ASSESSING KOREAN CONSUMERS' VALUATION FOR BSE-TESTED AND COUNTRY OF ORIGIN LABELED BEEF PRODUCTS*

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Abstract
The objective of this study is to estimate Korean consumers' willingness to pay (WTP) for beef products with BSE testing and country of origin labeling. We use a choice experiment to examine consumers' valuation for beef products with these labels. In addition to analysis using the pooled sample, we also conduct sub-sample analyses based on consumers' level of risk perception about beef consumption and selected socio-demographic characteristics. Results suggest that Korean consumers value BSE tested beef. They also have a preference for domestic beef vis-à-vis imported beef. Results also suggest that those with high risk perception tend to value BSE testing more than country

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of origin labeling while those with low risk perception value country of origin labeling more than BSE testing. Moreover, we found that young or high educated respondents tend to value BSE testing and imported beef from countries which have not experienced BSE outbreaks more than do older or lower educated respondents.

I. Introduction

Since Korea opened its beef import market in 1988, beef had been imported through a quota system. However, as a result of the Uruguay Round of the GATT negotiations, the Korean beef market was fully liberalized with beef import quotas being replaced by an import tariff system in 2001. This has caused beef imports in Korea to increase rapidly since 2001, with the market share of imported beef reaching over 50 percent of the total beef consumption in the country. Major exporting countries were the US, Australia, and Canada. However, after outbreaks of the mad cow disease (BSE) in the US and Canada, Korea temporarily stopped the importation of beef from those countries in 2004. Korea did not reopen its beef market to the US and Canada until 2007 and 2012, respectively.

Korean consumers have become more concerned about the safety of imported beef after the occurrence of BSE in major exporting countries (Song et al., 2004; Jeong et al., 2005; Lee et al., 2011). Consequently, consumers have asked for more information on imported beef such as safety and country of origin (Lee et al., 2011). The Korean government then enhanced the testing standards for imported beef during the quarantine process. This initiative, however, only examines specified risk materials (SRM) suspected beef products, but does not require BSE testing in beef products. In addition, even though there is a possibility that BSE could affect domestic cattle, the Korean government has not implemented any mandatory BSE testing on domestic cattle. Given this backdrop, Korean consumers highly demanded that the government should improve beef safety standards on domestic and imported beef by requiring BSE testing and country of origin labeling (COOL) in beef products.

No other study, however, has examined Korean consumers' valuation for BSE-testing and country of origin labeling in the beef market. This information is needed by policy makers and marketers when deciding whether or

not to implement BSE testing or country of origin labeling in beef products in Korea. For example, while anticipated costs of the implementation of a policy could be estimated by industry and/or the Korean government, this has to be combined with information about the public's valuation for such a policy to definitively assess the feasibility of the policy from both a public policy and marketing points of view. We attempt to fill this void by investigating consumers' willingness to pay (WTP) for beef labeled as being BSE tested and beef labeled with country of origin using a choice experiment design.

Given that consumers' risk perception about food safety can influence purchasing behaviors (Lusk and Coble 2005; Angulo et al. 2005; McCluskey et al. 2005; Angulo and Gil 2007), we examined the effect of consumers' level of risk perception about beef consumption on WTP for BSE testing and country of origin labeling by dividing our sample into two groups: low risk perception group (i.e., those who perceived a low risk from consuming beef) and high risk perception group (i.e., those who perceived a high risk from consuming beef).

Moreover, we also examined possible heterogeneity in WTP with respect to respondents' demographic characteristics. Specifically, we analyzed the effect of consumers' age and the level of education on WTP for BSE testing and country of origin labeling by dividing our sample by education and age levels (i.e., high education group and low education group; older respondents and younger respondents).

II. Beef Safety Valuation

A number of studies have attempted to examine consumers' attitudes toward beef safety and investigate their valuations for safer beef products. For example, McCluskey et al. (2005) identified the factors that affect Japanese consumers' valuations for BSE tested-beef using the dichotomous choice contingent valuation method. Their results indicated that 86 percent of respondents reported to have consumed less domestic beef after the BSE outbreak in Japan, and they were willing to pay over 50 percent premium for BSE tested beef. Yang and Goddard (2011) clustered household panel data by survey participants' risk attitude and perception toward beef, and examined the change in household beef purchasing-behavior according to beef risk attitude and perception. They con-

cluded that households with lower willingness to accept the risk on beef consumption have more elastic beef demand than those with higher willingness to accept the risk on beef consumption.

Cranfield (2011) investigated Canadian consumers' willingness to pay for beef that have been tested for BSE using a contingent valuation survey. The results indicated that respondents are willing to pay a premium of 43 percent for beef with BSE testing. Moreover, this premium increased with purchase intention. Lee et al. (2011) estimated Korean consumers' willingness to pay for imported beef with traceability using non-hypothetical experimental auction. They also analyzed the effects of different types of information about the traceability of imported beef on consumers' valuations. Their results indicated that consumers are willing to pay an average of 39 percent premium for imported beef that are "traceable" (i.e., with traceability system).

Lim et al. (2013) investigated US consumers' valuations for imported beef compared to domestic beef. They also investigated the premium for BSE tested and traceable beef. The results showed that for consumers to switch from domestic beef to Canadian beef, the price discount for Canadian beef must be in the range of US $1.09 to US $35.12 per pound. They also concluded that consumers show US $5.7 and US $5.9 premium for BSE tested and traceable beef, respectively. Chung et al. (2009) conducted a conjoint analysis to compare Korean consumers' willingness to pay for domestic and imported beef. Moreover, they calculated consumers' valuations for beef quality attributes such as genetically modified organism (GMO) free feed and antibiotic free. The results indicated that consumers are willing to pay US $14 per pound more for domestic beef compared to imported beef and that country of origin is the most critical factor contributing to the price differential between domestic and imported beef. Their result also showed that consumers are willing to pay a premium for GMO free and antibiotic free beef.

In summary, many previous studies concluded that consumers' food safety concerns have escalated after outbreaks of BSE and these concerns have changed consumers' beef purchasing behaviors. Consumers tend to be giving more weight on beef safety related attributes such as BSE testing, traceability, and antibiotic free compared to other quality attributes such as marbling and freshness, when purchasing beef in the market (Chung et al, 2009).

The occurrence of BSE in major beef exporting countries is a very sensitive issue in Korea relative to other food safety issues since Korea imports

60 percent of its total beef consumption. However, Korean consumers' willingness to pay for a BSE-testing and country of origin labeling has not been examined in the past. No other study has also examined possible heterogeneity in WTP with respect to Korean consumers' level of risk perceptions on beef consumption and socio-demographic characteristics.

III. Experimental Design

We conducted a nationwide online survey in October, 2012 in South Korea. Since housewives are by far the primary shoppers of beef in Korea, many studies on Korean beef consumption have selected only housewives (Rhee et al. 2001, Jeong et al. 2002, Song et al. 2004, MIFAFF 2010, MIFAFF and aT 2011). Therefore, a total of 500 randomly chosen housewives participated in our choice experiment Regional distribution of the sample: Seoul 26.6%, Busan 9.4%, Daegu 6.3%, Incheon 4.8%, Gwangju 3.8%, Daejeon 5.2%, Ulsan 2.1%, Gyeonggi-do 21.0%, Gangwon-do 0.9%, Chungcheongbuk-do 2.6%, Chungcheongnam-do 2.5%, Jeollabuk-do 3.6%, Jeollanam-do 2.3%, Gyeongsangbuk-do 4.0%, Gyeongsangnam-do 4.9%. We divided the survey into three parts; the first part included participants' demographic information; the second part included the choice experiment to estimate participants' valuations for BSE testing and country of origin; the last part included consumers' risk perception on consuming beef.

The attributes and levels of each attribute used in the choice experiment are presented in Table 1. We chose 1 kg of beef for "Bulgogi use" as the representative product since it is one of the most famous dishes in the country. Previous studies have identified that Korean consumers are usually concerned about food safety, country of origin, and price when they buy beef products (Lee et al. 2011; Chung et al. 2012). Therefore, the choice profiles are composed of three attributes: price, BSE testing, and country of origin. Increase in the number of attributes would produce an increase in the variance of the results and lead respondents to make mistakes when they make a decision (Wang and Li, 2002; Arentze et al. 2003). We, therefore, focused on intangible attributes of beef in our study. Price as an attribute has four levels ranging from 12,000 KW to 30,000 KW per kg. These price levels represent

market prices for three imported beef and domestic beef in Korea, respectively. Four types of country of origin were considered in the experiment. We included two countries (i.e. domestic and Australia) which have not experienced BSE outbreaks, and other two countries (i.e. US and Canada) which have experienced a BSE outbreak. Australia, US and Canada are major (Top 3) beef exporting countries to Korea. Moreover, we considered two levels of BSE testing (i.e. BSE tested or not) as an attribute.

Each respondent was presented with 8 choice sets. Each set includes 3 choices. Therefore, 12,000 observations are used in the analysis. To construct the choice sets, we used a full factorial design since this design method efficiently works in estimating participants' choice behavior (Lusk and Norwood 2005). No identical scenario was presented in each choice set and each participant answered 8 unique choice sets. D-optimality criterion for the fractional factorial design was then used to generate the choice sets in our choice experiment since it is invariant under different coding and programs based on D-efficiency run fast compared to other efficiency (D-efficiency = 100). We also provided a cheap talk script to participants (Lusk 2003; Carlsson et al. 2005; Silva et al. 2012) (see Appendix 1), prior to the presentation of the choice sets, to reduce potential hypothetical bias in the choice experiment. We outsourced the survey to research service agency, Macromillembrain (http://www.embrain.com). Pictures and descriptions of the attributes were provided to the participants during the survey. An example of a choice set is presented in Appendix 2.

TABLE 1. Attributes and Levels in Choice Experiment

Attributes	Levels
Price (Korean won/kg)	12,000, 18,000, 24,000, 30,000
BSE testing	Yes, No
Country of Origin	Canada, United States, Australia, Korea

IV. Summary Statistics and Methods

Summary statistics of the demographic characteristics of survey participants are presented in Table 2. The age distributions of survey participants are: 36 percent in their 40s; 31 percent in their 30s, and 25 percent in their 50s. Fifty-sev-

en percent of respondents graduated from a university, and thirty-four percent graduated from high school. For the monthly household income, the largest group is in the range of from 3 million to 4 million won.

In addition, the average household size of the subjects is approximately 3 persons, and they buy beef about 3 times per month. Average quantity of beef per purchase is about 0.867 kg and participants eat beef at home or away from home about 3.5 times per month on average. Survey participants prefer domestic beef mostly and Australian beef next. Moreover, participants indicated that they are first concerned with country of origin when they buy beef, and then, with food safety and then price. This implies that price is not the only main determinant of Korean consumers' beef purchase.

Table 2. Summary statistics of participants' socio-demographic variables

Variables	Categories	Value	
		Mean	Std.Dev
Household size		2.98	1.10
Number of purchase[1]		2.80	2.15
Quantity of purchase[2]		866.78	490.99
Frequency of eating[3]		3.53	2.76
Age	Twenties(20~29)	6%	
	Thirties(30~39)	30.8%	
	Forties(40~49)	35.6%	
	Fifties(50~59)	25.4%	
	Sixties(60~69)	2.2%	
Education	Elementary school	0.6%	
	Middle school	1.2%	
	High school	33.8%	
	University	57.2%	
	Post-graduate	7.2%	
Income	Less than 1 million	0.8%	
	1 to 1.99 million	5.0%	
	2 to 2.99 million	18.8%	
	3 to 3.99 million	24.8%	
	4 to 4.99 million	21.0%	
	5 to 5.99 million	13.2%	
	6 to 6.99 million	7.2%	
	7 to 7.99 million	5.4%	
	Higher than 8 million	3.8%	
Preferred country4	Korea	67.6%	
	US	1.2%	
	Australia	28.2%	
	Canada	0.4%	
	Other countries	1.2%	
	None	1.4%	
Concern	Country of Origin	38.1%	
	Safety	27.5%	
	Price	20.0%	

1 Frequency of buying beef a month.

2 Quantity of buying beef once (unit: g).

3 Frequency of eating beef at home or outside home a month.

4 Preferred country of origin when they buy beef in the market.

As previously mentioned, consumers' purchasing behaviors could be affected by their risk perceptions about food safety (Lusk and Coble 2005; Angulo et al. 2005; Angulo and Gil 2007; McCluskey et al. 2005). Therefore, survey participants were asked to answer risk perception questions using a Likert scale used by Lusk and Coble (2005) since they concluded that risk perception was a critical determinant of accepting food safety.

Table 3 indicates the specific statements and mean values of the responses to the risk perception questions. The results show that consumers expressed the highest risk value to the question related to imported beef, and lower value to the question related to domestic beef. This implies that consumers are more concerned about the safety of imported beef. In addition, consumers strongly agree with BSE labeling on beef products.

Table 3. Risk perception on Beef Consumption

Statement	Mean1 (Std.)
Absence of BSE testing in slaughtered domestic cattle that are 21 months or older will pose risks to my family and me.	6.99 (1.64)
My family and I could be exposed to risks from beef imported from countries which are not certified as BSE-free.	8.25 (1.14)
My family and I might be exposed to BSE risk when we buy or eat beef.	6.81 (1.62)
BSE free Labeling on beef will reduce risks to my family and me.	7.47 (1.45)
Not implementing BSE testing for all domestic beef will pose risks to my family and me.	7.14 (1.58)
Sum of Scales	36.66 (5.42)

1 Response to Scale Question (1=Strongly Disagree; 9=Strongly Agree)

We assumed that there might be heterogeneity in consumers' valuation on attributes with respect to their risk perceptions on beef consumption. To verify this assumption, we divided our sample into groups. We conducted k-means clustering which is a simple and easy way to classify a given data through a certain number of fixed clusters based on individual risk perception scale. Considering the difference of standard deviation among groups, we concluded that dividing the sample into two groups (i.e., low risk perception vs. high risk perception) is the most reasonable course of action (Appendix 3). Since sample

distribution of risk perception is slightly negative skewed (i.e., relatively few low values; Appendix 4), the differences between standard deviation get larger as the number of groups increases. Average risk perception is shown in Appendix 3. The average risk perceptions of the high risk perception group and low risk perception group are 8.1 and 6.2, respectively.

Demographic characteristics may also influence consumers' WTP with respect to BSE testing and country of origin labeling. Therefore, we conducted sub-sample analyses by dividing respondents into groups using mean values of education and age through k-means clustering (Appendix 5; Appendix 6). Results of the clustering method indicate that a respondent would be included in the high education group if he/she has at least a university degree, and included in the low education group if he/she has less than a university degree. A respondent who is between 20 and 39 years old would be included in younger group while a respondent who is at least 40 years old would be included in older group.

To analyze the choice experiment data, we applied the mixed logit model since this has been widely used in previous studies to capture unobserved heterogeneity (Alfnes, 2004; Hu et al. 2005; Lim et al. 2013). The mixed logit model is flexible so this model can approximate any discrete choice model (McFadden and Train, 2000). It precludes the three limitations arising from standard multinomial logit by allowing for random taste variation, unrestricted substitution patterns, and correlation in unobserved factors (Train 2003). The mixed logit also assumes that the unknown vector of regression coefficients is random, and this property allows one to overcome the independence from irrelevant alternatives (IIA) assumption.

The stochastic component of utility in mixed logit model is divided into two segments. One part is potentially correlated with alternatives and heteroskedastic with individuals and alternatives. The other is i.i.d. over alternatives and individuals (Hensher and Greene, 2003):

$$U_{ni} = ß_n' x_{ni} + [e_{ni} + \varepsilon_{ni}]$$

where U_{ni} is the utility that individual n obtains from alternative i; $ß_n$ is a vector of parameters of variables for person n representing the individual's tastes; x_{ni} is a vector of observed variables that relate to alternative i and to individual

n; e_{ni} is a random part with zero mean whose distribution over individuals and alternatives depends on underlying parameters and observed data relating to alterative i; $\varepsilon_{ni}$is a random term with zero mean that is i.i.d. over alternatives, does not depend on underlying parameters or data, and is normalized to set the scale of utility (Campbell, 2007). The mixed logit class of models assumes a general distribution for e_{ni}, which can take on a number of distributional forms such as normal, log-normal, uniform or triangular (McFadden and Train, 2000).

Denote the density of e_{ni}, , $f(e_{ni}|\Omega)$, where Ω is the fixed parameters of the distribution. For a given e_{ni}, the conditional probability for alternative i over alternative j, given the set of alternatives A, is logit, as the remaining error term is i.i.d. extreme value:

$$L_{ni}(ß_n|e_{ni}) = \exp(ß_n'x_{ni} + e_{ni}) / \sum_{j\in A} \exp(ß_n'x_{ni} + e_{ni})$$

where L_{ni} is the logit probability. As e_{ni} is not given, the unconditional choice probability becomes the integral of L_{ni} over all values of e_{ni} weighted by the density of e_{ni}:

$$P_{ni}(ß_n|e_{ni}) = \int_{e_{ni}} L_{ni}(ß_n|e_{ni}) f(e_{ni}|\Omega) e_{ni}\, dß_n$$

The mixed logit model accommodates the estimation of individual-specific preferences by deriving the individual's conditional distribution based on their known choices (Hensher and Greene, 2003). These conditional parameter estimates are strictly same choice specific parameters or the mean of the parameters of the sub-population of individuals who, when faced with the same choice task, made the same choices. We can only identify mean and standard deviation estimates for the sub-population which made the same choice. Using Bayes' rule, the conditional probability is given by (Hensher and Greene, 2003):

$$H_{ni}\left(ß_n\middle|\Omega\right) = L_{ni}(ß_n) g\left(ß_n\middle|\Omega\right) \Big/ P_{ni}\left(ß_n\middle|\Omega\right)$$

where $L_{ni}(ß_n)$ is the likelihood of an individual's choice if they have the specific $ß_n$ Ω is the set of parameters in the underlying distribution of $ß_n$ $g\left(ß_n\middle|\Omega\right)$ is the distribution in the population of $ß_n$s; and $P_{ni}(\Omega)$ is the choice probability

function defined in open form as:

$$P_{ni}(\Omega) = \int L_{ni}(ß_n) g(ß_n|\Omega)\, dß_n$$

This shows how one can estimate the person specific choice probability as a function of the underlying parameters of the distribution of the random parameters. This choice probability cannot be calculated exactly and is approximated through simulation (Brownstone and Train, 1999). For a given value of the parameters, a value of e_{ni} is drawn from its distribution. Using this draw, the logit formula $L_{ni}(e_{ni})$ is calculated. This process is repeated for many draws, and the mean of the result $L_{ni}(e_{ni})$ is taken as the approximate choice probability:

$$SP_{ni} = \left(\frac{1}{R}\right) \sum_{r=1...R} L_{ni}(e_{ni}{}^{r})$$

where R is the number of replications: $e_{ni}{}^{r}$ is the rth draw: and SP_{ni} is the simulated probability. SP_{ni} is strictly positive for any R and it is unbiased estimator of P_{ni}, so that $\ln(SP_{ni})$ is defined in a log-likelihood function. It is twice differentiable in parameters and variables, which helps in the numerical search for the maximum of the likelihood function.

V. Results

Table 4 shows the estimated coefficients of each attribute while Table 5 exhibits the marginal WTP values for the attributes, estimated by dividing each of the coefficients of the attributes by the coefficient of price. The results in Table 4 showed that coefficients are significant at 10 % significance level except Canada variable in the low risk model.

Base product in the estimation is US beef without BSE test label. Results indicate that respondents are willing to pay 19,864 won per kg more on the BSE test labeled US beef than on US beef without BSE test label. This

value suggests that consumers desire to have BSE testing and labeling on beef products. This is not surprising given that the BSE issue has received enormous public attention and has raised food safety concerns among Korean consumers in 2008 when the Korean government decided to allow re-importation of US beef.

Table 4. Results from mixed logit models

Grouping		Pooled	By risk perception		By education		By age	
			High risk	Low risk	High edu	Low edu	Older	Younger
Price		-0.00012*** (4.82e-06)	-0.00014*** (7.39e-06)	-0.00009*** (6.29e-06)	-0.00012*** (6.18e-06)	-0.00012*** (7.89e-06)	-0.00011*** (5.71e-06)	-0.00012*** (8.43e-06)
BSE	mean	2.415*** (0.119)	3.033*** (0.186)	1.749*** (0.153)	2.562*** (0.154)	2.269*** (0.204)	2.219*** (0.144)	2.628*** (0.206)
	st.d.	1.792*** (0.107)	2.048*** (0.164)	1.486*** (0.150)	1.805*** (0.134)	1.799*** (0.170)	1.726*** (0.128)	1.776*** (0.176)
Dom.	mean	2.928*** (0.143)	2.974*** (0.193)	2.739*** (0.204)	2.938*** (0.179)	2.826*** (0.232)	2.709*** (0.168)	3.119*** (0.240)
	st.d.	1.864*** (0.140)	1.865*** (0.182)	1.856*** (0.205)	2.027*** (0.177)	1.833*** (0.224)	1.752*** (0.157)	1.819*** (0.227)
Aus.	mean	1.338*** (0.113)	1.167*** (0.159)	1.556*** (0.159)	1.437*** (0.142)	1.153*** (0.198)	1.202*** (0.139)	1.604*** (0.192)
	st.d.	1.502*** (0.136)	1.633*** (0.214)	1.336*** (0.197)	1.530*** (0.162)	1.693*** (0.247)	1.441*** (0.167)	1.577*** (0.248)
Can.	mean	-0.714*** (0.155)	-1.143*** (0.217)	-0.157 (0.205)	-0.760*** (0.200)	-0.485** (0.232)	-0.804*** (0.195)	-0.392* (0.229)
	st.d.	-1.818*** (0.208)	-1.829*** (0.304)	1.381*** (0.282)	1.980*** (0.285)	1.309*** (0.324)	1.591*** (0.259)	1.503*** (0.303)
Log likelihood		-2903.55	-1592.87	-1287.41	-1865.37	-1030.34	-1878.60	-1028.34
AIC		5825.099	3203.743	2592.811	3748.739	2078.676	3775.197	2074.684
BIC		5891.633	3265.437	2651.451	3811.312	2135.914	3837.602	2132.221
Number of obs.		12000	7008	4992	7728	4272	7584	4416

*** denotes significance at 1% level.
** denotes significance at 5% level.
* denotes significance at 10% level.
( ) denotes standard error.

With regards to our findings on the country of origin information, consumers are willing to pay more for domestic beef than imported beef. Specifically, compared to US beef, respondents are willing to pay 24,081 won more for domestic beef, 11,006 won more for Australian beef, and 5,868 won

less for Canadian beef. These results clearly show that Korean consumers have a strong preference for domestic beef vis-à-vis imported beef and a preference for imported beef from a country which has not experienced a BSE outbreak over imported beef from a country which has experienced a BSE outbreak.

As previously mentioned, we also conducted separate analysis between respondents with low and high risk perception about beef consumption. The results suggest that the high risk perception group is willing to pay 21,324 won for BSE testing, while the low risk perception group is willing to pay 17,516 won for BSE testing. On the other hand, the low risk perception group tends to value country of origin more than the high risk perception group. These results indicate that the more important factor determining the WTP of consumers with high risk perception is BSE testing while the more important factor determining the WTP of consumers with low risk perception is country of origin. This result implies that consumers with high risk perception might require more accurate information on beef safety.

The separate analysis between respondents with low and high education suggests that the high education group is willing to pay more for BSE testing than the low education group. Specifically, the high education group is willing to pay 20,806 won while the low education group is willing to pay 18,641 won for BSE testing. Interestingly, we also found that the younger group (20~39) is willing to pay 21,119 won for BSE testing, while the older group (40~69) is willing to pay 18,963 won for BSE testing. Moreover, the high education group and the younger group tend to value imported beef from countries which have not experienced BSE outbreaks more than the low education group and the older group. These results indicate that high educated and younger consumers are more concerned about the safety of beef since they might easily access food safety information on beef consumption compared to low educated and older consumers.

These findings suggest that policymakers should realize that consumers' reaction to food safety can be different depending on their level of risk perception about beef consumption and socio-demographic characteristics. Hence, food safety policies could be differentiated for different segments of the population based on levels of risk perceptions and socio-demographic characteristics.

Table 5. Willingness to pay (WTP) for each attribute

Grouping	Pooled	By risk perception		By education		By age	
		High risk	Low risk	High edu	Low edu	Older	Younger
BSE	19864*** (833.06)	21324*** (1056.33)	17516*** (1393.25)	20806*** (996.06)	18641*** (1472.15)	18963*** (1066.40)	21119*** (1392.67)
Domestic	24081*** (936.85)	20914*** (1052.92)	27444*** (1758.12)	23865*** (1148.58)	23224*** (1560.81)	23154*** (1159.18)	25064*** (1417.12)
Australia	11006*** (864.85)	8207*** (1046.04)	15585*** (1462.15)	11669*** (1052.46)	9475*** (1530.33)	10271*** (1095.99)	12889*** (1542.88)
Canada	-5868*** (1297.59)	-8036*** (1539.48)	-1573 (2071.58)	-6170*** (1649.15)	-3982** (1934.81)	-6870*** (1692.11)	-3148* (1863.86)

*** denotes significance at 1% level.
** denotes significance at 5% level.
* denotes significance at 10% level.
( ) denotes standard error.

VI. Conclusions

Food safety is one of the most important issues in Korea. Since reports of the occurrence of BSE infected cattle in the mid-2000s in Canada and US, many beef importing countries have been concerned about consuming beef products. For example, the Japanese central government implemented BSE testing of all slaughtered cattle of all ages in 2001. Korean consumers also have significant concerns about the safety of imported beef after the occurrence of BSE in beef exporting countries. Thus food safety concerns on imported beef resulted in the strengthening of the country of origin indication system and the introduction of the traceability system in Korea. However, unlike in Japan, the Korean government only tests specified risk materials (SRM) suspected beef products just dur-

ing the quarantine process, and does not require BSE testing and country of origin labeling in beef products despite calls from consumer groups. An important information that the Korean government would need when deciding whether to implement BSE testing and country of origin labeling is consumers' willingness to pay for such a policy. No other known study, however, has examined this issue in the past. Therefore, this study focuses on finding Korean consumers' willingness to pay for BSE testing and country of origin labeled beef using a choice experiment.

In addition to analysis using the pooled sample, this study also conducted sub-sample analyses by dividing the sample into different groups using k-means clustering based on different levels of risk perception about beef consumption and different age and education levels.

Results from the whole sample suggest that consumers are willing to pay 19,864 won per kg more on the BSE test labeled US beef than on US beef without BSE test label. Results also suggest that Korean consumers have a strong preference for domestic beef over imported beef and for imported beef from a country which has not experienced a BSE outbreak over imported beef from a country which has experienced a BSE outbreak in both the whole sample and two risk perception sub-groups. This is not surprising given that the BSE issue has received enormous public attention and has raised food safety concerns among Korean consumers. Interestingly, however, respondents in the high risk perception group tend to value BSE test labeling more than country of origin labeling while respondents in the low risk perception group tend to value country of origin labeling more than BSE test labeling. In addition, this study also showed that high educated and younger consumers are willing to pay more for BSE testing than their counterparts, implying that these groups of consumers tend to be more concerned about the safety of beef than others. These findings imply that policymakers should consider differences in consumers' reaction to food safety issues and make appropriate strategies for improving food safety in beef consumption.

Notwithstanding the heterogeneity in WTP estimates across different consumer segments analyzed in this study, the findings tend to imply that Korean consumers are generally willing to support and pay for a policy that would require mandatory BSE testing of beef and country of origin labeling in the country. Since this policy would entail costs to the beef industry, these costs should, among others, be weighed-in with the public's WTP values to determine

the feasibility of adopting such a policy.

Given the importance and size of the Korean beef market, the findings of our study would also be valuable to countries exporting beef to Korea such as Australia, US, and Canada since they provide some insights on the sensitivities of Korean consumers with regards to the BSE issue. For example, it is clear from our findings that Korean consumers would value beef more from countries which have not experienced a BSE incident. Hence, beef exporting countries which are targeting the Korean market should strive not only to avoid having a BSE case but also perhaps protect and enhance their reputation by developing systems or policies (e.g., traceability system) that would credibly make their beef products safer.

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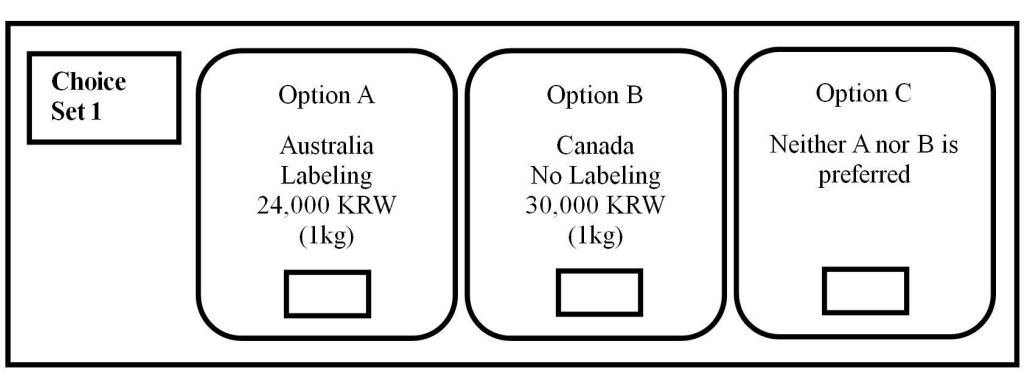
Appendix

Appendix 1. Cheap talk script

The experience from previous similar surveys is that people often state a higher willingness to pay than what one is actually willing to pay for the good. For instance, a recent study asked people whether they would purchase a new food product similar to the one you are about to be asked about. This purchase was hypothetical (as it will be for you) in that no one actually had to pay money when they indicated a willingness to purchase. In the study, 80% of people said they would buy the new product, but when a grocery store actually stocked the product, only 43% of people actually bought the new product when they had to pay for it. This difference (43% vs. 80%) is what we refer to as hypothetical bias.

Accordingly, it is important that you make each of your upcoming selections like you would if you were actually facing these exact choices in a store, i.e., noting that buying a product means that you would have less money available for other purchases.

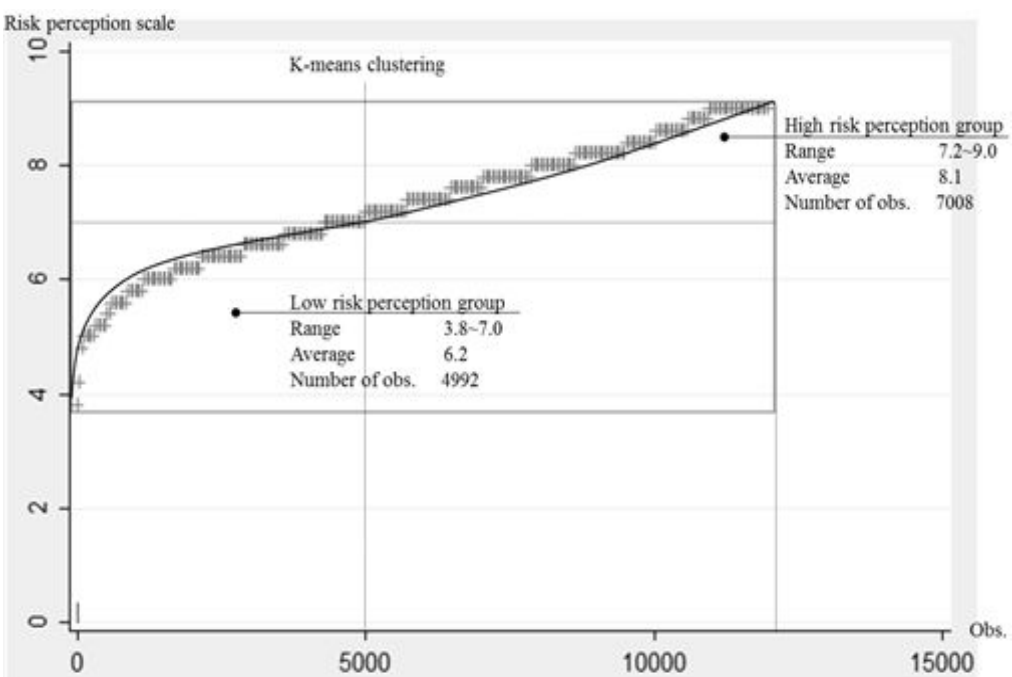
Appendix 2. An example of choice set



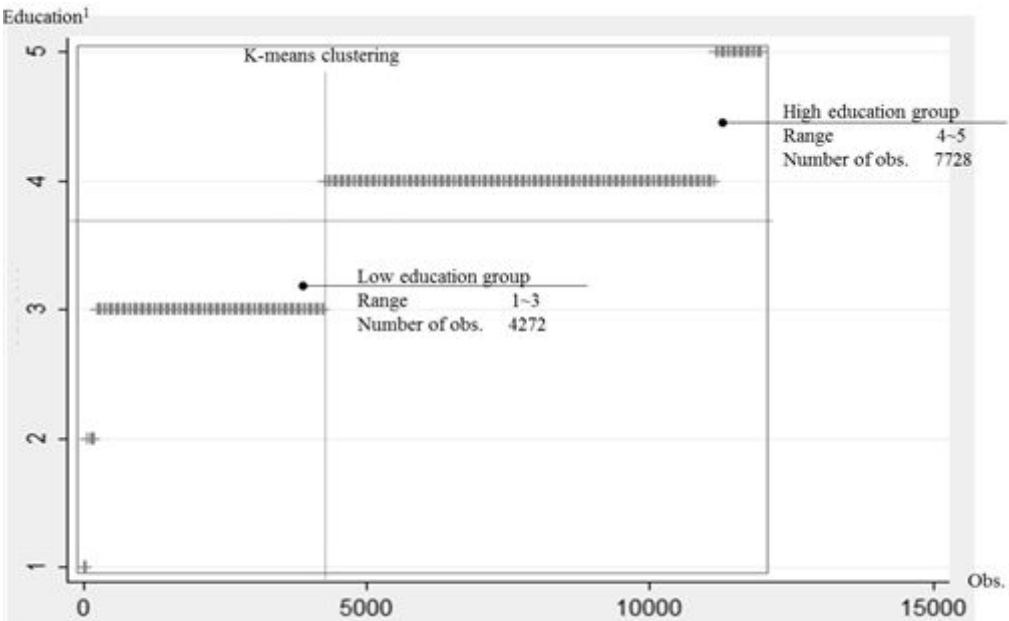
Appendix 3. K-means clustering based on individual risk perception scale

Number of Groups		Obs	Mean	Std. Dev.	Min	Max
Two groups	Group 1	4992	6.264	0.623	3.8	7
	Group 2	7008	8.092	0.586	7.2	9
Three groups	Group 1	1656	5.542	0.487	3.8	6
	Group 2	4824	6.834	0.393	6.2	7.4
	Group 3	5520	8.304	0.470	7.6	9
Four groups	Group 1	3600	6.017	0.561	3.8	6.6
	Group 2	3432	7.190	0.273	6.8	7.6
	Group 3	2976	8.071	0.213	7.8	8.4
	Group 4	1992	8.848	0.175	8.6	9

Appendix 4. K-mean clustering: high risk perception group and low risk perception group



Appendix 5. K-mean clustering: high education group and low education group



1: Elementary school, 2: Middle school, 3: High school, 4: University, 5: Post-graduate.

Appendix 6. K-mean clustering: older group and younger group