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Beef Labeling After BSE: Do Consumers Care about BSE Testing and GMO Labeling? Evidence From Canada and the US

Bodo Steiner and Jun Yang
Department of Rural Economy
University of Alberta

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Department of Rural Economy
Faculty of Agriculture & Forestry,
and Home Economics
University of Alberta
Edmonton, Canada

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Following the May 2003 Canadian BSE case, food safety issues have become even more prominent to policymakers and consumers. In both Canada and the US, governments and industry have responded with a variety of quality assurance, traceability and labeling schemes. However, there is little information available on the extent to which consumer perceptions differ regionally across North America towards labeling schemes. This paper attempts to fill this gap, by providing results on a variety of beef labeling strategies from choice experiments that were conducted in Alberta (Canada) and Montana (US). The analysis focuses on consumers' perceptions towards negative voluntary labeling with regard to BSE testing, genetically modified organisms (GMO) and the use of growth hormones in beef production. We find that four years after the first BSE case emerged in North America, consumers are willing to pay most to avoid risks associated with BSE. Montana and Alberta consumers are found not to be significantly heterogeneous in their preferences.

Keywords: Choice experiments; Multinomial logit; Beef labeling

JEL Classification: D12, L66, C35

Introduction and Background

In the course of the May 2003 Canadian BSE case, trade and food safety issues received top priority on the policy agenda on either side of the border. In Montana, the fifth largest beef producing region in the US, beef producers had lobbied for a sustained border closure with Canada that lasted until August 2005, two months after the first BSE case of US origin had emerged. Alberta's beef producers, which produced 72% of Canada's beef in 2003, were most significantly affected among all of the Canadian provinces by these trade restrictions. However, per capita beef consumption declined much less in Canada after May of 2003 than in Europe after March 1996, when scientists had first established a possible link between BSE and variant Creutzfeld-Jakob Disease[1]. Following the 2003 BSE cow, annual beef per-capita consumption declined in 2004 in both the US and Canada, yet it rebounded in both countries to levels exceeding the pre-BSE consumption levels in 2006 (Statistics Canada (2006); Figure 1, p.16).

However, despite similar aggregate consumption patterns across borders (Figure 1), we have little information on how consumer perceptions differ towards beef, and more specifically towards beef labeling strategies, across the US and Canada. This paper focuses on three labeling provisions with regard to growth hormones, genetically modified (GM) organisms and BSE testing. There are several reasons why this paper concentrates labeling issues. Following the recent BSE incidences in the North American meat sector, it is likely that consumer trust in private and public suppliers of labeling information has changed significantly compared to the situation prior to 2003 (deJonge, Frewer, vanTrijp, Renes, deWit, and Timmers 2004). Further, the difficulties for private firms to recoup food-safety related investments is likely to have increased, since an increasingly complex food demand chain opens the door for further market failures in cases where food hazards can enter the food chain at multiple points. As a result, government regulation is likely to have an increasing role in the future in mitigating market failures through labeling and through public quality assurance by regulating labeling (Caswell and Mojduszka 1996). This role for government regulation can also be

[1] According to consumer surveys between March to May 1996, consumers reduced their beef consumption by 70%, as compared to the week prior to March 26. A month later, beef consumption was still down by 30 to 50% (Southey 1996).

put forward for origin labeling and mandatory labeling for GM content (Umberger, Feuz, Calkins, and Sitz (2003), Unnevehr and Hasler (2000)).[2]

However, considering the aim of the present paper in pursuing a comparative analysis that focuses on labeling attributes, it is important to recognize that in response to past food safety crises and differences in consumers' food safety concerns, governments and industry in the US and Canada have responded with different quality assurance schemes and labeling regulations (Hobbs, Fearne, and Spriggs (2002); Roberts and Unnevehr (2003)). Voluntary labeling of beef from cattle administered growth hormones has long been practiced in the US, yet we have evidence that consumers are both critical as well as unaware of their use (Lusk and Fox 2002).[3] With regard to labeling regulations for foods with genetically modified (GM) content, there are only minor differences between the US and Canada. Both countries have not implemented mandatory labeling for foods with GM contents, and in both countries, food labels are only required to carry information about

GM contents in cases where genetic modification significantly alters the properties of the food (Teisl and Caswell (2003), Roe and Teisl (2007)). Whereas US consumers have been able to buy food products that are guaranteed to not contain GM ingredients based on a nationwide standard (USDA certified organic), this has not been the case in Canada. Largely due to the pressure of the European Union's import regulations, Canada has only now (December 2007) implemented a nationwide standard for organic produce, which also contains a guarantee for the absence of GM contents in organic produce.

Labeling for BSE testing is also a contentious issue, not at least since March 26, 2007, when the US District Court for the District of Columbia ruled that the USDA does not have authority to regulate testing for BSE. However, since this ruling was repealed by USDA, it has not entered the current Farm Bill.

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[2] The regulation of health claims in both the US and Canada is also done under the premise of improving the market for nutritional qualities (Unnevehr and Hasler 2000).

[3] Nutritional labeling has also a long history in the US. The US government has made nutrition labeling (nutrition information panels) mandatory since 1994 (Caswell 1997). In contrast, nutrition labeling in Canada became only mandatory for most prepackaged foods as of December 2005 (Statistics Canada 2007b). Smaller businesses have until December 12, 2007, to make nutrition information available (Statistics Canada 2007b).

Furthermore, the stringency of enforcing those regulations may differ between countries (Mitchell 2003), generating differences in consumer trust in public and private labeling efforts. In sum, as a variety of different factors impede on consumers' trust in governmental and non-governmental information providers, we expect to find differences in consumers' willingness to pay for labeling attributes across countries (Priest, Bonfadelli, and Rusanen (2003); Baker (2003)).

Objectives and Previous Work

Given the diversity of labeling approaches, Roosen, Lusk, and Fox (2003) suggest to categorize labels along four dimensions: the entity on whose behalf they signal (a single firm or a group); the information content of the label; the mechanism of accreditation (an independent organization or government); and the degree of government involvement (mandatory enforcement vs. voluntary industry compliance). In this paper, we abstract from both the entity on whose behalf the label signals, and the mechanism of accreditation. The analysis focuses on voluntary negative labeling: the guarantee that beef is tested for BSE, the guarantee that it is raised without growth hormones and antibiotics, and the guarantee that it is produced without GMO's.

Most recently, negative GM labeling was found to be more valued by US consumers than positive GM labeling. Roe and Teisl (2007) used a survey to show that simple claims of No-GM content are viewed by consumers as most adequate in terms of the information provided to make an informed decision. Roe et al. (2007) also show that a No-GM label that is certified by the FDA and includes contact information is perceived by consumers as most credible and adequate.

Consumers' perceptions toward other beef labeling attributes have been explored through a number of stated and revealed preference analyses. Hobbs, Bailey, Dickinson, and Haghiri (2005) conducted experimental auctions in 2002 to assess Canadian consumers' willingness to pay (WTP) for traceability assurance, food safety assurance and on-farm production methods assurance for beef and pork products. Their key finding that simple traceability assurance in the absence of quality assurances related to food safety is valued less by consumers, is stronger for beef than for pork, and is also

consistent with results obtained from an earlier experimental auction-based study in the US (Dickinson and Bailey 2002). Other studies have contrasted consumers' perceptions for beef versus bison. In an auction-based study which was conducted prior to the May 2003 BSE case (in 2002) and that encompassed five locations across Canada, Hobbs, Sanderson, and Haghiri (2006) evaluate Canadian consumers' willingness-to-pay for bison versus beef. Using beef and bison sandwiches as part of the experimental design, the study's results suggest that there was no statistically significant higher willingness-to-pay for bison sandwiches over beef sandwiches, either with or without the additional quality assurances.

We are aware of only one earlier Canadian study related to beef labeling and quality assurances. In 1996, Quagrainie, Unterschultz, and Veeman (1998) conducted choice experiments among Canadian consumers for origin labeling (beef and pork) and biopreservatives in packaging. While the study establishes a significant price premium for Canadian over US beef, it finds that Canadian consumers view biopreservatives negatively in packaging.

Our study is related to two other choice-experiment-based studies. Tonsor, Schroeder, Fox, and Biere (2005) conducted three choice experiments in 2002 in London, Frankfurt, and Paris, to analyze how consumers value beef steaks with attributes including “GM-free”, farm-specific source verification, and domestic origin. This study finds that consumers are significantly heterogeneous across regions in their preferences for beef steak attributes. Lusk and Schroeder (2004) conducted choice experiments in 2002 in the US, in order to test for hypothetical bias in consumers' valuation of beef steak attributes, including steaks that were “guaranteed natural”. The marginal WTP for steak attributes was found to be equivalent in both the hypothetical and real settings, where consumers where given the option to actually purchase steaks. However, purchasing propensities were found to be higher in the hypothetical setting, compared to the non-hypothetical setting.

Our study is also related to an analysis of beef labeling strategies in Europe. Roosen, Lusk, and Fox (2003) conducted mail-back surveys based on referendum design with follow-up in 2000 in France, Germany, and the UK to analyze consumers' WTP for

alternative beef labeling strategies. Their analysis focuses on brands, origin labels, and mandatory labeling of beef from cattle fed genetically modified feed. Consumers were asked to state their preferences for a brand that signals on behalf of an individual firm (not accredited by a third party nor by government), for a product origin label (producers belonging to a regional collective), and for a mandatory GM label (beef fed GM crops, certified by a government agency). The study results suggest that European consumers have high concerns over GM foods, as more than 90% of surveyed consumers wanted a mandatory labeling program for beef produced from cattle fed genetically modified crops.

Our study differs from the above in several ways. First, this is, to the best of our knowledge, the first comparative US-Canada study that analyzes consumers' valuation for beef labeling attributes. Second, our study also seems to be the first study to explore North American consumers' willingness-to-pay for BSE testing. Third, it is to the best of our knowledge also the first choice-experiment based study in North America focusing on beef labeling, in which the survey was conducted after the May 2003 Canadian BSE case. It provides thus a useful comparison to the results from previous studies that have explored labeling issues and consumers' GMO perceptions in the North American context (Hobbs, Bailey, Dickinson, and Haghiri (2005); Tonsor, Schroeder, Fox, and Biere (2005); Quagrainie, Unterschultz, and Veeman (1998)). Fourth, in contrast to previous choice-experiment based studies on beef (Quagrainie, Unterschultz, and Veeman (1998), Tonsor, Schroeder, Fox, and Biere (2005)), consumers in our study were first asked to identify their regular beef steak in terms of multiple attributes and attribute levels. This information was then used in the following choice experiment as consumers' status quo, such they were asked to trade off their status quo with alternative beef attribute combinations. In this way, we expect that consumers' trade-off decisions are close to trade-offs in the marketplace, since consumers are asked to compare less familiar steak options with a beef steak option that is close to their individual preference structure. Further, in contrast to previous choice-experiment based studies on beef labeling (Alfnes

(2004), Enneking (2004)), our study includes an opt-out option and tests for a restricted choice set.[4]

The remainder of the paper is structured as following. In section (3) we describe data collection and experimental design. Section (4) presents the econometric approach and the estimation results, and conclusions are presented in section (5).

Data and Experimental Design

Our analysis builds on two web-based surveys that were conducted during the same time period (April 2006) in Montana (US) and Alberta (Canada). The survey development was initiated by focus group research using Alberta consumers only, whereby two rounds of focus group discussions were facilitated with 8 to 10 consumers each. The focus group research was used to identify the key attributes and attribute levels for beef steaks, as well as to gain feedback on the web-format of the survey. Consumers for the first two focus groups were recruited from the student population of the University of Alberta. An international marketing firm was then commissioned to use random digital dialing (RDD) to recruit Alberta consumers for two additional focus groups. Then, the revised web-based survey was further tested by 8 individuals (members of the administrative, academic staff and graduate students). The survey was finally put live in the following manner: consumers were first contacted via phone and offered a $5 voucher upon participation; non-respondents received reminder emails and one reminder phone call. Following this procedure, the marketing firm first recruited 12 Alberta consumers via RDD and then stopped, so that final adjustments to the survey design could be performed. After these steps, the international marketing firm used RDD to recruit a total of 214 consumers from Montana, and another 205 consumers from Alberta.

The survey consisted of three parts. First, consumers were asked several rating and ranking questions that related to beef steak attributes, consumption behavior of organic foods and the information sources that consumers rely on when it comes to

[4] Choice experiments frequently include opt-out options, as it allows the analyst to consistently estimate the total WTP for specific attribute combinations (Louviere, Hensher, and Swait (2000), Bennett and Adamowicz (2001), Bateman, Carson, Day, Hanemann, Hanley, Hett, Jones-Lee, Loomes, Mourato, Ozdemiroglu, Pearce, Sugden, and Swanson (2004).

labeling and food safety issues. In one question, consumers were asked to rank their information sources, specifically:

"*What type of media do you rely on as a source of information on food-safety related issues (food poisoning, BSE, genetically modified organisms).*"

Table 1. Ranking counts of information sources

	*Rank*1	*Rank*2	*Rank*3	*Rank*4	*Rank*5	*Rank*6	*Rank*7
Magazines & Newspapers	**126**	**102**	46	39	0	44	62
TV & Radio	**120**	**118**	68	38	2	33	40
Internet	71	64	106	74	8	47	49
Family, friends, & colleagues	**44**	61	50	136	3	63	62
Telephone helpline	37	40	74	78	55	72	63
Health professionals	**17**	25	58	45	97	113	64
Labels on package	4	9	17	9	**254**	47	79

As Table 1 indicates, consumers mainly rely on print media followed by TV/radio as their primary sources of information on food-safety related issues. Considering information sources that were ranked as first and second sources, family, friends and work colleagues appear not even half as important as the above media sources. Somewhat surprisingly, health professionals are considered relatively unimportant sources of information. Not surprisingly, and in fact indirectly confirming that consumers understood the question and the typical information content of labels, is the fact that labels on packages were ranked least important as a source of information on food-safety related issues.

This rating and ranking part of the survey was followed by a choice-based experiment, which in turn was followed by questions on demographics. Before consumers proceeded to the choice experiment, they were asked to specify their regular beef steak purchase. This beef steak became their status quo in the following choice experiment, and was characterized in terms of four steak attributes. First, consumers could choose between four prices for their beef steak purchase. Second, they could

choose a beef label that carried a guarantee for BSE testing. Third, consumers could choose a label that carried a guarantee for absence of growth hormones. Fourth, consumers could choose beef steaks that were labeled as "Guaranteed produced without genetically modified organisms (GMO)". Once consumers had selected their regular beef steak purchase, they proceeded to a repeated choice experiment. This consisted of four tables (four separate web-pages), in each of which they could choose one of three options at varying attribute levels (choice A: their regular beef steak; choice B: a specified beef steak; choice C: neither). For such a given set of four treatments, the treatment order was randomized. The individual respondents were also randomly assigned to a given set of treatments. In order to analyze the role of the status quo (consumers' regular beef steak), we also specified a restricted choice set, in which the status quo was no longer available.

For the choice experiment, we specified an orthogonal main-effects only design (Louviere, Hensher, and Swait 2000). To reduce the number of treatment combinations, we used fractional factorial design and generated the experimental orthogonal design in SPSS.

Econometric Model and Results

For an analysis of consumers' unordered responses in the above choice experiments, we assume that consumers follow the standard assumptions of random utility theory. We further assume that an individual n's utility for alternative i can be written as:

$$U_{ni} = V_{ni} + \varepsilon_{ni} \qquad (1)$$

where the utility of an alternative consists of a deterministic component V (the beef steak attributes), and a random error term ε (unobservables and measurement error). The probability that individual n chooses alternative i from a choice set of alternatives J, can then be expressed as:

$$P_{ni} = P(U_{ni} > U_{nj}, \forall i \neq j \in J) = P(\varepsilon_{nj} > \varepsilon_{ni} + V_{ni} - V_{nj}, \forall i \neq j \in J) \qquad (2)$$

We further assume that the random error terms follow an extreme value Type I distribution, and that they are independently and identically distributed across

alternatives. The choice probabilities in equation (2) can then be expressed as a multinomial logit model (McFadden 1974),

$$P_{ni} = \frac{\exp(\mu\beta^T X_{ni})}{\sum_{j=1}^{J} \exp(\mu\beta^T X_{nj})} \tag{3}$$

The deterministic part of the utility function is assumed to be linear in parameters, $V_{ni} = \mu\beta^T X_{ni}$, μ denotes a scale parameter of utilities normalized to $\mu = 1$, and β^T is a parameter vector associated with the vector of explanatory variables X_{ni}. Therefore, the steak attributes (price, GMO, Growth hormones, BSE test) enter the consumer's utility function through X_{ni}. Interaction terms between socio-economic characteristics and the alternative-specific constants (as well as other attributes) were included to allow for preference heterogeneity (Louviere, Hensher, and Swait 2000).[5]

Table 2 provides summary statistics for the sample population in both Alberta and Montana.[6]

[5] A mixed logit model (Train 2002) was estimated, but did not converge. We used Limdep 8.0 and NLogit 3.0.1 for estimation.

[6] Consumers were asked to what extent they consider themselves to be red meat or white meat eaters (faced with a sliding scale of percentage distributions). Respondents were asked whether they would consider their roots to be rural or urban, which is reflected in 'urban'/ 'rural', below. Ethnic background is shown to document the diversity between Alberta and Montana, yet it is acknowledged that the perceptions of what constitutes, e.g. "European" is likely to vary significantly across the regions.

Table 2. Summary statistics of choice experiment participants

VARIABLE	CANADA (Alberta)	US (Montana)
Male (%)	38	42
Female (%)	62	58
Average age (years)	45	49
White meat eaters (40%red / 60% white or more white) %	30.55	25.48
Red meat eaters (60%red / 40% white or more red) %	44.15	53.37
Urban (%)	43.91	31.25
Rural (%)	56.09	68.75
Smokers (%)	13.84	12.02
Ethnic background:		
Asian	3%	<1%
British Isles	16.5%	21%
Central / South American	2%	<1%
European	30.5%	45.2%
Family income in 2005 after tax (%):		
Less than $50000 (Can/US dollar, respectively)	40.81	50
$50,000-$100,000 (Can/US dollar, respectively)	41.05	36.54
More than $100,000 (Can/US dollar, respectively)	18.14	13.46
Lived for less than 10 years in Can/US, respectively (%)	53.22	99.04
Married (%)	68.74	69.71

Table 3 shows the procedure that was followed for the model selection. We used likelihood ratio-tests to choose between models. Models for the restricted choice sets, where consumers had no longer their regular steak available, were included in our estimation procedure. Based on this model selection procedure, model (3) was selected as final model specification: since the -2LL value (46.65) is smaller than the critical Chi-square value (55.76), the model with all interaction terms is inferior; similarly, comparing the LL of the pooled model (A,B,C pooled with restricted choice set B,C) with the likelihoods from the two separate models (unrestricted choice set model and restricted choice set model), the pooled model is rejected since 186.05 exceeds the critical Chi-square value (the base model is the unrestricted choice model (A,B,C) with reduced interaction terms).

Table 3. Model selection

	Unrestricted choice set (A,B,C), *no interactions* **Model (1)**	Unrestricted choice set (A,B,C), *all interactions* **Model (2)**	Unrestricted choice set (A,B,C), *reduced interactions* **Model (3)**	Restricted choice set (B,C), *reduced interactions* **Model (4)**	Pooled data (A,B,C and B,C), *reduced interactions* **Model (5)**
(R-squared Adjusted)	(.3208)	(.3615)	(.3564)		
LR ratio test with respect to model (3)	LR = -2LL((3)-(1)) =155.0989; Chi-sq (34)=48.6	LR = -2LL((2)-(3)) =46.6453; Chi-sq (34)=55.7585			
LR ratio test model (5): LR=-2LL([(3)+(4)]-(5))=186.0524; Chi-aq (36)=51					

The results for model (3) are presented in Table (4).

Table 4. Estimation results for model (3)

VARIABLES	**PARAMETERS (standard errors)**
Choice A	4.5368*** (0.225)
Choice B	3.5554*** (0.2386)
Price	-0.1284 *** (0.0206)
BSE test guarantee	0.2735* (0.1521)
GMO guarantee	0.3045 (0.2009)
Guaranteed free of growth hormones	0.2295 (0.1815)
ChoiceA x Male	0.573*** (0.2186)
ChoiceB x Male	0.2242 (0.2338)
White Meat eater × Price	0.016** (0.0075)
Even white/red meat eater × Price	-0.0083 (0.0061)
Male × Price	-0.0101 (0.0112)
Age < 20 × Price	0.0267 (0.034)
20≤age<50 × Price	0.0089 (0.0178)
Edu less college × Price	-0.0025 (0.0052)
Regular smoker × Price	-0.0111* (0.0065)
< 5 years in Can(US) × Price	-0.0148*** (0.0048)
White meat preferred × Guaranteed BSE test	0.1649** (0.0789)
Even white/red meat eater × Guaranteed BSE test	0.0066 (0.0638)
Male × Guaranteed BSE test	0.1* (0.0513)
Age < 20 × Guaranteed BSE test	-0.2087 (0.2742)
20≤age<50 × Guaranteed BSE test	0.1986 (0.1471)
Education below college × Guaranteed BSE test	0.1604*** (0.0571)
Regular smoker × Guaranteed BSE test	-0.2675*** (0.0723)
< 5 years in Can(US) × Guaranteed BSE test	0.0015 (0.0492)
White meat preferred × Guaranteed free of GMO	0.1699** (0.0824)
Even white/red meat eater × Guaranteed free of GMO	-0.0055 (0.0685)
Even white/red meat eater × Guaranteed free of GMO	-0.0055 (0.0685)
Male × Guaranteed free of GMO	0.0619 (0.056)
Age < 20 × Guarantee free of GMO	-0.2338 (0.3758)
20≤age<50 × Guarantee free of GMO	0.1226 (0.1958)
Education below college × Guaranteed free of GMO	-0.0896 (0.061)
Regular smoker × Guaranteed free of GMO	0.1784** (0.0789)
< 5 years in Can(US) × Guaranteed free of GMO	0.0488 (0.0536)
White meat preferred × Guaranteed free of growth hormones	0.1226 (0.0808)
Even white/red meat eater × Guaranteed free of growth hormones	-0.0122 (0.0665)
Male × Guaranteed free of hormone	-0.1143** (0.054)
Age<20 × Guaranteed free of hormones	-0.525 (0.3373)
20≤age<50 × Guarantee free of growth hormones	0.2555 (0.1779)
Education below college × Guaranteed free of growth hormones	0.1837*** (0.059)
Regular smoker × Guaranteed free of hormone	0.0016 (0.0743)
R square adjusted	.3564
LogLikelihood at convergence	-1170.8378
Number of observations	419

In order to test for differences between Canadian and US consumers' preferences, we used models with and without interaction terms between the design variables (and the alternative specific constants) and the regional dummies, as a basis for a likelihood ratio test. The test statistics suggest that perceptions of Alberta and Montana consumers are not significantly different. This is not unexpected, since Alberta and Montana share not only the same border, but beef consumption and production is important in both of these regions (Lawrence and Otto (2003); Davis and Lin (2005b); TheDaily (2004); Su (2006)).

Given the inability to statistically differentiate consumer preferences in Alberta from those of Montana, the results in table 4 are based on a pooled data set (n= 419).[7] The results suggest that when consumers are given the option to value the above labeling attributes in a beef steak, namely (i) beef that is guaranteed produced without genetically modified organisms (GM guarantee), (ii) beef that is guaranteed raised without growth hormones (hormone guarantee) and (iii) beef that is guaranteed tested for BSE, the latter was valued most irrespective of the country of origin of the consumer. The strongly significant coefficient estimate for choice A suggests that consumers have, as expected, as strong preference for their status quo beef steak. Further, the estimation results suggest that risks associated with BSE appear to be less of concern to more educated consumers, whereas risks associated with GMO's appear to be more of concern to more educated consumers. Thus, in line with Roosen, Lusk, and Fox (2003), we find that consumers are concerned about the indirect consumption of genetically modified organisms, i.e. the use of GM feed in beef production. Further, female consumers show a lower marginal utility with regards to BSE testing and with regards to the GM guarantee than male consumers. Regular smokers appear to value BSE testing less than nonsmokers, yet this result is reversed for the GM guarantee. We also differentiated consumers in terms of white vs. red meat eaters, and, as expected, white meat eaters show a higher marginal utility for all three labeling attributes, compared to red meat eaters.

[7] The *,**,*** denote signi_cance at the 10%, 5% and 1% level, respectively.

Since we were also interested in welfare measures, we computed the marginal WTP (MWTP) for attributes based on the unrestricted model (A,B,C) with reduced interaction terms (model 3),

$$MWTP_j = \frac{1}{MUM} * MU_j \qquad (4)$$

where the negative marginal utility of price is the marginal utility of money (MUM), and MU_j denotes the marginal utility of j th attribute. The marginal utility of price was allowed to vary across individuals, since interaction terms between price and socio-economic variables were included in the model. Although an average consumer could be used to calculate the marginal WTP, due to the likely non-linear nature of the MWTP function, we calculated the individual MWTP's and then derived the average MWTP for specific attributes.

As a second welfare measure, we followed Freeman (1993) to obtain compensating variation measures (CV) for various attributes,

$$CV = \frac{1}{MUM} * (Log(\sum_i e^{v_i^1}) - Log(\sum_i e^{v_i^0})) \qquad (5)$$

Table (5) displays both of the above welfare measures.

Table 5. Welfare measures

	MWTP BSE test	MWTP GMO free	MWTP GRH free	CV BSE test	CV GMO free	CV CRH free
Mean	**4.01**	2.42	3.33	**7.41**	4.44	6.01
Median	3.68	2.33	3.31	6.79	4.01	5.90
Mode	5.42	2.48	3.52	2.83	2.94	4.87
SD	2.79	1.71	2.04	5.34	3.24	3.77

Comparing beef steaks that are labeled as not being produced with GMO's with beef steaks that carry a guarantee for absence of growth hormones, our welfare measures suggest that consumers are willing to pay most to avoid risks associated with BSE: the average (median) CV for guaranteed tested for BSE were $7.41/kg ($6.79/kg). Further, when we compare the growth hormone guarantee with the GM guarantee, the CV

measures suggest that consumers place a higher valuation on the guarantee that the animals were raised without growth hormones.

Conclusion

This paper reports the results from an internet-based consumer survey that was conducted in both the US (Montana) and in Canada (Alberta) after the May 2003 BSE case affected meat markets in North America. The analysis focuses on an attribute-based repeated choice-experiment to explore consumers' valuation of beef labeling strategies on both sides of the border. The labeling strategies that are explored are based on three labeling attributes related to beef steaks: (i) beef that is guaranteed produced without genetically modified organisms), (ii) beef that is guaranteed raised without growth hormones and (iii) beef that is guaranteed tested for BSE.

Our results suggest that perceptions of Alberta and Montana consumers towards the above beef steak labeling strategies are not significantly different. Using a pooled data set, our estimates suggest that four years after the first BSE case emerged in North America from an Alberta cow, consumers are willing to pay most to avoid risks associated with BSE (compared to risks associated with GMO's and growth hormones), as reflected in consumers' valuation of labels that assure consumers that beef is guaranteed tested for BSE. However, more educated consumers appear to value a guaranteed BSE tested steak less compared to less educated consumers. In contrast, more educated consumers seem to value beef that is guaranteed produced without genetically modified organisms more highly, compared to less educated consumers. Given the long history of the use of growth hormones in North American beef, it is not surprising that consumers' willingness to pay for a guarantee for BSE testing is higher compared to consumers' willingness to pay for a guarantee that the animals were raised without growth hormones.

References

Alfnes, F. 2004. Stated preferences for country of origin of beef: Application of a mixed logit model. *European Review of Agricultural Economics* 31: 19-37.

Baker, G. 2003. Food safety and fear: Factors affecting consumer response to food safety risk. *International Food and Agribusiness Management Review* 6: 1-11.

Bateman, I., R. Carson, B. Day, M. Hanemann, N. Hanley, T. Hett, M. Jones- Lee, G. Loomes, S. Mourato, E. Ozdemiroglu, D. Pearce, R. Sugden, and J. Swanson. 2004. *Economic valuation with stated preference techniques.* Cheltenham: Edward Elgar.

Bennett, J. and W. Adamowicz. 2001. Some fundamentals of environmental choice modeling. In J. Bennett and R. Blamey (Eds.), *The choice modeling approach to environmental valuation*, pp. 37-69. Cheltenham, UK: Edward Elgar.

Caswell, J. 1997. Uses of food labeling regulations. Paris: OECD working papers, vol. V, no.100.

Caswell, J. and E. Mojduszka. 1996. Using informational labeling to influence the market for quality in food products. *American Journal of Agricultural Economics, Proceedings* 78(5): 1248-1253.

Davis, C. and B.-H. Lin (2005a). Factors affecting U.S. Beef Consumption. Washington D.C.: Electronic outlook report from ERS, LDP-M-135-02, October 2005.

Davis, C. and B.-H. Lin (2005b). Factors affecting U.S. Beef Consumption. USDA-ERS Outlook Report No. (LDPM13502).

deJonge, J., L. Frewer, H. vanTrijp, R. Renes, W. deWit, and J. Timmers. 2004. Monitoring consumer confidence in food safety: an exploratory study. *British Food Journal* 106(10/11): 837-49.

Dickinson, D. and D. V. Bailey. 2002. Meat traceability: Are US consumers willing to pay for it? *Journal of Agricultural and Resource Economics* 2: 348-364.

Enneking, U. 2004. Willingness-to-pay for safety improvements in the German meat sector: the case of the q&s label. *European Review of Agricultural Economics* 31(2): 205-223.

Freeman, M. A. 1993. The measurement of environmental and resource values: Theory and methods. Washington, D.C.: Resources for the Future.

Hobbs, J., D. Bailey, D. Dickinson, and M. Haghiri. 2005. Traceability in the Canadian meat sector: Do consumers care? *Canadian Journal of Agricultural Economics* 53: 47-65.

Hobbs, J., A. Fearne, and J. Spriggs. 2002. Incentive structures for food safety and quality assurance: an international comparison. *Food Control* 13: 77-81.

Hobbs, J., K. Sanderson, and M. Haghiri. 2006. Evaluating willingness-to-pay for bison attributes: An experimental auction approach. *Canadian Journal of Agricultural Economics* 54: 269-287.

Lawrence, J. and D. Otto. 2003. Economic importance of Montana's cattle industry.http://www.beef.org/NEWSECONOMICIMPORTANCEOFMONTANASCATTLEINDUSTRY2711.aspx.

Louviere, J., D. Hensher, and J. Swait. 2000. Stated choice methods: Analysis and applications. Cambridge, UK: Cambridge University Press.

Lusk, J. and J. Fox. 2002. Consumer demand for mandatory labeling of beef from cattle administered growth hormones or fed genetically modified corn. *Journal of Agricultural and Applied Economics* 34(1): 27-38.

Lusk, J. and T. Schroeder. 2004. Are choice experiments incentive compatible? A test with quality differentiated beef steaks. *American Journal of Agricultural Economics* 86(2): 467-482.

McFadden, D. 1974. Frontiers in econometrics. In P. Zarembka (Ed.), *Conditional logit analysis of qualitative choice behavior*, pp. 105-142. New York: Academic Press.

Mitchell, L. 2003. Economic theory and conceptual relationships between food safety and international trade. In J. Buzby (Ed.), International Trade and Food Safety: Economic Theory and Case Studies, pp. 10-27. Washington, DC: Economic Research Service, Ag.Econ. Report No.828.

Priest, S., H. Bonfadelli, and M. Rusanen. 2003. The "trust gap" hypothesis: Predicting support for biotechnology across national cultures as a function of trust in actors. *Risk Analysis* 23: 751-766.

Quagrainie, K., J. Unterschultz, and M. Veeman. 1998. Effects of product origin and selected demographics on consumer choice of red meats? *Canadian Journal of Agricultural Economics* 46: 201-219.

Roberts, D. and L. Unnevehr. 2003. Resolving trade disputes arising from trends in food safety regulation: The role of the multilateral governance framework. In J. Buzby (Ed.), *International Trade and Food Safety: Economic Theory and Case Studies*, pp. 57-89. Washington, DC: Economic Research Service, Ag.Econ. Report No.828.

Roe, B. and M. Teisl. 2007. Genetically modified food labeling: The impacts of message and messenger on consumer perceptions of labels and products. *Food Policy* 32: 49-66.

Roosen, J., J. Lusk, and J. Fox. 2003. Consumer demand for and attitudes toward alternative beef labeling strategies in France, Germany, and the UK. *Agribusiness - An international Journal* 19(1): 77-90.

Southey, C. 1996. Beef consumption well below pre BSE levels. *Financial Times* 05.06.1996, 10.

Statistics Canada 2006. Food Consumption Highlights 2006. http://www.statcan.ca/english/ads/23F0001XCB/highlight.htm, accessed March 23, 2007.

Statistics Canada. 2007a. Food Statistics 2006. Statistics Canada, Agriculture Division, Catalogue no. 21-020-XIE, ISSN 1705-2920.

Statistics Canada. 2007b. Nutrition Labelling. http://www.hc-sc.gc.ca/fnan/label-etiquet/nutrition/index e.html, accessed March 13, 2007.

Su, C. 2006. Agriculture and Food Value Chain Facts 2006. AAFRD, http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/com7126, accessed March 23, 2007.

Teisl, M. and J. Caswell. 2003. Information policy and genetically modified food: Weighing the benefits and costs. Working Paper No.2003-1, Department of Resource Economics, University of Massachusetts, Amherst, MA.

TheDaily, S. 2004. Livestock estimates. Statistics Canada, http://www.statcan.ca/Daily/English/040819/d040819b.htm, accessed March 23, 2007.

Tonsor, G., T. Schroeder, J. Fox, and A. Biere. 2005. European preferences for beef steak attributes. *Journal of Agricultural and Resource Economics* 30(2): 367-380.

Train, K. (2002). Discrete choice methods with simulation. Cambridge: Cambridge University Press.

Umberger, W., D. Feuz, C. Calkins, and B. Sitz. 2003. *Country-of-origin labeling of beef products: U.S. consumers' perceptions*. Washington D.C., March 20-21: Paper Presented at the 2003 FAMPS Conference: "Emerging Roles for Food Labels: Inform, Protect, Persuade".

Unnevehr, L. and C. Hasler. 2000. Health claims and labeling regulation: How will consumers learn about functional foods? *AgBio Forum* 3(1): 10-13.

Figure 1. Annual beef per capita consumption in the US and Canada (kg)

	1980	1981	1985	1986	1990	1991	1996	2001	2002	2003	2004	2005	2006
US beef, not adjusted[a]	34.7		35.9		30.7		30.2	30.0	30.7	29.5	30.0		
Can beef, not adjusted[b]		39.86		38.2		33.28	31.45	30.75	30.46	31.77	30.66	31.08	31.74
Can beef, adjusted[c]		17.59		16.67		13.95	13.31	13.01	12.89	13.44	12.97	13.15	13.43

Source: Statistics Canada (2007a), Davis and Lin (2005a)

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[a]refers to "retail weight equivalent", where "*retail products are sold with less bone and closer trim"* (Davis *et al.* 2005, p.5)

[b]*Does not adjust for losses, such as waste and/or spoilage, in stores, households, private institutions or restaurants or losses during prepation."* (Statistics Canada 2006, p.24)

[c]refers to boneless weight; "*The data have been adjusted for retail, household, cooking and plate loss.*" (Statistics Canada 2006, p.32)