of Beef Attributes with Chicago Sample (Survey A)

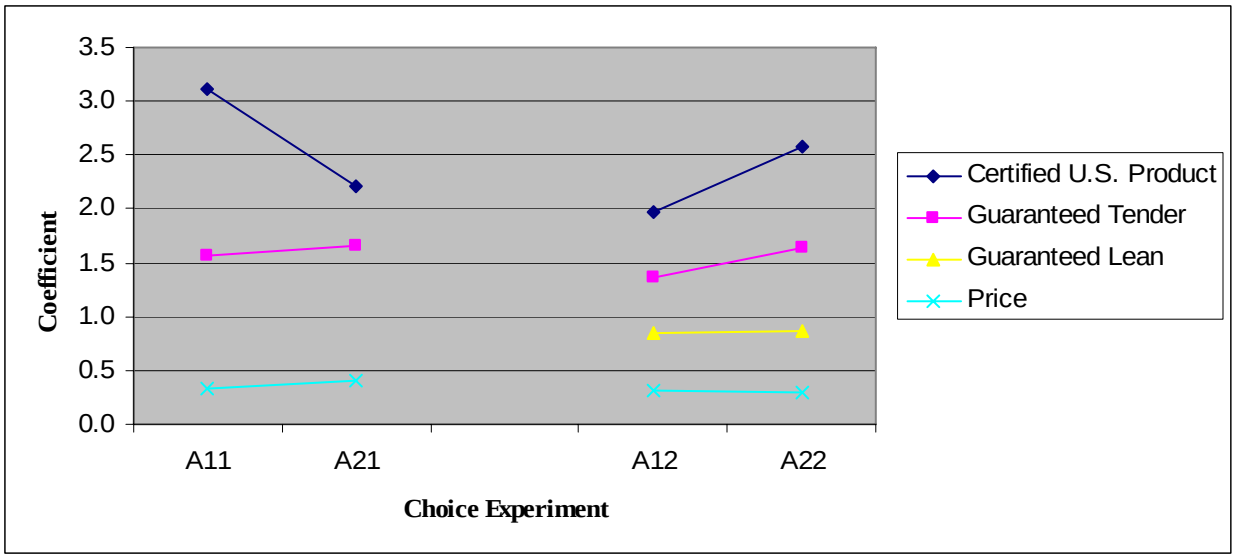

Figure 5.2 Between-subject Comparisons of Coefficients of Beef Attributes with Chicago Sample (Survey A)

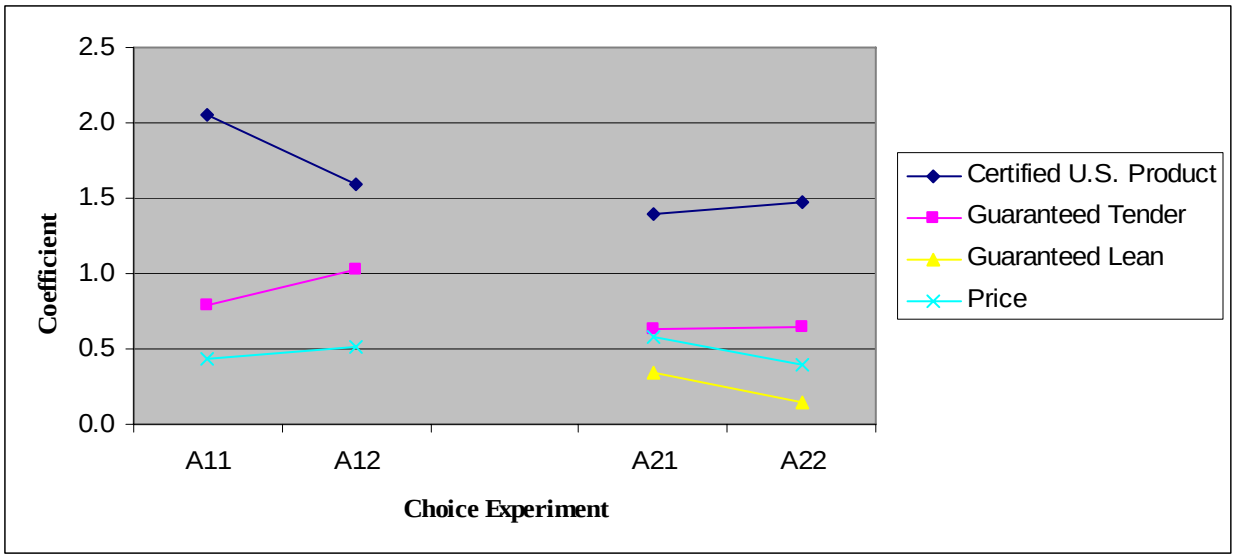

Figure 5.3 Within-subject Comparisons of Coefficients of Beef Attributes with K-State Sample (Survey A)

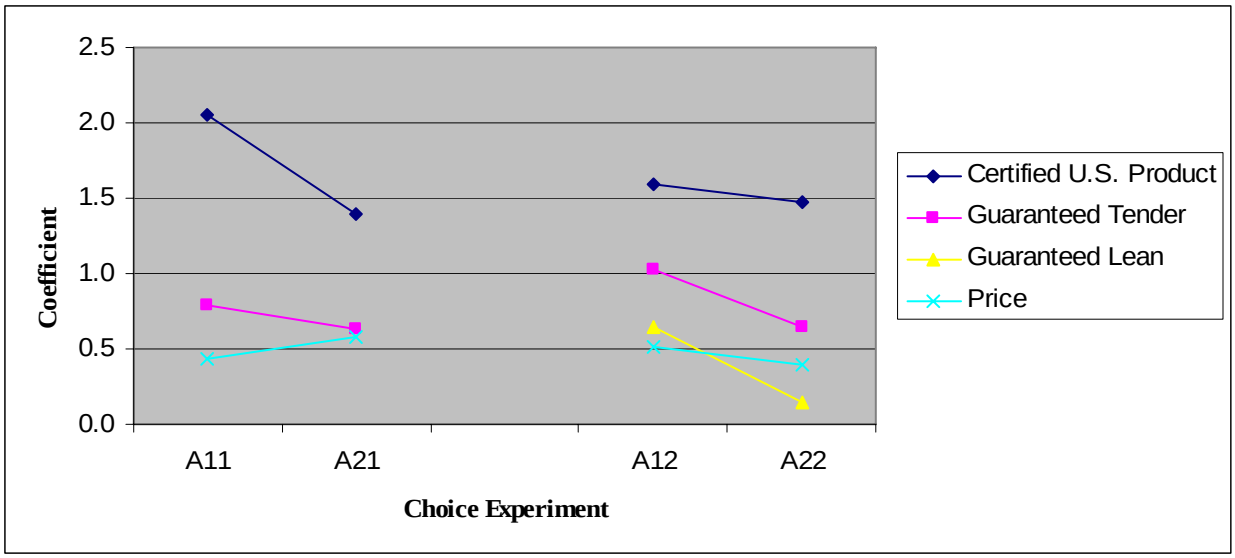

Figure 5.4 Between-subject Comparisons of Coefficients of Beef Attributes with K-State Sample (Survey A)

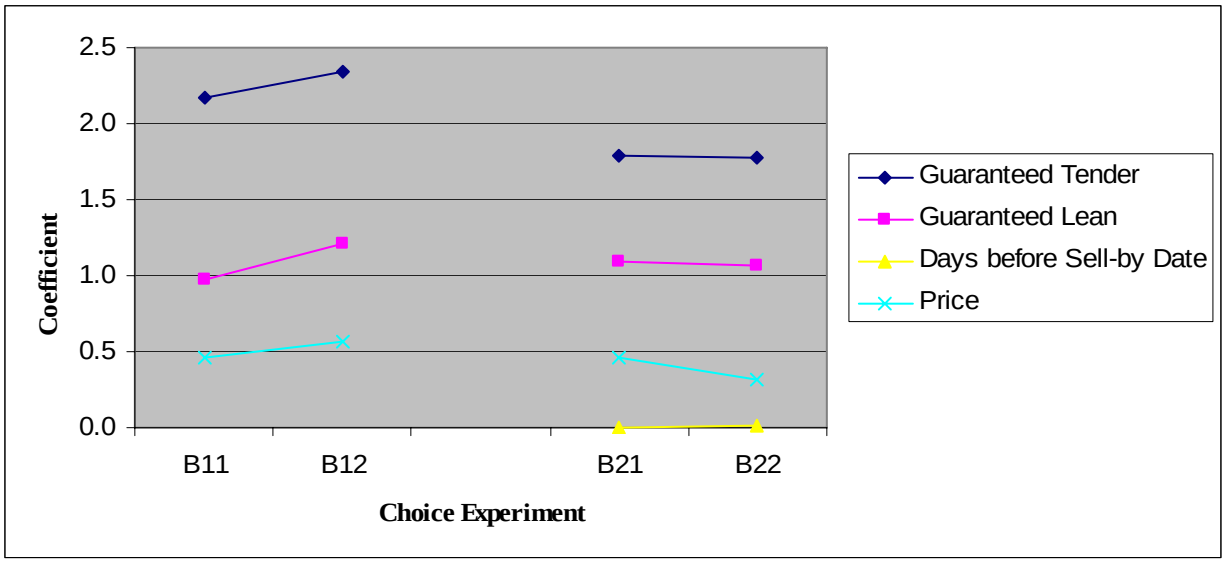

Figure 5.5 Within-subject Comparisons of Coefficients of Beef Attributes with Chicago Sample (Survey B)

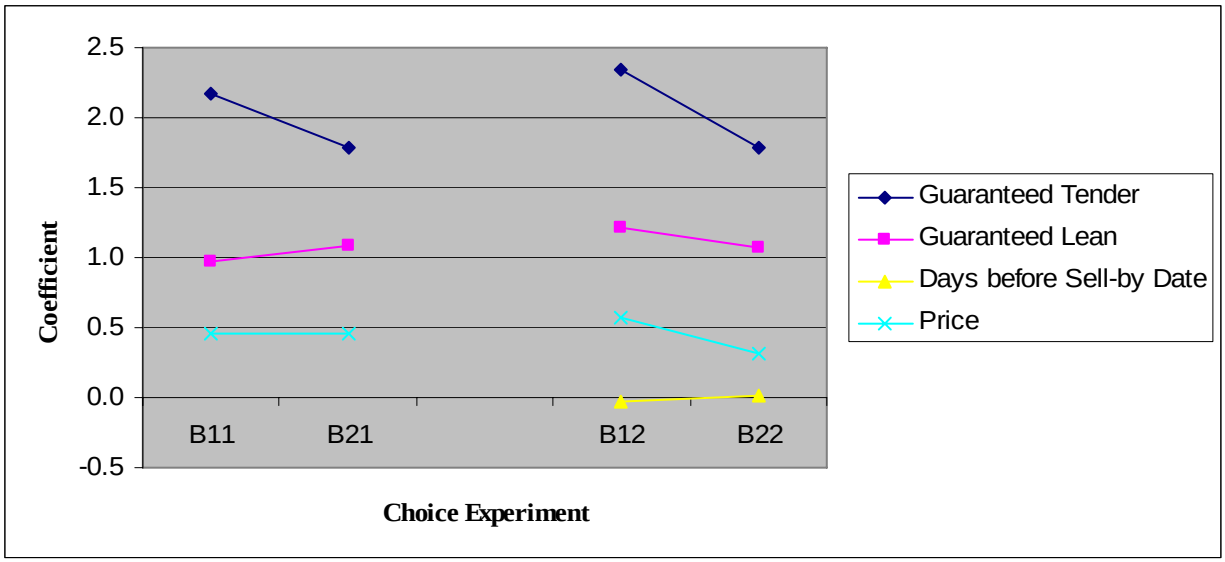

Figure 5.6 Between-subject Comparisons of Coefficients of Beef Attributes with Chicago Sample (Survey B)

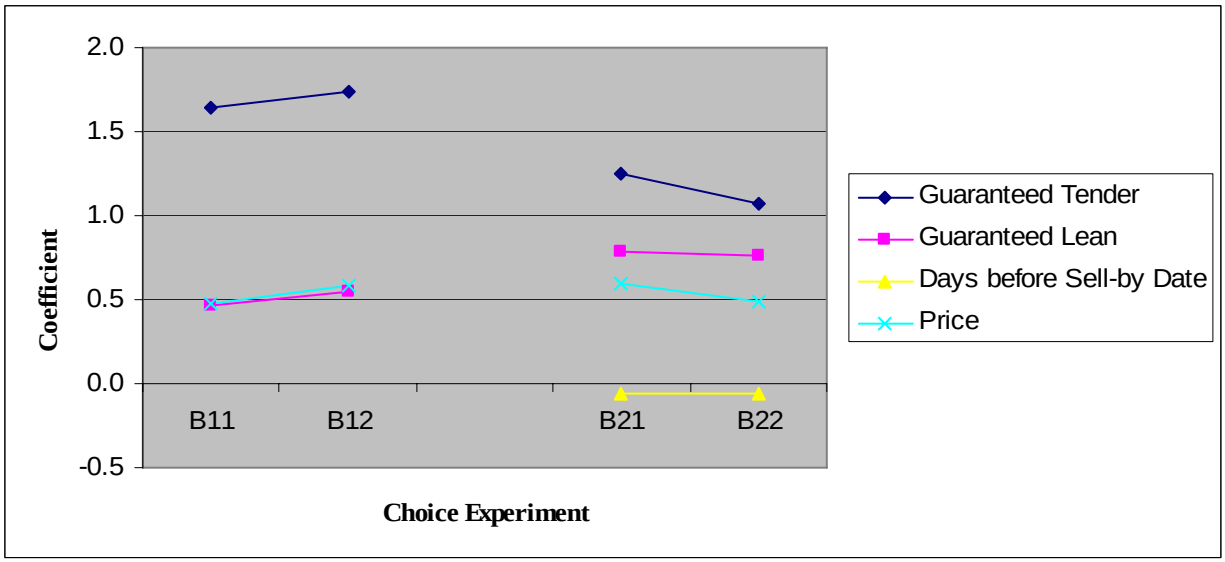

Figure 5.7 Within-subject Comparisons of Coefficients of Beef Attributes with K-State Sample (Survey B)

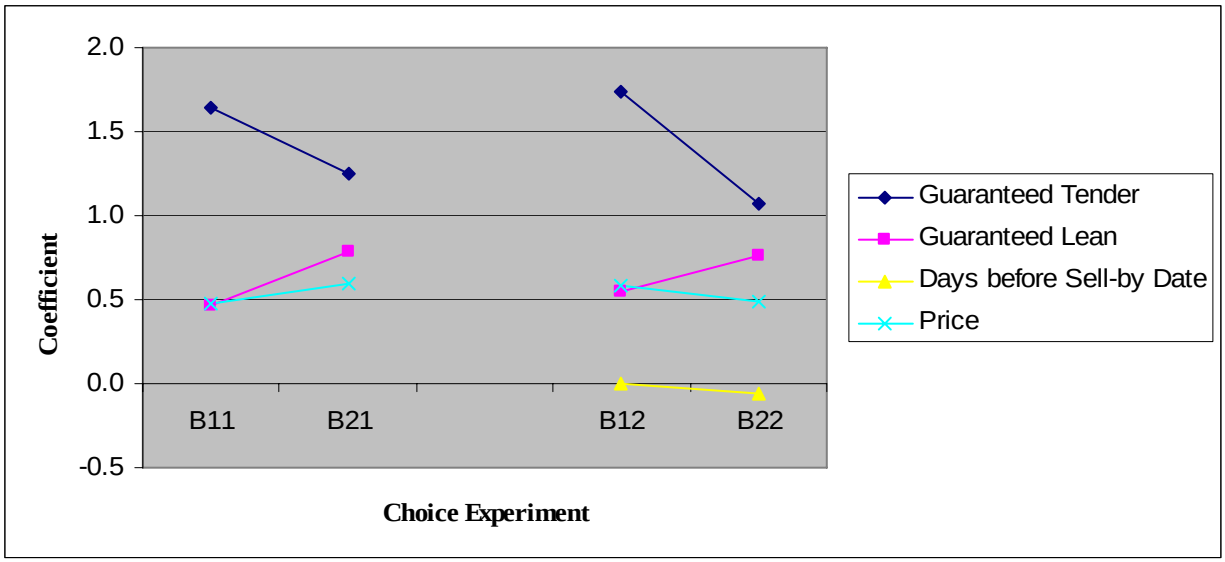

Figure 5.8 Between-subject Comparisons of Coefficients of Beef Attributes with K-State Sample (Survey B)

CHAPTER 6 - CONCLUSIONS and DISCUSSION

As consumers are concerning more about food qualities, progressively more studies on consumer perceptions and WTP for food attributes are being conducted to provide useful information to both food producers and economists. However, most studies assume that consumer WTP for one quality attributes is independent of other attributes by providing limited attribute information on food products. As a result, the information garnered from WTP studies may not be accurate reflections of real world behavior where consumers make actual purchase decisions. In the real world, consumers have a variety of sources and types of information regarding food quality attributes rather than the limited information that researchers provided to them in surveys.

Our study investigated the impact of additional quality attributes information on consumer choice decisions by tracking the changes in the coefficients in consumer utility function, consumer WTP for attributes and the importance of attributes when more attributes information were provided to consumers. Choice experiments were conducted with samples from Chicago and K-State. Both within-subject and Between-subject comparisons were used to explore the effects of addition quality attributes being presented in a choice experiment. Results showed that by providing additional information on food attributes, consumer preferences significantly changed. However, the changes in consumer preference for an attribute were results of impacts of various factors, including the number of attributes in the choice experiment, the relationships between attributes, and the attributes in the choice experiment.

One general conclusion was that when information of additional attributes were provided, consumer WTP for the most important attributes ("Certified U.S Product" in surveys A1 and A2, and "Guaranteed Tender" in surveys B1 and B2) in the choice experiment were most largely affected. And when the number of attributes in a choice experiment was small, the impacts of an additional attribute tended to be larger. In our case, consumers WTP for the most important attributes declined when an additional attribute was added. This was illustrated by WTP for "Certified U.S. Product" in choice experiment A11 and "Guaranteed Tender" in choice experiment B11 when the number of attribute in the experiments increased from three to four.

Our results showed that the impacts of an additional attribute on consumer WTP for an attribute could be classified into two sources: the impact on the total WTP and the impact on the

importance of the individual attributes. The additional attributes might increase or decrease the total WTP in a choice experiment, and they might also increase or decrease the importance of an attribute in a choice experiment. As a result, the change in the WTP for an individual attribute was a result of the two effects. This was especially true for the changes in WTP for "Guaranteed Tender" in survey B2, where the importance of this attribute decreased as "Enhance Omega-3 Fatty Acids" was added to the choice experiments. However, because of the larger increases in the total WTP, consumer WTP for "Guaranteed Tender" still increased, regardless of the decreases in the proportion of WTP for it.

In addition, consumer WTP for cue attribute such as "Certified U.S Product" tended to be affected more than the independent attributes such as "Guaranteed Tender" by additional attributes. However, consumer WTP for the cue attribute "Certified U.S. Product" was always the most important attribute no matter how largely it was decreased when additional attribute information were provided to respondents-the WTP for "Certified U.S Product" were almost equal to the sum of WTP for the other attributes of beef steaks. This implied that: (a) "Certified U.S Product" was the most important attribute of those used in our study that consumer were concerned with; (b) there were other important attributes of beef steaks which were ignored by our study; or (c) the signal of overall product quality provided by this attribute could not be replaced by simply providing a number of individual product attributes.

Another important result is that, no matter how consumer WTP changed with additional attributes provided to respondents, the ranks of those beef steak attributes never changed. "Certified U.S. Product" was always the most important attribute, followed by "Guaranteed Tender", "Guaranteed Lean", "Enhanced Omega-3 Fatty Acids" and "Days before Sell-by Date". This conclusion is especially useful to food companies who incline to launch new product lines by adding more attributes to existing product. That is, even though consumer WTP for individual attributes may be affected by other information not provided to consumer in research study, the rank of the attributes won't be affected by additional information, thus, the most important attribute should be consider first in the new product, as long as the cost of providing this attributes is not much higher than the provision of other attributes.

The impacts of dimensionality of choice experiments on consumer WTP have been investigated by Hensher (2006) under the context of a transportation study. We drew the same conclusion with Hensher that the number of attributes in choice experiment design affected

consumer WTP. The contribution of our study is that we focus more on the context of the attributes in the beef steaks rather than simply study the dimensionality of choice experiment design. By saying this, we mean that the impacts of additional attribute not only depend on the number of attributes, they also depend on the relationships between the added attribute and the attribute we are interested in, as well as other attributes in the choice experiments. From this point, the effects of additional attribute should not be restricted to the method of choice experiment; it should also apply to other WTP elicitation methods such as contingent valuation and experimental auction. In both cases, the problem of limited information provision exists.

Our study did not find consistent results regarding the impact of number attributes in the choice experiment. Whether the changes in WTP for attribute can keep stable when the number of attributes reaches a certain number or after the most important attributes of products are presented in the choice experiment is still unknown. In addition, we only used a choice experiment to investigate the effect of additional information on consumers WTP for certain attributes. Similar study may be conducted using experimental auctions and conjoint valuation methods to see if the additional attributes have same the impact as that in choice experiments. The last problem is that some of our conclusions are also affected by the location of the respondents, and within-subject and Between-subject comparisons did not provide consistent conclusions. More replications of this study with respondents from a larger number of locations should be conducted to address these issues.

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Appendix A - Questionnaire of Online Survey A1

Introduction

Hello, I am a graduate student from the Department of Agricultural Economics at Kansas State University. I am conducting a survey about consumer preferences for beef. Your assistance in completing this questionnaire is greatly appreciated.

This survey consists of some demographic and purchase choice questions.

The estimated time for completing the survey is about 10 minutes. All of your answers are anonymous and will remain confidential.

Shopping Scenario 1

Assume you are shopping for **beef strip loin steak** (also known as KC Strip) in your local grocery store. There are a variety of strip loin steaks on the shelf with different prices and attributes. In the questions that follow, you will be asked to compare two beef steaks, and decide which one you would prefer to purchase (**Option A** or **Option B**). If you are not satisfied with either steak, you can choose not to buy any product (**Neither A nor B**).

Please answer these questions as if you were actually making a steak purchase in the grocery store.

Beef attributes:
Price: The price per pound you would pay for the 12-ounce strip loin steak.

Certified U.S. Product: According to U.S. Department of Agriculture, this steak is certified to be from cattle born, raised, and processed in the United States.

Guaranteed Tender: According to U.S. Department of Agriculture, this steak is guaranteed to be tender.

*** Choice set #1**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$4.64
Certified U.S. Product:	Yes	Yes
Guaranteed Tender:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #2**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$4.64
Certified U.S. Product:	Yes	No
Guaranteed Tender:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #3**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$11.50
Certified U.S. Product:	No	No
Guaranteed Tender:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

Choice set #4

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$6.93
Certified U.S. Product:	Yes	Yes
Guaranteed Tender:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

Choice set #5

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$9.22
Certified U.S. Product:	No	No
Guaranteed Tender:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

Choice set #6

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$9.22
Certified U.S. Product:	No	Yes
Guaranteed Tender:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

Choice set #7

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$11.50
Certified U.S. Product:	No	Yes
Guaranteed Tender:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

Choice set #8

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$6.93
Certified U.S. Product:	Yes	No
Guaranteed Tender:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

Demographic Characteristics and Shopping Experiences

*** In which year were you born?**

*** What is your level of education?**

- 1st through 8th grade
- Some high school or high school graduate
- Some college/2 year Associate Degree
- Four year college degree
- Post Graduate
- Other (please specify)

What is your race?

- White
- Native Hawaiian and Other Pacific Islander
- Hispanic or Latino
- Black or African American
- Asian
- American Indian and Alaska Native
- Other (please specify)

*** What is your marital/family status?**

- Single
- Married
- Divorced, Widowed, or Separated

*** What best describes your current employment status?**

- Employed full-time
- Employed part-time
- Unemployed
- Student
- Retired
- Other (please specify)

*** Including yourself, how many adults, 18 years or older currently live in your household?**

- One
- Two
- Three
- Four
- More than Four

*** How many children (under 18 years old) do you have living with you?**

- None
- One
- Two
- Three
- Four
- More than four

*** Your annual household income is:**

- Under $10,000
- $10,000 to $24,999
- $25,000 to $34,999
- $35,000 to $49,999
- $50,000 to $74,999
- $75,000 to $99,999
- $100,000 to $124,999
- $125,000 to $149,999
- $150,000 to $174,999
- $175,000 to $199,999
- $200,000 to $249,999
- $250,000 to $299,999
- $300,000 to $399,999
- $400,000 and more

*** Approximately how much per week does your household spend on food you eat at home?**

- Less than $25
- $25 - $49
- $50- $74
- $75 - $99
- $100 - $124
- $125 - $149
- $150 - $174
- $175 - $200
- More than $200 per week

*** Approximately how much per week does your household spend on food consumed away from home?**

- Less than $25
- $25 - $49
- $50- $74
- $75 - $99
- $100 - $124
- $125 - $149
- $150 - $174
- $175 - $200
- More than $200 per week

*** Do you make the majority of food purchases in your household?**

Yes No

*** On average, how many times do you typically eat beef during a week?**

- Less than 1 time
- 1 or 2 times a week
- 3 or 4 times a week
- 5 or 6 times a week
- 7 or 8 times a week
- More than 8 times

Shopping Scenario 2

Now suppose that more information on beef attributes is available when you are shopping for the KC strip steak. **Please choose one steak (A or B) from each pair in the choice sets below, or choose neither A or B.**

Beef attributes:
Price: The price per pound you would pay for the 12-ounce strip loin steak.

Certified U.S. Product: According to U.S. Department of Agriculture, this beef steak is certified to be from cattle born, raised, and processed in the United States.

Guaranteed Tender: According to U.S. Department of Agriculture, this steak is guaranteed to be tender.

Guaranteed Lean: According to U.S. Department of Agriculture, this steak is guaranteed to have less than 10% fat, less than 4.5% saturated fat, and less than 0.1% cholesterol.

Choice set #1

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$9.22
Certified U.S. Product:	No	Yes
Guaranteed Tender:	No	Yes
Guaranteed Lean:	Yes	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #2**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$9.22
Certified U.S. Product:	Yes	No
Guaranteed Tender:	No	No
Guaranteed Lean:	No	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #3**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$4.64
Certified U.S. Product:	Yes	No
Guaranteed Tender:	Yes	No
Guaranteed Lean:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #4**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$6.93
Certified U.S. Product:	Yes	No
Guaranteed Tender:	Yes	Yes
Guaranteed Lean:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #5**

Attribute:	***Option A***	***Option B***
Price ($/lb.):	$6.93	$11.50
Certified U.S. Product:	No	Yes
Guaranteed Tender:	Yes	No
Guaranteed Lean:	No	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #6**

Attribute:	***Option A***	***Option B***
Price ($/lb.):	$6.93	$4.64
Certified U.S. Product:	Yes	Yes
Guaranteed Tender:	No	Yes
Guaranteed Lean:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #7**

Attribute:	***Option A***	***Option B***
Price ($/lb.):	$9.22	$11.50
Certified U.S. Product:	No	No
Guaranteed Tender:	No	Yes
Guaranteed Lean:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #8**

Attribute:	***Option A***	***Option B***
Price ($/lb.):	$11.50	$6.93
Certified U.S. Product:	No	Yes
Guaranteed Tender:	Yes	No
Guaranteed Lean:	Yes	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

These final **two questions** are about the importance of beef attributes in your purchase decision.

*** When you purchase steak, please rate the importance of the following attributes in your purchase decision.**

	Not important at all	A little important	Somewhat important	Important	Very important
Country of Origin					
Tenderness					
Leanness					
Sell by date					
Price					

What other attributes are important for you when you purchase steak?

A
B
C
D
E
F

Thank you very much for your time and valuable input!

Your assistance is very much appreciated.

Appendix B - Shopping Scenarios in Online Survey A2

Shopping Scenario 1

Assume you are shopping for **beef strip loin steak** (also known as KC Strip) in your local grocery store. There are a variety of strip loin steaks on the shelf with different prices and attributes. In the questions that follow, you will be asked to compare two beef steaks, and decide which one you would prefer to purchase (**Option A** or **Option B**). If you are not satisfied with either steak, you can choose not to buy any product (**Neither A nor B**).

Please answer these questions as if you were actually making a steak purchase in the grocery store.

Beef attributes:
Price: The price per pound you would pay for the 12-ounce strip loin steak.

Certified U.S. Product: According to U.S. Department of Agriculture, this steak is certified to be from cattle born, raised, and processed in the United States.

Guaranteed Tender: According to U.S. Department of Agriculture, this steak is guaranteed to be tender.

Guaranteed Lean: According to U.S. Department of Agriculture, this steak is guaranteed to have less than 10% fat, less than 4.5% saturated fat, and less than 0.1% cholesterol.

Choice set #1

Attribute:	***Option A***	***Option B***
Price ($/lb.):	$4.64	$9.22
Certified U.S. Product:	No	Yes
Guaranteed Tender:	No	Yes
Guaranteed Lean:	Yes	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #2**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$9.22
Certified U.S. Product:	Yes	No
Guaranteed Tender:	No	No
Guaranteed Lean:	No	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #3**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$4.64
Certified U.S. Product:	Yes	No
Guaranteed Tender:	Yes	No
Guaranteed Lean:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #4**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$6.93
Certified U.S. Product:	Yes	No
Guaranteed Tender:	Yes	Yes
Guaranteed Lean:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #5**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$11.50
Certified U.S. Product:	No	Yes
Guaranteed Tender:	Yes	No
Guaranteed Lean:	No	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #6**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$4.64
Certified U.S. Product:	Yes	Yes
Guaranteed Tender:	No	Yes
Guaranteed Lean:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #7**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$11.50
Certified U.S. Product:	No	No
Guaranteed Tender:	No	Yes
Guaranteed Lean:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

***Choice set #8**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$6.93
Certified U.S. Product:	No	Yes
Guaranteed Tender:	Yes	No
Guaranteed Lean:	Yes	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

Shopping Scenario 2

Now suppose that more information on beef attributes is available when you are shopping for the KC strip steak. **Please choose one steak (A or B) from each pair in the choice sets below, or choose neither A or B.**

Beef attributes:
Price: The price per pound you would pay for the 12-ounce strip loin steak.

Certified U.S. Product: According to U.S. Department of Agriculture, this beef steak is certified to be from cattle born, raised, and processed in the United States.

Guaranteed Tender: According to U.S. Department of Agriculture, this steak is guaranteed to be tender.

Guaranteed Lean: According to U.S. Department of Agriculture, this steak is guaranteed to have less than 10% fat, less than 4.5% saturated fat, and less than 0.1% cholesterol.

Days before Sell-by Date: According to U.S. Department of Agriculture, the "Sell-By" date tells the store how long to display the product for sale. Product should be purchased before the date expires. "Days before Sell-by Date" tells you how many days leave until expiration.

*** Choice set #1**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$11.50
Certified U.S. Product:	No	Yes
Guaranteed Tender:	No	No
Guaranteed Lean:	No	Yes
Days before Sell-by Date:	2	2

I choose.....

Neither A nor B | *Option A* | *Option B*

*** Choice set #2**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$9.22
Certified U.S. Product:	Yes	Yes
Guaranteed Tender:	Yes	Yes
Guaranteed Lean:	No	Yes
Days before Sell-by Date:	2	8

I choose.....

Neither A nor B | *Option A* | *Option B*

*** Choice set #3**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$9.22
Certified U.S. Product:	No	No
Guaranteed Tender:	Yes	No
Guaranteed Lean:	No	No
Days before Sell-by Date:	8	2

I choose.....

Neither A nor B | *Option A* | *Option B*

*** Choice set #4**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$11.50
Certified U.S. Product:	No	No
Guaranteed Tender:	Yes	Yes
Guaranteed Lean:	Yes	No
Days before Sell-by Date:	2	8

I choose.....

Neither A nor B | *Option A* | *Option B*

*** Choice set #5**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$4.64
Certified U.S. Product:	Yes	Yes
Guaranteed Tender:	Yes	No
Guaranteed Lean:	Yes	No
Days before Sell-by Date:	8	8

I choose.....

Neither A nor B | *Option A* | *Option B*

*** Choice set #6**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$6.93
Certified U.S. Product:	Yes	No
Guaranteed Tender:	No	No
Guaranteed Lean:	Yes	Yes
Days before Sell-by Date:	2	8

I choose.....

Neither A nor B | *Option A* | *Option B*

*** Choice set #7**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$6.93
Certified U.S. Product:	Yes	Yes
Guaranteed Tender:	No	Yes
Guaranteed Lean:	No	No
Days before Sell-by Date:	8	2

I choose.....

Neither A nor B | *Option A* | *Option B*

*** Choice set #8**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$4.64
Certified U.S. Product:	No	No
Guaranteed Tender:	No	Yes
Guaranteed Lean:	Yes	Yes
Days before Sell-by Date:	8	2

I choose.....

Neither A nor B | *Option A* | *Option B*

Appendix C - Shopping Scenarios in Online Survey B1

Shopping Scenario 1

Assume you are shopping for **beef strip loin steak** (also known as KC Strip) in your local grocery store. There are a variety of strip loin steaks on the shelf with different prices and attributes. In the questions that follow, you will be asked to compare two beef steaks, and decide which one you would prefer to purchase (**Option A** or **Option B**). If you are not satisfied with either steak, you can choose not to buy any product (**Neither A nor B**).

Please answer these questions as if you were actually making a steak purchase in the grocery store.

Beef attributes:
Price: The price per pound you would pay for the 12-ounce strip loin steak.

Guaranteed Tender: According to U.S. Department of Agriculture, this steak is guaranteed to be tender.

Guaranteed Lean: According to U.S. Department of Agriculture, this steak is guaranteed to have less than 10% fat, less than 4.5% saturated fat, and less than 0.1% cholesterol.

*** Choice set #1**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$4.64
Guaranteed Tender:	Yes	Yes
Guaranteed Lean:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #2**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$4.64
Guaranteed Tender:	Yes	No
Guaranteed Lean:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #3**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$11.50
Guaranteed Tender:	No	No
Guaranteed Lean:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #4**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$6.93
Guaranteed Tender:	Yes	Yes
Guaranteed Lean:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #5**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$9.22
Guaranteed Tender:	No	No
Guaranteed Lean:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #6**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$9.22
Guaranteed Tender:	No	Yes
Guaranteed Lean:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #7**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$11.50
Guaranteed Tender:	No	Yes
Guaranteed Lean:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #8**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$6.93
Guaranteed Tender:	Yes	No
Guaranteed Lean:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

Shopping Scenario 2

Now suppose that more information on beef attributes is available when you are shopping for the KC strip steak. **Please choose one steak (A or B) from each pair in the choice sets below, or choose neither A or B.**

Beef attributes:
Price: The price per pound you would pay for the 12-ounce strip loin steak.

Guaranteed Tender: According to U.S. Department of Agriculture, this steak is guaranteed to be tender.

Guaranteed Lean: According to U.S. Department of Agriculture, this steak is guaranteed to have less than 10% fat, less than 4.5% saturated fat, and

less than 0.1% cholesterol.

Days before Sell-by Date: According to U.S. Department of Agriculture, the "Sell-by" date tells the store how long to display the product for sale. Product should be purchased before the date expires. "Days before Sell-by Date" tells you how many days leave until expiration.

*** Choice set #1**

Attribute:	***Option A***	***Option B***
Price ($/lb.):	$4.64	$9.22
Guaranteed Tender:	No	Yes
Guaranteed Lean:	No	Yes
Days before Sell-by Date:	8	8
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #2**

Attribute:	***Option A***	***Option B***
Price ($/lb.):	$11.50	$9.22
Guaranteed Tender:	Yes	No
Guaranteed Lean:	No	No
Days before Sell-by Date:	2	2
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #3**

Attribute:	***Option A***	***Option B***
Price ($/lb.):	$4.64	$4.64
Guaranteed Tender:	Yes	No
Guaranteed Lean:	Yes	No
Days before Sell-by Date:	2	8
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #4**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$6.93
Guaranteed Tender:	Yes	No
Guaranteed Lean:	Yes	Yes
Days before Sell-by Date:	8	2
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #5**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$11.50
Guaranteed Tender:	No	Yes
Guaranteed Lean:	Yes	No
Days before Sell-by Date:	2	2
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #6**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$4.64
Guaranteed Tender:	Yes	Yes
Guaranteed Lean:	No	Yes
Days before Sell-by Date:	8	2
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #7**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$11.50
Guaranteed Tender:	No	No
Guaranteed Lean:	No	Yes
Days before Sell-by Date:	2	8
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #8**

Attribute:	***Option A***	***Option B***
Price ($/lb.):	$11.50	$6.93
Guaranteed Tender:	No	Yes
Guaranteed Lean:	Yes	No
Days before Sell-by Date:	8	8
I choose.....		
Neither A nor B	*Option A*	*Option B*

Appendix D - Shopping Scenarios in Online Survey B2

Shopping Scenario 1

Assume you are shopping for **beef strip loin steak** (also known as KC Strip) in your local grocery store. There are a variety of strip loin steaks on the shelf with different prices and attributes. In the questions that follow, you will be asked to compare two beef steaks, and decide which one you would prefer to purchase (**Option A** or **Option B**). If you are not satisfied with either steak, you can choose not to buy any product (**Neither A nor B**).

Please answer these questions as if you were actually making a steak purchase in the grocery store.

Beef attributes:
Price: The price per pound you would pay for the 12-ounce strip loin steak.

Guaranteed Tender: According to U.S. Department of Agriculture, this steak is guaranteed to be tender.

Guaranteed Lean: According to U.S. Department of Agriculture, this steak is guaranteed to have less than 10% fat, less than 4.5% saturated fat, and less than 0.1% cholesterol.

Days before Sell-by Date: According to U.S. Department of Agriculture, the "Sell-by" date tells the store how long to display the product for sale. Product should be purchased before the date expires. "Days before Sell-by Date" tells you how many days leave until expiration.

*** Choice set #1**

Attribute:	***Option A***	***Option B***
Price ($/lb.):	$4.64	$9.22
Guaranteed Tender:	No	Yes
Guaranteed Lean:	No	Yes
Days before Sell-by Date:	8	8
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #2**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$9.22
Guaranteed Tender:	Yes	No
Guaranteed Lean:	No	No
Days before Sell-by Date:	2	2
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #3**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$4.64
Guaranteed Tender:	Yes	No
Guaranteed Lean:	Yes	No
Days before Sell-by Date:	2	8
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #4**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$6.93
Guaranteed Tender:	Yes	No
Guaranteed Lean:	Yes	Yes
Days before Sell-by Date:	8	2
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #5**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$11.50
Guaranteed Tender:	No	Yes
Guaranteed Lean:	Yes	No
Days before Sell-by Date:	2	2
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #6**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$4.64
Guaranteed Tender:	Yes	Yes
Guaranteed Lean:	No	Yes
Days before Sell-by Date:	8	2
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #7**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$11.50
Guaranteed Tender:	No	No
Guaranteed Lean:	No	Yes
Days before Sell-by Date:	2	8
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #8**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$6.93
Guaranteed Tender:	No	Yes
Guaranteed Lean:	Yes	No
Days before Sell-by Date:	8	8
I choose.....		
Neither A nor B	*Option A*	*Option B*

Shopping Scenario 2

Now suppose that more information on beef attributes is available when you are shopping for the KC strip steak. **Please choose one steak (A or B) from each pair in the choice sets below, or choose neither A or B.**

Beef attributes:
Price: The price per pound you would pay for the 12-ounce strip loin steak.

Guaranteed Tender: According to U.S. Department of Agriculture, this steak is guaranteed to be tender.

Guaranteed Lean: According to U.S. Department of Agriculture, this steak is guaranteed to have less than 10% fat, less than 4.5% saturated fat, and less than 0.1% cholesterol.

Days before Sell-by Date: According to U.S. Department of Agriculture, the "Sell-by" date tells the store how long to display the product for sale. Product should be purchased before the date expires. "Days before Sell-by Date" tells you how many days leave until expiration.

Enhanced Omega-3 Fatty Acids: According to U.S. Department of Agriculture, this steak is guaranteed to have more Omega-3 fatty acids than other steaks.

*** Choice set #1**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$11.50
Guaranteed Tender:	No	Yes
Guaranteed Lean:	No	No
Days before Sell-by Date:	2	8
Enhanced Omega-3 Fatty Acids:	No	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #2**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$9.22
Guaranteed Tender:	Yes	Yes
Guaranteed Lean:	Yes	Yes
Days before Sell-by Date:	2	8
Enhanced Omega-3 Fatty Acids:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #3**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$9.22
Guaranteed Tender:	No	No
Guaranteed Lean:	Yes	No
Days before Sell-by Date:	2	2
Enhanced Omega-3 Fatty Acids:	Yes	No
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #4**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$11.50
Guaranteed Tender:	No	No
Guaranteed Lean:	Yes	Yes
Days before Sell-by Date:	8	2
Enhanced Omega-3 Fatty Acids:	No	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #5**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$9.22	$4.64
Guaranteed Tender:	Yes	Yes
Guaranteed Lean:	Yes	No
Days before Sell-by Date:	8	2
Enhanced Omega-3 Fatty Acids:	Yes	Yes
I choose.....		
Neither A nor B	*Option A*	*Option B*

*** Choice set #6**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$11.50	$6.93
Guaranteed Tender:	Yes	No
Guaranteed Lean:	No	No
Days before Sell-by Date:	8	8
Enhanced Omega-3 Fatty Acids:	No	Yes

I choose.....

Neither A nor B | *Option A* | *Option B*

*** Choice set #7**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$4.64	$6.93
Guaranteed Tender:	Yes	Yes
Guaranteed Lean:	No	Yes
Days before Sell-by Date:	2	2
Enhanced Omega-3 Fatty Acids:	Yes	No

I choose.....

Neither A nor B | *Option A* | *Option B*

*** Choice set #8**

Attribute:	*Option A*	*Option B*
Price ($/lb.):	$6.93	$4.64
Guaranteed Tender:	No	No
Guaranteed Lean:	No	Yes
Days before Sell-by Date:	8	8
Enhanced Omega-3 Fatty Acids:	Yes	No

I choose.....

Neither A nor B | *Option A* | *Option B*