

BSE in Japan: Consumers' Perceptions and Willingness to Pay for Tested Beef

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Abstract: The discovery of BSE, commonly known as “mad cow disease,” in Japan caused anxiety about consuming beef and beef products. As a result, there was a sudden fall in sales of beef, which hurt the Japanese beef industry as well as major beef exporters to Japan. We analyze factors that affect Japanese consumers' willingness to pay price premiums for BSE-tested beef and estimate the mean willingness to pay (WTP) for BSE-tested beef using data obtained from a consumer survey in Japan. A single-bounded dichotomous choice contingent valuation model that recovers the premium amount as a threshold is used for these purposes. We find that food safety and environmental attitudes, reduction in beef consumption following the BSE outbreak, and being female all have a statistically significant positive effect on the WTP for BSE-tested beef. In our sample, consumers are willing to pay a premium on average of greater than 50% for BSE-tested beef.

1. Introduction

On September 10, 2001, it was publicly announced that a dairy cow from Chiba Prefecture, Japan had tested positive for Bovine Spongiform Encephalopathy (BSE) commonly known as “mad-cow disease.” This was the first case of BSE in a domestic cow outside Europe giving the BSE-scare global dimensions (Ono and Stecklow, 2001). Until the BSE outbreak, the prospects for the Japanese beef market had been promising. Annual Japanese beef consumption had tripled over recent decades to about 21 pounds per person (Brooke, 2001), and the Japanese beef market had been liberalized allowing for the importation of fresh/chilled and frozen beef.

The BSE-scare caused a sudden, extreme disruption in consumer demand for beef. By the end of November 2001, after a total of three cases of BSE had been discovered in Japan, sales of domestic and imported beef had fallen by 70 percent (Zielenziger, 2002). A fourth case of BSE was discovered on May 13, 2002. Major beef exporters to Japan, such as Australia and the United States lost as much as 50 percent a month in volume of beef imports during the time September and November 2001 (Ono, 2002). These losses resulted in spite of the fact that both countries certify their beef to be “BSE-free.”

The handling of the BSE scandal by the Japanese beef industry and government further damaged consumer confidence. It took more than two weeks from the first confirmed case of BSE in Japan for the Japanese authorities to announce the finding (Zielenziger, 2001). After the first domestic BSE case, the Japanese beef industry assured consumers that domestic beef was healthy, but their credibility was harmed when, only a month later, a second case of BSE was discovered (Zielenziger, 2001). Japanese consumers who generally perceive domestically produced foods to be safer than imported foods now have become apprehensive about consuming both imported and Japanese beef (Zielenziger, 2001).

It is important for both beef producers and exporters to understand better Japanese consumers' characteristics and attitudes in order to restore consumer confidence. We investigate factors affecting Japanese customers' willingness to pay premium for beef labeled as being BSE tested, and we estimate the magnitude of such a premium. We use survey data collected during December 2001 at a local consumer cooperative in Nagano, Japan.

The paper proceeds as follows: Section 2 provides general information about the BSE outbreak and its economic impacts in Japan. In Section 3, previous studies are discussed. In Section 4, the survey methodology and the characteristics of the data are presented. In Section 5, we present the single-bounded dichotomous choice contingent valuation model. In Section 6, the estimation results are discussed, including factors that affect willingness to pay for BSE tested beef and the estimated average willingness to pay. A final section provides concluding comments.

2. Background

In 1984, the first case of the syndrome later identified as BSE was discovered in Great Britain, and the infected cattle died within few weeks (Cowley, 2001). In subsequent years, hundreds of British cows would be infected every week. In 1986, the syndrome was recognized as one of the nervous system diseases caused by prions, and the new syndrome was named BSE. The primary cause of BSE was discovered to be recycling of cows—meat-and-bone meal derived from diseased cattle was fed to cattle (Cowley, 2001). In 1988, Britain banned domestic use of meat-and-bone meal made of from ruminants in the feed for ruminants and started destruction of all BSE-infected cows (Cowley, 2001). However, up until 1996, Britain continued their export of meat-and-bone meal to 15 Asian countries and 27 European and

Middle- and Near-East countries likely spreading the BSE contamination globally. Between 1988 and 1996, Asian countries imported almost a million tons British meat-and-bone meal (Cowley, 2001).

Until 1995, victims of the fatal, nervous system disease Creutzfeldt-Jakob Disease (CJD) on average were 65 years old but after 1995, the number of CJD victims arising among people in their early 20's increased in Britain. It turned out that the young CDJ victims were suffering from variant CJD (vCDJ), a fatal disease that causes gradual destruction of the brain. In 1996, the British Government publicly announced that vCDJ was contracted from eating BSE-infected beef. They banned export of meat-based cattle-feed (Cowley, 2001).

Up until 1996, Japan was a major importer of meat-and-bone meal from the U.K to be used in animal feed. During the period 1996-2000, Japan continued to import meat-and-bone meal from other EU countries (Ono, 2001). Finally, in January 2001, the Japanese government decided to stop importing beef and processed beef products from the EU and other countries where BSE had been discovered (Yamanouchi, 2001). No cases of vCDJ have yet been discovered in Japan.

After the first BSE-infected cow was identified in Japan, the Japanese government took steps to assure the safety of domestic beef. On October 18, 2001, the Japanese Ministry of Health, Welfare, and Labor started national testing of all cattle for BSE-infection so that only safe beef may be sold (Brooke, 2001). According to the new, stricter regulations, highly infectious cow parts¹ must be destroyed at every meat slaughter plant throughout Japan (Asahi Shimbun, 2001). The Japanese government is working to establish a system of traceability in which the identity of each cow can be traced all the way through the supply-chain to the grocery store to be implemented by March 2002 (Asahi Shimbun, 2001).

Despite Japan's now stricter safety policy for beef, a general distrust in the government's assurances inhibits Japanese consumers from buying beef and beef products regardless of country of origin. Most consumers have reduced their consumption of beef or completely excluded it from their diets. Pork and chicken are common substitutes for beef, and consumers are also returning to their traditional fish-based diets for its safety (Brooke, 2001). In response to the falling beef demand, producers, supermarkets, and restaurants have increased their spending on advertisement and promotion of beef products hoping that it will contribute to restore consumer confidence in beef products. Most beef barbecue restaurants have changed their menus to include non-beef dishes and have lowered their prices to maintain their customer base (Ono and Stecklow, 2001). McDonald's Japan ran a \$4.1 million advertisement campaign, announcing that "McDonald's uses only beef from Australia, where the mad cow disease does not exist" (Ono, 2001). Supermarket chains are also promoting BSE-free American and Australian beef or Japanese beef with large discounts and a safety label on the package claiming that the beef has tested BSE-free.

3. Previous Studies

The BSE-outbreak and its effects on the livestock industry, beef demand, and consumers' food safety perceptions have been studied in Europe where a large number of countries have been affected. Loader and Hobbs (1996) analyze the expected impact of the BSE-crisis on the beef industry. They argue that in addition to the direct financial costs of the BSE-crisis for the industry, there are indirect or hidden costs, which are primarily transaction costs caused by asymmetric information. Loader and Hobbs (1996) also argue that there are some potential long-term benefits of the BSE-outbreak to the beef industry, such as that the industry will need to

become more consumer-oriented with a greater focus on food safety and opportunities for branding and market segmentation; creation of niche markets, and increased potential to capture price premiums. Certain firms such as organic producers and firms that emphasize quality assurance may gain direct benefits due to increased demand of their products.

Lloyd et al. (2001) studies the price adjustment in the U.K. beef market in response to the BSE outbreak, increased awareness, and likely effects of BSE. In the aftermath of the French BSE-outbreak, Latouche et al (1998) conducted a survey in France in 1997, eliciting consumers on consumption patterns and reasons for possible changes as well as consumers' attitudes about quality labels and sanitary norms. Consumers were asked how much of a premium they would be willing to pay for beef that could not transmit the human variant of BSE. The meat products were medium-quality, low-priced minced steak with little risk of vCDJ, and high-quality, higher-priced beef with no risk of vCDJ. The mean WTP premiums for the two meat products (including zero bids) were 22% of the original price and 13.7% of the original price, respectively. Further, the authors find that employed and highly educated respondents as well as respondents who preferred labeled or organic products indicate higher WTP, while respondents who are involved in agricultural activities are less willing to pay a premium.

In Belgium, Verbeke et al (2000) find that television coverage on meat safety has a negative effect on demand for red meat after the Belgium BSE-outbreak. Younger people are the most susceptible to such negative media coverage. Other factors that affect demand for red meat negatively are the presence of children younger than 12 years old in the household and the respondent's age. Verbeke and Ward (2001) analyze meat demand in Belgium after the BSE discoveries with an almost ideal demand system (AIDS) that includes an index of TV coverage

and advertising expenditures as explanatory variables. They find that advertising is found to have only a minor impact on demand compared to the negative media coverage.

In the Netherlands, Mangen and Burrell (2001) use a switching almost ideal demand system (AIDS) to investigate the preference shifts among Dutch consumers. They find that preference shifts due to the BSE crises reduced beef expenditures with offsetting gains in the shares of pork, prepared meat and fish.

The BSE-outbreak in Japan represents a dramatic example of the effect of consumers' food safety concerns on meat demand. A study of consumers in Japan, Australia and the United States by Erikson et al. (1998) indicates that consumers were concerned about food-borne illnesses in meat in these countries prior to the BSE outbreak. They find that the most important product attributes for consumers purchasing beef in these countries were the cleanliness of the display case and production/expiration date. They also find that geographical origin of the beef is more important to Japanese consumers than consumers from Australia and the United States. In a related study that is related to the current paper, Lusk et al (2003) compare consumer valuations of beef from cattle produced without growth hormones or genetically modified corn in selected European countries and the United States.

Quality labels on meat products can be an effective way to market quality (Loureiro and McCluskey, 2000). However, quality labeling for credence good attributes (Darby and Karni, 1973), such as BSE testing, can only be effective if consumers attach credibility to the label through monitoring or some other means of ensuring quality (McCluskey, 2000). In order to restore consumer confidence, quality labeling in Japan is now more widely applied. In June 2000, the Japanese Agricultural Standards (JAS) were revised to include an inspection and certification system for food products.

4. Data

The survey used in this study was pre-tested with Japanese subjects in Nagano, Japan, and conducted at the Seikatsu Club Consumer Cooperative (Seikyou), a grocery store-like setting, in Nagano-City, Japan during December 2001. Randomly selected shoppers were asked to participate as they bagged their groceries. By collecting data from consumers at the same time and place where actual purchase decisions are made, we hoped to better elicit consumers' true preferences about the products. The turndown rate was about 50% as observed by interviewers when they asked for participation. The survey was self-administered; consumers who were willing to participate were led to a rest area behind the bagging tables and were offered seats to answer the survey questions. When the survey was completed, a gift certificate, worth ¥130, was given as a reward.

Of the 400 consumers who participated, about 5% answered that they do not eat beef at all due to taste preferences or other personal reasons and were asked no further questions. In all, 381 consumers completed the survey-questionnaire. The target group for this survey was the main food shoppers. Japanese women typically do most of the grocery shopping for their households and as expected, 82% of respondents were women, and 85% said they were the main food purchaser in the household.

Our sample is similar to the national average in terms of age and income. The average respondent was in his/her forties, and in the 2000 Census of Japan, the average age for the Japanese population was found to be 41 years old. As for the level of annual household income, respondents were asked to place themselves in income intervals in order to obtain higher response rate. The household incomes of 31% of respondents ranged between ¥5,010,000 and

¥7,500,000. For the Japanese population, the average annual household income in 2000 was ¥6,613,920. In our sample, the highest education completed was on average two years of college. For the overall Japanese population, the average educational attainment includes upper secondary school. Of the total number of households in Japan, 28% have children younger than 18 years old. However, for our sample the same number is 51%, indicating that in our sample respondents may be more concerned about food safety, since respondents with children are generally more concerned about food safety (Loureiro, McCluskey, and Mittelhammer, 2000). Summary statistics and descriptions for the demographic variables are reported in Table 1.

The survey solicited information regarding respondents' attitudes about the environment and food safety. This information was obtained by presenting trade-off situations between environmental quality and economic growth, and between food safety and low prices, respectively (more details are presented in Table 1). Eliciting these attitudes from trade-off scenarios is an effective way of ensuring that the survey information is informative as well as useful in an empirical modeling context. For example, without the tradeoff, most respondents will say that they value the environment highly. The resulting lack of variation in response can lead to a lack of statistical significance of the effect of the environmental variable.

Concerning changes in consumption habits after the BSE-outbreak, 11% of respondents indicated that they now avoid eating beef. Of those who include beef in their diets, 23% eat beef daily or at least once a week, and 66% eat beef at least once a month. Eighty-six percent of respondent answered that they have been consuming less domestic beef since the BSE-outbreak. The fact that such a high percentage of respondents reduced their consumption of beef highlights the impact of BSE, especially since habit has been identified as important in Japanese beef

demand (Price and Gislason, 2001). Summary statistics and description for various consumers' perception and attitudinal variables are presented in Table 2.

Potential sources of bias in our sample need to be considered in the analysis. Using data collected from customers at a consumer cooperative may represent a bias since consumer cooperatives usually target quality conscious consumers by offering "safe foods" (Jussaume and Higgins, 1998). In addition, Seikyou labels the origin of all fresh products. After the BSE discovery, Nagano Seikyou has been focusing on ensuring customers of the safety of their beef using labels showing that their beef has passed BSE-testing. Therefore, our sample may be more willing than average to pay a premium for safety assured food products. Considerations regarding sample representativeness must be kept in mind when evaluating the broader implications of the findings of this study.

5. Empirical Analysis

This analysis utilizes contingent valuation dichotomous choice methodology. A single-bounded logit model is used to explore factors affecting willingness to pay for BSE-tested beef. We also estimate the mean willingness to pay for BSE-tested beef. There are many other possible approaches to estimating non-market quality attributes, such as experimental auctions or hedonic price analysis. Stated preference techniques, such as contingent valuation, are sometimes criticized because of the hypothetical nature of the questions and the fact that actual behavior is not observed (Cummings et al 1986; Mitchell and Carson, 1989). On the other hand, Adamowicz et al (1994) criticize revealed preference methods on the basis that the models of behavior developed constitute a maintained hypothesis about the structure of preferences that may not be testable. They also point out that revealed preference methods can suffer from

collinearity among attributes, precluding identification of the marginal impact of factors that affect choice. A number of studies test consistency or comparability between revealed and stated preferences with no consensus of findings.²

5.1 Contingent Valuation Dichotomous Choice Methodology

The contingent valuation method (CVM) is a standard approach to elicit WTP through dichotomous choice, market-type questioning format with a direct survey (Kanninen, 1993). In the dichotomous choice CVM, each respondent is asked whether he/she would be willing to pay a particular price for a particular good in a hypothetical market, letting him/her answer with “yes” or “no” to the “bid” amounts offered.

One of the bidding procedures used in CVM is the single-bounded dichotomous choice with the single-bounded model. The single-bounded model approach recovers the bid amount as a threshold by asking one dichotomous choice question (Hanemann, Loomis, and Kanninen 1991). Our survey includes a contingent valuation question regarding willingness to pay premium for beef tested for BSE. The hypothetical market for the good in question must be as close as possible to a real market in order to reveal people’s true preferences if an actual market existed (Pearce and Kerry 1990). The food product used in our study, beef, is appropriate to be examined since Japanese consumers regularly include it in their food purchases. Survey respondents were asked if they are willing to pay a premium for beef tested for BSE compared to the corresponding, non-tested product. The premium was set at one of the following levels: 5%, 10%, 25%, 40%, and 50%. Each level of premium was used for one fifth of the surveys. That is, eighty of the 400 surveys presented a 5% premium, another 80 surveys presented a 10%

premium, and so on. Each respondent faced only one premium. The assignment of survey version (and thus, premium) was random to the respondent.

Of the 381 respondents, 65.9% responded that they were willing to pay a premium for BSE-tested beef and 34.1% were not willing to pay the premium. There were 381 usable observations for the question about WTP premium for BSE-tested beef, and the distribution of the responses for the various discounts is presented in Table 3.

5.2 *Econometric Model*

The single-bounded dichotomous choice contingent valuation (DC-CV) model is applied to examine our data. For our DC-CV model, two outcomes are possible: either the respondent is not willing to purchase the BSE-tested beef at the premium offered, i.e. a “no” to the bid, or the respondent is willing to pay the premium presented for the BSE-tested beef product, i.e. a “yes” to the bid.

The premium bid, denoted by $B_p \geq 0^3$, is the percentage premium on BSE-tested beef compared to the non-tested beef product. The threshold premium for each respondent is located in one of the intervals $[0, B_p)$, $[B_p, +\infty)$. An upper bound on the true average WTP for BSE-tested beef can be placed via the dichotomous choice questions (Hanemann, Loomis and Kanninen 1991). The lower bound on the WTP for BSE-tested beef is determined *a priori* as no premium, because we assume that the BSE testing will not be perceived as reducing the value of the meat. Let WTP denote an individual’s WTP (or bid function) for the BSE-tested beef food product relative to the un-tested beef. The following discrete outcomes of the bidding process are observable:

$$(1) \quad D = \begin{cases} 1 & 0 \leq WTP < B_p \\ 2 & B_p \leq WTP \end{cases}$$

Respondents who are not willing to purchase the tested beef at the premium offered indicate the lowest WTP for BSE-tested beef and fall into the first group. Those who fall into the second group have a willingness to pay that is greater than or equal to the price of beef plus the premium and indicate a high WTP for BSE-tested beef. Individual i 's WTP function for BSE-tested beef is

$$(2) \quad WTP_i = \alpha + \rho B_i + \boldsymbol{\lambda}' \mathbf{z}_i + \varepsilon_i \quad i = 1, \dots, n$$

where WTP_i is consumer i 's unobservable true willingness to pay, B_i is the premium individual i faces for BSE-tested beef; \mathbf{z}_i is a column vector of observable characteristics of the individual; ε_i is a random variable accounting for random noise and possibly unobservable characteristics.

Unknown parameters to be estimated are α , ρ , and λ . Linearity in \mathbf{z} and ε is assumed for all individuals. Furthermore, the distribution of the error term is assumed to follow $\varepsilon \sim G(0, \sigma^2)$, where $G(0, \sigma^2)$ denotes a cumulative distribution function with mean zero and variance σ^2 .

Under these assumptions, the choice probabilities for individual i can be characterized as⁴:

$$(3) \quad \text{Prob}(D_i = j) = \begin{cases} G(\tilde{\alpha} + \tilde{\rho} B_{P_i} + \tilde{\boldsymbol{\lambda}}' \mathbf{z}_i) \\ 1 - G(\tilde{\alpha} + \tilde{\rho} B_{P_i} + \tilde{\boldsymbol{\lambda}}' \mathbf{z}_i) \end{cases} \text{ for } j = \begin{cases} 1 \\ 2 \end{cases}$$

Thus, the log-likelihood function becomes:

$$(4) \quad L = \sum_i \left\{ \begin{array}{l} I_{D_i=1} \ln[G(\tilde{\alpha} + \tilde{\rho} B_{P_i} + \tilde{\boldsymbol{\lambda}}' \mathbf{z}_i)] \\ I_{D_i=2} \ln[1 - G(\tilde{\alpha} + \tilde{\rho} B_{P_i} + \tilde{\boldsymbol{\lambda}}' \mathbf{z}_i)] \end{array} \right\}$$

where I_K is an indicator function for the event K , and $D_i = j$ denotes that the j th alternative occurred. In the empirical implementation of the model, we define $G(\cdot)$ to be the standard logistic distribution function with mean zero and standard deviation $\sigma = \pi / \sqrt{3}$.

The bid information as well as other information about the consumers is used to estimate the magnitude of factors that affect Japanese consumers' WTP and also how much premium

Japanese consumers are willing to pay for BSE-tested beef. The model is a specification of the model in (2) including a vector of predictors $\mathbf{z}_i = \{Safety_i * Enviro_i \quad Lessbeef_i \quad Female_i\}$ with corresponding parameters to be estimated $\lambda' = \{\lambda_1 \quad \lambda_2 \quad \lambda_3\}$. Additional parameters to be estimated are the intercept, α , and the coefficient of the bid-variable, ρ . The attitudinal variable investigated is $Safety * Enviro$. This variable is created by multiplication of the two attitudinal variables, $Safety$ and $Enviro$. The $Lessbeef$ variable indicates that the respondent reported that he or she reduced his or her beef consumption after the BSE-outbreak. Finally, the demographic variable $Female$ indicates the respondent is female.

6. Analysis of Factors that Affect WTP for BSE-tested Beef

The estimation results for the WTP model are reported in Table 4. Food safety and environmental attitudes, reduction in beef consumption following the BSE outbreak, and being female all have a statistically significant positive effect on the WTP for BSE-tested beef. As expected, the premium variable coefficient is negative. This means that as the premium offered to the respondent increases, the respondent is less likely to say “yes,” meaning he/she is willing to pay the premium. The suitability of the model is evaluated using the Pearson Chi-square goodness-of-fit test. This test is applied to detect major departures from a logistic response function, but it is not sensitive to small departures from a logistic response function (Neter et al., 1996). The test results provide support for the choice of model.

The magnitude of the coefficients in the model cannot be interpreted *per se*, but the sign and the odds ratios are useful in interpreting the results. The odds ratios reported in Table 4 can be interpreted as marginal effects in a binary logistic regression model. The odds ratios indicate the increased odds of success (willingness to pay the premium offered for BSE-tested beef) for a unit

increase in the predictor variable, when all other variables are kept constant (Neter et al., 1996). *Ceteris paribus*, the percentage increase in success for a unit increase in one predictor variables is calculated as $(1 - \text{Odds-Ratio}) * 100\%$.

The odds ratio shows that the odds of a customer being willing to pay the premium sharply decrease as the premium increases. This implies that increased premiums reduce customers' willingness to purchase BSE-tested beef. *Ceteris paribus*, the odds of being willing to pay the premium for BSE-tested beef increases in the variables *Safety*Enviro*, *Lessbeef*, and *Female* by 11%, 116% and 73% respectively. Considering the odds ratios, *Lessbeef* seems to be the major predictive variable, and in fact, 86% of customers responded that they had reduced their consumption of domestic beef over the last year. This considerable change in the consumption patterns for domestic beef is a likely reaction to the recent BSE-scandal and may indicate that there currently exists an unsupplied market for beef tested for BSE.

The mean sample willingness to pay for each of the BSE-tested beef, WTP, can be estimated by restricting $\lambda = 0$ (Hanemann et al 1991). The empirical mean WTP is then $-\tilde{\alpha}/\tilde{\rho}$. In our Japanese sample, the estimated mean willingness to pay is greater than a 50%⁵ premium for BSE-tested beef. It is greater than Latouche et al's (1998) mean WTP findings in France from 1997. Possible explanations for this difference could include that Japanese consumers are extremely concerned about food safety issues (Erikson et al, 1998; Jussaume and Judson, 1992) and the negative media coverage, which increased between the time of Latouche et al's study (1997) and the time of this study (end of 2001). As previously discussed, Verbeke and Ward (2001) find that negative media coverage of BSE has a major effect on demand for meat.

7. Conclusions

Food safety issues are receiving greater attention than ever in Japan. The discovery of BSE in Japan caused anxiety about consuming beef and beef products. As a result, there was a sudden fall in sales of beef, which hurt the Japanese beef industry as well as major beef exporters to Japan. It is important for the Japanese government and beef industry to restore the public confidence in safety of beef. It is also important for beef exporters to understand Japanese consumers' preferences and attitudes toward beef products in terms of food safety.

We analyze factors that affect Japanese consumers' willingness to pay price premiums for BSE-tested beef and estimated the mean willingness to pay (WTP) for BSE-tested beef using data obtained from a consumer survey in Japan. A single-bounded dichotomous choice contingent valuation model that recovers the premium amount as a threshold is used for these purposes. We find that food safety and environmental attitudes, reduction in beef consumption following the BSE outbreak, and being female all have a statistically significant positive effect on the WTP for BSE-tested beef. In our sample, the consumers at Seikyoku are willing to pay a greater than a 50% premium on average for BSE-tested beef.

Although, as with most samples, there is some uncertainty about the extent that the results can be generalized, this study should be useful for policy makers and beef exporters. It suggests that there is at least a niche market for BSE-risk-free beef. However, in order to command a price premium, consumers must be convinced of the safety of labeled beef products through documentation of standards and inspections.

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Table 1. Summary Statistics for Demographic Variables

Variable	Description	Distribution of Survey Responses	
<i>Age</i>	≤ 39 years	30.7%	Mean = 46.8 years St. Dev. = 12.26 years
	40 to 59	55.4%	
	60 to 79	13.6%	
	>80 years	0.3%	
<i>Female</i>	1 if female	82%	Mean = 0.82 St. Dev. = 0.38
	0 if male	18%	
<i>Shopper</i>	1 if main shopper	85%	Mean = 0.85 St. Dev. = 0.36
	0 otherwise	15%	
<i>Education</i>	1 if compulsory school	1%	Mean = 2.90 St. Dev. = 1.08
	2 if HS diploma	44%	
	3 if 2-year college	22%	
	4 if 4-year degree	21%	
	5 if Adv./Prof. degree	10%	
	6 if refuse	2%	
<i>Children</i>	1 if children younger than 18 year in household	51 %	Mean = 0.51 St. Dev. = 0.50
	0 otherwise	49%	
<i>Income (in 1000 Yen)</i>	1 if <¥2,500	3.93%	Mean = ¥6,560 St.Dev. = ¥2,440
	2 if ¥2,510-¥5,000	20.47%	
	3 if ¥5,010-¥7,500	30.71%	
	4 if ¥7,510-¥10,000	20.21%	
	5 if >¥10,010	12.60%	
	6 if refuse	12.07%	
<i>Household</i>	Number of people in household		Mean = 3.53 St.Dev. = 1.31

Table 2. Summary Statistics for Perception and Attitudinal Variables

Variable	Description	Distribution of Responses
<i>Environment</i>	Importance of environmental sensitivity vs. economic growth Scale from 1 to 10 where 1 = Economic growth is all-important 10 = Environment is all-important	Mean = 7.10 St. Dev.= 2.20
<i>Safety</i>	Importance of food price vs. food safety Scale from 1 to 10 where 1 = Food price is all important 10 = Food safety is all-important	Mean = 7.96 St. Dev.= 2.24
<i>Knowledge</i>	Self-Reported knowledge about BSE 1 if high knowledge 0 if little or no knowledge	90% 10%
<i>Beefsafety</i>	Overall safety of beef 1 if very or somewhat safe 0 if somewhat or very unsafe, or don't know	42% 58%
<i>Lessbeef</i>	1 if consume less domestic beef 0 if no change	86% 14% St. Dev. = 0.34
<i>Import</i>	Preference for domestic vs. imported food products 1 if prefers for domestic 0 if no preference	93% 7%

Table 3. Range and Distribution of Response Rates to the Randomly Assigned Discount Offer for BSE Tested Beef

Response	Premium				
	5%	10%	25%	40%	50%
Yes	58	55	46	42	43
No	17	19	30	30	34
Total	75	74	76	72	77

Table 4. Parameter Estimates for WTA Model for BSE

Parameter	Variable	Estimate	Odds Ratio	p-value
α	<i>Intercept</i>	-0.3933	-	0.369
ρ	<i>Bid (Premium)</i>	-2.3874	0.09	0.000
λ_1	<i>Safety*Enviro</i>	0.1004	1.11	0.020
λ_2	<i>Lessbeef</i>	0.7709	2.16	0.015
λ_3	<i>Female</i>	0.5498	1.73	0.053

Endnotes

¹Defined by the world organization for animal health (OIE).

² See Loureiro et al (2003) for a review of these studies.

³ The randomly assigned premium bids are $B_P = \{0.05, 0.1, 0.25, 0.4, 0.5\}$

⁴The condition of linearity on z is a simplifying assumption widely used in RUM (random utility models). This assumption implies that consumer's willingness to pay of c dollars is generally represented as:

$U(0, x_0, m - c) \leq U(1, x_1, m)$, $\Pr\{WTP \geq c\} = \Pr\{V_0 + \varepsilon_0 \leq V_1 + \varepsilon_1\} = \Pr\{\varepsilon_0 - \varepsilon_1 \leq V_1 - V_0\}$, where $V_1 - V_0 = \alpha + \beta c$.

⁵ Based on the data, the mean WTP for our sample would be outside of the highest bid offered (50%). Mean WTP estimates are obtained from an extrapolation of the WTP function, so that the level of uncertainty increases as one gets further outside the data. With an extrapolation, the confidence intervals around the mean WTP estimate must be wider than otherwise would be necessary.