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Bovine spongiform encephalopathy in Japan: consumers' food safety perceptions and willingness to pay for tested beef*

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The discovery of bovine spongiform encephalopathy (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 that hurt the Japanese beef industry as well as major beef exporters to Japan. We analyse factors that affect Japanese consumers' willingness to pay (WTP) price premiums for BSE-tested beef and estimate the mean WTP for BSE-tested beef using data obtained from a consumer survey in Japan. A single-bounded dichotomous choice contingent valuation model is used to recover the premium amount. We find that attitudes to food safety, 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. Interestingly, demographic variables such as age and income do not affect the WTP, possibly indicating that the BSE scare similarly affected multiple segments of the population. In our sample, consumers are willing to pay a premium on average of greater than 50 per cent for BSE-tested beef.

Key words: beef, bovine spongiform encephalopathy, Japan.

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 9.5 kilograms per person (Brooke 2001), and the Japanese beef market had been liberalised allowing for the importation of fresh/chilled and frozen beef.

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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 per cent (Zielenziger 2001). A fourth case of BSE was discovered on May 13, 2002. Major beef exporters to Japan, such as Australia and the USA, lost as much as 50 per cent a month in volume of beef imports during September to November, 2001 (Ono 2001b). These losses resulted in spite of the fact that both countries have been 'BSE-free'.¹

The handling of the BSE scandal by the Japanese beef industry and government further damaged consumer confidence. It took more than 2 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, became apprehensive about consuming both imported and Japanese beef (Zielenziger 2001).

This work is motivated by the importance for both beef producers and exporters to understand Japanese consumers' characteristics and attitudes in order to restore consumer confidence in beef following this crisis. In the following, we investigate factors affecting Japanese customers' willingness to pay (WTP) a premium for beef labelled as being BSE tested, and we estimate the magnitude of such a premium using survey data collected during December 2001 at a local consumer cooperative in Nagano, Japan.

2. Background

In 1984, the first cases of the syndrome later identified as BSE were discovered in Great Britain (Cowley 2002). In subsequent years, hundreds of British cows would be infected every week. In 1986, BSE was recognised as a nervous system disease caused by prions. The primary cause was discovered to be 'recycling of cattle', where meat-and-bone meal derived from diseased cattle was included as an ingredient in cattle-feed (Cowley 2002). In 1988, Britain banned the domestic use of meat-and-bone meal made from ruminants in the feed for ruminants and started destruction of all BSE-infected cows (Cowley 2002). 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 tonnes of British meat-and-bone meal (Cowley 2002).

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 20s increased in Britain. The young CJD victims were suffering from variant CJD (vCJD). In 1996, the British Government publicly

¹ Note that at the time of the study, no cases of BSE had been discovered in the USA or Australia. However, it was not the case that every slaughtered animal in these countries are tested for BSE. For example, in the USA only 'downer' animals are tested.

announced that vCJD was contracted from eating BSE-infected beef. They banned export of meat-based cattle-feed (Cowley 2002).

Up until 1996, Japan was a major importer of meat-and-bone meal. During the period 1996–2000, Japan continued to import meat-and-bone meal from other EU countries (Ono 2001a). In January 2001, the Japanese government decided to stop importing beef from countries where BSE had been discovered (Yamanouchi 2001).

After the first BSE-infected cow was identified in Japan in September 2001, the Japanese government took steps to ensure 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 would be sold (Brooke 2001). According to the new, stricter regulations, highly infectious cow parts must be destroyed at every meat slaughter plant throughout Japan.²

Our survey was held in December 2001, immediately after the first BSE-infected cow was identified in Japan. This was a time in which consumers were likely to be highly concerned about the safety of beef. In response to the BSE crisis, most Japanese consumers reduced their consumption of beef or completely excluded it from their diets. Pork and chicken are common substitutes for beef, and consumers also returned to their traditional fish-based diets because of its safety (Brooke 2001).

In response to the falling beef demand, producers, supermarkets and restaurants increased their spending on advertising and promotion of beef products hoping that this would contribute to the restoration of consumer confidence in beef. Most beef barbecue restaurants changed their menus to include non-beef dishes and lowered their prices to maintain their customer base (Ono and Stecklow 2001). McDonald's Japan ran a \$4.1 million advertising campaign, announcing that 'McDonald's uses only beef from Australia, where the mad cow disease does not exist' (Ono 2001b, p. B7).

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) analysed the expected impact of the BSE crisis on the beef industry. They argued 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. They also argued that there are some potential long-term benefits of the BSE outbreak to the beef industry, such as more consumer-orientation with a greater focus on food safety, more 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 emphasise quality assurance may gain direct benefits as a result of increased demand for their products.

Lloyd *et al.* (2001) studied the price adjustment in the British beef market in response to the BSE outbreak, increased awareness, and likely effects of BSE. In the aftermath of

² Defined by the World Organisation for Animal Health (OIE).

the French BSE outbreak, Latouche *et al.* (1998) conducted a survey in France in 1997, eliciting consumers' 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 would not transmit the human variant of BSE. The meat products were medium-quality, low-priced minced steak with little risk of vCJD, and high-quality, higher-priced beef with no risk of vCJD. The mean WTP premiums for the two meat products (including zero bids) were 22 per cent of the original price and 13.7 per cent of the original price, respectively. Further, the authors found that employed and highly educated respondents as well as respondents who preferred labelled or organic products indicated higher WTP, while respondents who were involved in agricultural activities were less willing to pay a premium.

In Belgium, Verbeke *et al.* (2000) found that television coverage on meat safety had a negative effect on the demand for red meat after the Belgian BSE outbreak. Younger people were the most susceptible to such negative media coverage. Other factors that affected demand for red meat negatively were the presence of children younger than 12 years old in the household and the respondent's age. Verbeke and Ward (2001) analysed meat demand in Belgium after the BSE discoveries with an almost ideal demand system (AIDS) that included an index of television coverage and advertising expenditures as explanatory variables. They found that advertising had only a minor impact on demand compared to the negative media coverage. In the Netherlands, Mangen and Burrell (2001) used a switching AIDS model to investigate preference shifts among Dutch consumers. They found that preference shifts caused by the BSE crises reduced beef expenditures with offsetting gains in the shares of pork, prepared meat and fish.

The general theme across previous published work is that the discovery of BSE has a significant effect on consumers' willingness to pay for and consume beef. Media coverage can increase the severity of the consumer response against beef. The current study complements this literature by adding the Japanese perspective. Our findings of willingness to pay to avoid BSE-tainted beef are higher than those of Latouche *et al.* (1998) in France. However, this is not surprising because, in general, Japanese consumers are accustomed to paying high premiums for quality.

4. Data

The survey used in the present study was pretested with Japanese subjects in Nagano, Japan.³ The main survey was conducted at the Seikatsu Club Consumer Cooperative (Seikyou), a grocery store-like setting, in Nagano-City, Japan during December, 2001. Shoppers were selected at random and 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

³ The survey was pretested with approximately 15 Japanese subjects in Nagano, Japan, during the week preceding the survey at the Seikyou. Based on this limited pretest, the bids seemed to be reasonably calibrated, and the translated questions were clear to the Japanese subjects. However, a more extensive pretest may have improved the calibration of the bids.

about the products. The rejection rate was approximately 50 per cent 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. This sample may be characterised as a convenience sample. Gift certificates worth approximately \$US13 in Japanese yen [\$US1 = 130yen(¥)] were given to every participant at the end of the survey as an incentive for participation.

Of the 400 consumers who participated, approximately 5 per cent answered that they do not eat beef at all because of 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 per cent of respondents were women, and 85 per cent 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 46.8 years, which is likely representative of the main food shoppers, as the average age for the Japanese population is 41 years old (Census Japan 2000), children were not included in the survey and the very old are unlikely to be out shopping. As for the level of annual household income, respondents were asked to place themselves in income intervals in order to obtain a higher response rate. The mode range of household incomes (31% of respondents) was between ¥5 010 000 and ¥7 500 000, which contains the Japanese average annual household income in 2000 of ¥6 613 920. The most frequent level of education included 2 years of college, which is slightly higher than the national average. 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 (see the Appendix for the translated questions). 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 modelling context. For example, without the trade-off, 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 per cent of respondents indicated that they now avoid eating beef. Of those who include beef in their diets, 23 per cent eat beef daily or at least once a week, and 66 per cent eat beef at least once a month. Eighty-six per cent of respondents 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 because habit has been identified as important in Japanese beef demand (Price and Gislason 2001). Summary statistics and descriptions 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 as

Table 1 Summary statistics for demographic variables

Variable	Description	Distribution of survey responses	
		Percentage	Mean/SD
Age	≤39 years	30.7	Mean = 46.8 SD = 12.26
	40–59	55.4	
	60–79	13.6	
	>80 years	0.3	
Female	1 if female	82	Mean = 0.82 SD = 0.38
	0 if male	18	
Education	1 if compulsory school	1	Mean = 2.90 SD = 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	
Income (in 1000 Yen)	1 if < ¥2 500	3.93	Mean = ¥6 560 SD = ¥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	

Table 2 Summary statistics for perception and attitudinal variables

Variable	Description	Distribution of responses
<i>Enviro</i>	Importance of environmental sensitivity versus economic growth	Mean = 7.10
	Scale from 1 to 10 where	SD = 2.20
	1 = economic growth is all-important	
	10 = Environment is all-important	
<i>Safety</i>	Importance of food price versus food safety	Mean = 7.96
	Scale from 1 to 10 where	SD = 2.24
	1 = food price is all important	
	10 = food safety is all-important	
<i>KnowBSE</i>	Self-reported knowledge about BSE	
	1 if high knowledge	90%
	0 if little or no knowledge	10%
<i>Lessbeef</i>	1 if consume less domestic beef	86%
	0 if no change	14%
		SD = 0.34

BSE, bovine spongiform encephalopathy.

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. 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 the present study.

5. Empirical analysis

This analysis uses the dichotomous choice contingent valuation methodology (CVM). This technique was chosen over the multiattribute techniques, such as conjoint analysis/choice modelling, as we were only considering one specific attribute; whether the beef had been tested. A single-bounded logit model is used to explore factors affecting WTP for BSE-tested beef. We also estimate the mean WTP 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 criticised because of the hypothetical nature of the questions and the fact that actual behaviour is not observed (Mitchell and Carson 1989). However, Adamowicz *et al.* (1994) criticise revealed preference methods on the basis that the models of behaviour 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.⁴

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.

The single-bounded model approach recovers the bid amount as a threshold by asking one dichotomous choice question (Hanemann *et al.* 1991). Our survey includes a contingent valuation question to identify the 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 Turner 1990). The food product used in our study, beef, is appropriate to be examined as 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 (see the appendix for the translated text.) The premium was set at one of the following levels: 5, 10, 25, 40 and 50 per cent. Each level of premium was used for one fifth of the surveys. That is, 80 of the 400 surveys presented a 5 per cent premium, another 80 surveys presented a 10 per cent 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 per cent responded that they were willing to pay a premium for BSE-tested beef and 34.1 per cent were not willing to pay the premium. The distribution of the responses for the various discounts is presented in Table 3.

One concern with the use of CVM is the tendency for 'yea-saying' or the tendency to subordinate outcome-based economic preferences in favour of expressive

⁴ See Loureiro *et al.* (2003) for a review of these studies.

Table 3 Distribution of responses for each level of premium for beef tested for bovine spongiform encephalopathy

Premium	Premium (%) [†]					Total
	5	10	25	40	50	
Yes-responses	58	55	46	42	43	244
No-responses	17	19	30	30	34	130
Total	75	74	76	72	77	374

[†]Each level of premium was randomly assigned to respondents.

motivations when responding to contingent valuation questions (Blamey *et al.* 1999) resulting in overstatement of willingness to pay. Possible approaches to mitigate the effects of yea-saying include 'cheap talk' (Cummings and Taylor 1999) and dissonance minimisation (Blamey *et al.* 1999). However, these are unsettled issues in research; there is not agreement on the magnitude, the cause, or how to mitigate the overstatement. Moreover, to our knowledge, there have been no articles on yea-saying in the context of Japan. Mitigating factors in our study are that the survey was self-administered (the interviewer did not influence the responses) and that beef is a private rather than a public good.

5.1 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 $B_P = 0$,⁵ 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 by the dichotomous choice questions (Hanemann *et al.* 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 untested beef. For the i th respondent, the following discrete outcomes of the bidding process are observable:

$$D_i = \begin{cases} 1 & 0 \leq WTP < B_P \\ 2 & B_P \leq WTP. \end{cases} \quad (1)$$

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

⁵ The randomly assigned premium bids are $B_P = \{0.05, 0.1, 0.25, 0.4, 0.5\}$.

fall into the second group have a WTP 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:

$$WTP_i = \alpha + \rho B_i + \lambda' z_i + \varepsilon_i \quad i = 1, \dots, n, \quad (2)$$

where WTP_i is consumer i 's unobservable true willingness to pay, B_i is the premium individual i faces for BSE-tested beef; 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 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 characterised as:⁶

$$\text{Prob}(D_i = j) = \left\{ \frac{G(\tilde{\alpha} + \tilde{\rho} B_i + \tilde{\lambda}' z_i)}{1 - G(\tilde{\alpha} + \tilde{\rho} B_i + \tilde{\lambda}' z_i)} \right\} \text{ for } j = \begin{cases} 1 \\ 2 \end{cases}. \quad (3)$$

Thus, the log-likelihood function becomes:

$$L = \sum_i I_{D_i=1} \ln[G(\tilde{\alpha} + \tilde{\rho} B_i + \tilde{\lambda}' z_i)] + I_{D_i=2} \ln[1 - G(\tilde{\alpha} + \tilde{\rho} B_i + \tilde{\lambda}' z_i)], \quad (4)$$

where I_K is an indicator function for the event K , and $D_i = j$ denotes that the j th alternative occurred, $j \in \{1, 2\}$. 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 estimated model is a re-specification of the model in (2) including a vector of predictors

$$z_i = \{Enviro_i \quad Safety_i \quad LessBeef_i \quad KnowBSE \quad Female_i \quad Age_i \quad Income_i\}, \quad (5)$$

with corresponding vector of parameters, λ , to be estimated. Additional parameters to be estimated are the intercept, α , and the coefficient of the bid-variable, ρ . The attitudinal variables investigated are *Safety* and *Enviro*. *Safety* takes higher values if the respondent is willing to trade off a lower price for more safe food. *Enviro* takes higher values if the respondent prioritises environment over the economy. The *LessBeef* variable indicates that the respondent reported that he or she reduced his or her

⁶ The 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 $V_1 - V_0 = \alpha + \beta c$.

beef consumption after the BSE-outbreak. *KnowBSE* indicates the respondent's self-reported knowledge about BSE (the English translation of the question used to elicit the information contained in this variable is included in the Appendix). Demographic variables *Female*, *Age* and *Income*, indicate whether the respondents are female, their age and household income-level, respectively.

6. Results: factors that affect WTP for BSE-tested beef

The estimation results for the WTP model are reported in Table 4. The magnitude of the coefficients in the model cannot be interpreted per se, but the sign and the marginal effects odds ratios are useful in interpreting the results. Food safety attitudes and a reduction in beef consumption following the BSE outbreak have a statistically significant positive effect on the WTP for BSE-tested beef at the 0.05 level of significance, and being female has a statistically significant positive effect at the 0.057 level of significance. As expected, the coefficient of the bid variable is negative with a *P*-value of 0.001, which means that as the bid offered for BSE-tested beef increased, the respondent was less likely to choose the product.

Because the magnitude of the coefficients of a binary logistic model are not directly interpretable, we also report the marginal effects in Table 4. For the significant parameters we find that, *ceteris paribus*, for a marginal increase in concerns with food safety the probability of accepting the premium is 0.22, the marginal effect of consuming less beef after the BSE is a 0.15 probability of accepting the premium, and women had an additional 0.13 probability of accepting the premium bid compared to men. It is also interesting that demographic variable such as age and income were not significant and that the variables that were significant did not have a very strong effect. This may indicate that the BSE scare affected all age and income groups, which may also explain the major drop in beef sales.

The suitability of the model is evaluated using the Pearson Chi-squared goodness-of-fit test with a null hypothesis that the distribution is logistic. This test is applied to detect major departures from a logistic response function, but it is not sensitive to small

Table 4 Parameter estimates for WTP model for BSE-tested beef in Japan

Parameter	Variable	Estimate	<i>P</i> -values of estimates	Marginal effects	<i>P</i> -values of marginal effects
α	Intercept	-1.8897	0.018	—	
ρ	Bid (Premium)	-2.4011	0.000	-0.5347	0
λ_1	<i>Enviro</i>	0.4599	0.395	0.1024	0.395
λ_2	<i>Safety</i>	1.0164	0.051	0.2263	0.05
λ_3	<i>Lessbeef</i>	0.6489	0.047	0.1531	0.055
λ_4	<i>KnowBSE</i>	0.3632	0.314	0.0842	0.33
λ_5	<i>Female</i>	0.5612	0.057	0.1310	0.065
λ_6	<i>Age</i>	1.0368	0.290	0.2309	0.29
λ_7	<i>Income</i>	0.3645	0.481	0.0812	0.481

WTP, willingness to pay; BSE, bovine spongiform encephalopathy. Pearson χ^2 356.20. *P*-value 0.3138.

departures from a logistic response function (Neter *et al.* 1996). That the distribution is logistic is not rejected for the sample.

The mean sample WTP for BSE-tested beef can be estimated at the mean of the covariates, \bar{z} . The empirical mean WTP is then $-(\tilde{\alpha} + \tilde{\lambda}\bar{z})/\tilde{\rho}$. In our sample, the estimated mean WTP is greater than a 50 per cent premium for BSE-tested beef.⁷ It is also greater than Latouche *et al.*'s (1998) mean WTP findings in France from 1997. Possible explanations for this difference could include the concerns of Japanese consumers about food safety issues (Erikson *et al.* 1998; Jussaume and Higgins 1998) and the negative media coverage, which increased between the time of Latouche *et al.*'s (1998) study and the time of this study (end of 2001). As previously discussed, Verbeke and Ward (2001) found that negative media coverage of BSE has a major effect on the 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 public confidence in the safety of beef. In order to win back this market, beef exporters must understand Japanese consumers' preferences and attitudes toward food safety in beef.

In this article, we analyse factors that affect Japanese consumers' willingness to pay price premiums for BSE-tested beef and estimate the mean WTP for BSE-tested beef using data obtained from a consumer survey at a consumer cooperative (Seikyou) in Nagano, Japan, in the period directly following the discovery of BSE. 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 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. The consumers in our sample are willing to pay a significant premium (greater than 50%) on average for BSE-tested beef over domestic beef. Our findings of willingness to pay to avoid BSE-tainted beef are higher than those of Latouche *et al.* (1998) in France. However, this is not surprising because, in general, Japanese consumers are accustomed to paying high premiums for quality and the fact that there was intense negative media coverage, which increased between the time of Latouche *et al.*'s (1998) study and the time of this study (end of 2001).

Still, because our data were collected from a consumer cooperative, which usually targets quality-conscious consumers by offering 'safe foods', our sample may be more willing than the general population to pay a high premium for safety-assured beef.

⁷ Based on the data, the mean WTP for our sample is a 56 per cent premium over other domestic beef, which is 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.

Considerations regarding sample representativeness must be kept in mind when evaluating the broader implications of the findings of this study. Even so, this study should still be useful for policy makers and beef exporters. In order to command a price premium, consumers must be convinced of the safety of labelled beef products through documentation of standards and inspections. There may be a greater market for beef imported from countries (such as Australia) where there have been no BSE outbreaks, which is the strategy McDonald's is taking.

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Appendix

Questions used to elicit food safety and environmental attitudes and self-reported knowledge of BSE

Where would you place yourself on a scale from 1 to 10, if **economic growth at all costs is a 1** and **saving the environment at all costs is a 10**? (Circle just one)

1 2 3 4 5 6 7 8 9 10

When you are purchasing food, how important are lower **food safety** risks vs. **lower cost food**. Please, place yourself on a scale of 1 to 10, where **10 means food safety is all important** and **1 means lower food prices are all-important**? (Circle just one)

1 2 3 4 5 6 7 8 9 10

How knowledgeable are you about 'mad cow' disease or bovine spongiform encephalopathy (BSE)?

- I 1. Very knowledgeable
- II 2. Somewhat knowledgeable
- III 3. Not informed

Questions related to willingness to pay

Would you be willing to purchase beef if it is was tested for BSE and offered at a price that is **[Insert random percentage premium]** more than other domestic beef?

- I 1. Yes
 - II 2. No
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