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Consumer Willingness-to-Pay for Non-taste Attributes in Beef Products

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Abstract

Beef is the most commonly consumed red meat and a major source of protein for US consumers. High-quality beef products are sold with substantial premiums, but the specific beef attributes by which high-quality standards are determined remain ambivalent. Most attribute studies have focused on palatability characteristics such as tenderness, juiciness, fatness, or marbling. More recent research finds increasing consumer interest in beef attributes that are not directly taste-related, such as food safety, organic, environmental impacts, local production, or DNA traceability. However, these studies have focused on a single non-taste attribute. Questions remain as to which of those attributes might have more of an influence on consumer preferences for beef products and whether there are interactions between these attributes in terms of consumer willingness-to-pay (WTP) for the beef product in question. This study uses results from a national survey of consumers to examine how the presence of multiple quality indicators of attributes influence WTP for beef products, which of these attributes have a relatively greater impact on consumer choice, and how these impacts vary based on consumer demographics. A WTP space modeling framework is used to analyze the survey data, allowing for variability and scaling of preferences.

JEL classification: Q18, Q54, Q56, Q58

Key words: Beef, Choice Experiment, Label, Willingness-to-Pay Space

Introduction

U.S. consumers spend more on beef than any other meat. In 2012, annual per capita expenditures on beef were $287.65, compared to $160.06 for pork, $154.14 for chicken, and $26.73 for turkey, while per capita consumption of beef (57.4 lbs.) trailed chicken (81.3 lbs.), but led pork (45.9 lbs.) and turkey (16 lbs.) (American Meat Institute, 2014). Some beef consumers are willing to pay a substantial premium for high-quality beef products, but how they view and evaluate particular attributes remain ambiguous (Gao & Schroeder, 2009; Hocquette, et al., 2012). Two categories of beef attributes are often used to determine the product quality: the intrinsic attributes, or the palatability of the beef product, such as tenderness, juiciness, fat content, or marbling; and the extrinsic attributes that are not directly related to taste or flavor, such as impacts on biodiversity, climate change or socioeconomic welfare (Hocquette, et al., 2012). Intrinsic attributes are often revealed at the time of purchase or after consumption, but extrinsic attributes might not be discerned to consumers even after purchase-and-consumption process is finished (Loureiro & Umberger, 2007). Studies by the cattle industry have typically focused on intrinsic sensory quality attributes (Feuz, et al., 2004), but recent consumer studies also find that consumers are interested in "extrinsic" quality (Hocquette, et al., 2012). These previous studies have typically focused on a single attribute. Questions remain as to the effects of these attributes on consumer willingness-to-pay (WTP).

Extrinsic quality attributes are often delivered to consumers in the form of a certification or information label because these attributes are not likely to be as directly perceivable to consumers as sensory quality attributes. The use of labels on food products is a common practice in the U.S. For example, the U.S. Department of Agriculture's (USDA) Choice, Prime and Organic labels are prominently displayed on the retail packaging for much of the beef sold in the

U.S (USDA, 2011). The use of labels for information provision to consumers is a means of avoiding market failure from information asymmetry (Kennedy, et al., 1994; Clark & Russell, 2005); yet the current food labels actively applied in the U.S. food market includes limited information of the aforementioned extrinsic quality attributes (Cohen & Vandenbergh, 2012). There has been a great deal of interest in labels for the last 2-3 decades and an explosion of labeling programs (some of which have endured, some not), and accumulating evidence that these labels can influence consumer behavior and, thus, serve as effective tools for both marketing and policy-making purposes.

As marketing tools, labels provide opportunities for farmers to differentiate their products from the more general competing products. For example, the livestock sector in the U.S. is faced with a highly saturated market with products that are generated from a fairly homogeneous production system emphasizing enhanced safety and sanitation standards; thus it is difficult for beef farmers to differentiate their products based on palatability characteristics (Grunert, 2006). However, studies suggest that consumers are willing to pay a premium for beef product attributes not related to palatability characteristics, including, for example, brand (Froehlich, et al., 2009), country or region of origin (Loureiro, 2007), reduced greenhouse gas (GHG) emissions during production (Gonzalez, et al., 2011), and cattle that are either hormone-free and non-genetically modified (Verbeke, et al., 2010), organically fed and locally produced (Sanjuan, et al., 2012; Zanoli, et al., 2012), or DNA traceable (Weaber & Lusk, 2010). Thus, labeling programs that aid consumers in differentiating beef products based on these attributes could help producers satisfy consumer preferences for these attributes and serve as a cost-effective way to promote high quality beef production with reduced environment impact.

This study contributes to this literature by examining how consumers respond to and value varieties of beef products that vary in non-sensory, extrinsic quality attributes. Consumer willingness-to-pay (WTP) for these attributes are based on these features. Similar to previous studies (Gao & Schroeder, 2009; Feuz, et al., 2004; Xue, et al., 2010; Froehlich, et al., 2009; Loureiro, 2007; McCluskey, et al., 2005), data for this study were collected using a contingent choice experiment to elicit consumer preferences for beef products. The contingent choice experiment method is consistent with the consumer theory developed by Lancaster (1972) and widely-applied empirical strategies (McFadden, 1994). Unlike studies that focus on a single extrinsic attribute, this study assumes all the beef product alternatives are identical in terms of palatability characteristics (taste, flavor, marbling, etc.) but vary across five attributes: 1) USDA Angus certification, 2) local production, 3) DNA traceability, 4) humane treatment, and 5) reduced GHG emissions. This design allows a concomitant and direct comparison of relative consumer preferences for these attributes. This study also addresses concerns that traditional multinomial logit models suffer from biases resulting from taste and scale heterogeneity across individual consumers (Greene & Hensher, 2010; Greene & Hensher, 2013; Hensher & Greene, 2011), and that the resulting WTP estimates are derived as ratios of attribute and price parameters following an arbitrarily-defined WTP distribution with high variances and reflecting less rational choice behaviors (Train & Weeks, 2005). To accommodate such heterogeneity and to retrieve more accurate WTP estimates, a random parameter logit (RPL) model (Train, 2003) estimated in WTP space (Train & Weeks, 2005), known as the generalized multinomial logit model adjusted for scale heterogeneity, or the WTP space model (Train & Weeks, 2005; Hensher & Greene, 2011), is used.

Data and Survey Methods

Data for this study were collected through an online survey of U.S. consumers, which was hosted by GfK® Custom Research, LLC (GfK) in November, 2012. GfK recruits panelists aged 18 or older for its KnowledgePanel® using a probability-based sample designed to represent the U.S. population. The sampling protocol uses address-based sampling (ABS) techniques based on a sample frame of the U.S. Postal Service's Delivery Sequence File and list-assisted random-digit dialing (RDD) techniques based on a sample frame of the U.S. residential landline telephone universe. Households with a home computer and Internet access are asked to take GfK surveys using their own equipment and Internet connection. Incentive points per survey redeemable for cash are provided upon survey completion. Households without a computer and access to the Internet are provided a laptop computer and free monthly Internet access in exchange for completing surveys. All panel members receive special incentive points to improve response rates and/or for all longer surveys as compensation for the extra burden of their time and participation (Dennis, 2013).

Panel members selected for this survey were sent a personalized e-mail invitation with an Internet link to the survey. Respondents were asked to complete a pre-survey questionnaire focusing on basic demographic information and household beef consumption habits. To qualify for participation in this study, a respondent or other members of his/her household must prepare and consume beef at home. A total of 3,187 surveys were fielded, of which 1,994 were completed, with 1,688 of these qualifying as preparers and consumers of beef-at-home. Thus, the overall completion rate to the survey was 63% and the qualification rate was 85%.

The survey employed a contingent choice experiment (also referred to as conjoint analysis), which has been widely used in consumer choice studies (Louviere, 1988). Notably,

this approach is an extension of the contingent valuation method (Mitchell & Carson, 1989) and is consistent with random utility theory (Adamowicz, et al., 1998). Contingent choice experiments allow researchers to model respondent choice as a function of the attributes of a product or service (Vermeulen, et al., 2008). In these experiments, respondents are asked to complete a series of choices comprised of choosing their most-preferred alternative from sets of more than two alternatives that are differentiated different values for a common set of attributes. In this survey, respondents were assigned to one of two sets of choice tasks, with one comprised of choices over beef steak alternatives and the other of choices over ground beef alternatives.

The survey began with a series of questions about household consumption of beef, such as the number of meals consumed per week that include beef, total expenditures on food consumed away from home and food prepared at home, percentage of food expenditures spent on beef, and the estimated monthly average dollar amount of these expenditures. These questions were followed by a series of Likert Scale questions where respondents were asked to evaluate and rate the importance of intrinsic palatability characteristics (such as leanness, freshness, tenderness, etc.) and nutrition facts (such as serving size, total calories, and cholesterol) of the beef product (steak or ground beef) which they were assigned. Then the extrinsic attributes that differentiated the product alternatives in the contingent choice experiments were introduced to the respondents with an information screen detailing each attribute. Respondents were also provided the option to access additional information on each attribute in the form of a second information screen containing more detailed information on each attribute.

Attribute information screens were followed by a screen asking respondents to consider their actual household food budgets in responding to the choice tasks. Such “cheap talk” (Cummings & Taylor., 1999) was included as an *ex ante* control of hypothetical biases, if any,

between solicited responses to hypothetical valuation questions and situations where actual payments are mandated (List, 2001; Loomis, 2014). The contingent choice experiments followed, as respondents were randomly assigned to either the *Steak* choice experiment or the *Ground* choice experiment. An example choice task is shown in Figure 1. Respondents were asked to assume that all of the beef product alternatives were identical in all ways except for the attributes they were asked to evaluate. Specifically, they were asked to imagine that the alternatives were identical in terms of palatability characteristics such as leanness, freshness, color and juiciness. The contingent choice experiments consisted of fourteen choice tasks, each requiring respondents to choose a single alternative from three varieties of a steak or ground beef product defined by different combinations of five non-palatability related, extrinsic attributes; USDA Angus certification, USDA identified local produced beef, beef produced from cattle that are "Raised Carbon Friendly" to reduce GHG emissions, DNA traceability of the cattle, and humane certifications for animal welfare, and price. A "*None. I would not buy any of these steaks (ground beef products)*" option was also available to the respondents (Vermeulen, et al., 2008). Thus, a total of four choices were available to the respondents in each choice task. A total of 801 respondents completed the *Steak* choice tasks and 887 respondents completed the *Ground* choice tasks; multiplied by the number of choice tasks (14) and alternatives (4), and after removal of observations with missing values, the number of observations used in this study is 44,676 for the steak version and 49,600 for the ground beef version.

Several sets of Likert-scale questions were presented to respondents following the choice experiments. These questions focused on respondent attitudes toward food safety, environment and climate change, perceptions of beef and other agricultural production activities, and opinions

on government policies. Finally, survey response data were supplemented with individual demographic characteristics collected by GfK.

Modeling Framework

The WTP Space Model

Consumer choice of beef products can be modeled in the random utility (RUM) theory framework (McFadden, 1974) and Lancaster's (1972) consumer utility maximization model such that each individual consumer *i* derives utility ($\widetilde{U}_{ij}$) by choosing a beef product *j* from a set of *J* alternatives where each alternative is defined and differentiated by a set of product characteristics or attributes, as follows:

$$\widetilde{U}_{ij} = V_{ij} + \tilde{\varepsilon}_{ij} = -\alpha_i P_{ij} + \beta_i{}' X_{ij} + \tilde{\varepsilon}_{ij} \tag{1}$$

where $V_{ij} = V(P_{ij}, X_{ij})$ is an approximation of the individual's utility that is strictly monotonic, homogeneous of degree zero and quasi-convex in income and prices and characterized by the price that the ith individual pays for the jth alternative beef product, P_{ij}, as a separable product attribute, and a vector of other observable product attributes, X_{ij}, including both sensory and extrinsic attributes. Individual *i* chooses alternative *j* if $\widetilde{U}_{ij} > \widetilde{U}_{is}, \forall\, j, s \in J \; and \; j \neq s$. The scalar α_i and the vector β_i measure the weights placed by the individual on these attributes, and the stochastic error term $\tilde{\varepsilon}_{ij}$ represents all other unobservable and unknown factors and is assumed to be independent and identically distributed type-one extreme value.

A general form of the RUM model described in Equation (1) is used in the RPL model and its parameters, α_i, β_i, and $Var(\tilde{\varepsilon}_{ij})$, can be estimated with maximum likelihood. The RPL model differs from other traditional logit models and accommodates unobserved taste

heterogeneity, which implies that preferences for a particular product attribute or set of attributes vary across individuals, by allowing the weight parameters to be randomized and vary across individuals rather than being fixed using some continuous individual taste distribution (Train 2003). However, a closer look into the RPL model when obtaining estimates of marginal WTPs raises additional questions (Scarpa, et al., 2008; Hensher & Greene, 2011; Greene & Hensher, 2013). Models employing arbitrary distributions for the taste parameters, such as the log-normal or normal distribution that have the advantage of being conveniently tractable, often generate estimates that deviate from rational choice behavior and imply counter-intuitive distributions of WTP values (Scarpa, et al., 2008). These problems are due to the fact that the analytical expression for WTP, a ratio of parameter estimates of non-cost attributes to the cost parameter, will explode if the values of the denominator, i.e. the cost parameter, has a value close to zero which is likely with most standard distributions such as the lognormal distribution (Scarpa, et al., 2008; Hensher & Greene, 2011). As a result, the derived WTP distribution is skewed with an implausibly long upper tail and, resulting in an inflated mean and variance (Train & Weeks, 2005; Scarpa, et al., 2008; Hensher & Greene, 2011).

Previous research has attempted to ameliorate this problem by assuming all non-cost parameters to be random but the cost parameter constant across individuals (Revelt & Train, 1998), so that the WTP distribution for a non-cost attribute is the corresponding non-cost parameter scaled by the fixed price parameter, and the mean and standard error of WTP estimates are the mean and standard error of the corresponding non-cost parameter scaled by the fixed price parameter. But this restriction lacks theoretical reasoning "…as to why response to costs should vary across respondents according to factors that can be independent of observed socioeconomic covariates" (Scarpa et al., 2008, page 995). Moreover, this restriction induces

bias from an additional dimension of heterogeneity, the scale heterogeneity, which implies differences in the degree of certainty individuals have regarding their choices; i.e., some respondents are more certain about the relative utility levels associated with their choices than others (Train & Weeks, 2005; Greene & Hensher, 2010; Greene & Hensher, 2013). Assuming that the cost parameter is fixed across individuals implies that the scale parameter, defined as the standard error of the unobserved utility, i.e. the stochastic error term, is the same across all individuals. However, in most cases, the scale parameter varies across individual observations (Greene & Hensher, 2010); therefore, Train and Weeks (2005) suggest manipulating the stochastic error term to recognize and accommodate the scale heterogeneity. Specifically, denote $\varepsilon_{ij} = \sigma_i \tilde{\varepsilon}_{ij}$ to be Gumbel distributed stochastic errors with variance $Var(\tilde{\varepsilon}_{ij}) = \sigma_i^2(\pi^2/6)$, where σ_i is the scale parameter of individual i. The model accommodates scale heterogeneity by allowing the scale parameter to vary across individuals.

To accommodate both taste and scale heterogeneity, the general RPL preference space model is re-parameterized such that the outcome can be predicted through estimation of the probability that the alternative *j* is chosen in WTP space, with all parameters including the cost parameter being random and the scale parameter varying across individuals. Following Train and Weeks (2005), the model is re-parameterized by multiplying both sides of Equation (1) by the scale parameter σ_i which does not affect behavior and yields the same variance of the error term across all individuals:

$$U_{ij} = -\sigma_i(\alpha P_j + \beta' X_{ij}) + \varepsilon_{ij} \tag{2}$$

where $U_{ij} = \widetilde{U}_{ij}/\sigma_i$. The parameters, σ_i, α_i, and β_i, or the preference heterogeneity and scale heterogeneity, are not separately identified in the model specification suggested by Train and

Weeks (2005) (Hensher and Greene 2011). Hence, Fiebig et al. (2010) suggest a specification of σ_i using an exponential transformation:

$$\sigma_i = \exp(\bar{\sigma} + \theta' Z_i + \tau\varepsilon_{0i}) \tag{3}$$

where $\varepsilon_{0i} \sim N(0,1)$ and Z_i is a vector of individual characteristics, with $\bar{\sigma}$ set at $-\tau^2/2$ so that $E(\sigma_i) = 1$ when $\theta = 0$. In (3), the degree of scale heterogeneity increases as the parameter τ increases. Further, Hensher and Greene (2011) suggest incorporating (3) into model specification in WTP space by substituting σ_i in (3) into (2) to yield

$$U_{ij} = \left[\exp(\bar{\sigma} + \theta' Z_i + \tau\varepsilon_{0i})\left(-\alpha P_j + \beta' X_{ij}\right)\right] + \varepsilon_{ij} \tag{4}$$

If WTP for an attribute is $\gamma_i = \beta_{ij} / \alpha_i$ for all i, then substituting into (4) yields:

$$U_{ij} = \alpha\left[\exp(\bar{\sigma} + \theta' Z_i + \tau\varepsilon_{0i})\left(-P_j + \gamma' X_{ij}\right)\right] + \varepsilon_{ij} \tag{5}$$

where γ is a vector of WTPs. By normalizing $\alpha_i = 1$, utility reduces to

$$U_{ij} = \exp(\bar{\sigma} + \theta' Z_i + \tau\varepsilon_{0i})\left[-P_j + \beta' X_{ij}\right] + \varepsilon_{ij} \tag{6}$$

Equation (6), known as utility in WTP space, is used in this study. WTP space models have the advantage of avoiding WTP estimates that are ratios of coefficients with dubious statistical properties (Hensher and Greene 2011). When the model is in WTP space, estimates for β are estimates of marginal WTP for the attributes in X_{ij} (Train and Weeks 2005).

Variables and Model Specification

Variable names, definitions and descriptions, along with sample statistics, are presented in Table 1. The beef product attribute variables included in the WTP space models are price ($6.92, $9.22, $11.53, $13.83, and $16.14 per pound for *Steak*; $2.35, $3.13, $3.91, $4.7, and $5.48 per pound for *Ground*) and binary variables for Angus certification (*Angus*), local production (*Local*), DNA traceability (*DNA*), reduced GHG emissions (*Carbon*), and animal welfare (*Humane*). An alternative specific constant (*ASC*) was created to indicate the "None" option. The parameters on product attribute variables were allowed to be randomized in the WTP space models. The scale heterogeneity variable is respondent's highest education level (*Educ)*, measured in four categories: 1 if less than high school, 2 if high school graduate, 3 if some college, 4 if bachelor's degree or higher.

Results and Conclusions

Estimation results for the WTP space models of beef product choices are presented in Table 2. A likelihood-ratio (LR) test suggests that the WTP space specification was preferred to conditional and general RPL specifications for both survey versions[1].

The estimated coefficients for *Angus*, *Local*, *DNA*, *Carbon*, and *Humane* are all positive and significant at the 1% level in both models indicating that, in general, consumers prefer beef

[1] For the *Ground* models: LR test statistic (LR stat) is 536.27 with degrees of freedom (df) = 6 for the WTP space model against the RPL model, and LR stat is 6812.588 with df = 8 for the WTP space model against the conditional logit model. For the *Steak* models: LR stat is 5100.884 with df = 6 for the WTP space model against the RPL model, and LR stat is 22095.3 with df = 8 for the WTP space model against the conditional logit model. Compared with critical values of $\chi^2(0.01,6) = 16.81$ and $\chi^2(0.01,8) = 20.09$, respectively, all tests results indicate that the WTP space model is preferred to either the RPL or conditional logit models at 1% or higher level of significance.

steak and ground beef products that are USDA Angus certified, locally produced, DNA traceable, produced with less carbon emissions, and from cattle raised humanely. In both models, the estimated coefficient for τ is significant at the 1% level, indicating that the WTP space model nests both the preference space and WTP space models. The positive sign on *Educ* in the models suggests that higher levels of education increase respondents' certainty about their choice of beef products.

The mean of individual WTP estimates for the extrinsic attributes are reported as $/per pound (Table 2). For the *Steak* model, the mean WTP is $2.22 for *Angus*, $1.64 for *Local*, $0.38 for *DNA*, $0.55 for *Carbon*, and $1.05 for *Humane*. For the *Ground Beef* model, mean WTP is $1.94 for *Angus*, $1.484 for *Local*, $0.45 for *DNA*, $0.52 for *Carbon*, and $1.20 for *Humane*. In general, respondents are interested in and would pay a premium for all of the extrinsic attributes. Specifically, respondents have, on average, higher WTP for the USDA Angus certification, local production and animal welfare, while relatively lower WTP for GHG emission reduction and DNA traceability. Further, we can roughly compare the annual WTPs with the estimated annual food expenditure *per capita* of $1,872[2]. For the *Steak* model, the mean of estimated annual WTP is $148.94 for *Angus* (7.96% of the annual food expenditure *per capita*), $109.75 for *Local* (5.86%), $25.53 for *DNA* (1.36%), $36.52 for *Carbon* (1.95%), and $70.42 for *Humane* (3.76%). For the *Ground* model, the mean of estimated annual WTP is $130.18 for *Angus* (6.95% of the annual food expenditure *per capita*), $99.43 for *Local* (5.31%), $30.35 for *DNA* (1.62%), $34.91 for *Carbon* (1.86%), and $80.07 for *Humane* (4.28%). By comparing to the annual estimates, it

[2] In the survey, we provided to the respondents with the information of an estimated food expenditure *per capita* each month of $156, thus the estimated annual (in twelve months) food expenditure is about $1,872. The estimated U.S. annual average beef consumption *per capita* was 67 pounds as reported by USDA (2005), thus we obtained the annual WTPs for each beef attributes by multiplying each WTP per pound with 67 pounds.

is likely that, over the long term, the respondents put more weights on the attributes that indicate high quality (*Angus*) and humanely cattle treatments (*Humane*), as well as showing supports for local agricultural production and agribusiness (*Local*).

Our results suggest that consumers place a premium on beef products bearing extrinsic attribute certifications relative to uncertified beef products of identical palatability characteristics. In general, consumer preferences for higher beef product quality, to some extent, are motivated by perceptions of these non-sensory characteristics, which are not directly observable if not for the information provided via labeling certifications, even if they are similar to other beef products in terms of sensory characteristics. Such findings suggest that labeling programs that empower consumers to differentiate products on the basis of these attributes could lead to increased prevalence of these attributes and, thus, higher beef quality, more local production, safer beef products, increased abatement of GHG emissions, and greater attention being paid to animal welfare.

These results imply that the cattle industry can employ government and third-party certification and labeling programs as effective marketing and communications strategies to promote the sale of high quality beef products. Meanwhile, policymakers may want to emphasize the extent to which concerns the public has with elements of agricultural production, such as food safety, contribution to climate change, and animal welfare, can be addressed by harnessing the power of the market through increased information provision in place of more contentious regulatory approaches.

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If the following were your ribeye steak choices, which ribeye steak would you choose? Select one rsteak at the bottom of this grid. Please note, the word "No" in a given attribute row means that the steak does not have that particular attribute.

Attribute	Ribeye Steak 1	Ribeye Steak 2	Ribeye Steak 3	
SDA Angus Certified	No			None. I would not buy any of these steaks.
Local Beef	LOCAL BEEF	LOCAL BEEF	No	
A Traceable	No	DNA traceable	No	
ised Carbon Friendly	No		No	
Humane Certified			No	
Price	$6.45	$8.60	$4.30	
eye Steak you uld choose→				

If the following were your ground beef choices, which ground beef would you choose? Select one ground beef product at the bottom of this grid. Please note, the word "no" in a given attribute row means that the ground beef does not have that particular attribute.

nd Beef		LOCAL BEEF	DNA traceable	Price ($/Pound)	RAISED CARBON FRIENDLY	HUMANE CERTIFIED
1)	Yes	No	No	$1.50	Yes	No
2)	No	Yes	Yes	$3.00	No	Yes
3)	No	No	No	$2.25	Yes	Yes
4)	None. I would not buy any of these ground beef products.					

Figure 1. Example Choice Task Screen

Table 1. Variable Descriptions and Sample Statistics

Variable	Description	Sample Means*	
		Steak	*Ground Beef*
		(N=44,676)	(N=49,600)
Chosen	1 if the beef alternative is chosen, 0 otherwise	0.25 (0.4330)	0.25 (0.4330)
Angus	1 if USDA certified Angus beef, 0 if not	0.3300 (0. 4702)	0.3298 (0.4701)
Local	1 if locally produced beef, 0 if not	0.3659 (0.4817)	0.3661 (0.4818)
DNA	1 if DNA traceable beef, 0 if not	0.3659 (0.4817)	0.3659 (0.4817)
Carbon	1 if "Raised Carbon Friendly" beef, 0 if side-by-side	0.3833 (0.4862)	0.3833 (0.4862)
Humane	1 if Humane Certified beef, 0 otherwise	0.3661 (0.4818)	0.3660 (0.4817)
Price	Prices of the beef alternatives, measured in $100	8.734 (5.764)	2.967 (1.957)
ASC	1 if "None" option, 0 otherwise	0.25 (0.4330)	0.25 (0.4330)
Scale Heterogeneity Variable			
Educ	Highest education levels, 1 if less than high school, 2 if high school graduate, 3 if some college, 4 if bachelor's degree or higher	2.803 (0.952)	2.827 (0.972)

* Standard deviation in parentheses.

Table 2. Estimated WTP-Space Models of Beef Choice[a] and Willingness-to-Pay

	(1) *Steak*		(2) *Ground Beef*	
Variable	Estimated Coefficient	Standard Error	Estimated Coefficient	Standard Error
Mean				
Price	1.000	---	1.000	---
Angus	3.988***	0.261	1.433***	0.099
Local	3.040***	0.171	0.968***	0.070
DNA	0.679***	0.110	0.295***	0.039
Carbon	1.012***	0.111	0.336***	0.036
Humane	2.212***	0.189	0.891***	0.068
ASC	-9.468***	0.456	-4.144***	0.133
Standard Deviation				
Angus	-5.661***	0.285	1.550***	0.071
Local	-2.656***	0.165	0.931***	0.095
DNA	0.603*	0.357	0.440***	0.124
Carbon	1.450***	0.249	0.465***	0.081
Humane	3.318***	0.269	0.957***	0.080
ASC	9.152***	1.199	3.281***	0.286
Scale Heterogeneity Parameters				
θ_0	-0.943***	0.117	0.195	0.134
θ_{Educ}	0.146***	0.038	0.109***	0.037
τ	0.859***	0.047	0.785***	0.048
N	44,676		49,600	
Log-likelihood	-9,695.287		-1,0627.562	
Wald (df=6)	1,057.030***		1,502.42***	
WTP (U.S. dollar per pound beef products consumption)				
	Mean	Standard Error	Mean	Standard Error
Angus	2.223***	0.113	1.943***	0.079
Local	1.638***	0.096	1.484***	0.044
DNA	0.381***	0.011	0.453***	0.017
Carbon	0.545***	0.022	0.521***	0.019
Humane	1.051***	0.053	1.195***	0.046

[a] *** indicates significance at α =.01, ** indicates significance at α =.05, and * indicates significance at α =.10.