Consumer Preferences for U.S. Beef Products: A Meta Analysis

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Selected Paper prepared for presentation at the Agricultural & Applied Economics Association 2010 AAEA,CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010

[Ψ] Corresponding Author. We are very grateful to Rainer Holst for his great research assistance.

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Abstract:

By conducting a meta-analysis using 50 observations collected from 15 primary studies, we systematically analyze heterogeneities in consumer preferences for U.S. beef products and the results have valuable implications both from a policy perspective as well as from a methodological perspective. The main findings include that consumers in European and Asian countries are willing to pay less for U.S. beef products than those in North American countries and that the BSE incidence in the U.S. substantially damaged consumer preferences for U.S. beef products outside the U.S. but not in the U.S. The results with respect to methodological heterogeneities also indicate that choice experiments yield higher WTP values and that the sample size is negatively correlated with WTP values.

Key Words: U.S. beef, COOL, WTP, Meta analysis,

JEL: Q18, Q51

Consumer Preferences for U.S. Beef Products: A Meta Analysis

Many developed countries, including the U.S., the members of the EU and Japan have introduced mandatory Country-Of-Origin Labeling (COOL) for food products, which invokes a lot of arguments either from political perspectives or from academic perspectives (Carter and Zwane 2003, Krissoff et al. 2004). The U.S. beef industry is an important case in this respect, as the 2002 U.S. Farm Bill, which took effect in September 2004, mandated COOL for fresh and frozen food commodities[1].

Opponents of COOL argue that it may decrease the profits of producers and retailers because of the high costs of labeling, record-keeping, and operating procedures that are necessary to ensure compliance with these regulations, and it might create a "deadweight" loss because of the distorted producer and consumer prices. Furthermore, international trade conflicts could arise because COOL is considered as a non-tariff barrier to trade (Carter and Zwane 2003; Brester et al. 2004). On the other hand, proponents of COOL insist that consumers have a "right to know" the country of origin of products and that COOL is a valuable marketing tool (Lust et al. 2006). Product information is often asymmetric in markets and COOL can help consumers, at least partially, to solve the problem of imperfect information because the country of origin can serve as a proxy for product quality, which is unknown in the market. Growers and ranchers have largely supported COOL because they regard it as a non-tariff barrier to trade that can potentially provide producers with a competitive advantage in domestic markets (Carter and Zwane 2003; Umberger 2004).

[1] COOL was mandatory for fish and shellfish in 2004 and is required for beef, lamb, chicken and other covered commodities by September 30, 2008.

A meta-analysis of consumer preferences regarding the country of origin of food by Ehmke(2006) indicates that consumers are willing to pay a premium for domestic food products , which can be explained by consumer ethnocentrism and patriotism (Lust et al. 2006). In particular, a number of studies on consumer preferences for U.S. beef find that U.S. consumers are generally willing to pay a premium for "Certified U.S." beef products, indicating that they believe that the domestic beef might be safer, of higher quality and fresher, even though the variations of premiums are quite large between different studies and different regions (Umberger 2004; Gao , Shroeder and Yu 2010). Most studies on consumer willingness-to-pay (WTP) for U.S. food products support the policy of mandatory COOL in the U.S.

However, the attitudes of non-U.S. consumers towards U.S. beef products are quite dispersed. Studies in Japan (Aizaki et at. 2006), Korea (Chung et al. 2009; Unterschultz et al.1998), Norway (Alfnes et al. 2003; Alfnes 2004) and Germany (Tonsor et al. 2005) find that the WTP for U.S. beef products is negative in these countries compared with local beef, which implies that consumers favor domestic beef products. However, studies in Spain (Beriain et al. 2009), France and the UK (Tonsor et al.2005) show a positive WTP for U.S. beef products, which indicates that consumers in these countries favor U.S. beef.

It would be very important to scrutinize the variations of consumer preferences for COOL with respect to U.S. beef products in the literature, given the fact that the beef industry plays a very important role in U.S. agriculture and international trade. For instance, in 2008 the retail equivalent value of U.S. beef industry was $76 billion, and 7.1% of the produced quantity, which amounts to a value of $2.98 billion, was exported.

Many factors can influence estimates of consumer preferences for the U.S. beef, including methodologies, samples as well as study place and time (Umberger 2004; Ehmke 2006). Meta-analysis is widely used for the synthesis of empirical studies and in particular for economic analysis. In this paper, a meta-analysis will be conducted to study consumer preferences for U.S. beef products, using 15 primary studies, which employed different methods and provide a total of 50 observations of the WTP for U.S. beef products in different countries. We hope to find out the systematic patterns in consumer WTP for U.S. beef products and to shed some light on current mandatory COOL compliance.

Data

We have collected 15 primary studies with 50 observations of the WTP values for U.S. beef products, out of which 26 observations relate to U.S consumers, 12 to European consumers, 10 to Asian consumers and the remaining 2 relate to Mexico and Canada. Table 5 lists all these primary studies and provides a brief introduction, including survey country, survey year, sample size, eliciting methods, estimation methods, type of the beef products, and WTP values. Table 1 in turn presents definitions and descriptive statistics with respect to all variables included in the meta-analysis.

The frequency distribution of all 50 observations is shown in Figure 1.1. The shape is not symmetric, and has a long-but-thin left tail and a short-but-thick right tail. The mean WTP of all observations is -1.84 $/lb, less than zero.

The frequency distribution of the 26 U.S. observations is shown in Figure 1.2. Its shape is close to a half normal distribution. All the U.S. observations are positive and

their mean value is 3.40 $/lb. This implies that U.S. consumers are willing to pay 3.40 $/lb more for domestic beef without controlling for other variables, which shows that the current literature is quite consistent and indicates that COOL does increase consumer welfare for beef products in the U.S..

The frequency distribution of the 24 non-U.S. observations is shown in Figure 1.3.Its shape is close to a symmetric bell-shape. The mean is -7.53$/lb and less than zero. It implies that non-U.S. consumers are willing to pay 7.53$/lb less for U.S. beef products than for domestic products. These statistics also show that the perceptions of U.S. and non-U.S. consumers regarding U.S. beef products are quite different.

Second, the first case of BSE (Mad Cow Diseases) in the U.S. was reported in December 2003, which severely shocked the U.S. beef industry and in particular affected its exports (Ward, Von Baily and Jensen 2005). For instance, the value of beef products exported from the U.S. was $3.19 billion in 2003. This figure dropped to $631 million in 2004, only about 20 percent of the export value in 2003. Even though the exports have continuously been recovering since that, they did not reach the pre-BSE-crisis level until 2008. However, the impacts of BSE on consumer preferences regarding U.S. beef have not been well discussed so far. Therefore, this study attempts to shed some light on it.

Usually, researchers cannot derive the WTP directly from market purchases. Instead, they usually turn to the data from artificial and hypothetical markets created by "stated preference" surveys. The "stated preferences" can be elicited by two different approaches: The contingent valuation method (CVM) and the choice experiment (CE). Another method is revealed preferences, and experimental auctions belong to it. Experimental auctions involve real purchases and thus creates artificial but non-

hypothetical markets. Out of the 50 observations, 30 are from choice experiments, 9 were derived using the CVM, and the remaining 11 are based on experimental auctions. The mean WTP values are -3.26$/lb, 0.64$/lb, and -0.01$/lb for CE, CVM and auctions respectively. The mean value using the "stated preference" methods is -2.36$/lb. These figures indicate that the differences with respect to methods are significant, which is consistent with the literature.

In the next part, we will statistically analyze the dispersion in consumer preferences for U.S. beef products by conducting a meta-analysis.

Method

A few meta-analyses have studied consumer preferences for COOL across different food products. For instance, Ehmke (2006) collected 13 studies with 27 observations of WTP for COOL and finds that consumer valuation of COOL depends on the number of other credence attributes included in product descriptions and the location of the consumers. However, to the best of our knowledge, no meta-analyses have specifically focused on U.S. beef products, even though the beef industry is a very important part of U.S. agriculture and many studies have been done regarding consumer preferences for U.S. beef products.

In an assessment of 130 meta-analyses in the field of environmental and resource economics, Nelson and Kennedy (2008) argue that sample heterogeneity, heteroskedasticity of effect-size estimates, correlation within and between multiple observations from primary studies and sample data heterogeneity are the main factors, which can significantly affect the results. Hence, they separate the sample heterogeneity

into factual and methodological heterogeneities, and suggest the use of the sample size as a proxy for the variance in order to deal with heteroskedasticity of effect-size estimates. Furthermore, they propose the use of a single estimate per primary study, random selection, panel-data method and other econometric tools dealing with correlated data.

Following Nelson and Kennedy (2008), first, we will separate the variation of consumer preferences for U.S. beef products into factual and methodological heterogeneity. Factual heterogeneity includes differences with respect to study location, time of study and the products. We categorize the study locations into the U.S., Asia, Europe and the remaining countries (Canada and Mexico) and use dummy variables to control for this heterogeneity. In addition, we separate the full sample into a U.S. and a non-U.S. sample in two regressions to examine whether there are any systematic differences between consumer preferences in the U.S. and outside of the U.S..

As aforementioned, the impact of BSE on the U.S. beef industry is very significant. Therefore, we introduce a time dummy variable (before BSE and after BSE) to model the impacts. The definitions and attributes of beef products are slightly different in the primary studies, which is regarded as factual heterogeneity. There are two types of beef products in primary studies: beef steaks and hamburgers. The main attribute differences are hormone-free products and conventional beef.

Lusk and Schroeder (2004) also point out that there are methodological differences in the studies of WTP and that choice experiments usually lead to a higher probability of payments. In order to capture the methodological heterogeneities, we comprise methodological dummy variables (CE and auction as compared to CVM) in the regression. The results are reported in Table 2. Then, we analyze only the 39 observations

of "stated preferences" in another regression, the results of which are reported in Table 3. Since most observations are obtained from choice experiments, we also perform a separate regression using only the 30 CE observations. The corresponding results are presented in Table 4. It is well known that experiment designs (number of attributes), survey methods (online survey or in-person) and estimation methods (multinomial Logit or mixed multinomial Logit) play significant roles in the choice experiment (Gao, House, and Yu 2010; Gao, Schroeder and Yu 2010). These methodological heterogeneities in choice experiments can also be scrutinized in this step, so that it might also be possible to derive important methodological implications for the use of choice experiments in the future.

Second, Nelson and Kennedy (2008) point out that the effect-size of samples in different primary studies can generate non-homogeneous variances and smaller variances are more reliable. However, the variance for each observation usually is not observed in primary studies, and Nelson and Kennedy (2008) and Dannenberg (2009) propose to use the sample size as a proxy used as a weight in estimations, as large sample sizes usually have smaller variances. However, the effect-size of samples can only cause heteroscedasticity in the Meta analysis and therefore the usual OLS is still consistent. Furthermore, large variances of the WTP in primary studies are probably caused by some large outliers in the respective samples and an increase in sample size can reduce the bias. Hence, we include the sample size as an explanatory variable in the regression instead of using it as a weight. Nevertheless, it can still reduce the influence of the effect-size of samples.

Third, even though Nelson and Kennedy (2008) suggest a single estimate per primary study, random selection and panel-data method to deal with the problems of heteroscedasticity and correlation within and between the observations in primary studies, they cannot be applied in this study due to the limited number of observations and too many dummy variables in our meta-analysis. However, in order to deal with this issue, we report the robust standard deviations proposed by White (1980) in estimation results.

Results and Discussions

We estimate models from three different categories: Models using the full set of observations, such that use only the stated-preference observations and models that consider only the choice-experiment observations. The results are reported in Table 2, Table 3 and Table 4 respectively.

- Full-Observation Model

Table 2 reports estimation results comprising 6 models using the observations from all the methods. In particular, Models 1.1 and 1.2 are the results for all observations, while Models 1.3 and 1.4 use only U.S. observations and Models 1.5 and 1.6 only non-U.S. observations. The results of F-tests and the R-squares indicate that all models fit the data well.

Comparing Models 1.1 and 1.2, the likelihood-ratio test rejects Model 1.2 and favors Model 1.1. The estimation results of Model 1.1 indicate that the coefficients with respect to study methods, study locations, study time and sample size of the primary studies are statistically significant, while the types of products are not important. First, compared with the contingent valuation method (CVM), the values of WTP from

auctions and choice experiments are 1.82 $/lb and 11.97$/lb higher respectively. However, only the coefficient for choice experiments is statistically significant and the coefficient for auctions is not. This indicates that the method of choice experiments yields significantly higher WTP values than both CVM and auctions, which is consistent with the findings of Lusk and Schroeder (2004), while the methodological difference between CVM and auctions is not significant. Second, the WTP for U.S. beef in the U.S., Europe, and Asian countries is lower than that in the neighboring countries of the U.S., namely in Canada and Mexico. The differences are 8.44 $/lb, 20.48$/lb, and 31.87 $/lb respectively and are statistically significant. This implies that the consumer evaluation of U.S. beef in North American countries is significantly higher than in other countries, given the fact that those three countries are in a free trade zone. Unfortunately, U.S. beef products receive the lowest evaluation in Asian Countries (Japan and Korea). If we include only one country dummy variable (U.S. vs. non-U.S.) in the regression, as shown in Model 1.2, in order to compare the valuations of U.S. beef products between the U.S. and non-U.S. countries, the coefficient for the dummy variable is 17.37 and statistically significant, which implies that consumers in the U.S. are willing to pay 17.37$/lb more for U.S. beef than consumers in other countries. Third, the coefficient of the BSE variable is -7.50 and statistically significant at the 10% level, which indicates that BSE has a significantly negative impact on consumer preferences for U.S. beef in the world. Specifically, BSE reduced consumer WTP for U.S. beef by 7.50$/lb. Finally, the coefficient of the variable representing the effective sample size is -0.01 and statistically significant at the 5% level, which can partly be explained by the heteroskedasticity of effect-size estimates in primary studies (Nelson and Kennedy 2008). In particular, some positive outliers in the

stated-preference methods (CVM or choice experiments) can push up the WTP values in primary studies and an increase in sample sizes will reduce the biases.

Models 1.3 and 1.4 only include the 26 observations of U.S. consumers in their regressions. The estimation results for the two models are quite close and the likelihood ratio test is also not statistically significant and favors Model 1.4 because of the efficiency. Only the CE variable is statistically significant in both estimations. The results indicate that the WTP values of U.S. consumers from choice experiments are 7.08$/lb higher than those from CVM, while the difference between auction and CVM is not statistically significant. Surprisingly, the coefficient of the BSE variable is statistically significant for the U.S. observations, which indicates that the impact of BSE on the U.S. consumer preference for U.S. beef is not significant. Other variables, such as the sample size and the types of beef products, are also not statistically significant.

Models 1.5 and 1.6 include only the 24 observations of non-U.S. consumers in the meta-analysis. The likelihood ratio test however rejects Model 1.6 and favors Model 1.5. For the non-U.S. observations, the methodological differences, sample size and product attributes are not statistically significant. Only the countries and the time dummy variables turn out to be important. Specifically, the coefficients of the dummy variables of Europe and Asia are -26.36 and -33.43 respectively and both are statistically significant at the 1% level, which implies that consumers in European and Asian countries are willing to pay 26.36$/lb and 33.43 $/lb less for U.S. beef products than those in Mexico and Canada . The coefficient of the BSE variable is -13.87 and statistically significant at the 5% level, which implies that consumers outside of the U.S. reduced their WTP for U.S. beef products by 13.87 $/lb after the BSE incidence in 2003.

- Stated-Preference Observations

Table 3 reports the estimation results for the observations only from the stated-preference methods, which are very close to the results of the full-observation model.

The meta-analysis for all stated-preference observations shows that methodological heterogeneity, study time and study locations are important for explaining the differences in consumer preferences for U.S. beef products. Specifically, Asian countries have the lowest WTP values and European countries have the second lowest ones, while the differences between the US, Canada and Mexico are not significant. Also, the impact of BSE is negative and statistically significant. Furthermore, methodologically, choice experiments yield higher WTP values than the CVM, which is consistent with Lusk and Schroeder (2004).

If we only include the observations regarding U.S. consumers in the meta-analysis, we find that only methodological heterogeneity plays a significant role in explaining the heterogeneity in consumer preferences for U.S. beef. Still, choice experiments yield higher WTP values than the CVM. Other factors are not important.

In the regression, which uses non-U.S. observations exclusively, we found that only the study countries are important for determinants of WTP for U.S. beef products. Similar to earlier results, consumers in Asian countries again have the lowest and consumers in European Countries have the second lowest WTP.

- Choice-Experiment Observations

Out of the 50 observations, 30 are obtained from choice experiments. We can also use only this subset of observations in order to examine the heterogeneities among them. Following Nelson and Kennedy (2008), we divide the heterogeneity into factual and methodological heterogeneity. Similar to the aforementioned analyses, the factors considered with respect to factual heterogeneity include study locations (the U.S., Europe, Asia and other countries), study time (before BSE or after BSE) and the types of products (hormone-free beef steaks or conventional beef steaks[2]). Methodological heterogeneities in choice experiments are mainly caused by their design, such as in terms of the choices of attributes, sample size, survey methods and econometric methods. Gao, Shroeder and Yu (2010) and Gao, House and Yu (2010) point out that the design of choice experiments can affect the results significantly. In particular, both the correlation between attributes and the increase in the number of attributes can increase the information load and cause confusions in answers of respondents. A large number of attributes usually requires a large sample size, so that there might be interactions between the number of attributes and the sample size. Therefore, we include the number of attributes, the effective sample size and their interactions in the meta-analysis, even though the sample size is also a good proxy for the heteroskedasticity of effect-size estimates. Some studies use online surveys in choice experiments instead of traditional in-person surveys. Therefore, we include a dummy variable (online survey vs. other methods) in the regression in order to capture the heterogeneity. Furthermore, there are two major econometric methods for estimating choice experiments: The multinomial Logit model (MLM) and the mixed multinomial Logit model (MMLM), which may also cause some methodological heterogeneity in WTP. Consequently, the choice of econometric method is also included in the regression.

[2] Hamburger products have not been considered in choice experiments.

In order to compare the results and check the robustness, we reported the results of five different models in Table 4. F-tests are statistically significant for all models and the values of the adjusted R-squares are pretty high, which indicates that the models fit the data well. However, the likelihood ratio tests show that Model 3.2 is the best and therefore the following discussions are based on the estimation of this model.

The estimation results show that study locations and time in the factors of the factual heterogeneity are statistically significant and that the types of products are not so important for explaining the heterogeneity in WTP. Similar to the results of Model 2.1, which used the full set of observations, Asian countries have the lowest WTP and European countries have the second lowest one as compared to the values of Canada and Mexico. However, the difference between the U.S., and Canada and Mexico is not significant.

With respect to the factors constituting methodological heterogeneity, sample size, the interaction between sample size and attributes as well as the estimation methods are statistically significant. In particular, the coefficient of the sample size variable is -0.045 and is statistically significant at the 1% level, which implies that the WTP for U.S. beef will decrease by 4.5 $/lb as the sample size increases by 100. As aforementioned, choice experiments are a stated-preference method and often yield some high outliers of payments, while an increase in sample size can reduce some bias. The coefficient of the variable capturing the interaction between the number of attributes and the sample size amounts to 0.007 and is statistically significant at the 5% level, which indicates that, consistent with our prediction, there is a positive interaction effect between the number of attributes and the sample size. The coefficient of the dummy variable for MMNL is -

0.843 and is also statistically significant at the 5% level. This implies that MMNL results in a lower WTP than MNL, which may be explained by the fact that MMNL can capture the heterogeneity of variables in the utility function. Other variables, such as the survey method (online or not) and the number of attributes in the experiments are not statistically significant in explaining the heterogeneity of consumer preferences for U.S. beef products.

Furthermore, we also included only one country dummy variable (U.S. or non-U.S.) in Model 3.5 in order to capture the difference between U.S. domestic WTP and the corresponding value in other countries. The coefficient of this variable is 20.86 and it is statistically significant at the 1% level, which indicates that consumers in the U.S. are willing to pay 20.86 $/lb more than consumers outside of the U.S. in choice experiments.

Conclusion

In trying to protect their domestic agriculture, many developed countries have introduced mandatory compliance of Country-of-Origin Labeling. This caused a lot of arguments both domestically and internationally. As an important agricultural product in the U.S., studies on the consumer preferences for U.S. beef have been conducted using different methods in different countries and the results are quite disperse.

This paper collected 50 observations of consumer WTP for U.S. beef in different countries from 15 primary studies and uses a meta-analysis to systematically analyze the heterogeneities of consumer preferences for U.S. beef products.

The results show that consumers in Asian countries (Japan and Korea) have the lowest WTP for U.S. beef products and that the WTP in European countries is the second

lowest. The consumer WTP values in North American countries including the U.S., Canada and Mexico are the highest. Consumers in the U.S. for example are willing to pay 17.37 $/lb more for U.S. beef than the consumers in other countries.

As we know, the BSE incidence in the U.S. in 2003 has a significantly negative impact on the U.S. beef industry. In general, consumers reduced their WTP by 7.50 $/lb after the BSE incidence. However, this study also finds that the impacts of BSE on the consumer preferences in the U.S. are not significant, while the WTP for U.S. beef outside of the U.S. decreased by 13.87 $/lb after the BSE incidence.

The methodological heterogeneity is also significant for studying consumer preferences for U.S. beef. Lusk and Schroeder (2004) point out that choice experiments often yield higher estimates of payment, which is consistent with the finding of this research that the WTP from choice experiments is 11.97 $/lb higher than that from the CVM, while the difference between auctions and CVM is not significant. The sample size is also important for explaining the heterogeneity of the WTP values since it is negatively correlated with these values, which may be explained by the facts that stated-preference methods often yield some high outliers of payments and that an increase in sample size can reduce some bias.

We also analyze the observations from choice experiments in a separate regression and find that study countries and BSE play important roles in explaining the factual heterogeneity. The effects of these factors are furthermore consistent with the analysis using the full set of observations. This study also finds that the number of attributes and the survey method are not statistically significant for explaining the heterogeneity of the WTP values, while the sample size and the estimation methods of

choice experiments are important. In particular, the sample size is negatively correlated with the WTP estimates and mixed multinomial Logit models (MMNL) have lower WTP values than multinomial Logit models (MNL). Besides, there is a positive interaction effect between the sample size and the number of attributes because a large number of attributes usually requires a large sample size.

The findings in this study can give valuable implications both from a policy perspective as well as from a methodological perspective. For instance, since consumer preferences for U.S. beef products are quite different across countries, governments should adopt different policies with respect to the COOL of different products so as to avoid international trade conflicts and to maximize the social welfare. Furthermore, this study also indicates that we should pay attention to methodological heterogeneities when estimating the WTP for non-market goods to get more reliable results.

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Figure 1. Relative Frequency of WTP

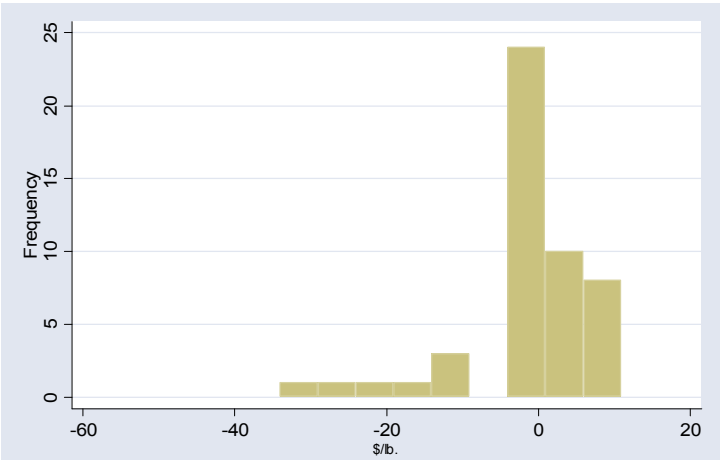

Figure 1.1 Frequency of WTP (All Studies)

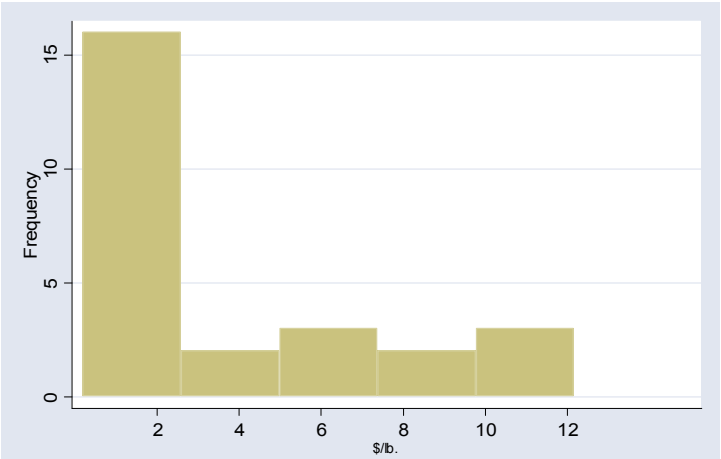

Figure 1.2 Frequency of WTP (US Studies)

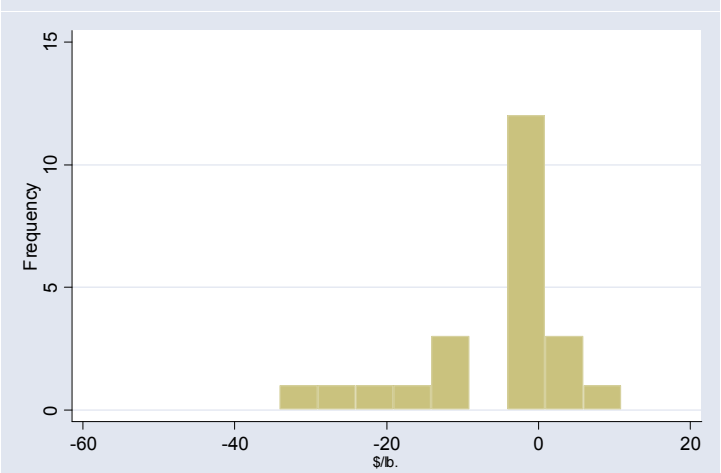

Figure 1.3 Frequency of WTP (Non-US Studies)

Table 1 Description of the variables

		Full Sample			US Studies			Non-US Studies			Choice Experiment			Auction		
		Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
WTP	WTP for US beef ($/lb.)	-1.84	-49.00	12.19	3.40	0.20	12.19	-7.53	-49.00	9.89	-3.26	-49.00	12.19	-0.01	-2.24	1.20
Auction	Obs from Auctions=1, otherwise=0	0.22	0	1	0.27	0	1	0.17	0	1	-	-	-	-	-	-
CE	Obs from Choice Experiments=1, otherwise=0	0.60	0	1	0.38	0	1	0.83	0	1	-	-	-	-	-	-
BSE	Study after BSE =1, otherwise=0	0.36	0	1	0.35	0	1	0.38	0	1	0.60	0	1	0	0	0
US	Study in US=1, otherwise=0	0.52	0	1	1.00	1	1	0.00	0	0	0.33	0	1	0.64	0	1
EU	Study in EU=1, otherwise=0	0.24	0	1	0.00	0	0	0.50	0	1	0.27	0	1	0.36	0	1
Asia	Study in Asia=1, otherwise=0	0.20	0	1	0.00	0	0	0.42	0	1	0.33	0	1	0	0	0
Sample_Size	Sample Size in the study	352.92	10	1066	241.73	74	1009	473.38	10	1066	455.80	10	1066	160.18	106	273
Steak	The product is steak=1, otherwise=0	0.92	0	1	0.85	0	1	1.00	0	1	1.00	0	1	1	1	1
Horm_Free	US beef is hormone-free =1, otherwise=0	0.16	0	1	0.00	0	0	0.33	0	1	0.17	0	1	0.27	0	1
MMNL	Estimated by Mixed Multinomial Logit Model (MMNL, or Random Parameter Logit)=1; and by Multinomial Logit Model (MNL)=0	-	-	-	-	-	-	-	-	-	0.70	0	1	-	-	-
Attributes	# of Attributes in Choice Experiment	-	-	-	-	-	-	-	-	-	4.33	2	7	-	-	-
On-Line	Surveyed by internet=1 , otherwise=0	-	-	-	-	-	-	-	-	-	0.37	0	1	-	-	-
# of WTP Obs.		50			26			24			30			11		

Table 2 WTP for U.S. Beef for All, U.S. and Non-U.S. Observations

WTP	Full Sample				US Samples				Non-US Samples			
	Model 1.1		Model 1.2		Model 1.3		Model 1.4		Model 1.5		Model 1.6	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Auction	1.818	1.679	2.868	1.943	0.294	0.470	0.261	0.449	-	-	-	-
CE	11.974	3.395***	9.561	3.628**	6.156	1.022***	7.084	1.140***	3.287	4.004	5.369	3.011*
BSE	-7.504	3.958*	-5.112	4.581	1.036	1.371	-	-	-13.872	7.981**	-7.345	7.385
US	-8.441	4.049**	17.366	4.884***	-	-	-	-	-	-	-	-
EU	-20.484	5.180***	-	-	-	-	-	-	-26.359	9.099***	-	-
Asian	-31.874	6.064***	-	-	-	-	-	-	-33.434	6.398***	-16.890	6.269**
Sample Size	-0.008	0.004**	-0.002	0.004	0.002	0.003	0.002	0.003	-0.007	0.006	-0.007	0.005
Steak	0.804	0.928	0.258	0.553	-0.116	0.498	-0.086	0.477	-	-	-	-
Horm_Free	3.038	4.307	9.142	3.117***	-	-	-	-	1.086	5.114	-4.039	5.584
Intercept	10.711	4.659**	-16.336	5.163***	0.182	0.545	0.251	0.538	24.882	6.867***	2.376	4.270
Adj. R2	0.581		0.302		0.700		0.711		0.496		0.296	
R2	0.658		0.401		0.760		0.758		0.628		0.449	
F test	F(9, 40) = 7.71***		F(7, 42) =4.85***		F(5, 20) =12.64***		F(4, 21) =12.70***		F(6, 17) =6.42***		F(5, 18) = 15.57***	
LR-test	Chi(2)=28.04***				chi2(1) = 0.22				chi2(1) =9.41***			
Number of Obs.	50				26				24			

Note: 1, ***, ** and * denotes the significant level of 1%, 5% and 10%, respectively.
2, S.E. are robust standard errors with adjustment of sample size.

Table 3 WTP for U.S. Beef for the Stated-Preference Methods

wtp	Full Sample				US Samples				Non-US Samples			
	Model 2.1		Model 2.2		Model 2.3		Model 2.4		Model 2.5		Model 2.6	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
CE	17.203	5.783***	14.305	5.750**	6.133	1.068***	7.085	1.153***	-	-	-	-
BSE	-11.336	5.717*	-8.047	5.963	1.062	1.400	-	-	-13.820	8.003	-7.803	7.814
US	-5.446	4.350	21.681	6.128***	-	-	-	-	-	-	-	-
EU	-24.774	8.056***	-	-	-	-	-	-	-26.525	9.934**	-	-
Asian	-32.099	5.999***	-	-	-	-	-	-	-33.385	6.499***	-17.642	6.917**
Sample Size	-0.006	0.004	0.000	0.004	0.002	0.003	0.002	0.003	-0.007	0.006	-0.007	0.005
Steak	0.609	0.794	0.094	0.547	-0.122	0.512	-0.090	0.487	-	-	-	-
Horm_Free	2.449	6.439	6.563	3.025**	-	-	-	-	1.455	7.375	-5.694	7.854
Intercept	7.273	5.084	-21.022	6.491***	0.169	0.568	0.242	0.557	28.069	6.407***	8.867	7.022
Adj. R2	0.620		0.351		0.351		0.654		0.472		0.429	
R2	0.700		0.454		0.454		0.711		0.611		0.276	
F Test	F(8, 30) =8.72***		F(6, 32) =7.29***		F(4, 14) = 8.73***		F(3, 15) =16.67***		F(5, 14) = 7.30***		F(4, 15) = 4.55**	
LR-test	Chi(2)= 23.37***				chi2(1) = 0.17				chi2(1) = 7.69***			
Number of Obs.	39				19				20			

Note: 1, ***, ** and * denotes the significant level of 1%, 5% and 10%, respectively.
2, S.E. are robust standard errors with adjustment of sample size.

Table 4 WTP for U.S. Beef for the Choice-Experiment Methods

wtp	Model 3.1		Model 3.2		Model 3.3		Model 3.4		Model 3.5	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
BSE	-10.977	4.531**	-8.515	4.339*	-4.894	4.312	-13.972	4.673***	-7.848	6.618
US	-11.046	6.372*	-6.650	4.782	-6.336	4.729	-6.410	4.670	20.860	6.378***
EU	-22.307	4.747***	-21.696	4.926***	-22.038	5.306***	-19.878	6.515***	-	-
Asia	-37.599	4.394***	-37.040	4.312***	-34.599	4.471***	-36.504	4.203***	-	-
Sample_Size	-0.038	0.017**	-0.045	0.015***	-0.011	0.005**	-0.060	0.016***	0.003	0.033
MMNL	-7.719	3.291**	-6.843	3.131**	-8.733	2.961***	-	-	-	-
Attributes	-0.557	3.403	-0.500	3.558	3.950	2.173*	-2.202	3.377	4.511	6.135
On-Line	7.024	5.515	-	-	-	-	-	-	-	-
Horm_Free	2.916	5.186	2.917	4.933	3.236	5.270	-1.517	7.102	4.516	4.419
Sample_Size * Attributes	0.006	0.004	0.007	0.003**	-	-	0.011	0.003***	-0.002	0.007
Intercept	34.823	13.452**	33.312	14.321**	12.890	8.393	38.912	13.954**	-23.914	26.173
Adjust-R2	0.753		0.748		0.740		0.729		0.375	
R2	0.838		0.826		0.812		0.804		0.504	
F Test	F(10, 18) =19.66***		F(9,20) =20.85***		F(8, 21) =13.84***		F(8, 21) = 10.74***		F(6, 23) =6.77***	
LR-Test	--		H0: Model 3.1; chi2(1) =2.18		H0: Model 3.2; chi2(1) =4.59*		H0: Model 3.1; chi2(2)=5.82*		H0: Model 3.1; chi2(4)= 33.60***	
Number of Obs.	30									

Note: 1, ***, ** and * denotes the significant level of 1%, 5% and 10%, respectively.
2, S.E. are robust standard errors with adjustment of sample size.

Table 5 Summary of the Primary Studies

#	Study	Country	Year	Sample size	Format	Method	Attributes	Estimation	Products	WTP	Units
1	Aizaki et at. (2006)	Japan	2005	351	mail	CE	2	MMNL	US beef	-1126	JPY/100g
	Aizaki et at. (2006)	Japan	2005	351	mail	CE	4	MMNL	US beef	-642	JPY/100g
	Aizaki et at. (2006)	Japan	2005	351	mail	CE	3	MMNL	US beef	-505	JPY/100g
2[a)]	Alfnes(2004)	Norway	2000	1066	In-person	CE	4	MMNL	US Hormone-free Beef	-47.80	NOK/Kg
	Alfnes(2004)	Norway	2000	1066	In-person	CE	4	MNL	US Hormone-free Beef	-52.89	NOK/Kg
	Alfnes(2004)	Norway	2000	1066	In-person	CE	4	MMNL	US Hormone-treated Beef	-226.75	NOK/Kg
	Alfnes(2004)	Norway	2000	1066	In-person	CE	4	MNL	US Hormone-treated Beef	-264.52	NOK/Kg
3	Alfnes et al.(2003)	Norway	2000	106	In-person	Auction			US hormone free	-5.78	NOK/ 0.5 Kg
	Alfnes et al.(2003)	Norway	2000	106	In-person	Auction			US hornome Treated	-14.94	NOK/ 0.5 Kg
	Alfnes et al.(2003)	Norway	2000	106	In-person	Auction			US hormone free	-10.61	NOK/ 0.5 Kg
	Alfnes et al.(2003)	Norway	2000	106	In-person	Auction			US hornome Treated	-21.38	NOK/ 0.5 Kg
4[b)]	Beriain et al. (2009)	Spain	2008	290	In-person	CE	3	MNL	US beef	11.73	% of price
5	Chung et al. (2009)	Korea	2007	1000	In-person	CE	7	MNL	US Beef	-13.35	$/lb
	Chung et al. (2009)	Korea	2007	1000	In-person	CE	8	MMNL	US Beef	-14.63	$/lb
6	Gao and Schroeder (2009)	US	2006	74	On-line	CE	3	MMNL	US Beef Steak	9.09	$/12 oz
	Gao and Schroeder (2009)	US	2006	74	On-line	CE	4	MMNL	US Beef Steak	6.31	$/12 oz
	Gao and Schroeder (2009)	US	2006	76	On-line	CE	4	MMNL	US Beef Steak	5.26	$/12 oz
	Gao and Schroeder (2009)	US	2006	76	On-line	CE	5	MMNL	US Beef Steak	9.14	$/12 oz
	Gao and Schroeder (2009)	US	2006	211	On-line	CE	3	MMNL	US Beef Steak	4.61	$/12 oz
	Gao and Schroeder (2009)	US	2006	211	On-line	CE	4	MMNL	US Beef Steak	3.03	$/12 oz
	Gao and Schroeder (2009)	US	2006	187	On-line	CE	4	MMNL	US Beef Steak	2.33	$/12 oz
	Gao and Schroeder (2009)	US	2006	187	On-line	CE	5	MMNL	US Beef Steak	3.89	$/12 oz
7	Killinger et al. (2004)	US	2002	124	In-person	Auction			US Beef Steak	0.86	$/lb
	Killinger et al. (2004)	US	2002	124	In-person	Auction			US Beef Steak	0.52	$/lb
8	Loureiro& Umberger (2002)	US	2002	243	In-person	Contingent		Single-Bounded	US Beef	1.9	$/lb

	Loureiro& Umberger (2002)	US	2002	243	In-person	Contingent		Single-Bounded	US Beef Hamburger	1.33	$/lb
9	Loureiro& Umberger (2005)	US	2003	632	mail	Contingent		Single-Bounded	US Beef Steak	0.198	$/lb
10	Loureiro& Umberger (2005)	US	2003	632	mail	CE	5	MNL	US Beef Steak	7.568	$/lb
11	Sitz et al.(2005)	US	2002	273	In-person	Auction			US Beef Steak	1.2	$/lb
	Sitz et al.(2005)	US	2002	273	In-person	Auction			US Beef Steak	0.38	$/lb
12	Tonsor et al.(2005)	UK	2002	121	In-person	CE	5	MMNL	US Hormone-free Beef	2.07	$/lb
	Tonsor et al.(2005)	Germany	2002	65	In-person	CE	5	MMNL	US Hormone-free Beef	-3.74	$/lb
	Tonsor et al.(2005)	France	2002	62	In-person	CE	5	MMNL	US Hormone-free Beef	5.96	$/lb
13 [a)]	Tonsoret al.(2007)	US	2006	1009	On-line	CE	6	MMNL	US Beef Steak	11.59	$/lb
	Tonsoret al.(2007)	Canada	2006	1002	On-line	CE	7	MMNL	US Beef Steak	9.89	$/lb
	Tonsoret al.(2007)	Japan	2006	1001	On-line	CE	8	MMNL	US Beef Steak	-29.62	$/lb
	Tonsoret al.(2007)	Mexico	2006	993	In-person	CE	9	MMNL	US Beef Steak	5.21	$/lb
14	Umberger et al.(2003)	US	2002	141	In-person	Contingent		Single-Bounded	US Beef Steak	0.36	$/lb
	Umberger et al.(2003)	US	2002	132	In-person	Contingent		Single-Bounded	US Beef Steak	0.48	$/lb
	Umberger et al.(2003)	US	2002	273	In-person	Contingent		Single-Bounded	US Beef Steak	0.42	$/lb
	Umberger et al.(2003)	US	2002	141	In-person	Contingent		Single-Bounded	US Beef Hamburger	0.36	$/lb
	Umberger et al.(2003)	US	2002	132	In-person	Contingent		Single-Bounded	US Beef Hamburger	0.36	$/lb
	Umberger et al.(2003)	US	2002	273	In-person	Contingent		Single-Bounded	US Beef Hamburger	0.36	$/lb
	Umberger et al.(2003)	US	2002	141	In-person	Auction			US Beef Steak	1.03	$/lb
	Umberger et al.(2003)	US	2002	132	In-person	Auction			US Beef Steak	0.57	$/lb
	Umberger et al.(2003)	US	2002	273	In-person	Auction			US Beef Steak	0.81	$/lb
15 [a) b)]	Unterschultz et al.(1998)	Korea	1995	43	In-person	CE	4	MNL	US Beef	-10.85	% of price
	Unterschultz et al.(1998)	Korea	1995	10	In-person	CE	4	MNL	US Beef	-19.51	% of price
	Unterschultz et al.(1998)	Korea	1995	11	In-person	CE	4	MNL	US Beef	-8.23	% of price
	Unterschultz et al.(1998)	Korea	1995	22	In-person	CE	4	MNL	US Beef	-10.96	% of price

Note: a) Alfnes(2004), Tonsoret al.(2007) and Unterschultz et al.(1998) did not calculate the WTP for the attributes of US beef products. We use the equation (5) in Nahuelhual et al. (2004) to compute the WTP values in stead.

b) Beriain et al. (2009) and Unterschultz et al. (1998) only give the WTP as percentage of prices, and we can get the WTP in cash by timing it with prices. Dardaji I. et al. (2009) gives the mean price of certified PGI beef is €3.37 /kg in Navarra region of Spain, the same region with the experiment field of Beriain et al. (2009), and it is used for calculating the WTP in cash in Unterschultz et al. (1998) . And Chung et al. (2009) gives that mean price of beef in Korea in 2007 is $30/kg which is used in calculating the WTP in cash for Unterschultz et al. (1998).