SC-X: Calibrating Stated Choice Surveys with Experimental Auction Markets

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Abstract: Experimental auctions (X) use real economic incentives but are limited by available products and locally recruited samples. Stated choice (SC) surveys can use a representative sample to estimate the willingness to pay (WTP) for hypothetical products with unavailable characteristics. However, a number of studies conclude that surveys give biased WTP estimates. We designed a method, SC-X, to calibrate the WTP estimates from stated choice surveys with WTP observed in experimental auctions. This method allows us to extend the results from auctions to products with unavailable characteristics and to socioeconomic groups not included in the auction. The SC-X method is illustrated using Norwegian consumers' preferences for country-of-origin and hormone status for beef.

Key words: beef, calibration, experimental auctions, stated choice, willingness to pay

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Stated choice (SC) methods are frequently used to assess the market potential for products with no or limited market data. Recent examples in agricultural marketing include Burton *et al*. (2001) who investigated the demand for GMO food; Blend and van Ravenswaay (1999) and Wessells, Johnston, and Donath (1999) who studied the demand for ecolabeled food; and Unterschultz *et al*. (1998), Quagrainie, Unterschultz, and Veeman (1998), and Alfnes (2002) who analyzed preferences for country-of-origin for beef.

In SC surveys, the respondents are presented with alternatives defined by their attributes (e.g., price and country-of-origin) and are asked to choose the preferred alternative. The choices can be used to assess the willingness to pay (WTP) for each alternative. However, the evidence strongly suggests that most survey participants exaggerate their WTP for private as well as public goods - see List and Gallett (2001), List (2001), List and Shogren (2002), Harrison and Rutström, and Shogren.

To avoid the hypothetical bias, experimental auctions (X) with participants facing non-hypothetical trade-offs between money and goods can be used. In their seminal paper, Shogren *et al*. (1994) used a second-price sealed-bid auction with repeated trials to elicit WTP. Similar auction mechanisms have been employed to elicit WTP for pork attributes (Melton *et al*., 1996), food safety (Hayes *et al*., 1995 and Fox *et al*., 1998), reduction in pesticide use (Roosen *et al*., 1998), GMO food (Noussair, Robin, and Ruffieux, 2002), and hormone-treated beef (Alfnes and Rickertsen). However, experimental auctions are limited to available products with existing product characteristics and are usually conducted in a laboratory setting with a relatively small and locally recruited sample.

Given the limitations of surveys and experimental auctions, it is of considerable interest to combine the results of the two methods. To reduce the problem of hypothetical bias, Blackburn, Harrison, and Rutström (1994); Fox *et al*. (1998); List, Magrolis, and

Shogren (1998); List and Shogren (1998); and List and Shogren (2002) use experimental auctions to calibrate values elicited in hypothetical settings. Two approaches have been used to calibrate the WTP values found in open-ended contingent valuation (CV) studies. First, Blackburn, Harrison, and Rutström (1994) investigated the potential hypothetical bias in answering discrete choice (take it or leave it offers) and estimated a statistical "bias function" to examine whether the hypothetical bias (accepting the offer in a hypothetical case but rejecting the same offer in a real case) for a particular good in one sample of subjects is transferable to a different good in another sample of subjects. They found few conclusive relationships between hypothetical bias and socioeconomic variables. Second, in the CVM-X method, developed by Fox *et al*. (1998), a large survey with open-ended WTP questions is conducted and some of the survey respondents participate in an experimental auction for the same good. The bids in the experimental auctions are used to calibrate the hypothetical WTP estimated from the survey. List, Magrolis, and Shogren (1998), List and Shogren (1998), and List and Shogren (2002) further investigated the method outlined in Fox *et al*. (1998).

In this paper, we deal with calibration of results from SC surveys rather than CV studies. We designed and implemented a method, SC-X, to calibrate the hypothetical WTP estimates from SC surveys with the WTP found in experimental auctions. This method allowed us to extend the results from auctions to hypothetical products with unavailable characteristics and to socioeconomic groups not included in the auction.

We illustrate the SC-X method here using Norwegian consumers' preferences for country-of-origin and hormone status for beef. First, the WTP values for Norwegian, Irish, US hormone-free, and US hormone-treated beef found in auctions are used to construct a calibration function for the WTP values found in the survey. Second, we use the calibration function to calculate WTP values for socioeconomic groups not participating in the auction.

Third, hormone-treated European beef is unavailable in the market and we use the calibration function to calibrate the survey WTP results for such beef.

Experimental Auction

In April 2000, we conducted an SC survey and an experimental auction to study Norwegian consumers' preferences for country-of-origin and hormone status for beef. A representative sample of the population in four counties 30 kilometers south of Oslo were recruited by ACNielsen Norway to take part in the experimental auction. The participants claimed to eat beef at least occasionally and they were paid NOK 300 to take part in the experiment.[1] We conducted ten sessions with a total of 106 participants in a cafeteria at the Agricultural University of Norway. The summary statistics of the auction and survey (see below) samples are presented in table 1. The auction participants are socioeconomically similar to the survey participants in the same region.

We generally followed the experimental design used in Shogren *et al*. (1994); however, we ran four simultaneous auctions as described in Alfnes and Rickertsen.[2] The participants were allocated with 250 grams of rib-eye steak, hereafter referred to as the base product, and asked to bid for an exchange to 500 grams. The winner paid a price equal to the second highest bid and had to give up the base product. We ran trials with candy bars to demonstrate the mechanism and used multiple trials to allow the participants to refine their bids to more accurately reflect their valuations. To avoid income effects, one trial was randomly selected as binding.

The participants bid simultaneously on 500 grams of four alternatives: hormone-free Norwegian, hormone-free Irish, hormone-free US, and hormone-treated US rib-eye steak. To avoid substitution effects, we imposed a winning restriction. If a participant was the highest

bidder for more than one alternative, he or she could choose which alternative to buy and the remaining alternative went to the second highest bidder.

We used 250 grams of Norwegian hormone-free and US hormone-treated beef as base product in five sessions each. In the comparison of the bids for the four alternatives, each participant's valuation of the base product is canceled out and the differences in bids represent differences in WTP for 500 grams of the four alternatives.

We estimate the following money-metric function, which relates the WTP differences to socioeconomic variables, using OLS:

$$
\begin{aligned}
WTP_{nit} = {} & \gamma_{COi} + \gamma_H H_i + \gamma_{1i} Gender_n + \gamma_{2i} Age_n + \gamma_{3i} Income_n + \gamma_{4i} Education_n \\
& + \gamma_{5i} Urban_n + \gamma_{6i} Travel_n + \gamma_{7i} Farm_n + \gamma_8 H_i Gender_n \\
& + \gamma_9 H_i Age_n + \gamma_{10} H_i Income_n + \gamma_{11} H_i Education_n \\
& + \gamma_{12} H_i Urban_n + \gamma_{13} H_i Travel_n + \gamma_{14} H_i Farm_n + \varepsilon_{nit} \ ,
\end{aligned} \tag{1}
$$

where WTP_{nit} is the difference in price individual *n* is willing to pay for one kilogram of alternative *i* and one kilogram of Norwegian beef in trial *t;*[3] γ_{COi} is the country-of-origin specific constant for alternative *i*; H_i is a dummy with the value 1 if the alternative is hormone treated, otherwise zero; *Gender*, *Age*, *Income*, *Education*, *Urban*, *Travel*, and *Farm* are socioeconomic variables as defined in table 1; the γ_{1i} to γ_{7i} are the country-specific marginal effects on WTP from changes in the associated socioeconomic variables; γ_8 to γ_{14} are the marginal effects on WTP for hormone-treated beef from changes in the associated socioeconomic variables, and ε_{nit} is an error term. The WTP difference observed in the auction between alternative *i* and the domestic alternative will hereafter be referred to as the observed WTP for alternative *i.*

Stated Choice Survey

ACNielsen Norway conducted 1066 home interviews of persons that were 15 years or older and the weighted survey sample is representative of the Norwegian population. An SC

experiment was completed as part of the survey. The participants were told that hormone-treated beef and beef produced abroad are likely to become available in the domestic market. Each participant was presented four choice sets with three alternatives in each set. Domestic hormone-free rib-eye steak costing NOK 99 per kilogram was included in all the choice sets. The remaining two alternatives were imported rib-eye steak with various combinations of country-of-origin, hormone status, and price. The participants were asked to choose the preferred alternative in each set. Next, they were asked to choose the preferred alternative given that their first choice was unavailable. The survey design is described in greater detail in Alfnes (2002).

To model the repeated choices made by the participants, we specify a mixed logit model for panel data (Greene, 2002). We assume that the utility from each alternative can be decomposed into a non-stochastic component containing country-specific constants, a hormone-status dummy, a price variable, and socioeconomic characteristics; one stochastic component (η) that is distributed normally over individuals and alternatives, independently over individuals, constant over repeated choice by one individual, and potentially correlated and heteroscedastic over alternatives; and a second stochastic component (ε) that is independently and identically extreme value distributed over individuals, alternatives, and choices. The utility of individual *n* from alternative *i* in choice situation *t*, U_{nit}, is:

$$
\begin{aligned}
(2) \qquad U_{nit} = {} & \beta_{CO_i} + \beta_H H_i + \beta_{Price} Price_{nit} + \beta_{1i} Gender_n + \beta_{2i} Age_n + \beta_{3i} Income_n \\
& + \beta_{4i} Education_n + \beta_{5i} Urban_n + \beta_{6i} Travel_n + \beta_{7i} Farm_n + \beta_8 H_i Gender_n \\
& + \beta_9 H_i Age_n + \beta_{10} H_i Income_n + \beta_{11} H_i Education_n + \beta_{12} H_i Urban_n \\
& + \beta_{13} H_i Travel_n + \beta_{14} H_i Farm_n + \beta_{15} Region2_n + \beta_{16} Region3_n \\
& + \beta_{17} Region4_n + \beta_{18} Region5_n + \beta_{19} Region6_n + [\eta_{ni} + \varepsilon_{nit}],
\end{aligned}
$$

where the variables are as defined in table 1; β_{COi} is the country-specific constant for alternative *i*; H_i is a dummy with the value 1 if the alternative is hormone treated, otherwise zero; $Price_{nit}$ is the price of alternative *i*; *Gender*, *Age*, *Income*, *Education*, *Urban*, *Travel*, and

Farm are socioeconomic variables as defined in table 1; the β_{1i} to β_{7i} represent the country-specific marginal effects on the utility from a change in the associated socioeconomic variables; β_8 to β_{14} represent the marginal effects on the utility for hormone-treated beef from changes in the associated socioeconomic variables; β_{15} to β_{19} represent the marginal effects on the utility for all imported beef from a change of region, and η_{ni} and ε_{nit} are error terms. Region 1, Southeast Norway, is used as the reference region. For identification, all domestic-specific parameters are normalized to zero.

The parameter estimates in equation (2) can be used to predict WTP for alternative *i* compared to the domestic alternative. We will refer to this WTP estimate as the hypothetical WTP for alternative *i*, $HWTP_i$. Individual *n*'s hypothetical WTP in choice situation *t* is the difference in utility between alternative *i* and the domestic alternative divided by the price parameter:

$$\widehat{HWTP}_{nit} = -\frac{\hat{\beta}_{0i} + \hat{\beta}_{1i}Gender_n + \hat{\beta}_{2i}Age_n + ... + \hat{\beta}_{19}Region6_n}{\hat{\beta}_{Price}}. \quad (3)$$

SC-X: Calibration Method

The SC-X calibration method consists of four steps and involves the construction of a calibration function relating hypothetical and observed WTP. We use superscript *A* and *S* to denote the auction and survey data. The four steps are as follows:

Step 1: Estimate a mixed logit model using the survey data:

$$U_{nit} = \beta_i' x_{nit}^S + [\eta_{ni} + \varepsilon_{nit}]. \quad (4)$$

In our case, we estimate equation (2).

Step 2: Use the estimated survey parameters from step 1 and calculate each auction participant's predicted hypothetical WTP, $\widehat{HWTP}_{nit}^A$, for the products included in the auction:

(5) $$\widehat{HWTP}^{A}_{nit} = \frac{\hat{\beta}'_{Domestic} x^{A}_{n} - \hat{\beta}'_{i} x^{A}_{n}}{\hat{\beta}_{Price}}.$$

In our case, we use equation (3) to calculate $\widehat{HWTP}^{A}_{nit}$.

Step 3: Use the observed WTP from the auction, WTP^{A}_{nit}, and the hypothetical WTP, $\widehat{HWTP}^{A}_{nit}$, estimated in step 2 to estimate a calibration function:

(6) $$WTP^{A}_{nit} = f(\widehat{HWTP}^{A}_{nit}) + \varepsilon_{nit},$$

where $f(\ )$ denotes a non-decreasing function with $f(0) = 0$. In our case we estimate:

(7) $$WTP^{A}_{nit} = \alpha_1 \widehat{HWTP}^{A}_{nit} + \alpha_2 (\widehat{HWTP}^{A}_{nit})^2 + \alpha_3 (\widehat{HWTP}^{A}_{nit})^3 + \varepsilon_{nit}.$$

The estimated calibration function is presented at the bottom of table 3.

Step 4: Use the model estimated in step 1 to calculate hypothetical WTP for any combination of product characteristics and socioeconomic attributes included in the survey model, $\widehat{HWTP}^{S}_{nit}$, and the parameters of the calibration function estimated in step 3 to calculate the calibrated WTP for the survey participants $\widehat{WTP}^{S}_{nit}$:

(8) $$\widehat{WTP}^{S}_{nit} = \hat{f}(\widehat{HWTP}^{S}_{nit}).$$

In our case, we use the estimated parameters of equation (7) and calculate:

(9) $$\widehat{WTP}^{S}_{nit} = \hat{\alpha}_1 \widehat{HWTP}^{S}_{nit} + \hat{\alpha}_2 (\widehat{HWTP}^{S}_{nit})^2 + \hat{\alpha}_3 (\widehat{HWTP}^{S}_{nit})^3.$$

Empirical Illustration of the SC-X Method

Because of high import tariffs, domestic beef accounts for 97% of beef sales in Norway. The remaining beef is imported mainly from developing countries. It is illigal to produce or sell hormone-treated beef in Norway (or the EU). Hence, there are no available market data for hormone-treated-beef and only few and scattered data for imported hormone-free beef.

We will illustrate the SC-X method using the choice data from the survey and the observed WTP from the auction discussed above. Norwegian, Irish, US hormone-free, and US hormone-treated beef were included in the survey as well as in the auction. We used the observed WTP for these products to calibrate the hypothetical WTP from the survey. Only people living in Southeast Norway (Region 1) participated in the auctions and we used the SC-X method to predict the WTP for people living in other regions of the country. The survey also included Swedish and Botswanan hormone-free beef and we predicted the WTP for these two products. Finally, we predicted the WTP for the hypothetical products Norwegian, Swedish, Irish, and Botswanan hormone-treated beef.

Comparison of Survey and Auction Results

The survey and auction parameters for Irish, US hormone-free, and US hormone-treated beef from equations (1) and (2) are presented in table 2. The negative country-specific parameters show that the average participant prefers domestic to imported beef. The average auction participant had a slight preference for Irish over US hormone-free beef, while the average survey participant showed no preference between the two alternatives. The negative hormone dummies suggest that the average participant in both studies prefer US hormone-free to US hormone-treated beef. Twenty-one of the survey parameters and nine of the auction parameters are significant at the 5 percent level of significance. All the significant parameters in one model are either significant with the same sign or insignificant in the other model.

The upper half of table 3 presents the hypothetical WTP estimates calculated from the survey using equation (3). The hypothetical WTP results are, as expected, considerably higher than the corresponding WTP amount observed in the auction, indicating a substantial bias. For Region 1, the hypothetical WTP for Irish, US hormone-free, and US hormone-treated beef are respectively NOK 60.46, NOK 58.18, and NOK 386.55 lower per kilogram

than the WTP for domestic beef, while the corresponding WTP amounts in the auction are respectively NOK 14.16, NOK 18.75, and NOK 37.56 lower per kilogram.

Extension to other Socioeconomic Groups

The parameter estimates reported in table 2 indicate that there are large regional differences in the WTP for imported beef. These differences cannot be captured using a locally recruited sample. Furthermore, a locally recruited sample will often be more homogenous with respect to socioeconomic variables, such as urbanization, than a nationally representative sample. We conducted our auction in Region 1, which has a substantial trade with neighboring Sweden. According to the estimates, people living in Region 1 are less reluctant to buy imported beef than people living in other parts of the country.

The lower half of table 3 shows the calibrated survey WTP values. For example, the numbers indicate that the WTP for Irish beef is NOK 6.32 higher in Region 1 than the average for all regions. The least willing to buy imported beef are people living in Region 6, Northern Norway. The average participant in Region 6 is willing to pay NOK 12.72 less than the average participant in Region 1 for Irish beef.

The calibrated national mean WTP values in the last row of table 3 show that the mean WTP amounts for Irish, US hormone-free, and US hormone-treated beef are NOK 19.66, NOK 19.44, and NOK 37.75 lower per kilogram than the WTP for domestic beef. The mean values are respectively 68%, 67%, and 9% higher for Irish, US hormone-free, and US hormone-treated beef than the corresponding values for Region 1.

The marginal effects of a change in a socioeconomic variable on the calibrated WTP values are calculated by inserting the predicted values of equation (3) into equation (9) and differentiating with respect to the socioeconomic variable of interest. Table 4 presents the calibrated marginal WTP for the imported alternatives. Women are coded as 1 and mens as –

1, and the results indicate that females are willing to pay on average NOK 10.14 less for US hormone-treated beef than men. For each ten-year increase in age, the WTP for US hormone-treated beef decreases on average by NOK 3.21. *Income* has no effect on the WTP for imported beef, while *Education* has a negative effect for US hormone-treated beef. As expected, the variables *Travel* and *Urban* have positive effects for the imported alternatives, while *Farm* has a negative effect.

Extension to Unavailable Products

Swedish and Botswanan hormone-free beef were included in the survey but not in the auction. We used the estimated calibration function (9) to predict the WTP for these two alternatives based on the survey results. In the lower half of table 3, the calibrated mean WTP amounts for all regions for Swedish and Botswanan hormone-free beef are respectively NOK 9.95 and NOK 29.72 lower per kilogram than for domestic beef.

Given identical hormone effects for European and Botswanan beef as for US beef, we can predict the WTP for European and Botswanan hormone-treated beef. Using equation (2) and the calibration function (9), the WTP estimates for hormone-treated Norwegian, Swedish, Irish, and Botswanan beef are respectively NOK 33.80, NOK 35.12, NOK 37.81, and NOK 46.83 lower than for domestic hormone-free beef. The WTP for Norwegian and Swedish hormone-treated beef is lower than the WTP for hormone-free Botswanan beef but higher than the WTP for US and Irish hormone-treated beef.

Concluding Remarks

Experimental auctions and stated choice surveys have complementary strengths. We designed and implemented the SC-X method to calibrate the hypothetical WTP estimates from SC surveys with the WTP observed in auctions. The method combines the product

flexibility and sample representativity of SC surveys with the economic incentives of experimental auctions. The method can be used to extend the WTP estimates from an auction to product characteristics and socioeconomic groups not included in the auction. The flexibility regarding product characteristics makes the method useful for evaluating the market potential for new food products under development.

Footnotes

1. In April 2000, US$1 was approximately NOK 8.60.
2. The instructions are available at http://www.nlh.no/ios/Publikasjoner/d2001/d2001-06.pdf
3. The bids are multiplied by two to obtain the WTP per kilogram.

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Table 1. Variables Definitions and Summary Statistics

Variable	Definition	Survey National Mean[a]	Survey Region 1 Mean[b]	Auction Mean[c]
Gender	Gender of respondent	0.02	0.07	0.08
	Male = -1; Female = 1	(1.00)	(1.00)	(1.00)
Age	Age of respondent	-0.01	-0.24	0.05
	0.1*(Actual age – 44 years)	(1.82)	(1.60)	(1.29)
Income	Total income of household (14 levels)	0.24	1.56	2.18
	NOK 0 = -8 to NOK 600,000+ = 6	(3.49)	(3.58)	(3.02)
Education	Highest completed education	-0.04	0.07	0.23
	Elementary school = -1	(0.72)	(0.76)	(0.70)
	High school = 0			
	College/University = 1			
Urban	Population density/Urbanization	0.25	0.13	-0.28
	Rural area = -1	(0.81)	(0.47)	(0.45)
	Relatively densely populated area = 0			
	Urban area = 1			
Travel	Frequency of traveling abroad (4 levels)	0.03	0.72	1.33
	Never = -3 to Every month = 3	(1.91)	(1.90)	(1.63)
Farm	Raised on farm	0.27	0.16	0.20
	No = 0 and Yes = 1	(0.44)	(0.37)	(0.40)
*Region*1	Southeastern Norway	0.17	1.00	1.00
	No = 0 and Yes = 1	(0.38)	(0.00)	(0.00)
*Region*2	Oslo, capital of Norway	0.11		
	No = 0 and Yes = 1	(0.31)		
*Region*3	Eastern Norway	0.22		
	No = 0 and Yes = 1	(0.41)		
*Region*4	Southern and Western Norway	0.28		
	No = 0 and Yes = 1	(0.45)		
*Region*5	Central Norway	0.14		
	No = 0 and Yes = 1	(0.35)		
*Region*6	Northern Norway	0.08		
	No = 0 and Yes = 1	(0.27)		

[a] The sample means and standard deviations are based on the weighted sample used in the estimation. Standard deviations are given in parentheses.
[b] Means and standard deviations of the weighted Region 1 survey subsample.
[c] Means and standard deviations of the auction participants. The participants were drawn from four counties in Region 1.

Table 2. Survey and Auction Results for Imported Beef Relative to Domestic Beef

	Survey			Auction	
Variable	Parameter[a]	P value	HWTP[b,c]	WTP[c]	P value
Irish origin					
Country dummy (I)	-4.02	0.00	-66.98	-12.64	0.00
I × *Gender*	-1.55	0.00	-25.83	-1.64	0.24
I × *Age*	-0.94	0.00	-15.74	1.01	0.28
I × *Income*	-0.02	0.76	-0.41	-0.50	0.28
I × *Education*	0.34	0.32	5.58	3.27	0.10
I × *Urban*	0.69	0.03	11.54	0.10	0.97
I × *Travel*	0.48	0.00	8.01	0.96	0.24
I × *Farm*	-1.61	0.00	-26.79	-11.84	0.00
US origin					
Country dummy (US)	-4.00	0.00	-66.59	-17.22	0.00
US × *Gender*	-1.54	0.00	-25.61	-1.68	0.23
US × *Age*	-1.11	0.00	-18.45	0.31	0.78
US × *Income*	0.01	0.92	0.12	0.20	0.67
US × *Education*	0.53	0.08	8.89	-4.11	0.04
US × *Urban*	0.62	0.04	10.39	1.70	0.57
US × *Travel*	0.43	0.00	7.17	1.03	0.21
US × *Farm*	-1.27	0.03	-21.13	-9.15	0.01
Hormone dummy (H)	-19.48	0.00	-324.61	-22.30	0.00
H × *Gender*	-3.54	0.00	-58.94	-7.71	0.00
H × *Age*	-2.10	0.00	-34.99	1.60	0.31
H × *Income*	-0.10	0.62	-1.58	-0.27	0.68
H × *Education*	-2.69	0.00	-44.84	-5.50	0.05
H × *Urban*	-0.75	0.33	-12.56	-3.04	0.47
H × *Travel*	0.00	1.00	0.00	3.69	0.00
H × *Farm*	-1.68	0.34	-28.07	0.95	0.84
All imported (*AI*)					
AI × *Region*2	-0.46	0.43	-7.58		
AI × *Region*3	-2.38	0.00	-39.68		
AI × *Region*4	-1.62	0.00	-26.92		
AI × *Region*5	-2.90	0.00	-48.36		
AI × *Region*6	-3.43	0.00	-57.21		
Generic					
Price	-0.060	0.00			

[a] The complete list of mixed logit parameters is available from the authors.

[b] The hypothetical survey willingness to pay is the survey parameters multiplied by -1 and divided by the price parameter, $\hat{\beta}_{Price}$ = -0.060.

[c] All willingness to pay estimates are given in NOK.

Table 3. Average WTP for Imported Beef Compared to Domestic Beef

	Hormone free				Hormone treated
Region	Sweden	Ireland	US	Botswana	US
			Survey HWTP[a]		
Region 1[b]	-5.45	-60.46	-58.18	-154.88	-386.55
Region 2	-10.01	-52.54	-53.52	-139.24	-392.99
Region 3	-57.76	-115.67	-114.85	-211.28	-457.44
Region 4	-42.03	-99.72	-97.72	-193.77	-428.60
Region 5	-67.37	-130.78	-128.38	-229.92	-461.22
Region 6	-87.74	-158.74	-156.62	-263.01	-503.47
All regions	-42.80	-100.32	-98.77	-195.51	-434.16
			Auction WTP[c]		
Region 1	NA	-14.16	-18.75	NA	-37.56
			Calibrated SC-X WTP[d]		
Region 1[e]	-1.41	-13.34	-12.93	-25.72	-35.46
Region 2	-2.56	-11.87	-12.06	-24.25	-35.71
Region 3	-12.85	-21.64	-21.54	-29.61	-39.30
Region 4	-9.79	-19.57	-19.30	-28.61	-37.43
Region 5	-14.57	-23.37	-23.11	-30.51	-39.59
Region 6	-17.85	-26.06	-25.87	-31.78	-43.50
All regions	-9.95	-19.66	-19.44	-28.72	-37.75

SC-X calibration function:

$$WTP_{nit}^{A} = 0.263 * \widehat{HWTP}_{nit}^{A} + 0.749 * (\widehat{HWTP}_{nit}^{A})^2 / 10^3 + 0.790 * (\widehat{HWTP}_{nit}^{A})^3 / 10^6 \,.$$ [f]

[a] The results are the predicted hypothetical WTP for the average respondent.
[b] Using the socioeconomic variables from the auction gives the following hypothetical WTP results for Region 1: -4.84, -67.52, -65.03, -171.67, and -412.19 respectively.
[c] The average WTP found in the auction.
[d] The SC-X WTP is found by using the hypothetical survey WTP in the SC-X calibration function.
[e] Using the socioeconomic variables from the auction gives the following calibrated SC-X WTP results for Region 1: -1.26, -14.59, -14.16, -27.10, and -36.56 respectively.
[f] Corresponding *p* values of the parameter estimates are: 0.00, 0.00, and 0.01.

Table 4. Calibrated Marginal WTP for Imported Beef Relative to Domestic Beef[a]

	Hormone free				Hormone treated
Variable	Sweden	Ireland	US	Botswana	US
National mean	-9.95	-19.66	-19.44	-28.72	-37.75
Gender	-2.24*	-3.62*	-3.59*	-2.35*	-5.07*
Age	-1.99*	-2.20*	-2.59*	-1.47*	-3.21*
Income	0.00	-0.06	0.02	0.08	-0.09
Education	1.45*	0.78	1.24	0.88	-2.16*
Urban	-0.13	1.61*	1.45*	1.70*	-0.13
Travel	1.20*	1.12*	1.00*	0.30	0.43
Farm	-2.70*	-3.75*	-2.96*	-1.05	-2.95*
Slope[b]	0.20	0.14	0.14	0.06	0.06

*The corresponding mixed logit parameters are significant at the 5% level of significance.
[a]The calibrated marginal effects are the marginal effects of the socioeconomic variables on the hypothetical survey WTP (as reported in table 2) multiplied by the slope of the calibration function at the national mean.
[b]Slope of calibration function at national mean.

Appendix A1. Complete Mixed Logit Results (for referee use)

Variable	Parameter	Std. err.	P value
Swedish origin			
Country dummy (S)	-0.62	0.38	0.11
St. dev. of *S*	4.64	0.32	0.00
S × *Gender*	-0.67	0.15	0.00
S × *Age*	-0.60	0.10	0.00
S × *Income*	-0.01	0.05	0.88
S × *Education*	0.44	0.22	0.04
S × *Urban*	-0.04	0.21	0.85
S × *Travel*	0.36	0.09	0.00
S × *Farm*	-0.81	0.41	0.05
Irish origin			
Country dummy (I)	-4.02	0.51	0.00
St. dev. of *I*	8.06	0.37	0.00
I × *Gender*	-1.55	0.25	0.00
I × *Age*	-0.94	0.15	0.00
I × *Income*	-0.02	0.08	0.76
I × *Education*	0.34	0.34	0.32
I × *Urban*	0.69	0.33	0.03
I × *Travel*	0.48	0.14	0.00
I × *Farm*	-1.61	0.62	0.00
US origin			
Country dummy (US)	-4.00	0.49	0.00
St. dev. of *US*	7.63	0.35	0.00
US × *Gender*	-1.54	0.23	0.00
US × *Age*	-1.11	0.15	0.00
US × *Income*	0.01	0.07	0.92
US × *Education*	0.53	0.30	0.08
US × *Urban*	0.62	0.30	0.04
US × *Travel*	0.43	0.12	0.00
US × *Farm*	-1.27	0.57	0.03
Hormone dummy (H)	-19.48	2.52	0.00
St. dev. of *H*	16.11	1.69	0.00
H × *Gender*	-3.54	0.85	0.00
H × *Age*	-2.10	0.48	0.00
H × *Income*	-0.10	0.19	0.62
H × *Education*	-2.69	0.93	0.00
H × *Urban*	-0.75	0.78	0.33

H × *Travel*	0.00	0.34	1.00
H × *Farm*	-1.68	1.78	0.34
Botswanan origin			
Country dummy (B)	-10.11	0.89	0.00
St. dev. of *B*	13.60	0.71	0.00
B × *Gender*	-2.35	0.41	0.00
B × *Age*	-1.47	0.24	0.00
B × *Income*	0.08	0.12	0.53
B × *Education*	0.88	1.57	0.12
B × *Urban*	1.70	0.54	0.00
B × *Travel*	0.30	0.22	0.17
B × *Farm*	-1.04	-1.15	0.25
All imported (*AI*)			
AI × *Region*2	-0.46	0.57	0.43
AI × *Region*3	-2.38	0.50	0.00
AI × *Region*4	-1.62	0.47	0.00
AI × *Region*5	-2.90	0.56	0.00
AI × *Region*6	-3.43	0.72	0.00
Generic			
Price	-0.060	0.01	0.00
Summary statistics			
Restricted log likelihood			-14630
Log likelihood of MNL model at convergence			-5678
Log likelihood of MXL model at convergence			-4022

Notes: The model was estimated with Limdep Version 7.1.x, June, 2001.
Model specifications: Freely correlated error terms. Repeated choice.
Halton draws. Replications for simulated probability = 500