# A non-compensatory choice modeling analysis of Japanese consumers' preferences for beef: A choice experiment approach

**Hideo Aizaki**
National Institute for Rural Engineering
National Agriculture and Food Research Organization
2-1-6 Kannondai, Tsukuba 305-8609, Japan
E-mail address: aizaki@affrc.go.jp

**Manabu Sawada**
Department of Agro-Environmental Science
Obihiro University of Agriculture and Veterinary Medicine
Obihiro 080-8555, Japan

**Kazuo Sato**
Faculty of Dairy Science
Rakuno Gakuen University
582 Bunkyoudai Midorimachi, Ebetsu 069-8501, Japan

**Toshiko Kikkawa**
Faculty of Business and Commerce
Keio University
2-15-45 Mita, Minato-ku, Tokyo 108-8345, Japan

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## Abstract

The purpose of this paper is to examine, using choice experiments, the Japanese consumers' valuation of domestic Wagyu beef, domestic dairy beef, Australian beef, and US beef when considering their bovine spongiform encephalopathy (BSE) test status. Some Japanese consumers give high priority to food safety while purchasing beef; this is expected to cause a non-compensatory valuation of food safety. As compared to the results derived from a compensatory utility model, a random parameters logit (RPL) with a non-compensatory utility model provides estimation results that are fitter for the respondents' decision-making rules and also provides more valid willingness to pay (WTP) for each type of beef. The results suggest that the RPL with the non-compensatory utility model is more suitable for measuring the valuation of food safety with regard to beef by the food safety conscious Japanese consumers. Moreover, the WTP for each BSE-tested type of beef reveals that the Japanese consumers seem to regard the BSE test to be very important for ensuring the food safety of beef.



***JEL** classification*: Q13, D18, D12

***Keywords***: BSE; food safety; consumers' valuation

## 1. Introduction

Approximately half of the total beef annually consumed in Japan was imported from the United States and Australia. However, Japan suspended the import of US beef when a bovine spongiform encephalopathy (BSE)-positive cow was first discovered in the United States. Although the ban on imports lifted, the amount of imported US beef was greatly reduced as compared to the amount imported before the ban. The following reasons may explain why the Japanese consumers tend to avoid US beef: (1) the Japanese consumers are sensitive to food safety with regard to beef; (2) they are of the opinion that all domestic beef is safe from BSE since BSE tests are carried out on all cattle slaughtered in Japan for consumption purposes, and hence, it is very important to them to know that BSE tests are conducted; and (3) BSE tests have not been carried out on US beef. We examine the Japanese consumers' valuation of the country of origin and the BSE-test status of beef by conducting choice experiments.

Studies on the consumers' valuation of beef attributes and food safety with regard to beef, using the stated preference methods, have been carried out in various countries (e.g., Unterschultz et al. 1998; Quagrainie et al. 1998; West et al. 2002; Lusk et al. 2003; Alfnes 2004; Lusk and Schroeder 2004; McCluskey et al. 2005; Tonsor et al. 2005; Watson et al. 2005). A case study related to Japanese consumers (Aizaki et al. 2006), using choice experiments, pointed out that some of the consumers might evaluate food safety with regard to beef on the basis of a non-compensatory decision-making rule. Other surveys revealed that Japanese consumers had strong intentions to avoid the purchase of US beef because of a food safety scare with regard to beef (e.g., Aizaki et al. 2004; Sawada et al. in press). These surveys suggest that some Japanese consumers give high priority to food safety while purchasing beef; this is expected to cause the non-compensatory valuation of food safety. The estimation results may be biased when assuming that all consumers have the compensatory utility

function since some consumers may have the non-compensatory utility function. Thus, Swait's non-compensatory choice model (Swait 2001) is applied in the present study.

## 2. Data and method

### *2.1. Data*

A questionnaire survey was mailed in December 2005 to 1,047 households in the Kiyota district of Sapporo city in Hokkaido, which were randomly selected from the register of voters. The household member who usually purchased beef was directed to respond to the survey. Of these, 371 households returned the survey by mail. Since the responses of 14 households were incomplete, a sample size of 357 households was considered valid for the following analysis. Table 1 shows the individual and household characteristics of the survey participants.

### *2.2. Method*

#### *2.2.1. Questions for choice experiment in evaluating beef*

The choice experiment questions asked respondents to choose their most preferred alternative from among four beef products—domestic Wagyu beef, domestic dairy beef, Australian beef, and US beef—and a "none of these" option (Fig.1). Country of origin (kind of beef) was given as an alternative-specific attribute. These four types of beef were presented as beef for *yakiniku*, a very popular type of Japanese cuisine (barbecue-style beef grilled indoors and served with heavy sauces). Each of the four beef alternatives had two generic attributes:

BSE-test status attribute and price per 100g attribute. The level of each attribute is shown in Table 2. Although the BSE test was carried out on all domestic Wagyu/dairy beef at the time the survey was conducted, these two types of domestic beef had two levels of the BSE-test status attribute: tested and untested. Australian beef and US beef were presented as having the BSE-test status attribute, although these were, in fact, not tested for BSE. The levels for each price attribute were determined based on a beef market price survey conducted by us in the survey area and past prices for beef. Choice sets were created by using a design method based on the D-efficiency criterion (Zwerina et al. 1996).

*2.2.2. Questions for capturing consumers' decision-making rules*

The characteristics of the non-compensatory discrete choice model developed by Swait (2001) serve to determine whether the consumers' utility function is non-compensatory or compensatory, by using the sign and magnitude of the estimated coefficient of a special dummy variable that is introduced in discrete choice models as the independent variable. The variable shows the relationship between consumers' decision-making rules and the characteristics of alternatives included in their choice sets. See Swait (2001) for the details of the model.

The present study uses a question presented in Fig. 2 and captures the respondents' decision-making rules for purchasing beef with regard to the BSE-test status. The three alternatives stating the intention with regard to purchasing beef were set for each type of beef, taking into consideration the respondents who would not purchase beef that was not tested for BSE as well as those who would not purchase beef regardless of the BSE-test status. The latter category of respondents seemed to be consumers who used the country of origin as an index for measuring beef quality (Davidson et al. 2003; Henson and Northen 2000; Lusk et al. 2006).

*2.2.3. Empirical non-compensatory discrete choice model*

In the choice experiment questions, respondent *n* had to choose from among five alternatives: domestic Wagyu beef, domestic dairy beef, Australian beef, US beef, and a "none of these" option. According to random utility theory, respondent *n* is assumed to select the alternative that provides the greatest utility. The systematic component of the utility of respondent *n* for choosing beef *j* is as follows (the systematic component of the utility for the "none of these" option is normalized to zero).

$$V_{jn} = ASC_j + b_{BSEj} BSE_{jn} + b_{Pj} P_{jn} + b_{CUT1j} CUT1_{jn} + b_{CUT2j} CUT2_{jn} + b_{CUT3j} CUT3_{jn}, \quad (1)$$

where *j* denotes the type of beef (1 = domestic Wagyu beef, 2 = domestic dairy beef, 3 = Australian beef, 4 = US beef). ASC*j* represents an alternative-specific constant for each of the beef alternatives relative to the "none of these" option. $b_{BSEj}$ is a coefficient of BSE*jn* that takes a value of 1 if beef *j*, which was presented to respondent *n*, was tested for BSE and zero otherwise. $b_{Pj}$ is a coefficient of P*jn* that is the price of beef *j* that was presented to respondent *n*.

The most important variables are the cutoff variables (Swait 2001): CUT1*jn*, CUT2*jn*, and CUT3*jn* ($b_{CUT1j}$, $b_{CUT2j}$, and $b_{CUT3j}$ are the respective coefficients of each variable). These variables are created on the basis of the combinations of the responses to the questions shown in Fig. 2 with the level of each attribute of the alternatives presented to respondent *n* in the choice experiment questions shown in Fig. 1. In response to the question presented in Fig. 2, respondent *n*, who answered, "I would not purchase the beef regardless of the BSE-test status," when presented with BSE-untested beef *j* has CUT1*jn* = 1 and otherwise has CUT1*jn* = 0. Moreover, when presented with BSE-tested beef *j*, respondent *n* has CUT2*jn* = 1 and otherwise has CUT2*jn* = 0. On the other hand, respondent *n*, who answered, "I would not purchase the beef when it was not tested for BSE," when presented with BSE-untested beef *j*

has CUT3*jn* = 1 and otherwise has CUT3*jn* = 0.

In the present study, we apply a random parameters logit (RPL) model based on the aforementioned systematic component of the utility, including cutoff variables (Eq.1), where each coefficient of all independent variables is assumed to randomly vary among the respondents according to normal distribution. Table 3 presents the definitions of the WTP for each type of beef, based on the non-compensatory utility function. When a cutoff variable related to an attribute for respondent *n* takes a value of 1 and has significant coefficients, respondent *n* is judged to have a non-compensatory utility for the attribute. The WTP of each type of beef is calculated on the basis of the magnitude of the systematic utility for each type of beef relative to that for the option of "none of these," which is normalized to be zero. In the present study, each of the cutoff variables (CUT1*jn*, CUT2*jn*, and CUT3*jn*) has a value of 1 if beef *j*, which is presented to respondent *n*, has an undesirable level of attribute as indicated by respondent *n*; therefore, each coefficient of each cutoff variable is expected to be negative. When the coefficient is extremely negative or $-\infty$, respondent *n* is judged to have a "hard" conjunctive decision-making rule (decision strategy) for valuing beef *j*, which is one of the non-compensatory utility function and is considered to imply that an alternative would not be chosen if an attribute did not fulfill a certain condition even when other attributes show desirable levels as indicated by the respondent. When the coefficient is a small or finite negative value, respondent *n* is judged to have a "soft" conjunctive decision-making rule for valuing beef *j*; this means that respondent *n* sometimes violates his/her own conjunctive rule. Different cutoff variables related to BSE-tested and BSE-untested beef *j* are set for respondents who answered "I would not purchase the beef regardless of the BSE-test status" to beef *j* to the question shown in Fig. 2 because the probability of the violation of the respondents' own conjunctive rule is expected to be varied depending on the BSE-test status.

In order to verify the validity of the RPL with the non-compensatory utility model, an

RPL with a compensatory utility model that does not include cutoff variables is also estimated.

## 3. Results and Discussion

Table 4 presents the estimated coefficients and p-values of the RPL with non-compensatory and compensatory models. A goodness of fit (McFadden's R-square) for the RPL with the non-compensatory model with an alternative (beef) specific coefficient of price was 0.485 and was smaller than that with a generic coefficient of price as shown in Table 4; therefore, the latter was accepted as the final model.

McFadden's R-square for the RPL with the compensatory model and that with the non-compensatory model were 0.454 and 0.490, respectively, indicating that the latter model was able to capture the respondents' decision-making process appropriately as compared to the former model. The mean coefficient estimates of ASC$j$ for domestic Wagyu beef ($j$ = 1) and domestic dairy beef ($j$ = 2) were significantly positive and those for Australian beef ($j$ = 3) and US beef ($j$ = 4) were not significantly different from zero, indicating that even a representative respondent placed a lower value on two types of BSE-untested imported beef. The mean coefficient estimate of the BSE-test status (BSE$j$) for each of the four types of beef was significantly positive, indicating that the representative respondent valued each type of beef for being BSE-tested as compared to when it was BSE-untested. The mean coefficient estimate of price was significantly negative and fulfilled the sign condition expected by standard economic theory. However, the standard deviation coefficient estimate of price was significantly different from zero and three respondents had a positive individual-specific coefficient estimate of price. When calculating the average of WTP for each type of beef

according to the respondent's type of decision-making rule, the three respondents' positive coefficient estimates would cause large variances in WTP; therefore, they were excluded from the subsequent calculations of WTP[1]. With the exception of CUT21 and CUT22, the other cutoff variables had significantly negative mean coefficient estimates.

Table 5 presents the average WTP for each beef with regard to the BSE-test status for each classified respondent, whose classification was determined based upon the responses to the question about the intention to purchase each of the four types of beef when considering the BSE-test status (Fig. 2). For example, the upper side of Table 5 shows the average WTP for BSE-untested and BSE-tested domestic Wagyu beef for three types of respondents: "I would purchase the beef if its price was reasonable when it was not tested for BSE," "I would not purchase the beef when it was not tested for BSE," and "I would not purchase the beef regardless of the BSE-test status." According to Table 5, the following can be summarized.

First, each WTP for "I would not purchase the beef when it was not tested for BSE" x "BSE-untested beef," "I would not purchase the beef regardless of the BSE-test status" x "BSE-untested beef," and "I would not purchase the beef regardless of the BSE-test status" x "BSE-tested beef" for each beef is expected to be negative (lower than the utility of the "none of these" option). The RPL with the non-compensatory and compensatory models fulfilled this expectation in nine cases and five cases, respectively (The values in the cases where this condition was significantly fulfilled appear in bold type in Table 5). The results indicate that a more valid WTP was calculated from the RPL with the non-compensatory model, as compared to the RPL with the compensatory model. We focus our attention on the WTP calculated from the RPL with the non-compensatory model.

Secondly, respondents who gave a "I would not purchase the beef regardless of the BSE-test status" answer regarding domestic Wagyu beef and domestic dairy beef had a positive WTP for BSE-tested domestic Wagyu beef and dairy beef (800 yen and 805 yen,

respectively). Although great care should be taken concerning a small sample size (14 and 9 respondents, respectively), this result suggests that consumers might value food safety with regard to two types of domestic beef by using the "soft" conjunctive rule.

Thirdly, respondents who answered, "I would not purchase the beef when it was not tested for BSE" regarding Australian and US beef had a negative WTP for each of the two BSE-untested imported beef (–983 yen and –821 yen, respectively), which were smaller than the WTP for each of the two types of BSE-untested domestic beef (–229 yen and –364 yen, respectively) for respondents who answered, "I would not purchase the beef when it was not tested for BSE" regarding domestic Wagyu beef and dairy beef. Similarly, respondents who answered, "I would not purchase the beef regardless of the BSE-test status" regarding Australian and US beef had a lower WTP for the two types of BSE-tested and BSE-untested imported beef as compared to the WTP for the two types of BSE-tested and BSE-untested domestic beef among those who gave the same answer regarding the two types of domestic beef. This result indicates that respondents who do not accept imported beef have a "harder" conjunctive rule as compared to those who do not accept domestic beef.

Fourthly, of a total of 354 respondents, 156 who answered, "I would not purchase the beef when it was not tested for BSE" regarding US beef valued BSE-tested US beef at an average of 193 yen, which was the price range of US beef before the import ban had been implemented. In addition, the WTP for BSE-tested US beef among respondents who answered, "I would purchase the beef if its price was reasonable when it was not tested for BSE" regarding US beef was 391 yen. These results indicate that the introduction of the BSE test to US beef seem to incline more Japanese consumers toward accepting US beef.

Lastly, the BSE test that has been conducted in Japan is not conducted in Australia, since Australia is a BSE-free country. Hence, the Australian beef that is currently sold in Japan is not tested for BSE. However, the number of respondents who answered, "I would not

purchase the beef when it was not tested for BSE" regarding Australian beef was 270 and their WTP for BSE-untested Australian beef was −983 yen. Although Japanese consumers may not generally know that the Australian beef in the market is not tested for BSE, they think that it is safe from BSE because it is sold in the market (that is, if it was not safe from BSE, it would be removed from the market by the Japanese government). Under these circumstances, the BSE test was hypothetically attributed to Australian beef in the questionnaire survey. This seemed to induce respondents to shift their food safety standard for Australian beef from BSE-untested, which was actually sold in the Japanese beef market and was safe from BSE, to that of BSE-tested and, thus, decrease their WTP for BSE-untested Australian beef.

## 4. Concluding Remarks

The purpose of the present paper was to examine Japanese consumers' valuation of domestic Wagyu beef, domestic dairy beef, Australian beef, and US beef when considering their BSE-test status—BSE-tested or BSE-untested—using a choice experiment. When comparing the estimated results of the choice experiment data gained from the RPL with the non-compensatory utility model with those gained from the RPL with the compensatory utility model, goodness of fit for the former model was shown to be greater than that for the latter. The respondents' WTP for each type of beef with regard to the BSE-test status, when calculated from the estimated results of the RPL with the non-compensatory model, coincided more with their decision-making processes in comparison with the results of the RPL with the compensatory model. These results suggest that the RPL with the non-compensatory model is more suitable for measuring valuations of beef by Japanese consumers who are sensitive to

food safety with regard to beef. Moreover, the estimation results showed the following: (1) BSE-tested status increased WTP for domestic Wagyu beef and domestic dairy beef; (2) with the exception of the respondents who disliked US beef regardless of the BSE-test status, WTP for US beef became positive if the BSE test that was conducted in Japan was introduced in US beef; and (3) when the BSE test that was conducted in Japan was attributed to beef from Australia, which is a BSE-free country, Japanese consumers considered BSE-tested Australian beef to represent the standard for food safety with regard to Australian beef; therefore, the WTP for BSE-untested Australian beef decreased. These results suggest that Japanese consumers regard the BSE-test status to be very important for food safety with regard to beef.

**Notes**

1. The sign condition could be fulfilled by shifting the distribution of the coefficient of price from normal distribution to triangular distribution with mean equal to spread (Hensher et al. 2003). However, the demerit of imposing an additional restriction on distribution of all respondents' coefficient of price in order to guarantee three respondents' coefficient of price to be negative did not seem to be smaller than the demerit of decreasing three valid respondents. Hence, the coefficient of price was also assumed to be distributed normally.

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12. In the following questions from 12-1 to 12-10, four types of beef for *yakiniku* will be shown. These four types of beef include "domestic Wagyu beef," "domestic dairy beef," "Australian beef," and "US beef." Each of them has two attributes: BSE-test status and price per 100g. Although BSE tests will occasionally not be carried out on each of them, specific risk materials—those with materials causing BSE—for all types of beef presented in the questions are removed. Note that the four types of beef have the same characteristics such as parts or use-by date, except for the two attributes.

In each question, please circle the item that you would be most likely to purchase, considering the attributes levels of each beef. If you would not purchase any of the four types of beef, please circle the "none of these" option.

12-1. Please circle one of four types of beef for *yakiniku* listed below that you would likely purchase.

| Circle one −> | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Country of origin | Domestic Wagyu beef | Domestic dairy beef | Australian beef | US beef | None of these |
| BSE-test status | Tested | Untested | Tested | Untested | |
| Price per 100g | 798 yen | 498 yen | 298 yen | 248 yen | |

Note: Questions from 12-2 to 12-10 are omitted.

Fig.1 Questions for choice experiment in evaluating beef

Please circle appropriate number that describes the relationship between your intention to purchase beef and the BSE-test status for each of four types of beef—"Domestic Wagyu beef," "Domestic dairy beef," "Australian beef," and "US beef"—for *yakiniku*. Note that all of the beef regardless of the BSE-test status were derived from cattle that were grew on feeds that had no materials causing BSE and from which specific risk materials that could cause BSE were removed when the cattle was slaughtered.

| | I would purchase the beef if its price was reasonable when it was not tested for BSE. | I would not purchase the beef when it was not tested for BSE. | I would not purchase the beef regardless of the BSE-test status. |
|---|---|---|---|
| Domestic Wagyu beef | 1 | 2 | 3 |
| Domestic dairy beef | 1 | 2 | 3 |
| Australian beef | 1 | 2 | 3 |
| US beef | 1 | 2 | 3 |

Fig.2 Questions for capturing the intention to purchase each of four types of beef considering the BSE-test status

Table 1

Characteristics of survey participants

| | N | % |
|---|---|---|
| Gender | | |
| Male | 105 | 29.4 |
| Female | 167 | 46.8 |
| No response | 85 | 23.8 |
| Age | | |
| Twenties | 11 | 3.1 |
| Thirties | 34 | 9.5 |
| Forties | 91 | 25.5 |
| Fifties | 132 | 37.0 |
| Sixties | 71 | 19.9 |
| Seventies | 15 | 4.2 |
| Eighties or above | 2 | 0.6 |
| No response | 1 | 0.3 |
| Family member | | |
| One | 7 | 2.0 |
| Two | 97 | 27.2 |
| Three | 100 | 28.0 |
| Four | 91 | 25.5 |
| Five or above | 59 | 16.5 |
| No response | 3 | 0.8 |
| Junior high or high school student's family member | | |
| Yes | 79 | 22.1 |
| No | 275 | 77.0 |
| No response | 3 | 0.8 |
| Family member under elementary school | | |
| Yes | 56 | 15.7 |
| No | 298 | 83.5 |
| No response | 3 | 0.8 |
| Family income (yen per year) | | |
| Under 2 million | 5 | 1.4 |
| 2 million | 15 | 4.2 |
| 3 million | 45 | 12.6 |
| 4 million | 37 | 10.4 |
| 5 million | 42 | 11.8 |
| 6 million | 26 | 7.3 |
| 7 million | 39 | 10.9 |
| 8 million | 50 | 14.0 |
| 9 million | 23 | 6.4 |
| 10 to under 12 million | 33 | 9.2 |
| 12 to under 15 million | 11 | 3.1 |
| 15 million or above | 6 | 1.7 |
| No response | 25 | 7.0 |

Table 2

Beef attributes and levels

| Attributes | Levels |
|---|---|
| Country of origin (kind of beef) | Domestic Wagyu beef, Domestic dairy beef, Australian beef, US beef |
| BSE-test status | Tested, Untested |
| Price per 100g | Domestic Wagyu beef: 498yen, 598yen, 698yen, 798yen, 898yen<br>Domestic dairy beef: 298yen, 398yen, 498yen, 598yen, 698yen<br>Australian beef: 148yen, 198yen, 248yen, 298yen, 398yen<br>US beef: 98yen, 148yen, 198yen, 248yen, 298yen |

Table 3

Definitions of willingness-to-pay (WTP) for each beef for respondent *n*

| Respondent *n*'s intention to purchase beef *j* when considering its BSE-test status | BSE-untested beef *j* | BSE-tested beef *j* |
|---|---|---|
| I would purchase the beef if its price was reasonable when it was not tested for BSE. | $ASC_{jn} / b_{P_j}$ | $(ASC_{jn} + b_{BSE_{jn}}) / b_{P_j}$ |
| I would not purchase the beef when it was not tested for BSE. | $(ASC_{jn} + b_{CUT3_{jn}}) / b_{P_j}$ | $(ASC_{jn} + b_{BSE_{jn}}) / b_{P_j}$ |
| I would not purchase the beef regardless of the BSE-test status. | $(ASC_{jn} + b_{CUT1_{jn}}) / b_{P_j}$ | $(ASC_{jn} + b_{BSE_{jn}} + b_{CUT2_{jn}}) / b_{P_j}$ |

Table 4

Random parameters logit estimates

| Independent Variable | | RPL with the compensatory model | | | RPL with the non-compensatory model | | |
|---|---|---|---|---|---|---|---|
| | | Estimate | S.E. | p-value | Estimate | S.E. | p-value |
| ASC1 | mean | 1.6667 *** | 0.2757 | 0.000 | 2.8879 *** | 0.4180 | 0.000 |
| | s.d. | 0.8747 *** | 0.1760 | 0.000 | 0.3953 ** | 0.2000 | 0.048 |
| ASC2 | mean | 0.8689 *** | 0.2111 | 0.000 | 2.3739 *** | 0.2812 | 0.000 |
| | s.d. | 1.4364 *** | 0.1285 | 0.000 | 1.0157 *** | 0.1436 | 0.000 |
| ASC3 | mean | −1.3155 *** | 0.3018 | 0.000 | 0.4831 | 0.3768 | 0.200 |
| | s.d. | 1.3071 *** | 0.2200 | 0.000 | 1.8294 *** | 0.1640 | 0.000 |
| ASC4 | mean | −6.0295 *** | 0.6170 | 0.000 | −0.5615 | 0.6662 | 0.399 |
| | s.d. | 3.6130 *** | 0.3390 | 0.000 | 2.3268 *** | 0.3412 | 0.000 |
| BSE1 | mean | 3.6238 *** | 0.2267 | 0.000 | 2.3924 *** | 0.3800 | 0.000 |
| | s.d. | 1.2278 *** | 0.2044 | 0.000 | 0.7746 *** | 0.2017 | 0.000 |
| BSE2 | mean | 5.0997 *** | 0.1985 | 0.000 | 3.6337 *** | 0.2595 | 0.000 |
| | s.d. | 0.7967 *** | 0.1943 | 0.000 | 0.0423 | 0.2920 | 0.885 |
| BSE3 | mean | 4.3027 *** | 0.2905 | 0.000 | 3.2285 *** | 0.3627 | 0.000 |
| | s.d. | 1.7549 *** | 0.2814 | 0.000 | 0.6338 *** | 0.2012 | 0.002 |
| BSE4 | mean | 5.0391 *** | 0.3859 | 0.000 | 2.1148 *** | 0.6390 | 0.001 |
| | s.d. | 0.0095 | 0.2502 | 0.970 | 1.7245 *** | 0.3269 | 0.000 |
| P | mean | −0.0084 *** | 0.0004 | 0.000 | −0.0079 *** | 0.0004 | 0.000 |
| | s.d. | 0.0040 *** | 0.0002 | 0.000 | 0.0043 *** | 0.0003 | 0.000 |
| CUT11 | mean | | | | −3.4827 * | 1.8967 | 0.066 |
| | s.d. | | | | 1.2510 | 2.3317 | 0.592 |
| CUT12 | mean | | | | −4.6361 * | 2.4016 | 0.054 |
| | s.d. | | | | 6.7262 *** | 2.5382 | 0.008 |
| CUT13 | mean | | | | −3.5241 *** | 0.8642 | 0.000 |
| | s.d. | | | | 0.0147 | 0.8494 | 0.986 |
| CUT14 | mean | | | | −10.9771 * | 6.4444 | 0.089 |
| | s.d. | | | | 4.9607 | 3.8315 | 0.195 |
| CUT21 | mean | | | | −0.8354 | 0.5657 | 0.140 |
| | s.d. | | | | 0.9133 | 0.9439 | 0.333 |
| CUT22 | mean | | | | −1.7038 | 1.1403 | 0.135 |
| | s.d. | | | | 3.0692 * | 1.7385 | 0.078 |
| CUT23 | mean | | | | −5.2773 *** | 0.7230 | 0.000 |
| | s.d. | | | | 1.9522 ** | 0.7579 | 0.010 |
| CUT24 | mean | | | | −6.1914 *** | 1.3585 | 0.000 |
| | s.d. | | | | 1.5169 | 0.9502 | 0.110 |
| CUT31 | mean | | | | −4.2400 *** | 1.3532 | 0.002 |
| | s.d. | | | | 3.3851 *** | 0.9633 | 0.000 |
| CUT32 | mean | | | | −4.3573 *** | 0.6821 | 0.000 |
| | s.d. | | | | 3.6084 *** | 0.4673 | 0.000 |
| CUT33 | mean | | | | −5.8160 *** | 1.0695 | 0.000 |
| | s.d. | | | | 2.8567 *** | 0.5384 | 0.000 |
| CUT34 | mean | | | | −4.0549 *** | 0.9637 | 0.000 |
| | s.d. | | | | 0.2307 | 1.0653 | 0.829 |
| Log likelihood at zero | | | −5,745.69 | | | −5,745.69 | |
| Log likelihood at convergence | | | −3,118.76 | | | −2,887.78 | |
| McFadden's R-square | | | 0.454 | | | 0.490 | |
| No. of respondents | | | 357 | | | 357 | |
| No. of observations | | | 3,570 | | | 3,570 | |

Note: 1) ***, **, and * are significantly different from zero at 1%, 5%, and 10%, respectively. 2) The simulated maximum likelihood results of the two RPL models were computed by NLOGIT 3.0, using 200 Halton draws for the replication.

Table 5
Average willingness-to-pay (WTP) for each beef

| Intention to purchase beef *j* when considering its BSE-test status | N | BSE-untested domestic Wagyu beef | | BSE-tested domestic Wagyu beef | |
|---|---|---|---|---|---|
| | | Compensatory | Non-compensatory | Compensatory | Non-compensatory |
| Domestic Wagyu beef | | | | | |
| I would purchase the beef if its price was reasonable when it was not tested for BSE. | 61 | 271 [219, 324] | 502 [414, 591] | 832 [703, 961] | 915 [753, 1,077] |
| I would not purchase the beef when it was not tested for BSE. | 279 | 254 [231, 278] | **−229** [−290, −168] | 826 [751, 901] | 927 [833, 1,021] |
| I would not purchase the beef regardless of the BSE-test status. | 14 | 224 [151, 296] | **−130** [−255, −5] | 750 [511, 988] | 800 [444, 1,157] |
| | | BSE-untested domestic dairy beef | | BSE-tested domestic dairy beef | |
| | | Compensatory | Non-compensatory | Compensatory | Non-compensatory |
| Domestic dairy beef | | | | | |
| I would purchase the beef if its price was reasonable when it was not tested for BSE. | 60 | 171 [121, 221] | 411 [340, 481] | 999 [855, 1,142] | 1036 [863, 1,208] |
| I would not purchase the beef when it was not tested for BSE. | 285 | 142 [110, 173] | **−364** [−410, −318] | 925 [831, 1,020] | 1062 [947, 1,177] |
| I would not purchase the beef regardless of the BSE-test status. | 9 | 217 [6, 428] | −607 [−1,453, 239] | 912 [449, 1,375] | 805 [166, 1,444] |
| | | BSE-untested Australian beef | | BSE-tested Australian beef | |
| | | Compensatory | Non-compensatory | Compensatory | Non-compensatory |
| Australian beef | | | | | |
| I would purchase the beef if its price was reasonable when it was not tested for BSE. | 32 | −75 [−127, −24] | 184 [138, 229] | 692 [528, 856] | 682 [513, 851] |
| I would not purchase the beef when it was not tested for BSE. | 270 | **−202** [−230, −175] | **−983** [−1,106, −860] | 441 [409, 474] | 554 [503, 605] |
| I would not purchase the beef regardless of the BSE-test status. | 52 | **−335** [−391, −278] | **−595** [−711, −479] | 210 [141, 280] | **−343** [−446, −240] |
| | | BSE-untested US beef | | BSE-tested US beef | |
| | | Compensatory | Non-compensatory | Compensatory | Non-compensatory |
| US beef | | | | | |
| I would purchase the beef if its price was reasonable when it was not tested for BSE. | 18 | −537 [−1,081, 6] | −11 [−155, 133] | 234 [−88, 557] | 391 [246, 535] |
| I would not purchase the beef when it was not tested for BSE. | 156 | **−746** [−857, −635] | **−821** [−947, −696] | −12 [−65, 40] | 193 [146, 240] |
| I would not purchase the beef regardless of the BSE-test status. | 180 | **−1,143** [−1,241, −1,046] | **−2,110** [−2,345, −1,875] | **−347** [−379, −315] | **−814** [−912, −716] |

Note:1) Unit : Japanese yen per 100g. 2) Figures in parentheses indicate lower and upper of 90% confidence interval for each WTP estimates.