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Willingness to Pay for Country-of-origin Labeled, Traceable, and BSE-tested Beef

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WILLINGNESS TO PAY FOR COUNTRY-OF-ORIGIN LABELED, TRACEABLE, AND BSE-TESTED BEEF

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Agriculture
at the University of Kentucky

By

Kar Ho Lim
Lexington, Kentucky

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ABSTRACT OF DISSERTATION

WILLINGNESS TO PAY FOR COUNTRY-OF-ORIGIN LABELED, TRACEABLE, AND BSE-TESTED BEEF

While previous studies have investigated country-of-origin effect from various angles, it remained unexplored the extent to which Country of Origin Labeling (COOL) affects U.S. beef imports from specific countries. Using choice-experiment data, willingness to pay (WTP) for Australian, Canadian beef in addition to other enhancement attributes were estimated with a Mixed Logit Model and a Latent Class Model. The results revealed unobserved taste heterogeneity and important differences in the WTP between the imported and domestic steak. The Latent Class Model estimated the range of discount needed for consumers to switch from U.S. to Canadian steak was a range from $1.09 to $35.12 per pound. Results from the Mixed Logit Model reiterated strong domestic preference. Significant positive WTP for BSE-tested, traceable, and tenderness-assured beef were also observed.

In addition, perceived risk theory was utilized to explain the difference in WTP for domestic and imported beef. The psychometric method proposed in Pennings et al. (2002) were adopted, which disentangled perceived risk into risk perception and risk attitude. Using a mixed logit model with error component specification, the result revealed a strong link between risk perception and risk attitude towards consumer choice of country-of-origin labeled beef. Specifically, we found that perceived risk factors have a stronger impact on imported beef than domestic beef, which could partially explain consumers' aversion towards imported beef.

Lastly, the perceived risk framework was expanded to explain variation in the WTP for traceable and BSE-tested beef. The results indicated significant and non-linear impact from risk attitude and risk perception to WTP for the attributes. In addition, BSE-concern, and perceived level of control agribusiness has on food safety significantly influenced WTP for traceable and BSE-tested beef.

Keywords: Willingness to Pay; Perceived Risk; Choice Experiment;
Country-of-Origin Labeling; Food Safety Attributes

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Date

Dedicated to my family, especially to my parents --
Chin Beng Lim, King Ching Heng,
and my lovely wife and son --
Libby and Elijah
for their unwavering love.

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I extent my upmost gratitude to our loving and everlasting God for redeeming me from blindness through the life and sacrifice of His beloved Son, our Savior, Jesus Christ. May His blessings continue to abound, and may His Holy Spirit empowers me to be a blessing to other.

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Chapter 1 Introduction

1.1 Motivation and Objective of this Dissertation

Consumers' demand is a complex process determined by multiple factors. Even for a low-involvement food item such as beef, a non-exhaustive list of the factors in beef purchase decision includes taste, health concerns, price, and perceived risks and benefits from consuming beef.

The passage of Country of Origin Labeling (COOL) in the 2002 farm bill introduced an extra dimension in consumers' consideration where previously information regarding country of origin was a credence attribute; in addition to periodical shock to consumer beef demand from outbreaks of BSE and other food safety events. The focuses of this dissertation is twofold, first, to gauge the potential impact of COOL through examination on consumer preference for domestic and imported beef. Second, we investigated the role perceived risk on consumer preference of imported beef and food-safety attributes.

Beef is the highest consumed meat by American consumers. In 2011, American consumers purchased an estimated $79 billion worth of beef in retail market (Figure 1.1). Even though the value consumed is on an increasing trend, the total quantity consumed has been declining over the years; we see a 9% decrease in the volume of beef consumed over a period of ten years from 2002 to 2011.

The decline in beef demand is partially cause by concern of food safety issues related to beef consumption, particularly the risk of contracting variant Creutzfeldt-Jakob disease (vCJD) from beef contaminated with Bovine Spongiform Encephalopathy (BSE), or commonly known as mad cow disease (Pennings et al. 2002; Schroeder et al. 2007).

Traceability and BSE-test on beef are discussed as measurements to counter the negative impact of food safety issues, but full implementation of such measures met strong opposition from stakeholders citing the compliance cost and technical difficulties in implementation (Golan et al. 2004). Thus far the discussion never amount to real policy changes.

The rising retail value of beef does not translate into higher profitability for cow-calf producers. The rising nominal beef retail price (Figure 1.2) is partly a result of rising production input cost (Schroeder 2011). Beef producers are facing pressure from rising fuel and grain cost in the recent year. A closer look at CPI adjusted price reveals that real price of ground beef remain relatively constant, and price of round steak slightly declined in real term from 1984 to 2011. Given the relatively low price, feedlots are expected to downsize in response to the increase input price and long-term declining domestic demand (Marsh 2003; Schroeder 2011).

Positive and sufficiently large willingness to pay (WTP) is a necessary condition for agribusiness to adopt add-ons attributes. Expenditure on food at home has grown on a steady pace over the last 2 decades (Figure 1.3), for instance, the nominal average expenditure on food at home for consumer unit of two or more has increased from $3016 in 1990 to $4335 in 2010, reflecting a growth of 43.7%. However, the share of expenditure on beef has declined from 9% in 1990 to 6.2% in 2010. While many factors undoubting contributed to this decline, demand of premium food products, such as organic and local food has increased in recent years (Dimitri and Oberholtzer 2010). The lower share of expenditure on beef could be an indication of room to grow for food-safety features and quality-enhanced beef such as tenderness guaranteed or

antibiotic/hormone free beef. This dissertation provides a timely answer to whether such price premiums exist.

Major beef exporting countries filed WTO litigation against United States' country-of-origin labeling (COOL), claiming the law unjustifiably impedes beef trade. Although the United States is the largest producers in the world, it utilizes beef imports to address shortage of supply. Beef exports to the United States accounts for a significant percentage of annual production for many countries (Figure 1.4). For instance, export to the United States account for more than a quarter of total beef production of Canada, Honduras, New Zealand and Nicaragua in 2011. Foreign exporters suspect that COOL plays a protectionist function, by conjuring ethnocentrism in American consumers. Proponents of the law argue that: first, consumers could use COOL as a food safety measures, and second, consumers have the right to know where their food comes from. An in-depth analysis on how and the extent of COOL's impact on consumer demand provide valuable insights to the debate.

This dissertation is structured as the following: the design aspect the choice experiment and summary statistics of the sample is covered on subsequent chapter of chapter 1. Chapter 2 describes the economics theoretical foundation of this dissertation. Chapter 3 provides an empirical analysis on consumer preference of country-of-origin labeled beef and other attributes. Chapter 4 examines the impact of perceived risk on consumer preference of domestic and imported beef. Chapter 5 covers a similar analysis using perceived risk to explain consumer preference of food-safety attributes. At last, Chapter 6 discusses the conclusion and future direction of this study.

1.2 Survey Design

Building on previous literature, we conducted an online survey in May 2010 through TNS Global, a survey company. The survey was open up to 150,025 of TNS panelist, of those who was contacted, 2775 started the survey. The survey yielded 1079 useable response, with 1696 of the responses ruled out because of incomplete survey, or failed to complete the survey when the targeted 1000 response was reached.

The survey consisted of two major components. The first part included questions adapted from related literature about consumer preferences for beef, and the second part consisted of a choice experiment intended to elicit consumers WTP for country-of-origin labeled beef and other attributes. The design of the choice experiments was similar to that developed by Schroeder et al. (2007) and Tonsor et al. (2009). However, this analysis focuses on BSE testing and traceability, rather than the risk reduction examined in the other studies. Strip loin steak (one pound) was chosen as the representative product for its well-defined characteristics and relatively homogeneity.

Although the food-safety attributes and COOL are the focus of this paper, the choice experiment included other attributes to avoid single-cue bias (Bilkey and Nes 1982). The choice profiles consisted of five categories: price, country, production practices, tenderness, and food-safety assurance. Table 1.1 provides the description of these attributes as given to respondents. Four levels of prices were chosen ranging from $5.50 to $16.00 per pound to reflected low-end and high-end prices that could be observed in actual grocery store settings at the time of this study. The three countries of origin were the USA and its two major beef suppliers, Australia (*AUS*)[1] and Canada (*CAN*). The two elements in production practices were natural – which means the beef was derived from

[1] Abbreviation used in subsequent sections were provided in parentheses

cattle not treated with hormones and antibiotics, or standard practices – which means the beef was derived from cattle treated with government-approved hormones and antibiotics. The tenderness categories encompassed two elements, with or without tenderness guarantees (*TENDER*). The food-safety assurance consisted of four elements; none—which included no additional food-safety attributes, BSE-tested (*BSE*)– which means the cattle were tested for BSE prior to slaughtering, traceable (*TRACE*)– which means that the steak was traceable from its producing farm to the point of sale, or a steak could be both BSE-tested and traceable (*BSE_TRC*). We did not designate agency that verify the accuracy of these attributes as in Steiner et al. (2010), as consumer valuation and trust of the verifying agency is not a focus of this study.

Although the ability of an online survey to represent the population is still being debated, Hu et al. (2011) showed that for a survey on food products, the two survey methods could produce highly consistent results. Olsen (2009) also showed that the difference in WTP estimation between mail and online surveys was minimal.

Respondents below age 17 were restricted from participation[2]; We designed and tested the survey following general guidelines given in Dillman (2007). The survey is divided into two sections; the first part included questions pointed to consumers preference on beef adapted from related literature and demographic information; the second section included a choice experiment to assess consumer WTP for imported beef and the aforementioned attributes. We did not pursue a mail survey after taking into account the challenges in targeting and obtaining a national sample. Nonetheless, Olsen (2009) suggested that internet surveys are viable alternative to mail surveys in estimation of consumer WTP.

[2] The respondents were not limited to only meat consumers.

The design of the choice experiments was similar to that developed by Schroeder et al. (2007) and Tonsor et al (2009). In this way, the results could be compared across studies. However the focus of the survey used in this study was narrowed to some specific interventions – BSE testing and traceability, rather than the food safety levels as used in the other studies. We used a fractional factorial design[3] to generate the choice set in this study, which follows the same design as Aubeeluck (2010). The procedure produced 191 choice sets. To maintain a balance between respondent fatigue and degrees of freedom, these choice sets were distributed across 14 versions of the survey, 12 versions contained 14 choice sets, one version contained 13 choice sets and one version contained 10 choice sets[4]. We assigned approximately 77 individuals completed each version of the survey. Each choice set presents choices of two steaks bundled with various attributes and prices (see appendix for a sample choice set); if neither steak appeals to them, the third choice of not buying (would-not-buy option) could be chosen..

Hensher et al (2005) noted that a would-not-buy alternative should be included in choice sets. Omitting the would-not-buy alternative constrained decision makers into making a choice from the listed alternatives, which in effective making the choice set conditional choices. A conditional choice set does not reflect all options available to decision makers in the real word. The inclusion of the would-not-buy option reflects a more realistic

[3] This analysis was generated using SAS™ software Version 9.2 for Microsoft Windows © 2010 SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.

[4] Previous choice experiments assigned a variety numbers of choice sets to each individual. Hu et al. (2005) asked each respondent to complete eight choice set while Tonsor et al. (2009) assigned 21 choice scenarios to each respondent. Although there has been discussion in the literature on the impact of scenario complexity on choices, this is not the focus of this research. A total of 10-14 choice sets per person are in line with the past literature.

choice environment, where respondents could delay or decline to make a choice if the options presented are not appealing.

The validity of stated preference analysis, such as choice experiments, is debated for its potential downfall of hypothetical bias: where the lack of incentive-compatibility in the experimental nature of stated preference may lead to overstatement of WTP. Nonetheless, for new or hypothetical attributes such as the attributes examined in our study, the lack of reveal preference data necessitate the use of stated preference method. Other stated WTP elicitation methods, such as contingent valuation may be used, but a choice experiment is well-suited for multiple-attributes setting as in this study (Adamowicz et al. 1998). Additionally, Lusk and Schroeder (2004) and List et al. (2006) suggest that the marginal WTP for private goods produced by choice experiments is comparable to WTP measures from experimental auctions, which are revealed preference alternatives to choice experiments and are often used to investigate the behaviour of a small group of consumers.

1.2.1 Hypothetical Bias

In a review of literature concerning hypothetical bias, Loomis (2011) categorized the means to addressed hypothetical bias into ex-ante and ex-post approaches. Although some of these techniques have shown promising signs of mitigation of hypothetical bias, Loomis concluded that no widely accepted methodology exists to control for hypothetical bias, and highlight the need for more research and development of a general theory that address the bias.

The first ex-ante method outlined was incentive compatible design, which stressed to construct the choice experiment such it incentivize respondent to reveal their true preference. Lusk and Schroeder (2004) put in practice such design by informing the respondents that one of their choices would be binding, namely, the respondents will purchase the product they chosen in a random choice sets determined by the experimenter. They found a statistical significant difference between the stated WTP values between the respondents subject to the incentive compatible design and the control group without being subject to the design. However, the objective of this study is to determine the preference of nationwide consumers, thus the method outlined in Lusk and Schroeder (2004) is unsuitable for choice experiments with large number of respondents such as this study, as the cost of executing a national face-to-face study could be prohibitive.

A version of cheap talk script was adopted in this study (see Appendix), which reminded respondents to state the amount they would actually pay as if the choice experiment were reality. The effectiveness of cheap talk is disputed, as literature found mixed result. Cummings and Taylor (1999) reported the WTP elicited with cheap talk were indistinguishable from the WTP measured involved real payment. Other studies find that cheap talk were effective only on certain type of respondents (Aadland and Caplan 2003; Blumenschein et al. 2008; Champ et al. 2009).

The certainty scale method has been used in several studies to perform an ex-post mitigation of hypothetical bias. The method was based on the ground that respondent could state preference on alternatives even though that they are not certain that such choice resemble their behavior in non-hypothetical setting. Thus, attaching certainty

scales at the end of WTP questions allow calibration of WTP in accordance to the professed certainty that such an amount could be paid in real life. A number of studies showed that such calibration method yield hypothetical WTP that matches actual payment on contingent valuation analysis (Blumenschein et al. 2008; Champ and Bishop 2001; Ethier et al. 2000) . Norwood (2005) and Norwood et al. (2006) extended the method to the context of choice experiment, these studies found that the method yield a different WTP values than analysis performed without certainty calibration. Similarly, Ready et al. (2010) found that certainty calibration mitigates hypothetical bias in a choice experiment, but showed that certainty calibration adds complexity to the choice experiment. Thus, certainty calibration on a choice experiment involving large number of choice sets per respondent could be overwhelming. Loomis (2011) noted that what levels certainty and why certain levels of certainty produce WTP estimates with lesser degree of hypothetical bias is an area that requires more research.

1.3 Summary Statistics

Table 1.2 presents the summary statistics. Eighty-three percent of the respondents identified themselves as the primary shopper in their household. The mean household annual income was a little over $52,000 and the median education level of the respondents was some college (including community college or technical training). Our sample corresponded closely to the U.S. population in gender, education, and income, but it over-represented older consumers. We suspect that the length of the survey deterred participations from younger respondents. Over representation of older population in online consumer surveys is not uncommon in the literature. For instance, Hu et al (2005)

and Loureiro and Umberger (2007) reported mean age of higher than national average in their surveys.

With the overrepresentation of older respondents, we do not claim the sample's representativeness to the population. However, sufficient observations of other age group were recorded, which enable simulation to be performed such that prediction about the choice and behavior could be obtained.

Table 1.1 Attributes Levels and Descriptions

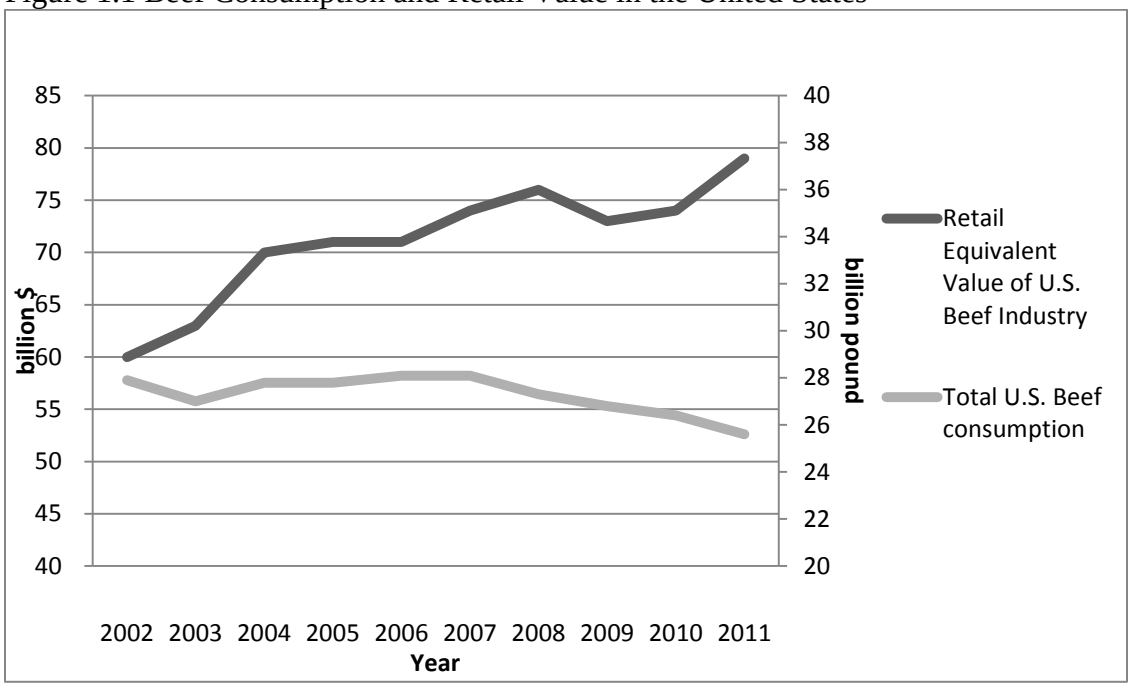
Categories	Levels	Abbr.	Descriptions
Price ($/lb)			Refers to steak price in retail grocery store or butcher where the respondent typically shops.
	5.50		
	9.00		
	12.50		
	16.00		
Country of Origin			Refers to country in which the cattle were raised
	USA		
	Canada	CAN	
	Australia	AUS	
Production Practices			Refers to the method used in production.
	Approved Standards		**Approved Standards** means production involved government-approved synthetic growth hormones and antibiotics.
	Natural	NAT	**Natural** means animal was raised without the use of synthetic growth hormones or antibiotics
Food Safety Assurance			Refers to the food safety assurance offered with the steak
	None		
	BSE-Tested	BSE	**BSE-Tested** means that cattle are tested for BSE prior to slaughtering process
	Traceable	TRACE	**Traceable** means the product is fully traceable back to farm of origin from the point of purchase
	BSE-Tested and Traceable	BSE_TRC	**BSE-Tested and Traceable** were offered in combination
Tenderness			Refers to the softness in the steak's eating quality
	Not Specified		**Not Specified** means there are no guarantees on tenderness level of the steak
	Assured Tender	TENDER	**Assured Tender** means the steak is guaranteed tender by testing the steak using a tenderness measuring instrument

Table 1.2. Sample Descriptive Statistics

Variable	Group	Percent	Sample Mean/Median	US Census Data
Age	15-19	0.93%	56.62	36.8[a]
	20-24	3.52%		
	25-29	2.22%		
	30-39	7.78%		
	40-49	12.70%		
	50-64	32.25%		
	65+	40.59%		
Gender	Male	47.54%		49.20%
	Female	52.46%		50.80%
Education	<High School	1.11%	14[a]	12[a]
	High School	23.08%		
	Some College	39.39%		
	4 year Degree	24.28%		
	Graduate	12.14%		
Household Income ($)	<25k	24.10%	52.37k	51.42k
	25k-40k	23.54%		
	40k-65k	23.82%		
	65k-80k	9.55%		
	80k-100k	7.32%		
	100k-120k	6.12%		
	>120k	5.56%		
Freq. grocery shopping	Never	1.85%		
	Sometimes	14.74%		
	Frequently	83.42%		

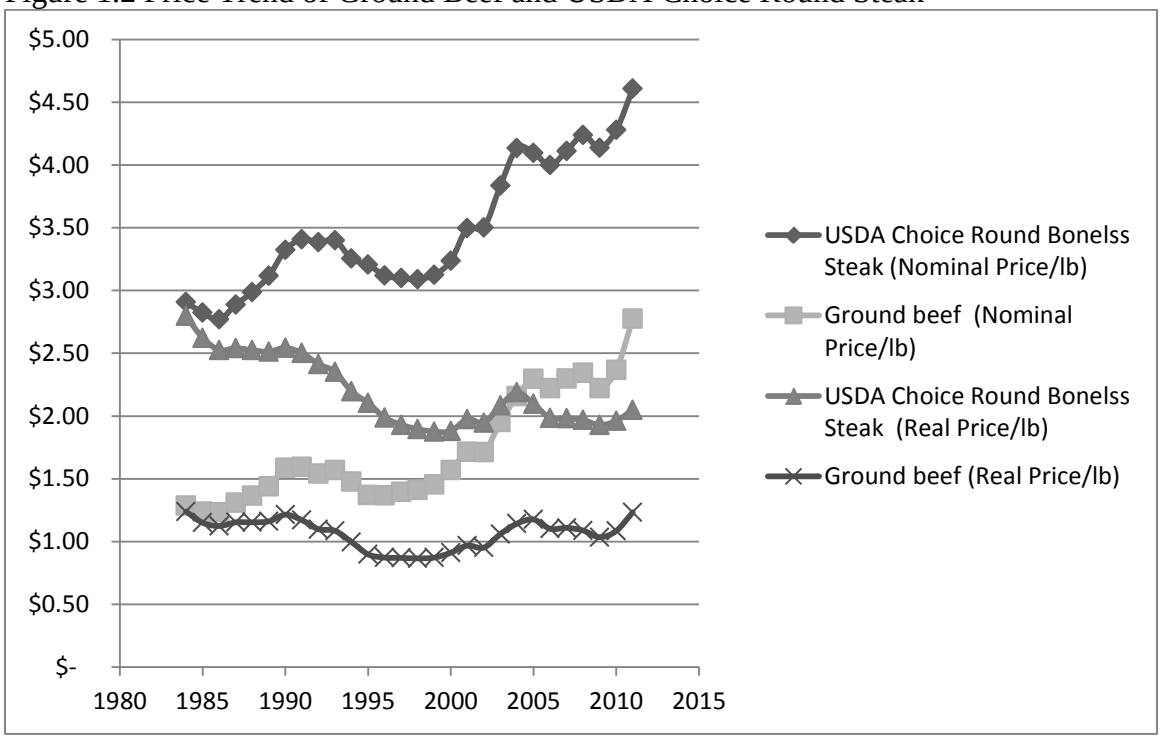
[a]Median values.

Figure 1.1 Beef Consumption and Retail Value in the United States



Source: Economic Research Service, USDA

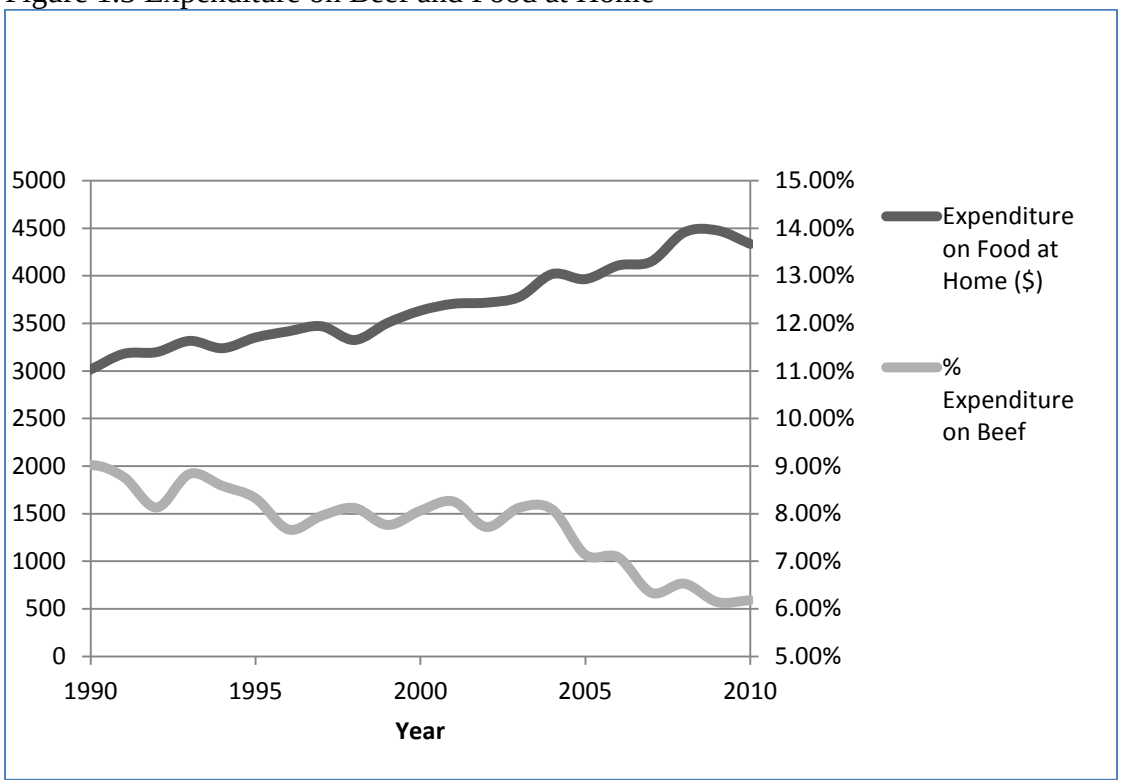
Figure 1.2 Price Trend of Ground Beef and USDA Choice Round Steak



Source: Bureau of Labor Statistics

Note: Base year for Real Price = 1983

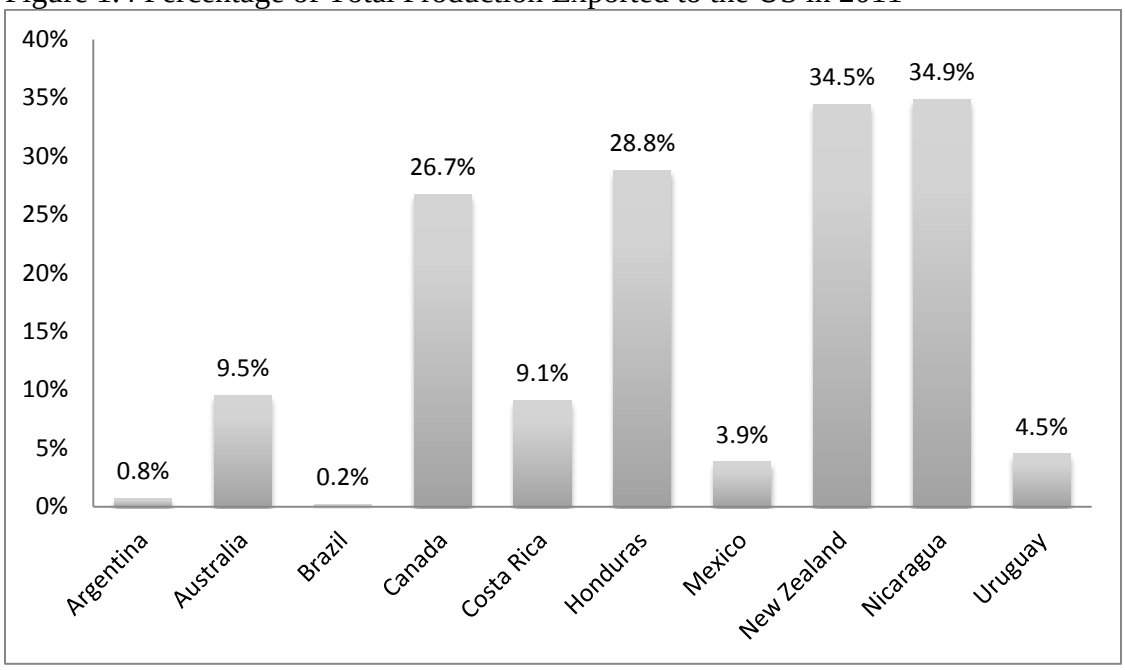
Figure 1.3 Expenditure on Beef and Food at Home



Source: Bureau of Labor Statistics

Note: Data on two or more persons in consumer unit
Expenditure ($) in Nominal Term

Figure 1.4 Percentage of Total Production Exported to the US in 2011



Source: USDA Foreign Agricultural Service

Chapter 2 Theoretical Foundation

The conventional linear utility function suffered from some rather peculiar and unrealistic traits:

> "All intrinsic properties of particular goods, those properties that make a diamond quite obviously something different from a loaf of bread, have been omitted from the theory, so that a consumer who consumes diamonds alone is as rational as a consumer who consumes bread alone, but one who sometimes consumes bread, sometimes diamonds (ceteris paribus, of course), is irrational." (Lancaster 1966: 132).

2.1 Lancaster's Theory of Demand

Lancaster laid out a framework, which in essence described that utility is derived not from a good itself, rather from attributes that is intrinsic to the good. This is expanded in Darby and Karni (1973), such that intrinsic characteristics of a good can be categorized into search, credence and experience attributes. Search attributes can be ascertained prior to purchase, experience attributes cannot be ascertained prior to purchase, but can be detected during consumption, whereas credence attributes cannot be ascertained even after consumption.

We begin with setting up a consumer utility model using Lancaster's work. For simplicity, assuming that beef is the only good consumed, consumers utility can be represented as:

$$U = U(\mathbf{x}) \tag{2.1}$$

where **x** is a vector representing attributes found in beef, such as flavor, tenderness, freshness, marbling and etc. Rational consumers are assumed, and the utility function is well behaved. Following the standard utility maximization framework, consumers attempt to maximize utility subject to a budget constraint:

$$\begin{gathered} \text{Max}_{z} U(\mathbf{x}) \\ \text{subject to} \sum_{n}^{N} p_n z_n \leq y \\ \text{where } \mathbf{x} = \mathbf{Bz} \\ \mathbf{x}, \mathbf{z} \geq 0 \end{gathered} \tag{2.2}$$

where z_n is the level of consumption of good *n*, p_n is a given price for good *n*, and *y* is a constant representing the total disposable income. Finally, the matrix **B** represents the coefficient, which allows the conversion of attributes from physical good.

2.2 Welfare Measurement

The dual for the maximization problem is an expenditure minimization problem The minimization problem yields expenditure function (Mas-Colell et al. 1995), from which compensation variation (CV) could be calculated. CV represents the amount of money one must be compensated for changes in attributes while holding utility at a constant, formally:

$$CV = E(\mathbf{x}', u^0) - E(\mathbf{x}, u^0) \tag{2.3}$$

where E(.) represents the expenditure function, and u^0 is a fixed utility level. If the assumption of static Hicksian theory holds, i.e., the purchase decision is performed with consumer's perfect knowledge about an attribute, then the CV measurement is equivalent to consumers' maximum willingness to pay for an attribute (Zhao and Kling 2004).

2.3 Econometric Foundation

Data limitations inhibit empirical analysis of novel attributes such as these features in this study. Discrete choice modeling is commonly prescribed to overcome such limitation. Building on the seminal work of Darren McFadden, consumer utility can be represented in Random Utility Model, namely:

$$U_{ijt} = \mathbf{x}_{ijt}\boldsymbol{\beta} + \varepsilon_{ijt} \quad \textbf{(2.4)}$$

where the subscript *i* refers to individual *i*, subscript *j* refers to alternative *j* within the choice set and *t* refers to choice set *t*. The utility level U_{ijt} is a linear function of observable vector of attributes $\mathbf{x}_{ijt}$ and its coefficient to be estimated, ε_{ijt} is a random error term, which captures all unobservable attributes and factors that influence the choice process. The utility level is unobservable, thus unsuitable as dependent variable in econometric modeling. This is circumvented by using consumers' choice as the dependent variable, which is observable in a choice experiment setting.

McFadden (1974) showed that if the error terms follows an IID maximum extreme value Type I distribution, the probability of alternative *j* in choice set *t* is chosen is given as:

$$P_{ijt} = \frac{\exp(\mathbf{x_{ijt}}\boldsymbol{\beta})}{\sum_{k=1}^{J}\exp(\mathbf{x_{ikt}}\boldsymbol{\beta})} \quad \textbf{(2.5)}$$

Equation 3.5 is the standard conditional logit choice probability, which is derived using maximum likelihood procedure. The choice probability can be intuitively explained. The numerator is the exponent of the observable utility of alternative *j* in choice set *t*, and the denominator is simply a collection of observable utility from all available alternatives

within a choice set (Train, 2003). Thanks to the relative ease of computation due to its closed-form function, logit models have been the workhorse model for choice modeling.

While logit's computational ease popularized its usage in empirical research, two important limitations of conditional logit are i.) Logit cannot represent random taste variation, ii.) Logit exhibits potentially restrictive and unrealistic Independent to Irrelevant Alternatives (IIA) property (Train, 2003).

Mixed logit addressed these limitations in conditional logit, the early applications of mixed logit were restrained to industry-wide data due to lack of computational power. Train et al. (1987) generalized the procedure with individual level data. The application of mixed logit was rather limited due to the high computational cost. Recent improvement in computational power tremendously increased applications of mixed logit (Train 2003). The choice probability function of mixed logit is:

$$P_{ijt} = \int \frac{\exp(\mathbf{x_{ijt}\beta})}{\sum_{k=1}^{J} \exp(\mathbf{x_{ikt}\beta})} h(\boldsymbol{\beta}) d\boldsymbol{\beta} \qquad \textbf{(2.6)}$$

The choice probability of mixed logit closely resemble that of conditional logit, with an additional mixing distribution, h(**β**). The mixing distribution allows the coefficient **β** to be random, rather than a fixed coefficient as in conditional logit. The immediate impact of the mixing distribution is that unobserved taste variation could now be incorporated in the model. In other words, unobserved taste variation is represented in the form of any appropriate distribution function. Among the commonly used distribution are normal, lognormal, triangular, and uniform distributions.

The IIA properties can be illustrated using the famous red bus and blue bus problem: The population in a city chooses between car and bus (red bus) as their transportation mode. The probability between choosing car and (red) bus were equal at 50% each. Assuming that a new bus operator (blue bus) enters the market, such that the two bus companies are differentiated only by the color of the bus, red bus and blue bus. The red and blue bus possess the same attributes and thus equally likely to be chosen. The IIA states that the ratio between red bus and car remain constant, such that, the spread of the probability is 33% of choosing red bus, blue bus and car, this is unrealistic since blue bus is expected only to draw probability from red bus but not car. This more realistic scenario should be that: the probability of red and blue bus being chosen at 25%, and the probability of car is being chosen remains at 50%.

Mixed logit does not exhibit the IIA property, thus free from the restrictive substitution pattern of conditional logit. The ratio of mixed logit probabilities depends on all data. This is shown in equation (2.7), where the percentage change in the probability for one alternative *i,* given a percentage change in the *m*-th attribute of another alternative *k* is given as:

$$\in_{ijx_{ik}^{m}} = -\frac{x_{ik}^{m}}{P_{ik}} \int \beta^{m} L_{ij}(\boldsymbol{\beta})\, L_{ik}(\boldsymbol{\beta})\, f(\boldsymbol{\beta}) d\boldsymbol{\beta}$$

$$where\ L_{ij} = \frac{\exp(\mathbf{x_{ij}\beta})}{\sum_{n=1}^{J} \exp(\mathbf{x_{in}\beta})} \qquad \textbf{(2.7)}$$

where β^{m} is the m-th element of β, P_{ik} is the probability of individual *i* to choose alternative *k*. The substitution pattern of mixed logit depends on the specification of variable and mixing distribution, the correlation between $L_{ij}(\beta)$ and $L_{ik}(\beta)$ directly

influence the substitution pattern. Thus, the substitution pattern is different for every alternative *j* in general (Train 2003).

Hanemann (1983) presented a CV measurement that is suitable in the context of conditional and mixed logit. The CV that measure the amount needed to switch from alternative *j* to alternative *k* can be expressed as:

$$CV_{CL} = -\frac{\{\ln[\exp(\boldsymbol{\beta x_j'})] - \ln[\exp(\boldsymbol{\beta x_k'})]\}}{\beta_{price}} \quad \textbf{(2.8)}$$

It follows that marginal WTP for an attribute can be derived using equation 3.8, such that the marginal WTP to switch from the base case, to an identical product with the additional attribute is simply the negative ratio of the estimated coefficient associate with the attribute and the price coefficient, namely:

$$CV_{CL} = -\frac{\beta_{attribute}}{\beta_{price}} \quad \textbf{(2.9)}$$

2.4 Perceived Risk Theory

Two-of-three analyses in this study targeted at investigating the relation between consumers perceived risk and their preference for imported beef and for BSE-tested and traceable beef. Perceived risk found its root in psychology and economics literature. The modeling approach in this study could serve as an example for future research in the same breath.

The discussion on the theory of demand to this point assumes that consumers can objectively evaluate the utility they derived from consuming a good. This rather

unrealistic assumption can be relaxed with perceived quality approach developed by marketing literature. The perceived quality approach analyses product quality from the viewpoint of consumers. Consumers form quality perceptions using quality cues (Bredahl et al. 1998; Steenkamp 1989). For example, consumers who desires attributes such as juiciness, taste, or tenderness, which enhances their enjoyment from beef consumption, may use quality cues such as color, fat content, cut, and meat juice to predict these attributes.

Importantly, perceived quality is a subjective assessment dependent on perceptions of needs and goals of individuals (Northen 2000). One such underlying factor that influences how consumers interpret quality cues is perceived risk, i.e. the subjective perception consumers has towards the inherent risk from consuming beef. Slovic (1987) argued that while the real risk measurement is of interest to policy makers and experts; lay people are motivated by perceived risk.

Slovic et al. (1982) laid out the Psychometric Paradigm, in which they proposed the use of simple psychometric scaling method to measure perceived risk. They showed that perceived risk correlates with controllability, how well scientific community understood the risk, whether the risk is taken on voluntarily, and the seriousness of the negative consequence from the risk. Savage (1993) showed that willingness to pay to mitigate risk through donation to scientific research are directly influence by the factors outlined in Slovic et al. (1982).

A growing number of studies applied perceived risk framework to analyze food choice and purchase behavior. For example, Frewer et al. (1994) found that knowledge of new

biotechnology does not reduce perception of risk. Yeung et al. (2010) found that brand, information, and quality assurance reduce consumer perception of food-safety riskss, and increase the likelihood of purchase. Mitchell (1999) suggests that most buyers are risk averters who are motivated to avoid mistakes.

A number of studies applied perceived risk analysis in the context of consumers' reaction to BSE and GM food. Both Pennings et al. (2002) and Schroeder et al. (2007) found strong evidence that perceived risk influenced consumers decision to reduce or eliminate beef consumption as the result of BSE. Lusk and Cobble (2005) suggest that perceived risk significantly affect consumers' acceptance and willingness to pay for GM food.

Evidence from studies suggests that perceived risk significantly affect willingness to pay for food products. With the debates on the viability and feasibility of COOL, traceability, and BSE test on the backdrop, this study is positioned to provide timely information to the debate with two practical ways, first, the WTP study in chapter 3 reveals consumers preference and marketing potential for COO-labeled beef and the food –safety features. Second, by inspecting the linkage between perceived risk and the WTP, we could provide credence as to whether COOL and the food-safety features are being used to mitigate food risk.

Chapter 3 U.S. Consumers' Preference and Willingness to Pay for Country-of-Origin-Labeled Beef Steak and Food Safety Enhancements

3.1 Introduction

Previous studies on the U.S. Mandatory Country of Origin Labeling (COOL) indicated that consumers are generally in favour of the policy (Schupp and Gillespie 2001). Further, Loureiro and Umberger (2003, 2005, and 2007) found that American consumers are willing to pay more for U.S.-labeled beef compared to unlabeled beef. However, in a meta-analysis that spans beyond agricultural products, Verlegh and Steenkamp (1999) found no significant country-of-origin effect on consumer purchasing intentions. In the light of a WTO litigation brought against US as the result of COOL, a study on the extent to which consumers may be willing to pay for imported beef from specific countries is timely.

Additionally, we explored consumers' preference for traceability, BSE testing, tenderness assurance, and natural (as opposed to conventional) beef. Although the primary focus is on the impact of COOL, realistically, steaks are often bundled with multiple attributes. Discussion with marketers and multiple studies signal potential of these value-added attributes (Bailey et al. 2005; Dickinson and Bailey 2002; Lusk et al. 2003; Thilmany et al. 2006; Tonsor et al. 2009; Verbeke and Roosen 2009; Yang and Goddard 2011). None of the attributes has been a widespread success yet in the U.S. market. With a plethora of attributes created by marketers in response to consumers' increasing attention to food safety and quality, Verbeke (2008) warned that information overload could result in rational ignorance – where consumers disregard information attached to a product (McCluskey and Swinnen 2004). By examining the WTP for these attributes, we can

understand how they jointly affect consumer choices, which should be of interest to meat marketers.

3.2 Background

The Country-of-Origin-Labeling (COOL) provision of the 2002 and 2008 Farm Bills caused controversy among nations that export food products into U.S. markets. The final ruling by the USDA Agricultural Marketing Service went into effect on March 16, 2009, requiring information regarding country of origin to be labeled on a number of fresh food including vegetables, fruits and meat. On beef, the law mandates only products derived from cattle born, raised, and processed in the U.S. can be labeled as U.S. origin (USDA 2009). The law, in essence, differentiates imported beef from domestic beef at the retail level, which could have widespread consequences for the demand for imported food. This prompted the governments of Canada and Mexico to challenge the legitimacy of COOL in accordance with the World Trade Organization's principle of national treatment (Suppan 2009).

The importance of the U.S. market for many beef exporting countries cannot be understated. The U.S. market accounts for about 30% of the total beef and veal sales for Canada, New Zealand and Nicaragua. Cattle exports from Canada and Mexico were almost exclusively destined for the U.S. market (USDA 2010). Trade representatives of Canadian cattle and beef industry claimed the law is "devastating the Canadian livestock industry" and could result in a "glut of meat on store shelves in Canada" (Wyld 2009).

Proponents of COOL argue that consumers have a right to know where food comes from. With COOL, consumers can use label information to assess the quality and safety of the

products. Some domestic producers also maintain that COOL may reduce search cost of those preferred domestic food products (Lusk et al. 2006). Because origin of food products is a credence attribute, without COOL, supporters contended that consumers who wish to consume domestic food products could not do so, because they lack the necessary information regarding the origin of the product. Under these conditions, the absence of a country-of-origin labeling law could be made a case for market failure (Caswell 1998; Darby and Karni 1973).

Critics of COOL contested the role of COOL as a food safety measure. Ikenson (2004) contended that the Food Safety and Inspection Service would not allow importation of any unsafe foods; COOL also exempts restaurants and smaller butcher shops, which diminishes the effectiveness of COOL's role as a food safety measure. Further, Krissoff et al. (2004) noted that foods are rarely voluntarily labeled with sources of origin, which cast doubt on the true appeal of domestic origin to consumers; they argued, profit maximizing retailers, processors, and producers would voluntarily indicate products origin with labels if they deemed the benefits to exceed the cost.

Whether COOL is warranted depends heavily on consumers' preference, as well as the extent that COOL might penalize imported food. By examining consumer preference for origin-differentiated beef, this study contributes to the debate on COOL.

3.3 Previous Research and Objective of this Study

Previous studies have suggested that consumers may use country-of-origin as an extrinsic cue in evaluation of the quality of the product (Grunert 2005; Hoffmann 2000; Lusk et al. 2006; Northen 2000). In summary, country of origin may invoke consumers' knowledge

and beliefs regarding the place of production of the products. Additionally, in cases of repeat purchases of products without a strong brand, as with most fresh food, consumers may use the origin to re-identify the quality that they have found appealing.

Increased international competition from trade liberalization incentivized producers to use country-of-origin information to differentiate their products. Marette et al. (2008) argued that with imperfect information and imperfect competition, domestic producers may gain from geographical-indication labels. When faced with the choice of familiar domestic products and unfamiliar imported products, domestic products inevitably emerge as the choice when the lack of knowledge or information regarding the quality of the imported products could induce uncertainty in consumers.

The country-of-origin effects gained research attention following introductions of mandatory origin-labeling law in the European Union, and more recently in the United States. Studies conducted on European consumers reveal consumers used country of origin to predict the eating quality and safety of beef (Becker 2000; Davidson et al. 2003). In its U.S. counterpart, Schupp and Gillespie (2001) found a vast majority of those surveyed indicated support for mandatory labeling of origin on fresh and frozen beef sold in the retail market. Further, 83% of the respondents rated U.S. beef as higher quality and safer than imported beef. Multiple studies indicated European consumers are willing to pay more for domestic meat than imported meat (Alfnes 2004; Alfnes and Rickertsen 2003; Mørkbak et al. 2010).

In an U.S. nation-wide survey, Loureiro and Umberger (2007) found a positive WTP for beef labeled as U.S. products compared to unlabeled product. Further, they suggested that

the WTP for USDA food-safety-inspection certification is higher than U.S.-labeled beef, but the WTP for tenderness assurance and traceability is lower than U.S.-labeled beef. However, the difference in WTP for domestic versus imported beef is absent. In addition, the rankings of the attributes, which were estimated through a Conditional Logit framework[5], could be further scrutinized using estimators capable of discerning unobserved taste heterogeneity.

Previous studies point strongly to the connection between consumers' perception and country-of-origin effect. We explore the differences in consumers' perceptions of safety between domestic beef and imported beef from specific countries. In addition, this study expands Loureiro and Umberger (2007) in significant ways: we refine the scope of investigation to the difference in WTP between domestic-labeled steak and steak labeled as imported. Further, we investigated consumers' relative preferences for additional value-added attributes in the form of BSE testing, and natural beef. Using a mixed logit and a latent class model, we incorporated heterogeneous consumers' preference in this analysis as well.

3.4 Preference and Perception Statistics

To assimilate consumers' reaction to COOL, we elicit the sampled consumers' preference for origin of beef. In this question, the respondents picked their most preferred country-of-origin for beef.[6] The options were Australia, New Zealand, Canada, other countries, avoid imported beef, and neither like nor dislike imported beef. Figure 3.1 reports the

[5] Loureiro and Umberger (2007) attempted Mixed Logit but found the model failed to detect significant unobserved heterogeneity.

[6] The checkbox question used in the survey was "Do you prefer imported beef from New Zealand, Australia, Canada or other? (one answer only)". The options were "Imported beef from Australia, Imported beef from New Zealand, Imported beef from Canada, Imported beef from … (please identify), I avoid imported beef as much as possible, and I neither like nor dislike imported beef".

result. While the majority (65.7%) indicated indifference towards imported and domestic beef, some of these respondents might pick this option to avoid sounding discriminatory. It is far reaching to conclude the majority of U.S. consumers to be equally likely to purchase imported and domestic steak based on these observations. Nonetheless, we expect these respondents to place less importance on the origin of beef. Consumers' country-of-origin preferences for beef are further explored with econometric analyses.

More than one-quarter (27.5%) of the sample stated they do not prefer imported beef. Although a minority, this group may be large enough to induce a reluctance to practice voluntary origin labeling if retailers deem that the consequences of selling origin-labeled imported beef exceed the benefits. After domestic beef, 4.4% of the sample preferred Canadian beef. Beef from Australia, New Zealand and Argentina combined were preferred by 2.4% of the sample.

To address proponents claim that COOL could serve as a food safety cue, we dedicated a question[7] to elicit respondents' perceived safety levels on beef from various origins. Along with a no-opinion option, the respondents rated with 5 point Likert items (1=very low perceived safety; 5=very high perceived safety) for beef from unknown origin, Australia, Brazil, Canada, New Zealand and the United States. Table 3.1 reports the result. As anticipated, the respondents perceived domestic beef as the safest. In contrast, unknown origin was perceived to be the most unsafe. Canadian beef ranked second despite multiple BSE cases reported over the last decade (Maynard and Wang 2010), follow by Australia, New Zealand and Brazil. These rankings coincided with previous

[7] The question used in the survey was "Whether you have ever knowingly purchased beef produced in another country or not, what is your perception of the level of food safety of beef by country of origin?"

findings in Loureiro and Umberger (2005). More than 30% responded no opinion in regards to safety of imported beef, indicating limited experience and knowledge of imported beef. The pairwise t-test rejected the notion that the respondents perceived beef from other origins to be as safe as U.S. beef. Although a confident statement can be made that U.S. beef is perceived to be the safest in general, some consumers may still prefer imported beef. A taste-panel study by Sitz et al. (2005), for instance, showed that a minority of consumers prefers Australian grass-fed steak. We address the aspect of taste heterogeneity econometrically in the next section.

3.5 Research Method: Mixed Logit, Latent Class Logit and WTP Analysis

Mixed Logit Models (MLM) and Latent Class Models (LCM) have been widely applied to capture unobserved preference heterogeneity in empirical research (Alfnes 2004; Hu et al. 2005; Scarpa and Del Giudice 2004). Greene and Hensher (2003) provided an excellent exposition of both the models.

MLM assumes that the parameters associated with product attributes follow some parametric distribution, instead of being fixed as in a Conditional Logit Model. The distribution of random parameters can capture taste heterogeneity. In addition, the MLM is free of the independence of irrelevant alternatives (IIA) assumption, thus reflecting a more realistic substitution pattern than conditional logit (Hensher et al. 2005; Train 2003).

In contrast, the LCM assumes that individuals can be assigned into a set of Q classes each representing a cluster of individuals who behave in a particular way. The most notable difference between MLM and LCM is on the distributional assumption of the parameters

associated with product attributes. Since LCM is semi-parametric, analysts are free from making potentially unreasonable distribution assumptions about the unobserved heterogeneity. However, Greene and Hensher (2003) argued that the extra flexibility in fully parametric MLM might compensate for having to make the distributional assumptions.

Random Utility Theory (McFadden 1974) furnishes MLM and LCM with an economic interpretation. The utility function of a consumer, *i*, facing alternatives, *j*, in choice set, *t*, is denoted as:

$$\mathrm{U}_{ijt} = \mathbf{x}_{ijt}\boldsymbol{\beta} + \varepsilon_{ijt} \qquad \textbf{(3.1)}$$

Vector $\mathbf{x_{jt}}$ represents the attributes as described in alternative *j* in choice situation *t*. The model estimates the unknown parameter vector $\boldsymbol{\beta}$. The error term ε_{ijt} signals the randomness of the utility. Assuming utility maximizing behaviour, the individual chooses alternative j if and only if the utility associated with alternative j is greater than other alternatives. McFadden (1974) showed that if the error term follows an IID maximum extreme value Type I distribution, the resulting choice probability is the conditional logit choice probability. It follows that the choice probability of individual i choosing alternative j in the t-th choice set is represented as:

$$\mathrm{P}_{ijt} = \frac{\exp\left(\mathbf{x}_{\boldsymbol{ijt}}\boldsymbol{\beta}\right)}{\sum_{\mathrm{k}=1}^{\mathrm{J}} \exp(\mathbf{x}_{\boldsymbol{ikt}}\boldsymbol{\beta})} \qquad \textbf{(3.2)}$$

3.5.1 The Mixed Logit Model

The MLM assumes that the unknown parameters **β** are random rather than fixed, thus allowing them to capture taste variation. Each random parameter β is assumed to be distributed as:

$$\boldsymbol{\beta} \sim h(\boldsymbol{\theta} + \mathbf{v}, \boldsymbol{\Omega}) \tag{3.3}$$

Researchers are free to specify any appropriate probability distribution function for the random parameters, denoted as h (.). The random parameters **β** includes the mean value to be estimated **θ**, and an iid error-term **v**. The matrix **Ω** represents the covariance matrix of the parameters. The attributes can be specified to reflect correlation among each other. With correlated parameters specified, h (.) becomes a joint probability density function and the off-diagonal elements in the matrix **Ω** are non-zero reflecting the correlations.

The choice probability under a MLM with joint distribution assumed is denoted as:

$$P_{ijt} = \int \frac{\exp(\mathbf{x_{ijt}\beta})}{\sum_{k=1}^{J} \exp(\mathbf{x_{ikt}\beta})} h(\boldsymbol{\beta}) d(\boldsymbol{\beta}) \tag{3.4}$$

Equation (4) has no closed form solution, and requires approximation by simulation. Halton draws, which offers better coverage of density function and faster convergence, were utilized at 150 draws per iteration in the simulated maximum likelihood estimator (Train 2003).

Partitioning the utility function in equation (1) into an observable component (V_{ijt}) and an error component according to our specification of MLM yields

$$V_{ijt} = \alpha' c_{ijt} + \boldsymbol{\beta_i}' \mathbf{x}_{ijt} + \boldsymbol{\gamma_1}'(\mathbf{d_i} \times \mathrm{CAN}_{ijt}) + \boldsymbol{\gamma_2}'(\mathbf{d_i} \times \mathrm{AUS}_{ijt})$$

$\mathbf{x}_{jt}$= [WOULD-NOT-BUY, AUS, CAN, BSE, TRACE, BSE_TRC, TENDER, NAT]$_{jt}$ **(3.5)**

$\mathbf{d_i}$=[MALE, AGE, INCOME, EDUCATION]

Three components made up the deterministic part of the utility: first, the price scalar (c_{ijt}) along with its fixed parameter α; the price coefficient is specified as a fixed coefficient to avoid an unrealistic positive coefficient associated with price (Meijer and Rouwendal 2006; Olsen 2009). Second, the 8x1 vector $\mathbf{x}_{jt}$ represents steak attributes with dummy variables. The variables in **x** correspond to attributes in the choice experiment as described in Table 1.1. The base cases are *USA* in origin label, *APPROVED STANDARDS* in production practices, *NONE* in food-safety assurance and *NOT SPECIFIED* in tenderness respectively.

Moreover, the random parameters **β** are specified to have a normal distribution and correlated attributes, the model produced an 8x8 covariance matrix with non-zero off diagonal elements reflecting the correlation. The last component captures the demographic-interaction effects ($\boldsymbol{\gamma_1}'(\mathrm{CAN}_{ijt} * \mathbf{d_i}) + \boldsymbol{\gamma_2}'(\mathrm{AUS}_{ijt} * \mathbf{d_i})$). The 4x1 demographic vector $\mathbf{d_i}$ interacts with the dummy variables *CAN* and *AUS* to capture the co-variation between demographic factors and country-of-origin preference.

3.5.2 The Latent Class Model

The LCM assumes that individuals are implicitly assigned into Q classes (or segments). LCM choice probability of individual *i* choosing alternative j in choice situation t given class q is given as:

$$P_{it|q}(j = 1) = \frac{\exp(\alpha' c_{ijt} + \mathbf{x}'_{it,j}\boldsymbol{\beta}_q)}{\sum_{j=1}^{J} \exp(\alpha' c_{ijt} + \mathbf{x}'_{it,j}\boldsymbol{\beta}_q)} \quad \textbf{(3.6)}$$

$\mathbf{x}_{jt}$ = [WOULD-NOT-BUY, AUS, CAN, BSE, TRACE, BSE_TRC, TENDER, NAT]$_{jt}$

As with the MLM, the scalar c_{ijt} represents the price and the 8x1 vector $\mathbf{x}_{ijt}$ represents observed characteristic of alternative j in choice situation t. Instead of just one set of parameters as in a conditional logit model, LCM estimates Q sets of parameters ($\boldsymbol{\beta}_q$), with each set describing the collective behaviour of individuals found within that particular class. Following Greene and Hensher (2003), the class assignment probability of an individual *i* to class *q* in the LCM model is given as:

$$H_{iq} = \frac{\exp(\mathbf{z}'_i \lambda_q)}{\sum_{q=1}^{Q} \exp(\mathbf{z}'_i \lambda_q)} \quad \textbf{(3.7)}$$

$\mathbf{z}_i$ = [CONSTANT, MALE, AGE, EDUCATION, INCOME] $_i$

where $\mathbf{z}_i$ is a set of observable characteristics of individual *i*, which are used to identify class memberships. In this application, gender, age, education level, and income level were chosen as the class determinants. The vector λ_q is the parameter associates with $\mathbf{z}_i$ to be estimated. Note that only *Q-1* sets of λ_q are produced, the *Q* th parameter is normalized to be zero for model identification purposes (Greene 2008: Chapter 21). From $H_{i,q}$, the LCM also estimates the probability that respondents belong to each class. LCM utilizes Maximum Likelihood procedure to produce parameter estimates.

The number of classes optimal in a LCM cannot be determined by a parametric statistical test (Swait 1994). Several information criteria are commonly used to determine the

number of classes, they are: the minimum of the Akaike Information Criterion (AIC), the modified Akaike Information Criterion (AIC3), the Bayesian Information Criterion (BIC) and the maximum of the Akaike Likelihood Ratio Index ($\overline{\rho}^2$) (Ben-Akiva and Swait 1986; Gupta and Chintagunta 1994; Hu et al. 2004; Kamakura and Russell 1989; Swait 1994).

Following Greene and Hensher (2003), the "testing down" approach was adopted where we started from a larger number of classes and gradually reduced to a smaller number of classes. The initial attempts on six or more classes failed computationally due to reaching singular covariance matrices. After comparing the information criteria in Table 3.2, we chose the five-class model as the final LCM specification as it achieved the best balance of parsimony and explanatory power.

3.6 Results

We tested an array of specifications before the MLM and LCM were finalized and presented in Table 3.3 and Table 3.4. Comparison of the McFadden R^2 and log-likelihood scores reveal that both the MLM model and LCM are superior in explanatory power than the conditional logit model. The conditional logit model recorded a McFadden R^2 of 0.1535 compared to 0.3437 in the MLM and 0.3641 in the LCM. Thus, we can confidently reject the conditional logit model in favour of the MLM and LCM.

The diagonal values of the Cholesky matrix (Table 3.5) identified the presence of taste heterogeneity within the tested attributes (Hensher et al. 2005). These diagonal values revealed significant taste heterogeneity in all eight coefficients specified as random parameters in the model. Multiple significant values in the off-diagonal elements of the

Cholesky matrix suggest that significant correlation exist between the attributes, thus justifying the specification of joint distribution.

Given the presence of interaction terms and differences in scales across model, interpretation of individual coefficients is discouraged in MLM and LCM (Greene and Hensher 2003; Scarpa and Del Giudice 2004). Hence, we interpreted the results from both models in the context of willingness to pay estimates.

3.6.1 Results from the Mixed Logit Model

Consumers' relative WTP for Australian and Canadian steak were calculated for nine selected consumer profiles based on their age, education, income, and gender. For brevity, we tied education to income as these factors tend to be positively correlated and the shopper's gender is assumed to be female.

The relative WTP follows the interpretation of dummy variables, where the base case is the U.S. labeled steak. The WTP is calculated as a negative ratio, where the numerator is the combination of the estimated mean values of the coefficients associated with a particular country ($\theta_{country}$) and its interaction effects ($\boldsymbol{\gamma}'_{country} \times \mathbf{d}$) and the denominator is the fixed price coefficient (α_{prince}).

$$\mathrm{WTP}_{\mathrm{country}} = -\frac{\theta_{\ \mathrm{country}} + \boldsymbol{\gamma}'_{\mathrm{country}} \times \mathbf{d}}{\alpha_{\mathrm{price}}} \qquad \textbf{(3.8)}$$

$$\mathbf{d} = [\mathrm{MALE} = 0, \mathrm{AGE}, \mathrm{INCOME}, \mathrm{EDUCATION}]$$

The standard errors of the WTP estimates were produced using Krinsky and Robb (1986) simulation procedures with 2,000 replications (Hensher and Greene 2003). The results are presented in Table 3.6.

Not surprisingly, the results revealed that on average, imported steak is less preferred by consumers across all education, income and age levels. The discounts (or negative WTP) calculated at the sample mean level of age (56.62 years), education (14 years) and income ($52.37k) were $6.07/lb and $8.40/lb on average for Canadian steak and Australian steak respectively when compared to steak from the U.S. These estimates suggest that high-value imported beef is likely to encounter less favorable receptions with the new mandatory Country-of Origin Labeling rule.

The magnitude of the discount indicated Canadian steak is prefered over Australian steak. We found that older consumers are less willing to pay for imported steak; similar observations of older consumers aversion towards imports were also reported in Alfnes (2004) and Loureiro and Umberger (2007). The magnitude of the discount decreased as education and income level of the shopper increased. For example, the average discount on the Canadian steak was $3.89 for a 35.3 year old female shopper with household income of $80,000 and 16 years of education. The discount increases 41% to $5.51 for a same-aged female shopper with household income of $30,000 and 12 years of education.

The negative WTP for imported steak suggests that holding other factors constant, most consumers need to be compensated, either in price or in favourable attributes, for choosing Canadian or Australian strip loin steak over U.S. strip loin steak. One such strategy is to incorporate some additional quality features into imported steaks. Table 3.7 presents the marginal WTP of the non-country of origin attributes. The WTP is calculated as the negative ratio between the coefficient of an attribute to the price coefficient. On average, the marginal WTP for BSE-tested beef, traceable beef or with both attributes combined were $5.70, $5.85, and $8.05 respectively; the WTP for these food-safety

enhancements eclipse a large portion of the discount associated with country of origin for most consumers. In addition, the tenderness-assured steaks garner a premium of $4.08 on average. Although natural steak was not found to be associated with significant WTP, overall, the food-safety and eating-quality attributes might provide a viable way to differentiate imported steak from domestic product.

3.6.2 Results from the Latent Class Model

The LCM provides a different perspective from the MLM. As noted, the model yielded five unique classes. We found that age, income and education are significant in determining the latent class an individual belongs to (see

Table 3.4). As with the MLM, coefficient estimates of the attribute variables from the LCM were best interpreted in the context of WTP. The average WTP for an attribute within a consumer class q is the negative ratio between an attribute coefficient in that class q ($\beta_{attribute,\ q}$) and price coefficient in the same class q ($\alpha_{prince,\ q}$). . The standard deviation of the WTP measure was simulated using the Krinsky and Robb procedure with 2,000 replications.

$$WTP_{attribute,q} = -\frac{\beta_{\ attribute,q}}{\alpha_{price,q}} \quad \textbf{(3.9)}$$

As with the MLM, the LCM also showed wide-ranging taste heterogeneity for country-of-origin and other attributes. Of particular interest is the discount needed (or negative WTP) to switch from U.S. steak to imported steak. From Table 3.8, the discount needed for Australian steak ranged from as little as $1.09/lb to a prohibitive $49.48/lb across different classes, holding other factors constant . Similarly, the discount needed for Canadian steak, across all class membership, ranged from $0.74/lb to $35.12/lb. The higher values of the WTP range suggest that a significant portion of consumers are likely to avoid imported steak.

Overall, the marginal WTP estimations for BSE, TRACE, BSE_TRC, and TENDER revealed positive consumer interest in these attributes. With the exception of consumers in one class, natural beef was generally not regarded as a an attractive attribute.

Of the five segments, only consumers in the first segment exibited postive WTP value for the would-not-buy coefficient that captured the utility/disutility yielded from not purchasing the steak. With the positive WTP value, these consumers disliked the strip

loin steaks outlined in the choice experiment. These consumers could be vegetarians or did not prefer the particular cut of beef. For this reason, this class of consumers were labeled as Non-Steak Consumers. They accounted for about 16% of the sample. Interestingly, even individuals who generally did not prefer the strip-loin steak, if they were to make a choice, they would still choose a U.S. product with almost all other quality guarantees/assurances (except for natural). Estimates of the class membership determinant coefficients in Table 3.4 indicated that female and older consumers were more likely to be in this class.

Surveyed respondents had a 17% probability of faliing into class 2. These consumers were labeled as Anti-Import Consumers for displaying strong aversion towards imported steaks. The estimated discount needed for this group to switch from U.S.-origin steak to Australian and Canadian steak were $49.48/lb and $35.12/lb respectively. Further, these consumers were found to be willing to pay more for tenderness than for BSE-tested and traceable steak; this implied, they valued eating-quality attributes more than food-safety attributes. The class determinant estimates revealed that female, older, or less educated consumers were more likely to be in this class.

The third group was categorized as Food-Safety-Conscious Consumers. Eventhough they displayed moderate aversion towards imported steak, they had the largest WTP for food-safety attributes among all the groups. Interestingly, they were willing to pay a small premium for natural beef, which was insignificant in the conditional logit model, the MLM and the other classes in the LCM. This group constituted the largest segment, accounting for 27% of the sample. Older consumers were found to be more likely to be in this segment.

We observed the lowest discount on the imported steaks ($1.09 for Australian and $0.74 for Canadian) for Value Seekers in segment 4. This segment accounted for 17% of the sample. Individuals in this segment exhibited the lowest WTP for all other attributes examined. Of all the segments, this group was the least likely to be affected by the COOL mandate. The class assignment estimates suggested older and more highly educated consumers were more likely to belong to this class.

Consumers in the fifth segment were willing to pay a modest amount to avoid imported steak and for the non-COOL attributes. This group had the largest disutility associated with not buying the steak (-$33.60), as reflected by the negative WTP associated with the would-not-buy. Hence, this group is labeled as strip-loin-steak lovers. They accounted for 24% of the sample.

From the country-of-origin WTP within the LCM model, only the Value-Seeking consumers in segment 4 appeared to be willing to make the trade-off between domestic and imported steaks with a modest WTP. The remaining 83% of the sample required at least $4.92/lb and $3.22/lb discounts for consuming Australian and Canadian steak. These findings reiterate the possibility of COOL exerting downward pressure on both the price and quantity demand for imported beef.

3.7 Conclusion

As a way to gauge the impact of the Mandatory Country-of-Origin Labeling provision, this study investigated the extent of consumers' willingness to trade-off between U.S. labeled steak and imported Canadian and Australian steak. Raging debate on the necessity of COOL and limited understanding of consumers' reaction to COOL

motivated the research question. The notable contribution of this study is the inclusion of source-differentiated beef in the choice experiment, which enable a direct analysis of consumers' preference and readiness to accept imported beef from the two biggest beef exporters to the United States.

Using MLM and LCM, we learned that imported beef is less preferred than domestic steak largely. Although significant taste heterogeneity exists in consumers' preference for Australian and Canadian steak, these imported steaks are likely to feature less prominently in the mainstream US market under COOL regime. Nonetheless, imported steak maybe sought after by value-seeking customers or as niche products. We also found that import aversion was more prevalent in females, older and less educated consumers. In addition, we found that consumers are willing to pay a premium for BSE-tested, traceable, and tenderness-assured beef. In particular, the potential for the food-safety attributes are stronger than tenderness assurance for most consumers.

Given the difference in the estimated WTP between domestic and imported beef, as shown in both the MLM and LCM, an immediate consideration is COOL's ability to generate a premium for domestic beef. While the results provided an argument for such a premium, it is uncertain if such a marked WTP would be observed in a non-hypothetical setting. As much as our choice experiment attempts to simulate the decision process faced by consumers, grocery stores are unlikely to stock a single cut of beef from multiple countries at once. The decision concerning the choice of country-of-origin is likely to be determined upstream in the supply chain. Nonetheless, consumers' preferences are likely to influence those decisions.

In addition, consumers are unlikely to pay the reported large premium for domestic beef for a long period. The WTP estimates calculated in this study may not reflect a sustained premium over a long period because various factors, such as demand and supply elasticities, market power, trade and other factors may influence WTP in the longer run (Chung et al. 2009).

Echoing Brester et al. (2004), we expect imported beef to be sold at a discount largely because domestic supply dominates the beef market. Even with COOL, sustaining a long-term price premium would still require producers' collaboration on producing higher quality beef, maintaining the quality, and restricting supply (Carter et al. 2006). For consumers to be willing to pay a premium, especially in repeated purchases, consumers must perceive higher quality for the food products (McCluskey and Loureiro 2003).

Table 3.1**.** Perceived Beef Products Safety Levels of Various Country of Origin

Countries of Origin	**Mean**[a]	**Std. Dev.**	**% No Opinion**
Unknown Origin	2.42	1.28	36.05
Australia	3.24	1.12	34.66
Brazil	2.83	1.09	37.16
Canada	3.40	1.10	30.49
New Zealand	3.21	1.13	34.66
United States	3.81	1.09	10.84
Hypothesis Test[b]	t-test value		p value
H_o: $\mu_{us} - \mu_{unknown\ origin} = 0$	18.32		0.000
H_o: $\mu_{us} - \mu_{Australia} = 0$	10.86		0.000
H_o: $\mu_{us} - \mu_{Brazil} = 0$	15.80		0.000
H_o: $\mu_{us} - \mu_{Canada} = 0$	9.34		0.000
H_o: $\mu_{us} - \mu_{New\ Zealand} = 0$	11.46		0.000

[a] 1 = Very Low; 5= Very High

[b] Tests of differences in mean perceived safety of meat originated from the United States against other origins.

N = 1079

Table 3.2 Information Criteria Used in Determining Number of Classes in the Latent Class Model

Number of Classes	**Number of Parameters (P)**	**Log-likelihood**	**AIC**	$\bar{\rho}^2$	**AIC3**	**BIC**
5	65	-10286.6	20703.2	0.3601	20768.2	10513.6
4	51	-10515.3	21132.7	0.3468	21183.7	10693.4
3	35	-11101.6	22277.2	0.3114	22308.2	11223.8
2	23	-11596.5	23238.9	0.2817	23261.9	11676.8

Notes:
The Sample size is 14724 choices from 1079 individuals (N)
The Restricted Log-likelihood score is -16175.97
The AIC (Akaike Information Criterion) is calculated as [-2(LL-P)]
The $\overline{\rho}^2$ (Akaike Likelihood Ratio Index) is calculated as [1-AIC/2LL (0)]
The AIC3 (Modified Akaike Information Criterion) is calculated as (-2LL + 3P)
The BIC (Bayesian Information Criterion) is calculated as [-LL + P/2 × ln (N)]

Table 3.3. Conditional Logit Model and Mixed Logit Model Parameter Estimates

		Conditional Logit Model			**Mixed Logit Model**		
Categories	Attributes	Coef.		S.E.	Coef.		S.E.
Price	PRICE	-0.1625	***	0.0039	-0.2567	***	0.0061
	WOULD-NOT-BUY	-0.8142	***	0.0577	-1.6537	***	0.1228
Country of Origin							
	AUS	-1.7046	***	0.2105	-3.3101	***	0.5537
	CAN	-1.0031	***	0.2033	-1.9477	***	0.4471
Food Safety							
	BSE	0.9072	***	0.0430	1.4633	***	0.0798
	TRACE	0.9278	***	0.0430	1.5005	***	0.0818
	BSE_TRC	0.6803	***	0.0285	2.0664	***	0.0881
Tenderness							
	TENDER	0.6803	***	0.0285	1.0502	***	0.0502
Production Practices							
	NAT	0.0225		0.0290	0.0465		0.0489
Interaction Terms							
	CAN*MALE	0.1916	***	0.0541	0.3061	**	0.1241
	CAN*AGE	-0.0139	***	0.0019	-0.0163	***	0.0042
	CAN*EDU	0.0554	***	0.0131	0.0895	***	0.0293
	CAN*INCOME	0.0008		0.0009	0.0012		0.0020
	AUS*MALE	0.2295	***	0.0564	0.4178	***	0.1523
	AUS*AGE	-0.0117	***	0.0019	-0.0135	***	0.0051

Table 3.3. Continue from previous page

	AUS*EDU	0.0659	***	0.0137	0.1262	***	0.0358
	AUS*INCOME	0.0039	***	0.0009	0.0029		0.0024
Log likelihood		-13608			-10616		
McFadden R2		0.1535			0.3437		
AIC		27251.30			21338.80		

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels.

Table 3.4. Latent Class Model Parameter Estimates

	Class 1 Coef.		**Class 2** Coef.		**Class 3** Coef.		**Class 4** Coef.		**Class 5** Coef.	
PRICE	-0.2547	***	-0.0847	***	-0.1860	***	-0.8526	***	-0.1240	***
	(0.0346)		(0.0159)		(0.0154)		(0.0457)		(0.0102)	
WOULD-NOT-BUY	1.6445	***	-1.0134	***	-0.5413	***	-5.3316	***	-4.1445	***
	(0.4261)		(0.2349)		(0.1912)		(0.3534)		(0.2827)	
AUS	-1.8228	***	-4.0782	***	-0.9112	***	-0.9252	***	-0.7591	***
	(0.2728)		(0.3090)		(0.0824)		(0.1491)		(0.0769)	
CAN	-1.6650	***	-2.8981	***	-0.5936	***	-0.6326	***	-0.5815	***
	(0.2469)		(0.2351)		(0.0751)		(0.1322)		(0.0712)	
BSE	1.3496	***	0.3425	**	1.6655	***	1.4151	***	0.9051	***
	(0.3446)		(0.1703)		(0.1405)		(0.1782)		(0.0937)	
TRACE	1.4709	***	0.3105	*	1.7450	***	1.5769	***	0.8422	***
	(0.3280)		(0.1643)		(0.1395)		(0.1834)		(0.0911)	
BSE_TRC	1.6195	***	0.7634	***	2.3832	***	1.8915	***	1.3698	***
	(0.3448)		(0.1678)		(0.1571)		(0.1932)		(0.0986)	
TENDER	0.8512	***	0.9217	***	1.0855	***	0.9058	***	0.6497	***
	(0.1866)		(0.1210)		(0.0712)		(0.1168)		(0.0616)	
NAT	0.0354		0.0573		0.1475	**	0.0470		0.0341	
	(0.1706)		(0.1068)		(0.0679)		(0.1187)		(0.0640)	
Latent Segment Parameter Estimates H(.)										
Constant	0.2526		-0.0968		-1.0574		-4.1372	***	-	
	(0.8788)		(0.9745)		(0.8663)		(0.9078)			
MALE	-0.4628	**	-0.3925	*	-0.1105		-0.2138		-	
	(0.2180)		(0.2311)		(0.2102)		(0.2230)			
AGE	0.0155	**	0.0369	***	0.0223	***	0.0404	***	-	
	(0.0074)		(0.0082)		(0.0074)		(0.0088)			
EDU	-0.0697		-0.1392	**	-0.0004		0.1168	**	-	
	(0.0589)		(0.0601)		(0.0516)		(0.0521)			

Table 3.4. Continue from previous page

INC	-0.0061	-0.0034	0.0003	-0.0026	-
	(0.0039)	(0.0038)	(0.0033)	(0.0035)	
Class Probability					
	0.16	0.17	0.27	0.17	0.24
Log likelihood	-10287				
McFadden R2	0.3641				
AIC	20703.20				

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels.

Table 3.5. Cholesky Matrix of Correlated Random Parameters in the Mixed Logit Model

	WOULD-NOT-BUY		AUS		CAN		BSE		TRACE		BSE_TRC		TENDER		NAT	
WOULD-NOT-BUY	3.13	***														
AUS	-0.30	***	1.97	***												
CAN	-0.21	***	-1.38	***	0.51	***										
BSE	-0.57	***	-0.18	**	0.40	***	1.08	***								
TRACE	-0.66	***	-0.16	*	-0.071		-1.03	***	0.73	***						
BSE_TRC	-0.64	***	-0.13		0.073		-1.59	***	0.27	**	0.40	***				
TENDER	-0.25	***	-0.019		-0.46	***	-0.28	***	-0.011		-0.22	**	0.55	***		
NAT	-0.26	***	-0.15	**	-0.28	***	-0.30	***	-0.24	***	0.39	***	0.22	**	0.37	***

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels.

Table 3.6. Willingness-to-Pay Estimations of Selected Profiles Following Mixed Logit Model

	Canadian Steak			Australian Steak		
	($/lb)		S.E.	($/lb)		S.E.
Higher Income, Higher Education						
Income= $80K, Education = 16 yrs						
Age=35.3	-3.89	***	0.53	-5.99	***	0.66
Age=45.0	-4.51	***	0.45	-6.49	***	0.56
Age=56.62	-5.24	***	0.41	-7.10	***	0.52
Sample average Income and Education						
Income= $52.37K, Education = 14 yrs						
Age=35.3	-4.71	***	0.48	-7.29	***	0.60
Age=45.0	-5.33	***	0.39	-7.80	***	0.49
Age=56.62	-6.07	***	0.36	-8.40	***	0.45
Lower Income, Lower Education						
Income= $30k, Education= 12 yrs						
Age=35.3	-5.51	***	0.54	-8.52	***	0.67
Age=45.0	-6.13	***	0.47	-9.03	***	0.59
Age=56.62	-6.86	***	0.45	-9.64	***	0.56

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels.

Table 3.7 Marginal Willingness-to-Pay Estimates from Mixed Logit Model

	Coef. $/lb		S.E.	95% Confidence Interval	
WOULD-NOT-BUY	-6.44	***	0.4403	-7.30	-5.58
BSE	5.70	***	0.3306	5.05	6.35
TRACE	5.85	***	0.3307	5.20	6.50
BSE_TRC	8.05	***	0.3642	7.33	8.76
TENDER	4.08	***	0.2068	3.68	4.49
NAT	0.18		0.1884	-0.19	0.55

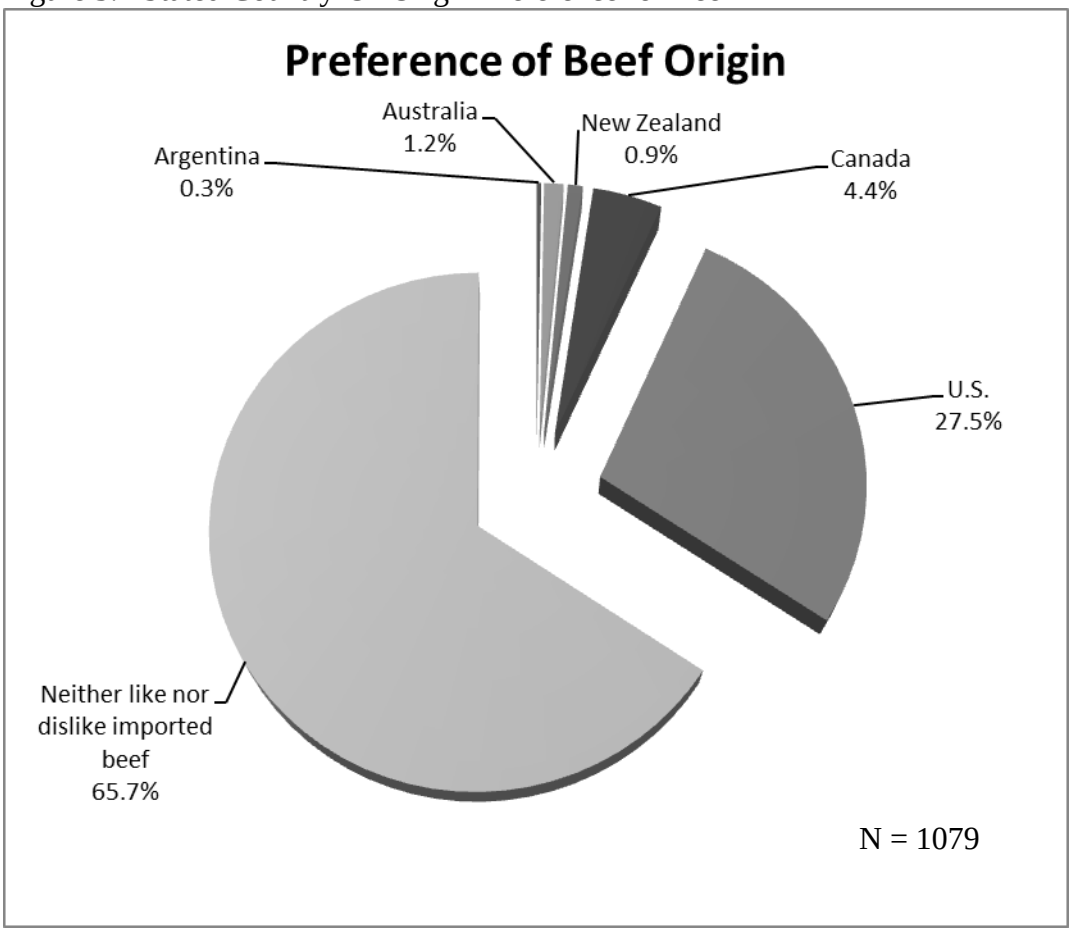
Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels.

Table 3.8. Willingness-to-Pay Estimates from the Latent Class Model

	Class 1		**Class 2**		**Class 3**		**Class 4**		**Class 5**	
	Non-consumer		Anti-Imports Consumers		Food-Safety Conscious Consumers		Value-seekers		Strip-loin Lovers	
	($/lb)		($/lb)		($/lb)		($/lb)		($/lb)	
WOULD-NOT-BUY	6.67	***	-12.10	***	-2.91	***	-6.25	***	-33.60	***
	(2.35)		(2.03)		(0.89)		(0.24)		(3.15)	
AUS	-7.28	***	-49.48	***	-4.92	***	-1.09	***	-6.18	***
	(1.45)		(9.16)		(0.59)		(0.17)		(0.77)	
CAN	-6.64	***	-35.12	***	-3.22	***	-0.74	***	-4.74	***
	(1.30)		(6.50)		(0.46)		(0.16)		(0.68)	
BSE	5.33	***	4.07	*	8.95	***	1.66	***	7.39	***
	(1.41)		(2.15)		(0.86)		(0.20)		(0.90)	
TRACE	5.83	***	3.65	*	9.40	***	1.85	***	6.86	***
	(1.46)		(1.94)		(0.86)		(0.20)		(0.87)	
BSE_TRC	6.45	***	9.17	***	12.83	***	2.22	***	11.17	***
	(1.49)		(2.56)		(1.08)		(0.22)		(1.11)	
TENDER	3.41	***	11.16	***	5.86	***	1.06	***	5.26	***
	(0.87)		(2.49)		(0.53)		(0.14)		(0.64)	
NAT	0.12		0.70		0.78	**	0.05		0.29	
	(0.69)		(1.33)		(0.37)		(0.14)		(0.52)	
Class Probability	0.16		0.17		0.27		0.17		0.24	

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels.

Figure 3.1 Stated Country-Of-Origin Preference for Beef



Chapter 4 Impact of Consumer Perceived Risk on Willingness to Pay for Imported Beef

4.1 Introduction

The Country-of-Origin Labeling (COOL) provision has been a source of heated debate since its introduction in the 2002 Farm Bill. The final ruling was released by the USDA Agricultural Service and went into effect on March 16, 2009; the law mandates that information regarding the country of origin be clearly labeled on several fresh food products sold in retail markets. Several U.S. trading partners have filed complaints against this law in the World Trade Organization (WTO). In November 2011, the WTO determined that COOL constitutes a technical barrier to trade and therefore violates WTO's agreement. The WTO's statement maintained that the U.S. has a right to enforce the origin-label rule but contented the requirement on imported cattle intended to be processed in U.S. processing plants constitute an unjustifiable trade barrier (WTO 2012). The debate on COOL policy has implications for many industries in the agricultural and food sector, including the cattle and beef industry. In particular, access to U.S. markets is important for many beef exporting countries, for example, exports to the U.S. accounts for 30% of beef produced in Canada, New Zealand and Nicaragua. In addition, almost all cattle exports from Canada and Mexico are destined for the U.S. (USDA 2010).

To better understand COOL's impact, we investigated consumer preference for country-of-origin labeled beef from Australia, Canada, and the United States in a perceived risk framework. The contribution of this study is twofold. First, there has been a lack of research on U.S. consumer preference for beef products from various countries, despite the discussion on COOL at policy level. Given the size of the U.S. cattle and beef

industry, it is imperative to fill this gap in research. Secondly, this study ties the literature on consumer perceived risk to understand their choice of beef products. Specifically, we followed the psychometric method proposed in Pennings et al. (2002), which disentangled perceived risk into risk perception (RP) and risk attitude (RA). The relation between perceived risk and preference for COO labeled beef is formally investigated through a mixed logit model with an error component specification. The result suggested a strong link between risk perception and risk attitude towards consumer choice of COO labeled beef.

4.2 Literature Review

Consumer reaction to COOL is a critical component of understanding COOL's impact on food imports. Earlier efforts to understand consumers' reactions to COOL, notably works by Loureiro and Umberger, Loureiro and Umberger (2007) focus on relative willingness to pay (WTP) for U.S. labeled beef and unlabeled beef. Loureiro and Umberger (2007) found that U.S. consumers were willing to pay a modest premium for beef labeled with "Product of USA" versus unlabeled beef. WTP for domestic labeled beef over imported beef has been explored more recently, Abidoye et al. (2011) found that U.S. consumers were willing to pay more for domestic beef over imported beef.

Although several studies have addressed consumers' relative WTP for domestic and imported beef, what motivates consumer preference for domestic beef is relatively unexplored. Along with other factors, Lusk et al. (2006) suggested that subjective perceptions of risk for imported products could play a prominent role in COOL's influence on consumers. The potential role of COOL as a food safety cue is a common argument used by proponents of the law. The determination of food safety is not always a

straightforward process for consumers. Using beef as an example, although consumers can discern spoiled meat by discoloration or an unpleasant odor, pathogenic microorganisms and unsafe chemical residues are not detectable by the naked eye (Buzby et al. 1998). In some cases, consumers could associate food safety incidents with country of origin; for example, the discovery of a BSE-infected cow in Washington State caused persistently lower demand for U.S. beef by Japanese consumers (Saghaian et al. 2007).

Consumers' perception of food safety, or any risk in general, is inherently subjective. Pennings et al. (2002) differentiated perceived risk into risk perception and risk attitude, an idea that traces back to Cooper et al. (1988). Risk perception corresponds to perceived probability of exposure to a risk, subject to consumers' assessment, and risk attitude corresponds to how much a person dislikes the risk. How risk perception and risk attitude drive consumer behavior has far-reaching implications for marketers. Namely, if risk perception is the dominant driver, then better risk communication could educate consumers about true risks; if risk attitude is the driver, then elimination of the risk could be the only solution (Pennings et al. 2002).

Perceived risk is influenced by multiple factors. Among the psychological factors are societal and individual knowledge about a risk, and the perception of whether the risk is imposed or voluntarily undertaken, which is directly associated with how much control one has over the risk (Grunert 2005; Slovic 1987; Yeung and Morris 2006). For instance, Zepeda et al. (2003) found that risk perception about rbST, an artificial growth hormone, in milk increased when respondents claimed their local stores did not carry non-rbST treated alternatives, as well as when respondents stated they had prior knowledge of rbST. Additionally, socioeconomic characteristics are correlated with risk perceptions.

For instance, Zepeda et al. (2003) found that female and Caucasian consumers are more likely to perceive rbST as a risk.

Although actual risk may be of interest to policymakers, perceived risk is often the dominant factor in consumer behavior. Perceived risk drives consumers' willingness to purchase (Schroeder et al. 2007; Slovic 1987; Yeung and Morris 2006). Mitchell (1999) suggested that most buyers are risk averse and motivated to avoid mistakes. Unsafe food products could cause severe and wide-ranging consequences, as the consumer's health and long-term wellness are at stake. For example, Creutzfeld-Jakob Disease and E.coli have prolonged negative health impacts (Bruce et al. 1997; Clark et al. 2010). Thus, even if the probability of suffering ill effects is near zero, the severe consequences could prevent consumers from accepting risky foods (Wohl 1998).

Risk perception and risk attitude effects on consumers beef demand have been studied in different econometric modeling and experimental method contexts. For instance, Pennings et al. (2002) and Schroeder et al. (2007) focus on consumers' reaction to BSE crises in different countries using surveys; Lusk and Coble (2005) investigated consumer acceptance of GM food with an experimental auction. Pennings et al. (2002) found that beef consumption reduction in Germany could be attributed to high-risk aversion and high-risk perception with logit models. Schroeder et al. (2007) found significant interaction effects between risk attitude and risk perception in explaining the reduction in beef consumption following BSE events using a double-hurdle model, Lusk and Coble (2005) found that risk perception and risk attitude significantly affected acceptance, willingness to purchase and willingness to accept GM food with an ordered-probit model.

Further, some evidence suggests that perceived risk contributes to consumers' willingness to pay. For instance, respondents in Savage (1993) were willing to donate more to research risks with higher perceived probability, risks not well-understood by science, and risks resulting n dreadful consequences. Tonsor et al. (2009) found that Canadian and Japanese consumers who perceived higher risk from eating beef were willing to pay a premium for reduced-risk beefsteak, but the effect on American and Mexican consumers was not statistically significant.

Summarizing the literature, we found strong evidence of preference for domestic products, which translates to lower WTP for imported beef. Perceived risk is widely used in explaining consumer behavior when facing the choice in purchasing goods involving risk and uncertainty. The linkage between consumer preference for COO labeled beef (including domestic) and perceived risk is to the best of our knowledge, not yet well addressed. In this study, we explore consumer preference for country of origin as an attribute. The connection between country-of-origin effects and perceived risk is investigated using a choice model, which is based on the perceived risk framework and the choice-experiment design in Tonsor et al. (2009).

4.3 Perceived Risk Statistics

We measured perceived risk with psychometric measurements. These measurements were grouped into four categories. The first were consumer risk perception and risk attitude for beef products, which were product-class measurements for inherent risk (Mitchell 1999). The next two were statements inquiring about respondents' self-perception of food-safety knowledge, and perceived self-control and involuntary exposure to food risk, and lastly, statements that capture respondents' evaluation of food

safety level for beef from different countries of origin, which corresponds to a measure of product-specific risk perception.

Consumers' risk perception and risk attitude were captured using the adaptation of scaling procedure proposed in Pennings et al (2002). These scales were developed to mirror as closely as possible the Pratt and Arrow framework (Pennings et al. 2002). The distribution and statements used are described in Table 4.1.

Using a rating of three as the middle point, it appears that most American consumers believed that eating beef posed a non-severe risk based on the observed average sum score of 2.53. A closer look reveals that fewer than 20% of the respondents stated that eating beef was risky. Fewer than half of the respondents perceived beef as a low risk food. Additionally, from the risk attitude statements, most American consumers were willing to accept the perceived risks of eating beef. More than half responded with ratings of 4 and 5, and fewer than 20% responded that they were not willing to accept risks of eating beef. These results compared closely to those in Pennings et al. (2002) and Schroeder et al. (2007).

In terms of consumers' perceived self-knowledge of and perceived control over food safety, about half of the sample proclaimed themselves knowledgeable (rating of 4 or 5) about food safety; only 20% of the sample acknowledged that they were not knowledgeable about food safety. Further, about two thirds of the sample believed that other parties in food chain determine food safety. This shows a perception of lack of control over food safety by consumers. The sentiment is again reflected by about 38% responding that they had significant control of the safety of food themselves.

The last series of questions were used to capture risk perception for beef by countries of origin. A larger portion of the respondents perceived U.S. beef to be safer than the foreign products by a significant degree. Those who had rated U.S. beef as safe accounted for 59.3% of the sample compare to 27.5% for Australian beef and 32.6% for Canadian beef. The difference could be attributed to the fact that a significantly larger portion of the respondents expressed that they have "no opinion" regarding the safety of the imported beef relative to U.S. beef. The "no opinion" option is typically provided to reduce the pressure for respondents who hold no true opinion to state otherwise (Krosnick et al. 2002).Thus, the higher number of "no opinion" responses on imported beef could be reflecting consumers' unfamiliarity with imported beef.

4.4 Econometric Model

We used a mixed logit error-component model to explain consumers' choice of beefsteak in the risk perception framework. The model combines useful features from a mixed logit model and an error-component logit model. Consumer utility underlying their choices of alternatives presented in the choice experiment can be represented using the Random Utility Model (McFadden 1974). The utility function is denoted as:

$$\boldsymbol{U}_{njt} = \begin{cases} \propto_n price_{n1t} + \boldsymbol{\beta}_n{}'\boldsymbol{x}_{n1t} + \boldsymbol{\delta}_n'\mathbf{d}_{n1t} + \mu_n z_{n1t} + \varepsilon_{n1t} & , if\ j = 1 \\ \propto_n price_{n2t} + \boldsymbol{\beta}_n{}'\boldsymbol{x}_{n2t} + \boldsymbol{\delta}_n'\mathbf{d}_{n2t} + \mu_n z_{n2t} + \varepsilon_{n2t} & , if\ j = 2 \\ \boldsymbol{\beta}_n{}'\boldsymbol{x}_{n3t} + \varepsilon_{n3t} & , if\ j = 3 \end{cases} \quad \textbf{(4.1)}$$

where subscript *n* corresponds to individual, *j* corresponds to alternative (*j*=1, 2, and 3) and *t* corresponds to choice sets. The price coefficient α is specified as a fixed parameter rather than a random parameter to avoid unrealistic welfare measures associated with a random price parameter (Meijer and Rouwendal 2006; Olsen 2009). Taste heterogeneity is captured by the random coefficient $\boldsymbol{\beta_n}$, which is an 8 × 1 vector associated with vector **x**. The elements in the 8 × 1 vector **x** describe an alternative given in a choice set with a series of dummy variables:

$$\mathbf{x}_{njt} = [WOULD - NOT - BUY, AUS, CAN, BSE, TRACE, BSE\_TRC, TENDER, NATURAL] \quad \textbf{(4.2)}$$

The variables in **x** correspond to attributes in the choice experiment as described in Table 1.1. The base cases are *USA* origin labeling, *APPROVED STANDARDS* in production practices, *NONE* in food-safety assurance and *NOT SPECIFIED* in tenderness assurance.

Interaction effects between country of origin and an individual sociodemographic and risk perception factors are accounted for in the term $\boldsymbol{\delta}_n'*\mathbf{d}_n$:

$$\begin{gathered}\mathbf{d}_n = \left[[\mathrm{AUS}_{njt} * \mathbf{factor}][\mathrm{CAN}_{njt} * \mathbf{factor}][\mathrm{USA}_{njt} * \mathbf{factor}]\right]_{1\times 39} \\ \mathbf{factor_n} = [AGE, EDU, INC, RP, RA, KNOW, FC, CONT, \mathbf{fs}]_n \\ \mathbf{fs} = [very\ low, low, moderate, high, very\ high]\end{gathered} \quad \textbf{(4.3)}$$

Where $\mathbf{d}_n$ is a 1 × 39 vector, where it consist of interaction terms between the country dummy variables (*AUS*, *CAN*, *USA*) and the 13 elements in the vector **factor**, which correspond to individual's sociodemographic, perceived risk factors, knowledge, and control statements in Table 4.1. The *RP* and *RA* measurements correspond to the average

risk perception and risk attitude score, which are individual specific. Lastly, **fs** is the country-of-origin specific perceived food-safety level measurements, which are transformed into dummy variables where the base case is 'no opinion'. Although some other significant interaction effects could exist, to control the size of the model, we limit the interaction effects to only those on country-of-origin attribute.

The error term of the utility function consists of two components. First, $\boldsymbol{\varepsilon}_{nt}$ is assumed to be *iid* and distributed as a standard maximum extreme value type I distribution as in a conditional logit model. The second error term, $\boldsymbol{\mu}'_n\mathbf{z}_{nt}$, corresponds to the error component, which captures correlation between the two non-empty alternatives (the first two alternatives in each choice set). We specify the 3 × 1 vector $\mathbf{z}_{nt}$ to be equal to [1, 1, 0] to reflect the correlation structure in individuals' decision-making process (Scarpa et al. 2008) .The random coefficient $\boldsymbol{\mu}_n$ is assumed to be independently normally distributed: $\boldsymbol{\mu}_n \sim N(0, \sigma)$ (Train 2003),where σ, the additional parameter to be estimated, is the covariate between alternative 1 and 2.

Lastly, the random coefficient $\boldsymbol{\beta}_n$ is assumed to follow a distribution, such that:

$$\boldsymbol{\beta}_n \sim F(\boldsymbol{\theta}_0, \boldsymbol{\Omega}_n) \qquad \textbf{(4.4)}$$

Analysts are free to choose any appropriate mixing distributions that reflect behavior of the subject (Train 2003). All random coefficients in this study are specified as normally distributed to account for either positive or negative signs associated with the coefficients. In addition, we specify the random coefficients to be correlated between attributes and choice sets. The correlated specification allows the model to reflect that each individual uses the same preference to evaluate all attributes in all choice sets. The

correlation is represented in the off-diagonal values in the covariance matrix $\boldsymbol{\Omega}_n$ (Greene and Hensher 2007; Hensher et al. 2005).

4.5 Results

Multiple specifications were tested before the model was finalized. For comparison purposes, we estimated a conditional logit model (see Table 4.2). The result of the final mixed logit model with error component specification is presented in Table 4.3. Marginal willingness to pay for the perceived risks was calculated based on a Krinsky and Robb simulation with 5,000 replications (Greene and Hensher 2003; Krinsky and Robb 1986). The marginal willingness to pay is the ratio of a coefficient over the price parameter, such that:

$$WTP = -\frac{\beta_{attribute}}{\beta_{price}} \quad \textbf{(4.5)}$$

As expected, the mixed logit model significantly improved explanatory power over the conditional logit model. The mixed logit model reported a McFadden R^2 of 0.35, compare to 0.18 in the conditional logit model. Further, the standard deviation estimates that captured correlation between alternatives 1 and 2 were significant. Judging from the diagonal values from the Cholesky matrix, we found significant latent taste heterogeneity in *WOULD-NOT-BUY*, *AUS*, *CAN*, *TENDER* and *NAT* (see Table 4.4), but none in *BSE*, *TRACE,* and *BSE_TRC* as indicated by the insignificant corresponding estimates.

Comparison across models of individual coefficients is meaningless given the difference in scales between models (Greene and Hensher 2003). However, *ceteris paribus* interpretation of coefficients is feasible in the mixed logit model setting (Alfnes 2004).

We begin with examining the coefficients on the random parameters. The coefficient on *WOULD-NOT-BUY* was negative as expected, which suggested that consumers suffered utility loss if the consumption of the featured beefsteak were to be removed from market. Except for the coefficient on *NAT* beef, the coefficients on other food safety and quality guarantee (*BSE*, *TRACE*, *BSE_TRC*, and *TENDER*) were positive and significant and were as expected. However, although the average effect of *NAT* was statistically zero, the significant standard deviation coefficient indicated that about half of the population preferred *NAT*. Lastly, the nonrandom coefficient on *PRICE* was negative as theory suggested and significant at the 1% level. We skip interpreting the coefficients on *AUS* and *CAN* since multiple interaction terms were specified with the country-of-origin variables, which should all be used to calculate the overall impact of *AUS* and *CAN*.

Focusing on how risk perception and risk aversion of consumers affected the likelihood of choosing imported beef, the coefficients on the interaction terms for Canadian beef (*CAN*RP*), Australian beef (*AUS*RP*) and beef risk perception were negative and significant. This suggested that risk perceptions about beef are negatively correlated with the likelihood of purchasing imported beef. In other words, consumers who perceived beef as unsafe were less likely to purchase imported beef. On average, a one point increment in consumers' perception of beef safety can be translated into -$0.95/lb for Australian beef and -$0.58/lb for Canadian beef (see Table 4.5 for marginal WTP estimates). These WTP estimates highlighted that significant discounts were required for consumers who perceived beef as unsafe to switch to imported beef. In contrast, the equivalent interaction term between U.S. beef and risk perception (*USA*RP*) was insignificant; this meant that no significant difference in WTP was observed between

consumers who think beef was safe vs. unsafe, which also suggested that U.S. beef was likely the choice for consumers who were concerned about the safety of consuming beef.

On the interaction terms between country of origin and risk attitude towards beef (*AUS*RA*, *CAN*RA*, and *USA*RA*), the positive coefficients suggested that in general, consumers who were more willing to accept risk from consuming beef had higher utility associated with purchasing beef. The difference in magnitude revealed that the coefficient on imported beef was greater, which suggested that consumers who were more willing to accept risk in beef were more likely to purchase imported beef. On average, consumers who were most willing to accept risk from consuming beef were willing to pay $0.63/lb and $0.42/lb more for Australian and Canadian beef per unit of average-sum score in willingness to accept risk.

Further, a significant relation existed between perceived safety level of beef from a given country and the likelihood of purchasing beef from that given country. As a reminder, "no opinion" was the base case. Consumers who gave a "very low" rating to Australian and Canadian beef were less likely to purchase imported beef from these countries; the average differences between WTP for a rating of "no opinion" and a rating of "very low" were -$4.84/lb and -$3.90/lb for Australian and Canadian beef. However, purchase likelihood was statistically indistinguishable between consumers who gave a rating of "no opinion" and those who gave a rating of "low" for Australian and Canadian beef. Not surprisingly, consumers who rated the imported beef as "moderate," "high" or "very high" in food safety rating were more likely to purchase the imported beef. The coefficient on the interaction effects between U.S. beef and a very low safety rating on U.S. beef (*USA* Very Low*) was statistically insignificant, however, all other interaction

coefficients of U.S. beef and perceived safety level of U.S. beef were positive and statistically significant.

The advantage of U.S. beef over imported beef was reflected by the coefficients associated with the interaction effect of country of origin and risk perception of beef from the given country of origin. First, significantly fewer respondents gave ratings of "no opinion" for U.S. beef than for the imported beef; only 11% of the respondents rated "no opinion" compared to more than 30% of the respondents for Australian and Canadian beef. Second, the penalty was greater for imported beef than for domestic beef when consumers were unfamiliar or displeased with the safety of beef associated with a country of origin. We observed negative WTP for Australian and Canadian beef for a rating a "very low" in safety, but the similar WTP estimates for U.S. beef was statistically insignificant; similarly, the WTP for Australian and Canadian beef were statistically insignificant for a rating of "low" in safety, however, the similar WTP estimates for U.S. beef were positive.

Consumers who are more proactive in managing food risk were generally less likely to choose imported beef, as indicated by negative coefficients on *AUS*CONT* and *CAN*CONT*. Consumers were willing to pay $0.86/lb and $0.72/lb less for each increment in their rating of control over food safety. Conversely, consumers who perceived food risk was transmitted from handling by other parties in the food chain were less likely to purchase beef. However, these consumers were more likely to purchase U.S. beef than imported beef judging by the magnitude of the coefficients, where coefficients on *AUS*FC* and *CAN*FC* were smaller than *USA*FC*. Consumers were willing to pay

$0.47/lb and $0.18/lb less for Australian and Canadian beef than U.S. beef per increment in rating of perceived influence of food chain over food safety.

Lastly, examining the demographic interaction terms suggested that older consumers were less likely to purchase imported beef. The same trend that older consumers tended to prefer domestic beef was also observed in Loureiro and Umberger (2007) and Tonsor et al. (2009). Less educated consumers tended to prefer U.S. beef. Moreover, income effects were found for Australian and U.S. beef, but not for Canadian beef.

To illustrate the impact of perceived risk on consumer demand, we calculated total willingness to pay for Australian and Canada beefsteak in comparison to U.S. beefsteak based on the estimates from the mixed error-component logit model. These estimates were produced with Krinsky and Robb simulation with 5,000 repetitions and are presented in Table 4.6. An infinite number of profiles could be calculated based on different demographic and risk profiles. To be concise, we considered two risk profiles, and the demographic profiles were assumed as 40 years of age, 12 years of education, and $52,000 of household income. The perceived knowledge about food safety and perceived personal control over food safety and perceived control of food safety by the food chain were set to values of three.

The first risk profile reflected a person with low perceived risk, this person perceived little risk in beef products (RP = 1), was generally willing to accept risk from eating beef (RA = 5), and perceived that both domestic and imported beef were very safe. This consumer was willing to pay $4.52/lb and $3.42/lb less, respectively, for Australian and Canadian beefsteak as compared to domestic beefsteak. The second person perceived

higher risk in beef products (*RP* = 5), was not willing to accept risk from eating beef (*RA* = 1), and perceived beef from imported and domestic source as very low in safety. The model estimated that the person with higher perceived risk was willing to pay $14.53/lb and $11.08/lb less, respectively, for Australian and Canadian beefsteak than domestic beefsteak. These WTP estimates suggested that consumers with higher perceived risk were much less likely to purchase imported beef than consumers with lower perceived risk when given the choice.

4.6 Conclusion and Discussion

The mandatory Country of Origin Labeling regulation is worrisome to many food exporters to the U.S. This study focuses on the underlying reasoning for consumers' aversion to imported beef through a perceived risk framework, which disentangles perceived risk into risk perception and risk attitude. The nature of consumers' concerns dictates the effectiveness of instruments developed by policy makers and industry (Schroeder et al. 2007). Our model revealed strong correlations between consumers' WTP for imported beef and perceived risk. Several important marketing implications can be made based on the results.

First, consumers who were concerned about safety of beef and were not willing to accept risk from eating beef generally prefer U.S. beef. We found that consumers' risk perceptions on beef correlated negatively to preferences for imported beef. Further, consumers' risk attitudes correlated positively with consumers' willingness to choose imported beef. However, more than 40% of the sample believed eating beef posed little or very little risk and more than 50% of the sample appeared to be willing or very willing to accept the risks from eating beef; this suggested that most U.S. consumers would still

be willing to consume imported beef even it was considered inferior to domestic products.

More importantly, our results points to a potential discrepancy between real and perceived food risks for imported beef. Although no scientific evidence suggests that imported beef is less safe than U.S. beef, about one-third of the sample professed that they had no opinion about the safety of imported beef, which reflected consumers' unfamiliarity and uncertainty about the risk level associated with imported beef. Our model suggested that consumers were willing to pay significantly less when they were uncertain or unfamiliar with about the safety of imported beef. Evidence from our study suggested that consumers' risk perception of imported beef might be misaligned with real food risks. Using Australian beef as an example, most Australian beef is grass-fed, which could in turn translate into a lower incident of BSE and E.coli contamination (Nathanson et al 1997; Russell et al 2000). However, we observed that 14% of the respondents perceived Australian beef as unsafe and 35% responded they had no opinion about the safety of Australian beef.

In summary, findings from our study suggested that beef exporters to the U.S. could benefit from risk communication campaigns. There is no scientific evidence that suggest imported beef from Australia or Canada is less safe than domestic beef. Foreign policy makers could help imported beef gain market share by a concerted effort on risk communication. By risk communication, we mean that the exporting countries' government or firms could provide credible assessment and assurance of food-safety risks in their products. Imported beef could look to the success of New Zealand lamb on establishing a successful brand based on country of origin (Clemens and Babcock 2004).

Establishing a higher collective reputation, either in terms of lower food-safety riskss or differentiation in eating quality, seems to be a viable strategy for imported beef.

Table 4.1. Perceived Risk Statistics

	1	2	3	4	5	Mean	Std. Dev
	(%)	(%)	(%)	(%)	(%)		
Risk Perception Statements							
When eating beef, I am exposed to … (1=very little risk … 5=a great deal of risk)	17.90	26.44	38.22	12.99	4.45	2.60	1.06
I think eating beef is risky (1=strongly disagree … 5=strongly agree)	22.63	28.94	32.1	11.04	5.29	2.47	1.11
For me, eating beef is … (1=not risky … 5=risky)	21.71	27.18	33.3	12.8	5.01	2.52	1.11
Average Sum Score						2.53	
Risk Attitude Statements							
I accept the risks of eating beef (1=strongly disagree … 5=strongly agree)	5.47	8.44	29.13	35.16	21.8	3.59	1.08
For me, eating beef is worth the risk (1=strongly disagree … 5=strongly agree)	6.49	10.39	31.91	29.78	21.43	3.49	1.13
I am … the risk of eating beef (1=not willing to accept … 5=willing to accept)	6.12	8.72	30.06	32.93	22.17	3.56	1.11
Average Sum Score						3.55	
Knowledge and Control Statements							
How much knowledge do you think you personally have about the safety of food? [1=insignificant, … , 5=a great deal]	3.71	16.31	30.12	39.39	10.47	3.37	1.00
The safety of food products is mainly influenced by parties in the food chain other than myself [1=strongly disagree, … , 5=strongly agree]	2.13	4.91	27.43	46.62	18.91	3.75	0.89

Table 4.1. Continue from previous page

How much control do you think you personally have over the safety of food? 1=[insignificant, … , 5=a great deal]	5.75	18.26	38.18	30.95	6.86	3.15	0.99

Risk Perception by Country of Origin

Whether you have ever knowingly purchased beef produced in another country or not, what is your perception of the level of food safety of beef by country of origin?

	Australia (%)	Canada (%)	USA (%)
Very Low	6.21	4.82	4.26
Low	8.06	7.14	6.02
Moderate	23.54	24.93	19.56
High	18.91	20.85	32.16
Very High	8.62	11.77	27.15
No Opinion	34.66	30.49	10.84

Table 4.2. Conditional Logit Model Estimation Result

Main Effects Coefficients								
Would-Not-Buy	-0.5920	**	BSE	0.9294	***	TENDER	0.6906	***
	(0.2824)			(0.0436)			(0.0290)	
AUS	-1.3756	***	TRACE	0.9540	***	NAT	0.0293	
	(0.3873)			(0.0436)			(0.0295)	
CAN	-0.5193		BSE_TRC	1.3741	***	PRICE	-0.1670	***
	(0.3689)			(0.0432)			(0.0040)	
Risk Perception Interaction Terms								
AUS*RP	-0.0639	*	CAN*RP	-0.0422		USA*RP	-0.0312	
	(0.0339)			(0.0326)			(0.0295)	
AUS*RA	0.3924	***	CAN*RA	0.3157	***	USA*RA	0.2875	***
	(0.0346)			(0.0324)			(0.0293)	
AUS*CONT	-0.1075	***	CAN*CONT	-0.1301	***	USA*CONT	-0.0249	
	(0.0316)			(0.0298)			(0.0275)	
AUS*FC	-0.1095	***	CAN*FC	-0.1007	***	USA*FC	-0.0839	***
	(0.0331)			(0.0319)			(0.0292)	
AUS*KNOW	-0.0018		CAN*KNOW	-0.0208		USA*KNOW	-0.0209	
	(0.0312)			(0.0295)			(0.0270)	
Country Specific Perceived Risk Interaction Terms								
AUS* Very Low	-0.9009	***	CAN* Very Low	-0.6531	***	USA* Very Low	0.4241	***
	(0.1528)			(0.1519)			(0.1431)	
AUS* Low	-0.2141	*	CAN* Low	0.1808		USA* Low	0.4235	***
	(0.1210)			(0.1172)			(0.1262)	
AUS* Moderate	0.3484	***	CAN* Moderate	0.4361	***	USA* Moderate	0.4724	***
	(0.0759)			(0.0749)			(0.0951)	
AUS* High	0.7746	***	CAN* High	0.6758	***	USA* High	0.5743	***
	(0.0806)			(0.0784)			(0.0892)	

Table 4.2. Continue from previous page

AUS* Very High	0.8432	***	CAN* Very High	0.8995	***	USA* Very High	0.8472	***
	(0.1078)			(0.0953)			(0.0930)	
Demographic Interaction Terms								
AUS*AGE	-0.0184	***	CAN*AGE	-0.0209	***	USA*AGE	-0.0095	***
	(0.0021)			(0.0020)			(0.0018)	
AUS*EDU	0.0414	***	CAN*EDU	0.0403	***	USA*EDU	-0.0258	**
	(0.0144)			(0.0138)			(0.0126)	
AUS*INC	0.0044	***	CAN*INC	0.0004		USA*INC	0.0031	***
	(0.0010)			(0.0010)			(0.0009)	
McFadden R2				0.1794				
Log likelihood function				-13142.65				
AIC				26381.3				

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels.

Table 4.3. Estimation Result of the Mixed Logit Model with Error Component Structure

Main Effects Coefficient			Diagonal Values of Cholesky Matrix					
Would-Not-Buy	-2.0934	**	Would-Not-Buy	1.5054	***			
	(0.8374)			(0.1172)				
AUS	-1.8870	**	AUS	1.3302	***			
	(0.7977)			(0.0885)				
CAN	-1.0488		CAN	0.4351	***			
	(0.6567)			(0.0811)				
BSE	1.3653	***	BSE	1.1846	***			
	(0.0742)			(0.0848)				
TRACE	1.4633	***	TRACE	0.1563				
	(0.0771)			(0.1127)				
BSE_TRC	2.0223	***	BSE_TRC	0.0290				
	(0.0855)			(0.0932)				
TENDER	1.0471	***	TENDER	0.1141				
	(0.0508)			(0.0886)				
NAT	0.0427		NAT	0.3146	***			
	(0.0493)			(0.0783)				
PRICE	-0.2579	***						
	(0.0040)							
Risk Perception Interaction Terms								
AUS*RP	-0.2461	***	CAN*RP	-0.1496	*	USA*RP	-0.0745	
	(0.0807)			(0.0833)			(0.0869)	
AUS*RA	0.7501	***	CAN*RA	0.6936	***	USA*RA	0.5849	***
	(0.0803)			(0.0836)			(0.0830)	
AUS*CONT	-0.2207	***	CAN*CONT	-0.1853	**	USA*CONT	-0.0361	
	(0.0820)			(0.0793)			(0.0790)	
AUS*FC	-0.3952	***	CAN*FC	-0.3186	***	USA*FC	-0.2723	***
	(0.0838)			(0.0836)			(0.0830)	
AUS*KNOW	0.0802		CAN*KNOW	0.0045		USA*KNOW	-0.0202	
	(0.0807)			(0.0794)			(0.0791)	

Table 4.3. Continue from previous page

Country Specific Perceived Risk Interaction Terms								
AUS*Very Low	-1.2409 (0.2805)	***	CAN*Very Low	-1.0032 (0.2223)	***	USA*Very Low	0.4111 (0.2942)	
AUS*Low	-0.2553 (0.2104)		CAN*Low	0.0525 (0.1688)		USA*Low	0.4905 (0.2960)	*
AUS*Moderate	0.5907 (0.1489)	***	CAN*Moderate	0.4780 (0.1351)	***	USA*Moderate	0.6672 (0.2302)	***
AUS*High	1.0289 (0.1681)	***	CAN*High	0.8276 (0.1467)	***	USA*High	0.5369 (0.2196)	**
AUS*Very High	0.7155 (0.2088)	***	CAN*Very High	0.8901 (0.1968)	***	USA*Very High	1.0559 (0.2233)	***
Demographic Interaction Terms								
AUS*AGE	-0.0315 (0.0051)	***	CAN*AGE	-0.0327 (0.0050)	***	USA*AGE	-0.0177 (0.0053)	***
AUS*EDU	0.0514 (0.0369)		CAN*EDU	0.0247 (0.0348)		USA*EDU	-0.0648 (0.0380)	*
AUS*INC	0.0050 (0.0026)	*	CAN*INC	0.0030 (0.0025)		USA*INC	0.0046 (0.0026)	*
Standard Deviation of Error Component			2.5786 (0.0838)	***				
McFadden R2			0.3550					
Log likelihood function			-10423.68					
AIC			21017.4					

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels
Results produced with NLOGIT 4.0, 150 Halton Draws

Table 4.4. Cholesky Matrix

	WOULD-NOT-BUY		AUS		CAN		BSE		TRACE		BSE_TRC		TENDER		NAT	
WOULD-NOT-BUY	1.51	***														
	(0.12)															
AUS	1.18	***	1.33	***												
	(0.10)		(0.09)													
CAN	0.86	***	-0.99	***	0.44	***										
	(0.08)		(0.08)		(0.08)											
BSE	0.47	***	-0.03		-0.04		1.18	***								
	(0.10)		(0.09)		(0.12)		(0.08)									
TRACE	1.04	***	0.67	***	-0.02		-0.70	***	0.16							
	(0.10)		(0.09)		(0.11)		(0.09)		(0.11)							
BSE_TRC	0.82	***	0.59	***	-0.04		-1.50	***	-0.11		0.03					
	(0.11)		(0.10)		(0.12)		(0.09)		(0.11)		(0.09)					
TENDER	0.34	***	0.39	***	-0.25	***	-0.11		-0.39	***	0.55	***	0.11			
	(0.07)		(0.06)		(0.09)		(0.07)		(0.09)		(0.07)		(0.09)			
NAT	0.32	***	0.04		-0.20	**	0.03		-0.08		-0.47	***	0.41	***	0.31	***
	(0.07)		(0.07)		(0.09)		(0.07)		(0.09)		(0.07)		(0.09)		(0.08)	

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels

Table 4.5. Marginal Willingness-to-Pay Estimates

	$/lb			$/lb			$/lb	
Marginal WTP estimates for Perceived Risk								
AUS*RA	2.90	***	CAN*RA	2.69	***	USA*RA	2.28	***
	(0.31)			(0.32)			(0.32)	
AUS*RP	-0.95	***	CAN*RP	-0.57	*	USA*RP	-0.28	
	(0.32)			(0.32)			(0.33)	
AUS*CONT	-0.86	***	CAN*CONT	-0.73	**	USA*CONT	-0.15	
	(0.32)			(0.31)			(0.31)	
AUS*FC	-1.54	***	CAN*FC	-1.24	***	USA*FC	-1.06	***
	(0.32)			(0.32)			(0.32)	
AUS*KNOW	0.32		CAN*KNOW	0.02		USA*KNOW	-0.08	
	(0.32)			(0.31)			(0.31)	
Marginal WTP estimates for Country-of-Origin Specific Risk Perception								
AUS* Very Low	-4.80	***	CAN* Very Low	-3.88	***	USA* Very Low	1.60	
	(1.08)			(0.86)			(1.14)	
AUS* Low	-0.99			0.21		USA* Low	1.91	*
	(0.81)		CAN* Low	(0.66)			(1.14)	
AUS* Moderate	2.28	***	CAN* Moderate	1.86	***	USA* Moderate	2.59	***
	(0.58)			(0.52)			(0.90)	
AUS* High	4.00	***		3.23	***	USA* High	2.09	**
	(0.65)		CAN* High	(0.57)			(0.86)	
AUS* Very High	2.77	***	CAN* Very High	3.44	***	USA* Very High	4.10	***
	(0.79)			(0.76)			(0.87)	

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels
Results produced with NLOGIT 4.0, 5,000 Krinsky and Robb Simulations

Table 4.6. Total Willingness to Pay for Selected Consumer Profiles

	Australian Beef		Canadian Beef	
	$/lb		$/lb	
Low Perceived Risk RP = 1, RA = 5, "Very High" risk perception on beef from AUS, USA & CAN	-4.52 (1.17)	** *	-3.42 (1.01)	** *
High Perceived Risk RP = 5, RA = 1, "Very Low" risk perception on beef from AUS, USA & CAN	-14.53 (1.66)	** *	-11.08 (1.48)	** *
Assumed profile characteristics: Age = 40, Education = 12 years, Income = $52,000, KNOW = 3, CONTROL = 3, FC = 3				

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels
Results produced with NLOGIT 4.0, 5,000 Krinsky and Robb Simulations

Chapter 5 Stated Preference and Perception Analysis for Traceable and BSE-tested Beef

5.1 Introduction

Recent studies showed that marketing potential for BSE-tested and traceable beef might exist (Abidoye et al. 2011; Bailey et al. 2005; Dickinson and Bailey 2002, 2005; Loureiro and Umberger 2007). The studies that showed consumers' willingness to pay(WTP) is an important first step, because willingness to pay is a necessary condition for adoption of a potentially costly attribute.,Agribusiness and policy makers can benefit from understanding why consumers are willing to pay for such attribute. Despite decent coverage of WTP studies on BSE-tested and traceability, the underlying intention for consumers to willing to pay for these attributes remains relatively unexplored.

Food safety issues about beef have been a recurring concern for many American consumers. Beef consumption is susceptible to multiple food borne diseases. In particular, periodical outbreaks of BSE cases propagate consumers' concerns, which were documented to disrupt consumption in some cases. The perceived risk framework has been applied to explain disruption in consumption (Pennings et al. 2002; Schroeder et al. 2007). Adaptation of the perceived risk framework could be promising in unveiling the reasons why consumers are willing to pay for the food-safety attributes.

In this study, we conducted a choice experiment to elicit consumer willingness to pay for BSE-tested and traceable beef. We adopted the perceived risk framework suggested by Pennings et al 2002 to explore the relation between consumer perceived risk and WTP for these food-safety attributes. Our results revealed that risk perception, risk attitude, BSE-

concern, and perceived level of control agribusiness has over food safety significantly influenced WTP for traceable and BSE-tested beef.

5.2 Literature Review

Consumers face inherent uncertainty from eating food, as the multitude of food-borne disease are not easily detected by human senses (Buzby et al. 1998). Further, mounting evidence now suggests that consumers are motivated by perceived risk, rather than the actual probability of risk itself (Slovic 1987; Starr 1969). Pennings et al. (2002) suggested that perceived risk could be disintegrated into risk perception and risk attitude, namely, the probability of suffering negative consequences from consuming a product and the willingness of an individual to accept risks from consuming a product. Scrutinizing the WTP for traceability in the light of perceived risk could provide useful information to marketers and policy makers on the implications of implementing traceability. Schroeder et al. (2007) argued that the decision makers' optimal response could depend on whether risk perception or risk attitude is the dominant factor; namely if consumers perceived higher risk than the actual risks presence, then effective risk communications could eliminate such discrepancy. However, if the driver was risk aversion, then high levels of food-safety assurance could be the only instrument. Since traceability conceivably influence consumers' perceived risk, it could be an effective risk management tool in handling both effects from risk perceptions and from risk attitudes.

Beef traceability is often discussed in conjunction with BSE (Bailey et al. 2005; Golan et al. 2004). Souza-Monteiro and Caswell (2004) suggested that traceability could enhance ability of food-safety agencies to identify hazard source following a BSE outbreak. Traceability does not directly reduce food risk per se. However, it indirectly mitigates

food risks by providing necessary information to hold offending food producers liable for introducing food hazards. This creates incentives for food producers to implement measures that encourage food safety, and cultivates a proactive attitude towards prevention and identification of food safety hazards (Souza-Monteiro and Caswell, 2004). Implementation of traceability could increase consumer confidence through reduction of consumers perceived risk, which could manifest in a form additional WTP.

A number of studies have investigated consumer WTP for traceability for various food types. Dickinson and Bailey (2002) conducted an experimental auction on meat sandwiches, they found a sizable price premium on meat sandwiches with traceability feature. However, the participants of the experiment were either university students or employees, thus attracting the question about the samples' representativeness.

Abidoye et al. (2011) conducted a national online choice experiment on consumer preferences for traceable beefsteak. They examined three types of traceable beef of varying depth—traceable to birth / feedlot / or processing plant only. Again, Abidoye et al. (2011) reported significant and positive WTP for traceable beef; however, their experiment design omitted the no traceability level, which impeded the ability of the study to measure the difference in WTP between not-traceable and traceable beef. Further, none of these studies addressed why consumers were willing to pay for traceability in beef.

Loureiro and Umberger (2007) also conducted a choice experiment that studied traceable beefsteak, which indicated a positive WTP for traceable beef. However, they claimed their model did not detect unobserved taste heterogeneity on consumers' preference for

traceable beef, which is unrealistic suggesting that the premium for traceable beef is universally applicable for all U.S. consumers.

A limited number of studies have investigated WTP for BSE-tested beef. McCluskey et al. (2005) investigated the Japanese consumers WTP for BSE-tested beef with a contingent valuation model; they found an average price premium of over 50%. They also found that the WTP is correlated to consumers' attitude about importance of food safety, whether they have reduced beef consumption as a result of BSE, and with gender. On American consumers, Bailey et al. (2005) performed an intercept survey on shoppers from Utah and Idaho, they found that 72% of the respondent stated they would be willing to pay 5% more for BSE-tested beef. The choice experiment in this study can serve to enhance understanding on consumers' WTP for BSE-tested beef by a mean to verify the robustness of the estimated WTP in the two previous studies, and by unveiling underlying factors that motivates the WTP for BSE-tested beef.

5.3 Perceived Risk Statistics

We measured perceived risk with psychometric measurements. These measurements were grouped into two categories. The first were consumer risk perception and risk attitude for beef products, which were product-class measurements for inherent risk (Mitchell 1999). The next two were statements inquiring about the extent of concern respondents have towards BSE, and the extent they think farmers, processors and retailers have influence over food safety.

Consumers' risk perceptions and risk attitudes were captured using the adaptation of scaling procedure proposed in Pennings et al (2002). These scales were developed to

mirror as closely as possible the Pratt and Arrow framework (Pennings et al. 2002). The distribution and statements used are described in Table 5.1. Note that the risk perception ratings has been recoded, such that 1 reflects very risky and 5 reflects very little risk. This is to allow consistent interpretation of the interaction terms between risk perception and risk attitude, such that a low score indicate unwillingness to accept the risk and perceived high risk in beef, and a high score reflect willingness to accept the risk and perceived low risk in beef.

Using a rating of three as a position of neutral, it appears that most American consumers believed that eating beef poses a minimal risk based on the observed average sum score of 3.47. A closer look reveals that fewer than 20% of the respondents stated that eating beef was risky and fewer than half of the respondents perceived beef as a low-risk food. From the risk attitude statements, most American consumers were not risk averse towards the risk from eating beef. More than half responded with ratings of 1 and 2, and fewer than 20% responded that they were not willing to accept risks from eating beef. These results compared closely to those in Pennings et al. (2002) and Schroeder et al. (2007).

The respondents were asked about the extent they were concern about BSE risk in beef, which could be transmitted and developed as vCJD in human -- a fatal and cureless neurological disease. Concerns about BSE (or vCJD) are dichotomous, where 35% of the sample are not concerned and have little concern about the disease. Conversely, about 30% of the respondents are highly or extremely concerned about the disease.

About 65% of the respondent thought safety of food products is influence not by themselves but intermediaries in the food chain, such as farmers, processors and retailers;

this perhaps points to, respondents perceived food risk is involuntarily imposed upon them.

5.4 Econometric Model

We present a model for consumer preferences for BSE-tested and traceable beef, and account for the relationship between preference for the attributes and perceived risk. Consumer utility associated with the attributes examined in the choice experiment is formally represented in a Random Utility Model, such that:

$$\boldsymbol{U}_{njt} = \begin{cases} \propto_n price_{n1t} + \boldsymbol{\beta}_n{}'\boldsymbol{x}_{n1t} + \boldsymbol{\delta}_n'\mathbf{d}_{n1t} + \mu_n z_{n1t} + \varepsilon_{n1t} & , if\ j = 1 \\ \propto_n price_{n2t} + \boldsymbol{\beta}_n{}'\boldsymbol{x}_{n2t} + \boldsymbol{\delta}_n'\mathbf{d}_{n2t} + \mu_n z_{n2t} + \varepsilon_{n2t} & , if\ j = 2 \\ \boldsymbol{\beta}_n{}'\boldsymbol{x}_{n3t} + \varepsilon_{n3t} & , if\ j = 3 \end{cases} \quad \textbf{(5.1)}$$

where subscript *n* corresponds to individual, *j* corresponds to alternative (*j*=1, 2, and 3) and *t* corresponds to choice sets. The price coefficient α is specified as a fixed parameter rather than a random parameter to avoid unrealistic welfare measures associated with a random price parameter (Meijer and Rouwendal 2006; Olsen 2009). The 8 × 1 vector random coefficient $\boldsymbol{\beta_n}$ captured taste heterogeneity associated with attributes in the vector **x**. The elements vector **x** describe alternatives given in the choice set with a series of dummy variables:

$$\mathbf{x}_{njt} = [WOULD - NOT - BUY, AUS, CAN, BSE, TRACE, BSE * TRC, TENDER, NATURAL] \quad \textbf{(5.2)}$$

The variables in **x** correspond to attributes in the choice experiment as described in Table 1.1. The base cases are *USA* origin labeling, *APPROVED STANDARDS* in production practices, *NONE* in food-safety assurance and *NOT SPECIFIED* in tenderness assurance.

WOULD-NOT-BUY, *TRACE*, *BSE*, and *BSE_TRC* are interacted with the key variables: risk attitude (*RA*), risk perception (*RP*), the interacted term between risk perception and risk attitude (*RA***RP*), concern about BSE (*BSECONCERN*), and belief that others in the food chain influence food safety (*FC*). Age, education level and income level were also interacted with *TRACE*, *BSE*, and *BSE_TRC* to reveal the demographic characteristics of the consumers. As consumers may shy away from consuming beef when RA or RP is high, we interacted *WOULD-NOT-BUY* with the perceived risk variables since omitting these terms could result in omitted variable bias, where the effects from RA and RP resulted in non-consumption of the product spill over to the coefficients associated with the food-safety attributes.

These interaction terms are collectively represented by the vector $\mathbf{d}_n$. The product of coefficient vector $\boldsymbol{\delta}_n$ and $\mathbf{d}_n$ accounts for the contribution of these interaction terms to the utility function. Although other interaction terms not included may have significant impacts on the utility, we limit the model to the interaction effects between the food-safety attributes examined to be concise to the focus of this paper.

Two separate components comprised the error term in the utility function. First, $\boldsymbol{\varepsilon}_{nt}$ is assumed iid and distributed as a standard maximum extreme value type I distribution as in a conditional logit model. The second error term, $\boldsymbol{\mu}'_n\mathbf{z}_{nt}$, corresponds to the error component, which captures correlation between the two non-empty alternatives (the first two alternatives in each choice set). We specify the 3×1 vector $\mathbf{z}_{nt}$ to be equal to [1, 1, 0] to reflect the correlation structure in individuals' decision-making process (Scarpa et al. 2008) .The random coefficient $\boldsymbol{\mu}_n$ is assumed to be independently normally distributed:

$\boldsymbol{\mu}_n$~N(0, σ) (Train 2003),where σ, the additional parameter to be estimated, is the covariate between alternative 1 and 2.

$$\boldsymbol{\beta}_n \sim \mathrm{F}(\boldsymbol{\theta}_0, \boldsymbol{\Omega}_n) \quad \textbf{(5.3)}$$

Analysts are free to choose any appropriate mixing distributions that reflect behavior of the subject (Train 2003). As there is no prior theory to suggest any particular form of distribution is associated with the random variables in this study, all random coefficients in this study are specified as normally distributed.

5.5 Results

The results of a conditional logit model of identical specification and the mixed logit model and results were included in Table 5.2 and Table 5.3 respectively. Comparing the log-likelihood score between the two models indicated a large improvement in goodness-of-fit on the mixed logit model. The efficiency improvement of the Mixed Logit Model could be attributed to the inclusion of unobserved taste heterogeneity, as evident by multiple significant estimated standard deviation values for the random coefficient; in addition to the error component structure reflected by the significant estimated value of the standard deviation of the error component.

As the random coefficients are specified to be correlated, we used the diagonal values of the Cholesky matrix which indicates presence of unobserved taste heterogeneity (Hensher et al. 2005). The statistically significant diagonal values on TRC, BSE points to diverse consumers' preferences for traceable and BSE-tested beef.

Although ceteris paribus interpretation is feasible in a mixed logit model setting, we presented the interpretation of the results in the more meaningful form of marginal

willingness to pay. To account for non-linearity, the WTP estimates and standard errors were produced with Krinsky and Robb Simulation with 5000 replications specified (Hensher and Greene 2003). Table 5.4 presents the WTP estimates.

First, we examined the marginal WTP for *TRACE*, *BSE*, and *BSE_TRC* attributed to consumers concern about BSE. Concern about BSE has a positive and statistically significant impact for the WTP of these food-safety attributes. On average, a single point increase in concern about BSE, for example, from "not concerned at all" to "minor concern" raised the WTP by $1.10/lb, $1.22/lb and $1.60/lb for TRC, BSE, and BSE_TRC respectively. These are evidence that consumers seek to alleviate BSE concerns with traceability and BSE-tested beef.

We then examine the marginal WTP that correlates with the variable FC, which reflects WTP that attribute to consumers feeling that others in the food chain determine food safety. On average, a unit increment in FC resulted in $0.52/lb, $0.66/lb and $0.91/lb extra in WTP for TRACE, BSE-Tested and BSE_TRC beef.

Next, we turn to marginal WTP for the added food-safety features attributed to risk perception and risk attitude. These estimates reflect changes in WTP for the attributes resulting from one-unit change in either risk attitude or risk perception. As interaction terms between risk perception and risk attitude were included in the model, the appropriate marginal WTP estimated is calculated as:

$$WTP_{att*RP} = -\frac{\beta_{att*RP} + \beta_{att*RP*RA} * RA}{\beta_{price}} \quad \textbf{(5.4)}$$

$$WTP_{att*RA} = -\frac{\beta_{att*RA} + \beta_{att*RP*RA} * RP}{\beta_{price}}$$

from equation (4), the marginal willingness to pay due to risk perception is a function of risk attitude, and vice versa, the marginal willingness to pay due to risk attitude is a function of risk perception. For this reason, marginal willingness to pay due to risk perception are calculated with varying levels of risk attitude, and marginal willingness to pay due to risk attitude are also calculated with varying levels of risk perception.

5.5.1 Marginal WTP associated with Risk Attitude

The marginal WTP for risk attitude represents the changes in WTP for traceable and BSE-tested beef accompanied by a unit change in risk aversion, i.e. increase or decrease in WTP for the attributes when consumers become less risk averse.

For traceable beef, consumer who perceived beef as very low risk (RP = 1) are willing to pay $1.02 less, as each unit increment on risk aversion. In other words, as consumers become more averse to risk from consuming beef, consumers who perceived beef as safe are willing to pay less for traceable beef. Consumers with high-risk perception for beef showed no significant relationship between risk attitude and WTP for traceable beef.

In contrast, for BSE-tested beef, for each unit increment in consumers' risk aversion about consuming beef, consumers who perceived beef as risky (RP = 3, 4, 5) are willing to pay more for BSE-tested beef. Changes in risk attitude have no statistically significant impact on the WTP of low risk perception consumers.

Finally, for beef marketed with both traceability and BSE testing, significant negative marginal WTP were found for consumers who perceived beef as very low risk (RP=1) and very risky (RP=5). Respectively, consumers who perceived beef as very low risk

(RP=1) were WTP $1.02/lb less for the beef as they become more risk averse; Consumers who perceived beef as very risky (RP=5) were WTP $1.40/lb more for the beef as they become more risk averse.

5.5.2 Marginal WTP associated with Risk Perception

We examine the effect from a one-unit change in risk perception to consumers' WTP for traceable and BSE-tested beef. The marginal WTP for risk perception measures changes in WTP for traceable and BSE-tested beef, in response to a one unit increment in risk perception.

We observed that consumers who are most risk averse (RA = 5) were WTP $1.29/lb more for traceable beef on average. However, no statistically significant impact was observed on consumers in lower risk aversion group.

For BSE-tested beef, increasing risk perception results in $1.25/lb and $0.74/lb less in WTP for consumers who are less risk averse (RA = 1 or 2). Nonetheless, the impact is statistically indistinct from zero for consumers in higher risk aversion groups.

Lastly, for traceable and BSE-tested beef, consumers who claimed higher risk aversion (RP = 3, 4, or 5) are willing to pay more for the beef with a unit increment in risk perception. The marginal WTP was measured at 0.66/lb, $1.27/lb and $1.88/lb for risk perceptions of 3, 4, and 5 respectively.

5.5.3 Estimates of Total WTP

The total WTP compare WTP for beef with and without the added food-safety attributes beef. Total WTP is calculated as:

$$\mathrm{WTP}_{att} = -\left(\frac{\beta_{att} + \beta_{att*RP} \times RP + \beta_{att*RA} \times RA + \beta_{att*RP*RA} \times RA \times RP}{\beta_{price}} + \frac{\boldsymbol{\beta}_{att*dem} \times \mathbf{dem}}{\beta_{price}}\right) \quad \textbf{(5.5)}$$

$$\mathbf{dem} = [age, education, income]$$

An infinite number of total WTP could be calculated based on various combinations of demographic and risk profiles. To simplify, a profile of a typical middleclass American was adopted, the demographic variables are set at 40 years of age, 14 years of education and household income of $52,000. Total WTP of all (5 by 5) twenty five risk profiles were calculated. Table 5.5 presents the estimates of total WTP.

The model estimated that a wide range of WTP for the attributes, which strongly points to a significant influence of risk perception and risk attitude on consumers' WTP for the attributes. The WTP for traceable beef ranged from $1.76/lb to $6.85/lb, the WTP for BSE-tested beef ranged from $0.73/lb to $7.12/lb, and the WTP for BSE_TRC ranged from $3.99/lb to $11.41/lb. As most combinations of profiles exhibit positive and statistically significant WTP, these findings strongly suggest that premiums exist for traceable beef and BSE-tested beef.

However, the premium could diminish with the number of food-safety attributes added, as the WTP for the features combined were lower than the aggregate of the two features marketed individually, which is in line with findings from Gao and Schroeder (2009).

The inclusion of interaction terms between risk attitude and risk perception (RA*RP) allowed the model to uncover a rich set of consumer behaviors. Consistent trends were observed throughout the WTP for the three attributes. First, low risk averse (RA=1)

consumers' WTP decreased as they perceived more risk in eating beef, while the WTP remained positive in most cases. Second, risk-averse (RA=5) consumers are willing to pay more for these food-safety features as their risk perception about eating beef becomes higher. This may suggest that consumers with low risk aversion are not confident that these food-safety attributes mitigate risk if consuming beef is risky. Conversely, consumers who are risk averse are more likely to be using the food-safety features as a tool to increase their confidence and afford extra food-safety in beef consumption.

From a different angle, among consumers who think beef is relatively safe (RP=1), the WTP decreases as risk aversion rises. This suggests that the food-safety attributes do not serve to counterbalance consumer's lack of willingness to accept the risks from eating beef. Further, this may reflect consumers' belief that a scarce budget allocated to food-safety attributes could be better spent elsewhere than on beef traceability, BSE testing or both. In contrast, among consumers who perceived beef as risky (RP=5), their WTP increases as risk aversion increases. This may reflect that consumers who perceived beef to be risky, believe that the food-safety attributes may help to counteract the risks from eating beef. In summary, a strong marketing potential for traceable and BSE-tested beef exists among consumers who are risk averse and perceive beef as risky.

5.6 Conclusion

We investigated the underlying reasons for WTP for BSE testing and traceability by linking consumers WTP for these attributes with perceived risks adapted from the psychometric framework in Pennings et al (2002). Our results showed that consumers are willing to pay a premium for traceable and BSE-tested beef. We also found that concerns about BSE, the perceived influence of food manufacturer/ retailers over food safety, risk

perception, and risk attitude were factors that influence consumers' WTP for traceable and BSE-tested beef. In particular, we found that consumers who perceived beef as high in risk and who were unwilling to accept the risks from eating beef showed strong WTP for the attributes.

The finding of positive consumers' demand for traceable and BSE-tested beef leads to more unanswered policy questions and opportunities for future research. Given that both traceable and BSE-tested beef are relatively uncommon in the present market, it is not clear how much consumers understood the functioned validity of traceability and BSE-tested beef. For example, it is not clear whether consumers would trust a voluntary traceable system designed and maintained by agribusinesses or third parties as much as a mandatory traceable system regulated by a government authority. Further, it is not clear that consumers are aware of the inconclusiveness of present BSE testing on cattle aged less than 30 months, which is the dominant beef cattle age from which the majority of fresh and processed beef is produced.

Table 5.1. Psychometric Statements

	1 %	2 %	3 %	4 %	5 %	mean	std dev
Risk Perception Statements							
When eating beef, I am exposed to … (1 = a great deal of risk … 5 = very little risk)	4.45	12.99	38.22	26.44	17.90	3.40	1.06
I think eating beef is risky (1 = strongly agree …5 = strongly disagree)	5.29	11.04	32.10	28.94	22.63	3.52	1.11
For me, eating beef is … (1 = risky … 5 = not risky)	5.01	12.80	33.30	27.18	21.71	3.48	1.11
Average Sum Score						3.47	
Risk Attitude Statements							
I accept the risks of eating beef (1 = strongly disagree … 5 = strongly agree)	5.47	8.44	29.13	35.16	21.80	3.59	1.08
For me, eating beef is worth the risk (1 = strongly disagree … 5 = strongly agree)	6.49	10.39	31.91	29.78	21.43	3.49	1.13
I am … the risk of eating beef (1 = not willing to accept … 5 = willing to accept)	6.12	8.72	30.06	32.93	22.17	3.56	1.11
Average Sum Score						3.55	
To what extent are you concerned about BSE and Creutzfeldt Jakob Disease (vCJD) (1 = not at all … 5 = extremely concerned)	17.61	17.61	34.85	17.98	11.96	2.89	1.24
The safety of food products is mainly influenced by parties in the food chain other than myself [1 = strongly disagree, … , 5 = strongly agree]	2.13	4.91	27.43	46.62	18.91	3.75	0.89

Table 5.2. Conditional Logit Model

Main Effects								
WOULD-NOT-BUY	-1.4572	***	BSE	0.6311		TENDER	0.6882	***
	(0.2586)			(0.3905)			(0.0288)	
AUS	-1.112	***	TRACE	0.5276		NAT	0.025	
	(0.0356)			(0.3915)			(0.0292)	
CAN	-0.8574	***	BSE_TRC	0.5919		PRICE	-0.1657	***
	(0.0340)			(0.3781)			(0.0039)	
Socio-Demographic Interaction								
WOULD-NOT-BUY * BSECONCERN	0.1243	***						
	(0.0315)							
WOULD-NOT-BUY*FC	0.1812	***						
	(0.0397)							
BSE*AGE	-0.009	***	TRACE*AGE	-0.0113	***	BSE_TRC * AGE	-0.0067	***
	(0.0021)			(0.0020)			(0.0021)	
BSE * BSECONCERN	0.2016	***	TRACE * BSECONCERN	0.2397	***	BSE_TRC * BSECONCERN	0.1805	***
	(0.0385)			(0.0376)			(0.0385)	
BSE * EDU	0.0248	*	TRACE * EDU	0.0371	***	BSE_TRC * EDU	0.0303	**
	(0.0145)			(0.0136)			(0.0145)	
BSE * FC	0.1216	**	TRACE * FC	0.1472	***	BSE_TRC * FC	0.1085	**
	(0.0486)			(0.0477)			(0.0484)	
BSE * INC	0.0028	***	TRACE * INC	0.0023	**	BSE_TRC * INC	0.0024	**
	(0.0010)			(0.0010)			(0.0010)	

Table 5.2. Continue from previous page

Perceived Risk Interaction								
WOULD-NOT-BUY*RA	-0.3047	***						
	(0.0876)							
WOULD-NOT-BUY*RP	-0.5572	***						
	(0.0904)							
WOULD-NOT-BUY * RA*RP	0.2647	***						
	(0.0347)							
BSE*RA	-0.254	**	TRACE*RA	-0.3394	***	BSE_TRC*RA	-0.3293	***
	(0.1056)			(0.1038)			(0.1069)	
BSE*RP	-0.353	***	TRACE*RP	-0.1929	*	BSE_TRC*RP	-0.2149	**
	(0.1074)			(0.1055)			(0.1083)	
BSE*RA*RP	0.1199	***	TRACE*RA*RP	0.1289	***	BSE_TRC*RA*RP	0.1014	**
	(0.0410)			(0.0401)			(0.0415)	
Log Likelihood	-13330.52							
McFadden R2	0.17							
AIC	26737.1							

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels.
Standard error in parentheses.

Table 5.3. Mixed Logit Model with Error Component

Main Effects			Diagonal Values in Cholesky Matrix		
WOULD - NOT-BUY	-2.5736	***	WOULD - NOT-BUY	1.0754	***
	(0.6054)			(0.1205)	
AUS	-1.8195	***	AUS	0.9300	***
	(0.0847)			(0.1050)	
CAN	-1.3278	***	CAN	0.4502	***
	(0.0736)			(0.0759)	
BSE	0.0213		BSE	1.1724	***
	(0.6878)			(0.0874)	
TRACE	0.0472		TRACE	0.4566	***
	(0.6544)			(0.1079)	
BSE_TRC	0.2295		BSE_TRC	0.1292	
	(0.7465)			(0.1363)	
TENDER	1.0640	***	TENDER	0.3857	***
	(0.0505)			(0.0824)	
NATURAL	0.0313		NATURAL	0.2840	***
	(0.0473)			(0.0909)	
PRICE	-0.2587	***			
	(0.0040)				
Socio Demographic Interaction					
WOULD-NOT-BUY * BSECONCERN	0.2433	***			
	(0.0764)				

Table 5.3. Continue from previous page

WOULD-NOT-BUY *FC	0.2186	**						
	(0.0952)							
BSE*AGE	0.0068		TRACE*AGE	0.0103	**	BSE_TRC *AGE	0.0009	
	(0.0043)			(0.0042)			(0.0046)	
BSE * BSECONCERN	0.3165	***	TRACE * BSECONCERN	0.2836	***	BSE_TRC * BSECONCERN	0.4143	***
	(0.0605)			(0.0581)			(0.0666)	
BSE*EDU	0.0193		TRACE*EDU	0.0255		BSE_TRC *EDU	0.0327	
	(0.0296)			(0.0278)			(0.0315)	
BSE*FC	0.1678	**	TRACE*FC	0.1324	*	BSE_TRC*FC	0.2332	***
	(0.0759)			(0.0735)			(0.0831)	
BSE*INC	0.0009		TRACE*INC	-0.0002		BSE_TRC*INC	-0.0006	
	(0.0020)			(0.0021)			(0.0023)	
Perceived Risk Interaction								
WOULD-NOT-BUY *RA	-0.6939	***						
	(0.2031)							
WOULD-NOT-BUY *RP	-0.9328	***						
	(0.2033)							
WOULD-NOT-BUY *RA*RP	0.5110	***						
	(0.0740)							
BSE*RA	-0.2489		TRACE*RA	-0.3878	**	BSE_TRC*RA	-0.4210	**
	(0.1774)			(0.1796)			(0.2026)	

Table 5.3. Continue from previous page

BSE*RP	-0.4579	***	TRACE*RP	-0.2877		BSE_TRC*RP	-0.3010	
	(0.1605)			(0.1787)			(0.2016)	
BSE*RA*RP	0.1325	**	TRACE * RA*RP	0.1243	*	BSE_TRC * RA*RP	0.1574	**
	(0.0629)			(0.0682)			(0.0755)	
Std Dev of Error Component	2.6551	***						
	(0.0857)							
Log Likelihood	-10481.6							
McFadden R2	0.3514							
AIC	21113.2							

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels. Standard error in parentheses. Results produced with NLOGIT 4.0, 200 Halton Draws

Table 5.4. Marginal WTP Estimates

		$/lb		Std Err.	t-value	[95% CI]	
Marginal WTP associated with BSE Concern							
TRACE		1.10	***	0.22	4.89	0.66	1.54
BSE		1.22	***	0.24	5.18	0.76	1.69
BSE_TRC		1.60	***	0.25	6.29	1.10	2.10
Marginal WTP associated with Perceived Control of Food Chain							
TRACE		0.52	*	0.29	1.80	-0.05	1.08
BSE		0.66	**	0.29	2.24	0.08	1.23
BSE_TRC		0.91	***	0.32	2.87	0.29	1.54
Marginal WTP associated with Risk Attitude							
	Risk Perception						
Traceable	1	-1.02	**	0.47	-2.14	-1.95	-0.09
	2	-0.53		0.33	-1.61	-1.19	0.12
	3	-0.05		0.37	-0.14	-0.77	0.66
	4	0.43		0.54	0.79	-0.64	1.49
	5	0.91		0.77	1.18	-0.60	2.42
BSE-Tested	1	-0.45		0.48	-0.92	-1.40	0.50
	2	0.06		0.34	0.19	-0.61	0.74
	3	0.58	*	0.34	1.67	-0.10	1.25
	4	1.09	**	0.49	2.23	0.13	2.04
	5	1.60	**	0.69	2.32	0.25	2.95
BSE-tested and Traceable	1	-1.02	*	0.54	-1.86	-2.08	0.05
	2	-0.41		0.38	-1.09	-1.15	0.33
	3	0.19		0.39	0.49	-0.58	0.97
	4	0.80		0.58	1.37	-0.34	1.94
	5	1.40	*	0.83	1.69	-0.23	3.03
Marginal WTP associated with Risk Perception							
	Risk Attitude						
Traceable	1	-0.63		0.47	-1.33	-1.55	0.29
	2	-0.15		0.32	-0.46	-0.78	0.48
	3	0.33		0.35	0.94	-0.36	1.02
	4	0.81		0.53	1.53	-0.23	1.85
	5	1.29	*	0.76	1.70	-0.20	2.77

Table 5.4. Continue from previous page

BSE-Tested	1	-1.25	***	0.42	-2.96	-2.08	-0.42
	2	-0.74	**	0.31	-2.36	-1.36	-0.13
	3	-0.23		0.37	-0.62	-0.95	0.49
	4	0.28		0.54	0.53	-0.77	1.33
	5	0.80		0.75	1.07	-0.67	2.26
BSE-tested and Traceable	1	-0.56		0.54	-1.05	-1.62	0.49
	2	0.05		0.37	0.13	-0.68	0.77
	3	0.66	*	0.40	1.65	-0.12	1.44
	4	1.27	**	0.59	2.14	0.10	2.43
	5	1.88	**	0.85	2.21	0.22	3.54

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels
Results produced with NLOGIT 4.0, 5,000 Krinsky and Robb Simulations

Table 5.5. Total WTP Estimates

Traceable Beef		Risk Attitude									
		1		**2**		**3**		**4**		**5**	
Risk Perception	1	5.81	***	4.79	***	3.78	***	2.76	**	1.76	
		(0.79)		(0.64)		(0.80)		(1.16)		(1.58)	
	2	5.17	***	4.63	***	4.11	***	3.58	***	3.03	***
		(0.62)		(0.48)		(0.54)		(0.77)		(1.05)	
	3	4.53	***	4.48	***	4.44	***	4.39	***	4.31	***
		(0.77)		(0.51)		(0.44)		(0.64)		(0.93)	
	4	3.89	***	4.32	***	4.77	***	5.20	***	5.58	***
		(1.12)		(0.71)		(0.59)		(0.89)		(1.33)	
	5	3.24	**	4.17	***	5.10	***	6.01	***	6.85	***
		(1.53)		(0.98)		(0.87)		(1.32)		(1.95)	

BSE-tested Beef		Risk Attitude									
		1		**2**		**3**		**4**		**5**	
Risk Perception	1	5.75	***	5.30	***	4.84	***	4.40	***	3.97	**
		(0.82)		(0.66)		(0.83)		(1.18)		(1.57)	
	2	4.50	***	4.56	***	4.62	***	4.68	***	4.75	***
		(0.62)		(0.48)		(0.57)		(0.79)		(1.07)	
	3	3.24	***	3.82	***	4.39	***	4.96	***	5.54	***
		(0.68)		(0.47)		(0.47)		(0.66)		(0.95)	
	4	1.99	**	3.07	***	4.16	***	5.25	***	6.33	***
		(0.96)		(0.64)		(0.62)		(0.91)		(1.33)	
	5	0.73		2.33	***	3.93	***	5.53	***	7.12	***
		(1.32)		(0.90)		(0.91)		(1.34)		(1.93)	

Table 5.5. Continue from previous page

BSE-tested and Traceable Beef		Risk Attitude									
		1		**2**		**3**		**4**		**5**	
Risk Perception	1	8.01	***	6.99	***	5.97	***	4.95	***	3.99	**
		(0.93)		(0.73)		(0.89)		(1.27)		(1.75)	
	2	7.46	***	7.04	***	6.63	***	6.22	***	5.84	***
		(0.71)		(0.54)		(0.60)		(0.84)		(1.17)	
	3	6.90	***	7.10	***	7.29	***	7.50	***	7.70	***
		(0.84)		(0.56)		(0.50)		(0.71)		(1.03)	
	4	6.34	***	7.15	***	7.96	***	8.77	***	9.55	***
		(1.21)		(0.78)		(0.67)		(0.99)		(1.46)	
	5	5.78	***	7.20	***	8.62	***	10.04	***	11.41	***
		(1.67)		(1.08)		(0.97)		(1.46)		(2.14)	

Notes: ***, **, and * indicate significant at the 1%, 5%, and 10% significance levels. Standard error in parentheses.
Results produced with NLOGIT 4.0, 5,000 Krinsky and Robb Simulations

Chapter 6 Conclusion and Future Research

This study focused on the viability and necessity of Country of Origin labeling, traceability and BSE testing on beef. An important question was raised about the potential of these attributes to ameliorate concerns from beef consumption. We approached the questions from the viewpoint of consumers by analysing the consumers' preference with choice models.

The common denominator of COOL, traceability, and BSE test is food safety. Supporters of these measurements argued that these could alleviate consumers concerns from beef consumption. Opponents of COOL believes that the law was designed to protect domestic interest group, and some producers have vehemently opposed mandatory traceability and BSE test, citing that these attributes could add unnecessary technical complexity and cost. In addition to evaluating the dollar value consumers paced on COO-labeled, traceable and BSE-tested beef, we sought to explain the WTP through perceived risk theory. This allows us to understand the connection between food-safety concern and these debated attributes.

6.1 Summary

Chapter 3 analyzed preference with a latent class logit model and a mixed logit model. While both the models were capable to discern unobserved heterogeneity, latent class logit does so with segmenting consumers into different group, and mixed logit captures unobserved taste variation with random coefficients. Both models revealed that consumers preferred domestic steak in general, and sizeable WTP existed for traceable, BSE-tested and tenderness assured beef.

The latent class logit model assigned consumers into five segments. Only one segment, at 24% of the sample, demonstrated low negative WTP for the imported beef when compared to domestic beef. The WTP were -$0.79/lb for Canadian beef and -$1.09/lb for Australian beef. Three segments of the sample showed a steep negative WTP for imported beef, ranging from -$3.22/lb to -$7.28/lb. One segments, estimated at 17% of the sample, were the most unlikely to purchase imported beef. Their WTP for Australian and Canadian beef were -$49.48/lb and -$35.12/lb.

The mixed logit model reiterated that most consumers preferred domestic beef. The mixed logit model estimated steep negative WTP for the imported beef. In addition, the results suggested younger and highly educated consumers show lower aversion to imported beef.

Chapter 4 focused on the underlying reasons of consumers' domestic preference. The perceived risk framework from Pennings et al (2002) was utilized in the choice model. Perceived risk is decomposed into risk perception and risk attitude. The mixed logit model in this chapter featured an explicit error component, purposed to capture the correlation between non-empty choice sets to increase the realism of the choice model. The results suggest than risk perception negatively impact consumers acceptance of imported beef, namely the higher risk consumers perceived from eating beef, the less likely consumers would choose Australian and Canadian beef. In addition, consumers who are averse to risk from eating beef are less likely to choose imported beef.

By choosing "don't know", a large number of the sample showed uncertainty about the safety of imported beef from Australia (34.7%) and Canada (30.5%), compared to only

10.8% for domestic beef. The choice model suggested that the uncertain response adversely affected consumers WTP for beef. The negative impact was more pronounced on imported beef than domestic beef. The higher uncertain-response rate could mean that American consumers are unfamiliar with the inherent food-safety risks on imported beef, although no scientific research suggested lower food safety rate in imported beef to the best of our knowledge. Foreign beef imported and foreign producers are recommended to engage in risk communication in order to increase awareness of American consumers to the real risk of consuming imported beef.

On Chapter 5, the perceived risk framework from Pennings et al (2002) were employed to shed light on the relation between risk perception, risk attitude and the WTP for traceable and BSE-tested beef. The data was analysed with mixed logit model with error component. The model estimated insignificant mean coefficient for traceable, BSE-tested, and beef featured with both traceability and BSE test, however, the standard deviation of the random variation suggested that significant unobserved taste heterogeneity persisted for traceable and BSE-tested beef.

We found that concerns about BSE significantly increased consumer's preference for beef marketed with traceability and BSE-test. Interaction effects of risk perception and risk attitude revealed a complex, non-linear relationship between WTP and the perceived risk factors. Overall, perceived risk influenced consumers' WTP for traceable and BSE-tested beef. In particular, we found those who perceived high risk on consuming beef and unwilling to accept risk from eating beef showed strong WTP for the attributes.

6.2 Future Research

The analyses showed that COOL can have deleterious effect on imported beef, and consumers are willing to pay a premium for traceable and BSE-tested beef. Further, risk perception and risk attitude significantly affect the extent of the WTP. The results from this study could serve as a launching pad for future related research.

Utilization of experimental auction, field experiment, or revealed-preference data could enhance the analyses in this study. Choice experiment, as conducted in this study is susceptible to hypothetical bias. Although numerous studies have attempted to tackle hypothetical bias, Loomis (2011) concluded that no clear solution existed to date. Similar studies on COOL or food-safety attributes performed with other methods could complement or validate the results from this study.

The results showed that perceived risk is an important factor in consideration of country of origin and food-safety attributes on beef. While the results provided some notable breakthrough, other unobserved but important factors could affect the variability of choice. In particular, several factors in behavioral economics literature such as reference point bias, anchoring effects (Thaler 1980) could enhance understanding of the way beef consumption decision in regards to these attributes is made. One may argue that factors not considered in this study could cause omitted variable bias. The future solution to this is to increase the data coverage, so that analysis of such relevant variables is feasible. More advance modeling, such as the BLP structural demand system could be utilized to address simultaneity issues in certain key variables (Berry et al. 1995; Nevo 2000).

The final ruling of COOL provided incentive for beef to be labeled as mixed-origin. The final ruling of COOL stated that mixed-origin labels can be applied if imported cattle are commingled with cattle born and raised in the United States during the production day (USDA 2009). Given the less stringent requirements on mixed-origin labels, most meat cuts derived from cattle of Canadian or Mexican origin are likely to be labeled as such. We expect mixed-origin labeled meat products to be more prevalent as the result of COOL, which make analyses on mixed-origin beef as a worthwhile investigation for future research.

Appendix

Stated Preference

In this final section of this survey, you are provided with 14 different pairs of alternative strip-loin beefsteaks (also known as Kansas City strip and New York steak) that could be available for purchase in the retail grocery store or butcher where you typically shop that possess differing attributes. Steak prices vary from US $5.50/lb. to $16.00/lb. For each pair of steaks, please select the steak that you would purchase, or neither, if you would not purchase either steak. It is important that you make your selections like you would if you were actually facing these choices in your retail purchase decisions.

For your information in interpreting alternative steaks:

• **Country of Origin** refers to the country in which the cow/animal was raised and includes USA, Canada, and Australia.

• **Production Practice** is the method used to produce the cow/animal where:

Approved Standards means the cow/animal was raised using scientifically determined safe and government-approved use of synthetic growth hormones and antibiotics (typical of cattle production methods used in Canada and USA)

Natural is the same as typical except the cow/animal was raised without the use of synthetic growth hormones or antibiotics

• **Tenderness** refers to how tender the steak is to eat and includes

Assured Tender means the steak is guaranteed tender by testing the steak using a tenderness-measuring instrument

Uncertain means there are no guarantees on tenderness level of the steak and the chances of being tender are the same as typical steaks you have purchased in the past

• **Food Safety Assurance** refers the level of food safety assurance with the steak

None food safety means the steak meets current minimum government standards for
food safety

Traceable means the product is traceable back to farm of origin from your point of purchase

BSE Tested means that all animals are tested for BSE prior to meat being sold at your point of purchase

CHOICE SET

Steak Attribute	**A**	**B**	**C**
Price ($/lb.)	$16.00	$12.50	I would not purchase any of these products
Country of Origin	Australia	Canada	
Production Practice	Natural	Approved Standards	
Tenderness	Assured Tender	Assured Tender	
Food Safety Assurance	Traceable	BSE Tested and Traceable	
I would choose . . .	○	○	○

Food Safety, Animal Testing and Traceability

1. In which of the following age groups do you fall?

1. ❒ 15-19
2. ❒ 20-24
3. ❒ 25-29
4. ❒ 30-39
5. ❒ 40-49
6. ❒ 50-64
7. ❒ 65+

2. Please indicate your gender.

1. ❒ Male
2. ❒ Female

3. How many people live in your household?

1. ❒ 1
2. ❒ 2
3. ❒ 3 +

4. How many children younger than 18 live in your house?

1. ❒ No home living children < 18 years
2. ❒ 1
3. ❒ 2
4. ❒ 3
5. ❒ 4
6. ❒ More than 4

5. What is your position in the household? **ONLY ONE ANSWER POSSIBLE**

1. ❒ Head of household/main income
2. ❒ Partner of head of household
3. ❒ Child
4. ❒ Other family member
5. ❒ Other person (no family)

6. What is your marital status? **ONLY ONE ANSWER POSSIBLE**

1. ❒ Married/Living together/Common Law
2. ❒ Single
3. ❒ Divorced/Separated
4. ❒ Widowed

7. What is the highest level of education you've completed? **ONLY ONE ANSWER POSSIBLE**

1. ❒ Elementary or junior high school
2. ❒ High school
3. ❒ Technical training/ Community college/Some college
4. ❒ Four-year college or university
5. ❒ Graduate (Masters or PhD) or professional degree (MBA, JD, etc.)

8. Which of the following best describes your employment status? **ONLY ONE ANSWER POSSIBLE**

1. ❒ Employed full-time or self-employed
2. ❒ Employed part-time
3. ❒ Homemaker
4. ❒ Student and full-time employed
5. ❒ Student and part-time employed
6. ❒ Student only
7. ❒ Retired
8. ❒ Unemployed
9. ❒ Other

9. What is the approximate range of your total household income? **ONLY ONE ANSWER POSSIBLE**

1. ❒ $ 24,999 or under
2. ❒ Between $ 25,000 and $ 39,999
3. ❒ Between $ 40,000 and $ 64,999
4. ❒ Between $ 65,000 and $ 79,999
5. ❒ Between $ 80,000 and $ 99,999
6. ❒ Between $ 100,000 and $ 119,999
7. ❒ $ 120,000 or more

10. Which region do you live in? **ONLY ONE ANSWER POSSIBLE**

1.	❒	Northeast
2.	❒	Mid-Atlantic
3.	❒	Southeast
4.	❒	North Central
5.	❒	Midwest
6.	❒	South Central
7.	❒	Northwest
8	❒	California or Southwest
9.	❒	Alaska or Hawaii

11. Do you live in a city, in a town or in the countryside? **ONLY ONE ANSWER POSSIBLE**

1.	❒	In a city (>100.000 inhabitants)
2.	❒	In a town (> 10.000 inhabitants)
3.	❒	In the countryside/rural area

Section: General Trust

12. Generally speaking, would you say that most people can be trusted?

People can be trusted	**Can't be too careful in dealing with people**	**Don't know**
1	**2**	**3**
❒	❒	❒

13. We would like to know whether you, **in general**, worry a lot in daily life. Please indicate to what extent you find the following statements characteristic of yourself. Give your answer on a scale from 1 ("not at all typical") to 5 ("very typical").

	not at all	**untypical**	**somewhat typical**	**typical**	**very typical**
	1	**2**	**3**	**4**	**5**
Many situations make me worry	❒	❒	❒	❒	❒
I know I shouldn't worry about things, but I just cannot help it	❒	❒	❒	❒	❒
I notice that I have been worrying about things	❒	❒	❒	❒	❒

14. **Please indicate your level of agreement with the following statements**	**strongly disagree**	**disagree**	**neither agree, nor**	**agree**	**strongly agree**
	1	**2**	**3**	**4**	**5**
I am optimistic about the safety of food	❒	❒	❒	❒	❒
I am confident that food products are safe	❒	❒	❒	❒	❒
I am satisfied with the safety of food	❒	❒	❒	❒	❒
Generally, food products are safe	❒	❒	❒	❒	❒
I worry about the safety of food	❒	❒	❒	❒	❒
I feel uncomfortable regarding the safety of food	❒	❒	❒	❒	❒
As a result of the occurrence of food safety incidents I am suspicious about certain food products	❒	❒	❒	❒	❒

Assessment of food industry

15. These statements are about your trust in individuals and institutions with respect to the safety of food. We distinguish between the government, farmers, retailers, and manufacturers of food products. Please indicate to what extent you agree with each statement.

DISPLAY IN DIFFERENT ORDER, I.E.:

1. GOVERNMENT FARMERS RETAILERS MANUFACTURERS
2. FARMERS RETAILERS MANUFACTURERS GOVERNMENT
3. RETAILERS MANUFACTURERS GOVERNMENT FARMERS
4. MANUFACTURERS GOVERNMENT FARMERS RETAILERS

GOVERNMENT	**strongly disag**	**disagree**	**neither agree,**	**agree**	**strongly agree**
	1	**2**	**3**	**4**	**5**
The government has the competence to control the safety of food	❒	❒	❒	❒	❒
The government has sufficient knowledge to guarantee the safety of food products	❒	❒	❒	❒	❒

The government is honest about the safety of food	❒	❒	❒	❒	❒
The government is sufficiently open about the safety of food	❒	❒	❒	❒	❒
The government takes good care of the safety of our food	❒	❒	❒	❒	❒
The government gives special attention to the safety of food	❒	❒	❒	❒	❒

FARMERS	**strongly disag 1**	**disagree 2**	**neither agree, 3**	**agree 4**	**strongly agree 5**
Farmers have the competence to control the safety of food	❒	❒	❒	❒	❒
Farmers have sufficient knowledge to guarantee the safety of food products	❒	❒	❒	❒	❒
Farmers are honest about the safety of food	❒	❒	❒	❒	❒
Farmers are sufficiently open about the safety of food	❒	❒	❒	❒	❒
Farmers take good care of the safety of our food	❒	❒	❒	❒	❒
Farmers give special attention to the safety of food	❒	❒	❒	❒	❒

RETAILERS	**strongly disag 1**	**disagree 2**	**neither agree, 3**	**agree 4**	**strongly agree 5**
Retailers have the competence to control the safety of food	❒	❒	❒	❒	❒
Retailers have sufficient knowledge to guarantee the safety of food products	❒	❒	❒	❒	❒
Retailers are honest about the safety of food	❒	❒	❒	❒	❒
Retailers are sufficiently open about the safety of food	❒	❒	❒	❒	❒

Retailers take good care of the safety of our food	❒	❒	❒	❒	❒
Retailers give special attention to the safety of food	❒	❒	❒	❒	❒

MANUFACTURERS OF FOOD	**strongly disag 1**	**disagree 2**	**neither agree, 3**	**agree 4**	**strongly agree 5**
Manufacturers have the competence to control the safety of food	❒	❒	❒	❒	❒
Manufacturers have sufficient knowledge to guarantee the safety of food products	❒	❒	❒	❒	❒
Manufacturers are honest about the safety of food	❒	❒	❒	❒	❒
Manufacturers are sufficiently open about the safety of food	❒	❒	❒	❒	❒
Manufacturers take good care of the safety of our food	❒	❒	❒	❒	❒
Manufacturers give special attention to the safety of food	❒	❒	❒	❒	❒

16. **To what extent are you concerned about the following issues?**

	Not at all 1	**Minor concerns 2**	**Some concerns 3**	**Major Concerns 4**	**Extremely concerned 5**
The feed given to livestock	❒	❒	❒	❒	❒
Conditions in which food animals are raised	❒	❒	❒	❒	❒
Genetically modified animal feeds	❒	❒	❒	❒	❒
Animal diseases	❒	❒	❒	❒	❒
BSE and Creutzfeldt Jakob Disease (vCJD)	❒	❒	❒	❒	❒
The origin of products/ animals	❒	❒	❒	❒	❒

Antibiotics in meat	❒	❒	❒	❒	❒
Animals genetically modified for meat/poultry or dairy production	❒	❒	❒	❒	❒

17. To what extent do you think the following individuals and organizations are responsible for guaranteeing the safety of food? Please give your answer on a scale from 1 ("not at all responsible") to 5 ("completely responsible").

	Not at all responsible	**Minor responsibility**	**Some responsibility**	**Major responsibility**	**Completely responsible**
	1	**2**	**3**	**4**	**5**
To what extent do you think … is/are responsible for the					
Farmers	❒	❒	❒	❒	❒
The government	❒	❒	❒	❒	❒
Manufacturers of food	❒	❒	❒	❒	❒
Retailers	❒	❒	❒	❒	❒
Consumer and healthy advocacy organizations	❒	❒	❒	❒	❒
The consumer	❒	❒	❒	❒	❒

18. Various individuals and organizations provide information about the safety of food. Please indicate to what extent you trust the information provided by the following sources, where 1 refers to "no trust in information at all" and 5 refers to "complete trust in information".

	No trust in information at all	**Some trust in information**	**Trust most information**	**Trust majority of information**	**Complete trust in information**
	1	**2**	**3**	**4**	**5**
To what extent do you trust information about the safety of food provided by …?					

Farmers	❒	❒	❒	❒	❒
The government	❒	❒	❒	❒	❒
Manufacturers of food	❒	❒	❒	❒	❒
Retailers	❒	❒	❒	❒	❒
Consumer and health advocacy organizations	❒	❒	❒	❒	❒

19. Please answer the following questions. Give your answer on a scale from 1 ("insignificant") to 5 ("a great deal").

	Insignificant	**Very little**	**Minor**	**Some**	**A great deal**
	1	**2**	**3**	**4**	**5**
How much risk do you think there is to **you personally** of experiencing negative consequences from eating unsafe foods?	❒	❒	❒	❒	❒
How much risk do you think there is to **the average American person** of experiencing negative consequences from eating unsafe foods?	❒	❒	❒	❒	❒
How much control do you think **you personally** have over the safety of food?	❒	❒	❒	❒	❒
How much control do you think **the average American person** has over the safety of food?	❒	❒	❒	❒	❒
How much knowledge do you think **you personally** have about the safety of food?	❒	❒	❒	❒	❒
How much knowledge do you think **the average American person** has about the safety of food?	❒	❒	❒	❒	❒

20a. Do you recall a particular incident over **the past six months** where the safety of food was compromised or threatened? Your memory can be based on personal experience, but also on information you received through the news media.

❒ Yes [>>20b]

❒ No [>>21]

20b. [after this question, continue with 21]

Which incident(s) do you recall? Could you indicate when the incident occurred?

MORE THAN ONE ANSWER POSSIBLE

	DESCRIPTION OF INCIDENT	WHEN DID THE INCIDENT OCCUR?
INCIDENT 1	_____	_____
INCIDENT 2	_____	_____
INCIDENT 3	_____	_____

21. Please indicate how much confidence you, generally, have in the safety of the following product groups. Give your answer on a scale from 1 (“no confidence at all”) to 5 (“complete confidence”).

	no confidence **1**	**some** **2**	**reasonable** **3**	**high** **4**	**complete confidence** **5**
Beef	❒	❒	❒	❒	❒
Pork	❒	❒	❒	❒	❒
Chicken / poultry	❒	❒	❒	❒	❒
Fish	❒	❒	❒	❒	❒
Meat replacers / substitutes	❒	❒	❒	❒	❒
Canned products	❒	❒	❒	❒	❒
Products sold in jars	❒	❒	❒	❒	❒
Fresh vegetables and fruit	❒	❒	❒	❒	❒
Precut and washed fresh vegetables	❒	❒	❒	❒	❒
Milk products	❒	❒	❒	❒	❒
Cheese	❒	❒	❒	❒	❒
Eggs	❒	❒	❒	❒	❒
Bread products	❒	❒	❒	❒	❒
Frozen products	❒	❒	❒	❒	❒
Ready-to-eat meals	❒	❒	❒	❒	❒
Vitamin supplements	❒	❒	❒	❒	❒
Baby food	❒	❒	❒	❒	❒
Confectionery products	❒	❒	❒	❒	❒

Processed Meat	❒	❒	❒	❒	❒

22. We would like to ask some more questions about your opinion regarding poultry (chicken and turkey) and beef.

[DISPLAY CHICKEN AND BEEF RANDOMLY, ALSO DISPLAY ITEMS RANDOMLY WITHIN TYPE]

What do you think about poultry?						
	1	**2**	**3**	**4**	**5**	
not safe	❒	❒	❒	❒	❒	safe
not trustworthy	❒	❒	❒	❒	❒	trustworthy
contains harmful substances	❒	❒	❒	❒	❒	does not contain harmful substances
What do you think about beef?						
not safe	❒	❒	❒	❒	❒	safe
not trustworthy	❒	❒	❒	❒	❒	trustworthy
contains harmful substances	❒	❒	❒	❒	❒	does not contain harmful substances

23a.

[DISPLAY CHICKEN AND BEEF RANDOMLY, SHOW ITEMS WITHIN TYPE OF MEAT ALSO RANDOMLY]

Do you eat beef?

❒	Yes	**Routing: Continue with [23b]**
❒	No	**Routing: Continue with [24a]**

23b.

What do you think about eating beef?

When eating beef, I am exposed to …

	1	2	3	4	5	
very little risk	❒	❒	❒	❒	❒	a great deal of risk
I accept the risks of eating beef						
strongly disagree	❒	❒	❒	❒	❒	strongly agree
I think eating beef is risky						
strongly disagree	❒	❒	❒	❒	❒	strongly agree
For me, eating beef is …						
not risky	❒	❒	❒	❒	❒	risky
For me, eating beef is worth the risk						
strongly disagree	❒	❒	❒	❒	❒	strongly agree
I am … the risk of eating beef						
not willing to accept	❒	❒	❒	❒	❒	willing to accept

24. Please provide the approximate percentage of your beef consumption over the past year that would include the following beef products (your best guess is fine, they should add to 100%, skip question if you do not consume beef):	
ground or minced (e.g., hamburger)	___%
roasts	___%
steaks	___%
sausage, brats, hotdogs, beef luncheon meats, deli meats	___%
organ meats (e.g., liver, tongue, tripe, etc.)	___%
other (please list_____)	___%

25a. Do you eat poultry?

❒ Yes **Routing: Continue with [25b]**

❒ No **Routing: Continue with [26]**

25b. What do you think about eating poultry?

When eating poultry, I am exposed to …						
	1	**2**	**3**	**4**	**5**	
very little risk	❒	❒	❒	❒	❒	a great deal of risk
I accept the risks of eating poultry						
strongly disagree	❒	❒	❒	❒	❒	strongly agree
I think eating poultry is risky						
strongly disagree	❒	❒	❒	❒	❒	strongly agree
For me, eating poultry is …						
not risky	❒	❒	❒	❒	❒	risky
For me, eating poultry is worth the risk						
strongly disagree	❒	❒	❒	❒	❒	strongly agree
I am … the risk of eating poultry						
not willing to accept	❒	❒	❒	❒	❒	willing to accept

26. Imagine you have a question about the safety of your food. To what extent would you use the following information sources to discover more information about food safety?

	Definitely not		**Use occasionally**		**Definitely**
	1	**2**	**3**	**4**	**5**
Neighbors	❒	❒	❒	❒	❒
Center for Science in the Public Interest	❒	❒	❒	❒	❒
Dietician or family doctor	❒	❒	❒	❒	❒

Product labels	❒	❒	❒	❒	❒
Family	❒	❒	❒	❒	❒
USDA	❒	❒	❒	❒	❒
State ministry of agriculture	❒	❒	❒	❒	❒
US Department of Health	❒	❒	❒	❒	❒
State ministry of health	❒	❒	❒	❒	❒
Research institutes	❒	❒	❒	❒	❒
Food manufacturers	❒	❒	❒	❒	❒
Friends and acquaintances	❒	❒	❒	❒	❒
Scientists	❒	❒	❒	❒	❒
Retailers or supermarkets	❒	❒	❒	❒	❒
USDA Food Safety and Inspection Service	❒	❒	❒	❒	❒

27. The next questions are about news messages in the media about the safety of food. Those messages may concern **actual incidents**, but may also provide **background information** about the safety of food products in general, and so not be related to a particular incident. We would like to know to what extent you recall news messages about actual incidents or about background information. Please answer the following questions for **the most recent message** that you recall.

What was the most recent message about?

_____

27b. [after this question, continue with 27c]

Was the most recent message positive or negative?

❒ Positive

❒ Negative

27c. [after this question, continue with 28]
How alarming did you find the most recent message?

not alarming at all	**slightly**	**somewhat**	**moderately**	**very alarming**
1	**2**	**3**	**4**	**5**
❒	❒	❒	❒	❒

28. The following questions have to do with different factors that influence the safety of food. Could you please indicate to what extent you agree with the following statements?

	strongly disagree	disagree	neither agree, nor	agree	strongly agree
	1	2	3	4	5
I am in control over the safety of the food products that I eat	❒	❒	❒	❒	❒
The safety of food products is mainly influenced by how I handle food products	❒	❒	❒	❒	❒
The safety of food products is mainly influenced by parties in the food chain other than myself	❒	❒	❒	❒	❒
The safety of food products cannot be controlled, but is mainly determined by coincidental factors	❒	❒	❒	❒	❒

29. How often are you involved in the daily grocery shopping for your household?

never	once in a while	occasionally	frequently	always
1	2	3	4	5
❒	❒	❒	❒	❒

30. Do you ever buy organic products?

never	once in a while	occasionally	frequently	always
1	2	3	4	5
❒	❒	❒	❒	❒

31. Which of the following best describes your food preferences?

1 ❒ I eat meat and fish

2 ❒ I eat fish but don't eat meat

3 ❒ I do eat meat but I don't eat fish

4 ❒ I am a vegetarian (I don't eat either meat or fish)

32. Please answer with the following: 1 = strongly disagree, 2 = disagree, 3 = neither agree or disagree, 4 = agree, 5 = strongly agree)

	strongly disagree	**disagree**	**neither agree, nor**	**agree**	**strongly agree**
	1	**2**	**3**	**4**	**5**
I think that government food safety regulations protect me adequately	❒	❒	❒	❒	❒
I would like to see stronger food safety standards imposed in the US.	❒	❒	❒	❒	❒
I would pay more for a product with a higher than average level of food safety	❒	❒	❒	❒	❒
I do not eat meat prepared by someone outside my household	❒	❒	❒	❒	❒
I am confident that food in restaurants is safe to eat.	❒	❒	❒	❒	❒
I would be willing to pay a premium for beef that would guarantee animals were tested to ensure that they would not transmit the human variant of BSE (mad cow disease)?	❒	❒	❒	❒	❒
I purchase meat based:					
a. on the brand name	❒	❒	❒	❒	❒
b. country of origin	❒	❒	❒	❒	❒
c. on the price	❒	❒	❒	❒	❒

33. How often do you buy beef? Is it…	Never	Occasionally	Regularly
	1	**2**	**3**
	❒	❒	❒

34. When you buy beef, is it **usually in ……..** (One ONLY)		
a supermarket or warehouse club,	❒	**1**
a butcher’s shop	❒	**2**
another small shop	❒	**3**
a farmer’s market	❒	**4**
or another way (directly from a farm or through acquaintances)	❒	**5**

35. Thinking about buying beef, would you say that the following characteristics are unimportant, matter a bit or are important to you?	Unimportant	Matters a bit	Important
	1	**2**	**3**
the beef tastes good	❒	❒	❒
the beef is lean	❒	❒	❒
the beef is safe to eat	❒	❒	❒
the price is low	❒	❒	❒
the shop is easily accessible	❒	❒	❒

36. When buying beef, would you say that the following safety and quality concerns are unimportant, matter a bit or are important to you?	Unimportant **1**	Matters a bit **2**	Important **3**
You know the staff personally	❒	❒	❒
You know where the beef originates from	❒	❒	❒
Local hygiene inspectors visit the place regularly	❒	❒	❒
US authorities practice strict hygienic standards for beef	❒	❒	❒
US establishes good food safety regulations for beef	❒	❒	❒
You know the shop from previous experience	❒	❒	❒
The beef is labeled with full product information	❒	❒	❒

37. Do you prefer imported beef from New Zealand, Australia, Canada or other? (one answer only)		
Imported beef from Australia	❒	1
Imported beef from New Zealand	❒	2
Imported beef from Canada	❒	3

Imported beef from _____ please identify	❒	4
I avoid imported beef as much as possible	❒	5
I neither like nor dislike imported beef	❒	6

38. Would you say that the following food issues are an important risk to human health in our society, are not a very important risk or no risk at all?

	Important	Not very	No risk	Don't know
	1	**2**	**3**	**4**
Salmonella food poisoning	❒	❒	❒	❒
BSE (mad cow disease)	❒	❒	❒	❒
GM foods (genetically modified)	❒	❒	❒	❒
Products from livestock housed in large numbers, in cages or other restricted conditions	❒	❒	❒	❒
Pesticides	❒	❒	❒	❒
Listeriosis (Listeria) food poisoning	❒	❒	❒	❒
Unhealthy eating	❒	❒	❒	❒

Additives (like preservatives, coloring)	❒	❒	❒	❒
Food allergies	❒	❒	❒	❒
E. coli food poisoning	❒	❒	❒	❒
Unreasonable food prices	❒	❒	❒	❒

39. Over the past four years, have you lowered your beef consumption because of food safety concerns?	No	Yes
	1	**2**
	❒	❒
	If yes, reduced by roughly _____% (please give your best estimate	

40. Whether you have ever knowingly purchased beef produced in another country or not, what is your perception of the level of food safety of beef by country of origin?

Your Perceived Level of Food Safety	Very Low	Low	Moderate	High	Very High	No Opinion
	1	**2**	**3**	**4**	**5**	**6**
Unknown Country of Origin	❒	❒	❒	❒	❒	❒

Australia	❒	❒	❒	❒	❒	❒
Brazil	❒	❒	❒	❒	❒	❒
Canada	❒	❒	❒	❒	❒	❒
New Zealand	❒	❒	❒	❒	❒	❒
US	❒	❒	❒	❒	❒	❒

41. Have you ever heard of traceability in the food industry	Yes	No
	1	**2**
	❒	❒

42. Please indicate the importance of the use of traceability under each of the following circumstances.				
	Very important	Somewhat important	Somewhat unimportant	Not important at all
	1	**2**	**3**	**4**
To withdraw products should they prove to be dangerous	❒	❒	❒	❒
To offer reassurance as to the quality of products that people purchase	❒	❒	❒	❒
To provide information about every stage of the manufacturing process	❒	❒	❒	❒
To provide better information on product ingredients	❒	❒	❒	❒
To fight counterfeiting	❒	❒	❒	❒

To offer guarantees as to food being produced using environmentally sustainable production methods	❒	❒	❒	❒
To help people in choosing "healthy" products	❒	❒	❒	❒
To provide specific information for "at risk" individuals (weakened immune system, for example)	❒	❒	❒	❒

43. Tell me which of the following phrases you consider to be important information provided on food labels?					
	Very important	Somewhat important	Neutral	Somewhat unimportant	Not important at all
	1	**2**	**3**	**4**	**5**
The list of ingredients that make up a product	❒	❒	❒	❒	❒
The list of allergens	❒	❒	❒	❒	❒
Information about GMOs (genetically modified organisms or ingredients)	❒	❒	❒	❒	❒
The country of origin of a product	❒	❒	❒	❒	❒
Information about dietary norms (recommended daily allowances)	❒	❒	❒	❒	❒

The name of a product's manufacturer (the brand)	❒	❒	❒	❒	❒
The different intermediaries involved in the manufacture of a product	❒	❒	❒	❒	❒

44. **For you, who should guarantee the traceability of a product?**					
	Manufacturers	Government	Consumer associations	Scientists	Media
	1	**2**	**3**	**4**	**5**
	❒	❒	❒	❒	❒

45. When you buy beef, how important are the following factors to you?

	Very Important	**Somewhat Important**	**Not Important**
	1	**2**	**3**
Product Leanness (fat)	❒	❒	❒
Food borne disease	❒	❒	❒
The use of antibiotics in livestock production	❒	❒	❒
The use of hormones in livestock production	❒	❒	❒
BSE or Mad cow disease	❒	❒	❒
Product Nutritional Information	❒	❒	❒
Price	❒	❒	❒

Product Flavor	❒	❒	❒
Product Tenderness	❒	❒	❒
Product Juiciness	❒	❒	❒
Product Preparation Ease	❒	❒	❒
Product Preparation Time	❒	❒	❒
Product Freshness (i.e., “Sell by Date” in U.S.; “Packaged on Date” in Canada; “Best Before” Date in Japan)	❒	❒	❒
Product Color	❒	❒	❒
Product Labeled Natural	❒	❒	❒
Product Labeled Organic	❒	❒	❒
Traceability of Product Back to Farm	❒	❒	❒
Country of Origin of Product	❒	❒	❒

46. **If you had a problem with a product, who would you hold responsible? More than one may apply**					
	Restaurant	Manufacturer	Government	Retailer	Farmer
	1	**2**	**3**	**4**	**5**
	❒	❒	❒	❒	❒

47. **By which of the following ways, may humans get mad cow disease? (Check all that apply)**

Touching the contagious meat	❒
Eating beef steak	❒
Blood transfusions from people who have variant Creutzfeldt-Jakob disease	❒
Drinking milk	❒
Eating beef brain	❒
None of the above	❒

48. How has your consumption of beef changed since you first heard about BSE (mad cow disease)?

Increased dramatically	Increased slightly	Remained the same	Decreased slightly	Decreased dramatically
1	**2**	**3**	**4**	**5**
❒	❒	❒	❒	❒

49. If you are not consuming conventional beef, what are you substituting? **(Check all that apply)**

- ❒ Seafood
- ❒ Pork
- ❒ Chicken
- ❒ Lamb
- ❒ Organic beef

❒ Grass-fed beef

❒ Other _____

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Refereed Publication

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Non-refereed Publication

Lim, Kar H., Wuyang Hu, Leigh Maynard, and Ellen Goddard 2012. "Consumer Perceived Risk and the Willingness to Pay for Imported Beef." *Working Paper*, Department of Agricultural Economics, University of Kentucky.

Lim, Kar H., Wuyang Hu, Leigh Maynard, and Ellen Goddard 2011. "Willingness to Pay for Imported Beef and Risk Perception: An Application of Individual-Level Parameter." *Working Paper,* Department of Agricultural Economics, University of Kentucky.

Lim, Kar H. Leigh Maynard, Wuyang Hu, "The Willingness to Pay Impact of Country of Origin Labeling on Imported Beef." Consumer and Market Demand – Agricultural Research Policy Network working paper CMD 552, Edmonton, Alberta, September, 2010.

Woods, Tim, Kar H. Lim. 2009 "Feasibility of Starting a Sweet Potato Processing Plant in Kentucky." Extension Project

Grant

$30,000 Maynard L, Wuyang Hu, Ellen Goddard and Kar H. Lim. "Willingness-to-Pay for Value-Added Canadian Beef Among US Consumers." Consumer and Market Demand Agricultural Policy Research Network, University of Alberta, May 2010 – Dec 2011.

$30,000 Wuyang Hu, Kar H. Lim, "Canadian Consumer Preference and Willingness to Pay for Local Beef: Does the Distance and Scope Matter? "Consumer and Market Demand Agricultural Policy Research Network, University of Alberta, Sep 2011 – Aug 2012

Presentation (noted if refereed)

Lim, Kar H., Wuyang Hu, Leigh Maynard and Ellen Goddard. "Stated Preference and Perception Analysis for Traceable Beef: An Application of Mixed Error-Component Logit Model." Selected Paper Presentation at Agricultural & Applied Economics Association 2012 Annual Conference, Seattle WA, Aug 12-14, 2012. [Refereed]

Lim, Kar H., Wuyang Hu, Leigh Maynard and Ellen Goddard. "Consumers' Risk Perceptions and Willingness to Pay for Country-of-Origin Labeled Beef: An application of Individual-Level Parameter." Accepted Poster at 2012 AAEA/EAAE Conference on Food Environment, Boston, MA. May 30-31, 2012. [Refereed]

Lim, Kar H., Wuyang Hu, Leigh Maynard and Ellen Goddard. "Consumers' Risk Perceptions and Willingness to Pay for Country-of-Origin Labeled Beef: An application of Individual-Level Parameter." Selected Paper Presentation at Southern Agricultural Economics Association 2012 Annual Meeting, Birmingham, AL. Feb 4-7, 2012. [Refereed]

Lim, Kar H.. "A Primer to Mixed Logit: With an Illustration with Consumers Demand on Country-of-Origin Differentiated Beef" University of Kentucky, Department of Agricultural Economics Brown Bag Seminar. Lexington, KY. Nov 15, 2011.

Lim, Kar H., Wuyang Hu, Leigh Maynard and Ellen Goddard. "Perceived Risk and the Demand for Country-of-Origin-Labeled Beef." Accepted Paper Presentation at Consumer Market and Demand Network 2011 Workshop, Guelph, Canada. Aug 16, 2011. [Refereed]

Lim, Kar H., Leigh Maynard, Wuyang Hu, and Ellen Goddard. "Willingness to Pay for Country-of-Origin-Labeled Beef Steak: An Application of Mixed Error Component Logit Model." Selected Paper Presentation at Agricultural & Applied

Economics Association 2011 Annual Conference, Pittsburgh, PA. Jul 26, 2011. [Refereed]

Lim, Kar H., Leigh Maynard, Wuyang Hu, and Ellen Goddard. "U.S. Consumers' Preference and Willingness to Pay for Country-of-Origin Labeled Beef Steak and Food Safety enhancements." Selected Poster Presentation at Comparative Decision Making Studies 2011 Conference, Lexington, KY. May 15, 2011. [Refereed]

Lim, Kar H.. "The Impact of Food Aid on Domestic Grain Production In Africa: An Application of Granger Causality Test Using Arellano-Bond Dynamic Panel Estimator." University of Kentucky, Department of Agricultural Economics Seminar. Lexington, KY. May 13, 2009

Teaching Experience

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Advanced Quantitative Methods in Agricultural Economics, AEC 624 (Graduate Level), Spring 2012

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