U.S. Consumers' Valuation of Quality Attributes in Beef Products

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A sample of U.S. consumers were surveyed in a choice based experiment in the Fall of 2005 and Spring 2006 to elicit consumers' preferences for quality attributes in beef products. Based on the resulting data, a random coefficients logit model is estimated, and consumers' willingness to pay for these quality attributes in beef products is obtained. The results indicate that consumers have strong valuation for traceability, grass-fed, and U.S. origin attributes in a standard rib-eye steak and are willing to pay a premium for these attributes.

Key Words: choice experiment, conjoint analysis, quality attributes, random parameters logit, willingness to pay

JEL Classifications: Q10, Q1

Amid high profile food scares and recalls, health concerns, threats of bioterrorism and competition from other protein sources, the U.S. beef industry faces increasing demands from consumers for assurances regarding source and production methods both in domestic and export markets. These attributes (also known as credence attributes) include feed type, animal treatment, quality assurances, process verification, source, and traceability information. The traditional focus in the beef industry has been on volume and efficiency, with marbling as a primary quality measure. However, the trend in consumer demands challenges this view and necessitates looking into differentiation opportunities based on a range of production attributes and their marketability. United State Department of Agriculture (USDA) has devoted resources to support this trend with its program of *Know Your Farmer - Know Your Food,* a USDA-wide effort to create new economic opportunities by better connecting consumers with local producers. USDA believes "there is too much distance between the average American and their farmer and we are marshalling resources from across USDA to help create the link between local production and local consumption (USDA, 2010)." Perhaps if consumers get to know their farmer as USDA suggests there is no need for traceability in the food chain. In fact, the House Appropriations Subcommittee has cut all funding for the voluntary National Animal Identification System (National Agricultural and Food Law and Policy Blog, 2010). While recent media attention and now government resources

have focused on local food and more personal connections between farmer and consumer, questions remain regarding consumer demand for credence attributes and the value they place on them.

Although the Federal mandate is abated, there remains a need to assess the profitability of investing and marketing non-traditional attributes; while many of these attributes exist in current beef products, the additional value/cost contributions of these attributes have not been tested in the market, nor on their impact to the operation and added expense to the supply chain (Lusk and Hudson, 2004). Furthermore, at least in the case of livestock and poultry, the USDA Grain Inspection and Packers and Stockyard Administration (GIPSA) has proposed changes to regulations that some believe will make it harder to reward differentiated products. For example, the proposed changes, "establishes criteria the Secretary may consider in determining if an undue or unreasonable preference or advantage, or an undue or unreasonable prejudice or disadvantage has occurred under the Act" (USDA, GIPSA, 2010). While the example of preference given is volume, will price differences paid for other attributes be considered undue preference? Will a buyer have to justify each price difference paid and will the added burden discourage price and ultimately product differentiation?

The objective of this paper is to provide information on the importance of the aforementioned differentiating production attributes in the U.S. consumers' demand for beef by examining their willingness to pay (WTP) for these attributes. The data comes from a survey based on choice based conjoint (CBC) experiment where potential consumers of beef were asked to choose among rib eye steaks featuring various combinations of production attributes and cost. The consumer preferences for the quality attributes in beef and other meats have been investigated to some extent in previous studies such as Lusk and Fox (2001); Umberger, et al. (2002); Dickinson and Bailey (2002); Lusk, Roosen, and Fox (2003); Hobbs et al. (2005); Loureiro and Umberger (2007); Mennecke et al. (2007); Umberger, Boxall, and Lacy (2009); and Lusk and Parker (2009) to mention a few. The findings of these studies are reviewed along with the discussion of our results. Our study is based on a national sample, is up-to-date, and takes advantage of CBC methodology to elicit the WTP estimates for a variety of quality (particularly credence) attributes. Our econometric approach differs from that of Mennecke et al. (2007) who adopted the conjoint analysis framework with key outcomes defined as *part-worths* of the various attributes. The *part-worths* in Mennecke et al. (2007) are estimated assuming that the attributes are independent of each other and used to rank the importance of the quality attributes to consumers. The model presented in this paper allows for a more general correlation structure.

Data Sources

Survey Design

The primary data used for this study was obtained from a CBC experiment conducted using a web-based application. CBC experiments are appealing to researchers for their practicality and ability to simulate typical market situations and are widely used in marketing research and willingness to pay studies. The CBC approach has the ability of placing value and/or importance on combinations of different attributes that make up the product. This is particularly useful to learn about consumers' preferences for new products and attributes. The CBC method has been used in beef studies and other contexts (Banarjee, Hudson, and Martin, 2007). An extensive description of the CBC methodology is provided in Mennecke et al. (2007).

In designing the web-based survey, SSI Web-CBC software with traditional full-profile CBC design was used (Mennecke et al., 2007).[1] The complete enumeration design option of random design strategy was used to create the assignment of the attributes and levels. This approach is a randomized design that reduces bias due to order and learning effects and approximately orthogonal designs with the advantage that all the interactions can be measured. Although the design is randomized, it conforms to the principles of:

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[1] Detailed description of the survey design methodology is presented in the manual (SSI Web-CBC v5. Manual) provided by the software provider available at http://www.sawtoothsoftware.com/products/ssiweb/.

Minimal Overlap. Each attribute level appears as few times as possible with each level shown only once for cases with equal number of questions (product concepts) and levels. This increases the precision of the main effects to be estimated.

Level Balance. The characteristics of an attribute are shown approximately equal number of times in the survey;

Orthogonality. Attribute levels are chosen independently of other attribute levels, so that the effect of attribute levels are measured independently of all other effects.

Each respondent is presented with the same set of questions and ordering. The CBC design requires specifying how many random (experimentally designed) choice sets are to be used in the experiment. For this study, each consumer is asked to make a choice between three steaks with varying attributes over 27 choice occasions. That is, the questionnaire has three products on each choice occasion with nine attributes and cost of steak randomized 27 times following the complete enumeration design option described earlier. A sample questionnaire is presented in Figure 1.

We note that though CBC design allows for the inclusion of *none option* where respondents are allowed not to choose any of the options offered, our particular experiment did not allow for this. One disadvantage of not including this option is that the experiment does not mimic the real world where consumers can decide not to buy the product described. However, not allowing for *none option* forces the respondents to choose the "best" option out of the products they are presented with and allows them to put some effort into evaluating each question. For an extended survey where many respondents might not really be interested in doing the cognitive work necessary to report their true opinions, the *none option* might reduce the quality of the data (Krosnick et al., 2002).[2]

Survey Sample and Experiment

The final survey questions and instruments were arrived at following a focus group that consists of animal science researchers at Iowa State University. A pretest sample of 76 students at Iowa State University was also done before conducting the survey on the national sample used for this paper. This sample comprises of 41 students in the Animal Science Department and 34 students in the business school. Out of this sample, 57% are male. The students were compensated with class credit for their participation in the survey.

The national sample used in this paper was recruited by Return Path, Inc (a marketing firm that provides online panel sample). Their panel is an actively managed sample that is used primarily for web based market research surveys. The respondents are recruited to their panel while actively engaged in a website unrelated to market research such as CNET and MSNBC. One advantage of this panel is that they do not offer or refer to incentives during recruitment of people into the panel, nor participate in panel co-registration. This reduces duplication and decreases the likelihood of attracting professional panelists. For general population studies, the panel takes into account response rate variables and uses stratification tools to balance the sample so the survey mirrors the latest census figures. For a target audience like ours, a pre-screening tool is used before sending a panelist into a survey to check for consistency in answers and to append new information to their profile for future targeting.
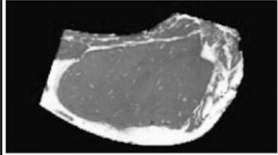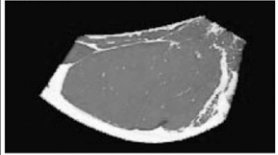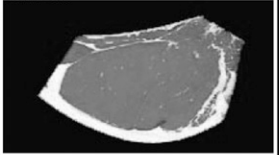
As stated earlier, panelists are not provided an incentive to initially join the panel but are provided cash incentives through PayPal for completed survey and sweepstakes for partial survey completion. For this survey, respondents were paid $5 for completed surveys.

Only potential consumers of beef are eligible and recruited for this survey. Though the sample does not fully match U.S. demographics, this subset of the general population was chosen to mimic the latest census figures as close as possible. In total, 1,513 individuals were sent the survey with 1,171 responding to the survey. Fifty-eight percent of the total sample is female with 86% white/Caucasians. Other race/ethnicity are appropriately represented and summary statistics are presented in Table 1. The age groups are also appropriately represented.

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[2] Refer to Krosnick et al. (2002) for a study on the inclusion or exclusion of *none* option in surveys.

If a steak with these characteristics were your only choices, which steak would you choose? Make your choice by clicking one of the three options at the bottom of the page. Once you have made your selection, click the next button:

Product Features	Choice Cut	Select Cut	Select Cut
Steak Cut:			
Animal Breed:	Angus	Breed not specified	Angus
Animal Feed:	A mix of grass and grain	Grass	Grain
Farm Ownership:	Corporate Farm	Family Farm	Corporate Farm
Region of Origin:	Producer from a Quality Region	Mexican producer	Local producer
Traceability:	Traceable to processing plant only	Traceable to the birth farm	Traceable to the feed lot
Growth Promoters:	Growth promoters were used	No growth promoters were used	No growth promoters were used
Cost of Cut:	Average price	10% above average	10% below average
Guaranteed Tender:	No guarantee of tenderness	Tenderness is guaranteed	No guarantee of tenderness
Organic Certification	Not certified organic	Not certified organic	Certified organic
	○	○	○

Next

Figure 1.   Sample Choice Based Experiment

In total, we use data on 1,145 consumers that completed the survey. The respondents were asked to value different attributes with varying levels in the survey. These attributes include steak cut, animal breed, animal feed, farm ownership, region of origin, traceability, growth promoters, the cost of the cut, organic certification, and guaranteed tenderness. A detailed description of the attributes and definition of all the possible

Table 1. Select Summary Statistics of Consumers' Socio-Demographic Characteristics

Variable	Percentage of Sample (%)
Gender	
Female	58
Male	42
Ethnicity	
White/Caucasian	86
Black/African American	6.2
Hispanic	2.3
Age	
Under 35 years	22.1
35–44 years	22.9
45–54 years	29.3
Over 54 years	25.7

levels was also provided before being presented with the survey questions. Table 2 presents a description of the attributes and levels as presented in the survey.

Finally, as consumer preferences continue to evolve, the web-based data collection process and procedures should be helpful in evaluating the niche potential of a product. The use of a web-based survey application allows not only low cost data collection, but also the potential to target analysis by region or demographic profile. Our study provides an application that elicits consumers' willingness to pay for the attributes of interest using data from a CBC experiment conducted using a web-based application.

Econometric Modeling

McFadden's (1981) Random Utility Maximization (RUM) model has been a major tool for estimating demand systems in economics and marketing. The RUM hypothesis speculates that maximization of utility is the driving force behind an individual agent's decision to choose among available alternatives and thus individual preference distribution is a consequence of choices made by the whole population. This feature makes

Table 2. A List of Steak Attributes Considered in Estimations

Steak Attribute	Attribute Description and Levels
Steak Cut	Steak cut has two levels with pictures shown depicting what a choice and select steak looks like 1) Choice Steak ◼; 2) Select Steak ◼
Animal Breed	1) Angus; 2) Breed not specified
Animal Feed	The animal was fed one of the following during finishing: 1) Grain; 2) A mix of grass and grain; 3) Grass
Farm Ownership	The animal came from either a 1) Family Farm; or 2) Corporate Farm
Region of Origin	The meat came from either a 1) U.S. producing farm; or 2)a Non U.S. producer
Traceability	The ability to retrieve the history, treatment, and location of the animal that a cut of meat comes from, through a recordkeeping and audit system or registered identification program. Traceability usually refers to the ability to track meat to the animal from which it was produced 1) Traceable to the birth farm; 2) Traceable to the feed lot; 3) Traceable to processing plant only
Growth Promoters	Hormonal growth promoters are naturally occurring or synthetic products that are approved in the U.S. for use in beef cattle. The effect of hormonal growth promoters is to increase lean tissue growth 1) Growth promoters were used; 2) No Growth promoters were used
Cost of Cut	The steak is priced at three different levels: 1) 10% more than average; 2) Average Price; 3) 10% less than average
Guaranteed Tender	The steak is guaranteed by the processor to be tender. Tenderness is measured though a variety of techniques depending upon the processor, but all are designed to assess the ease with which the steak can be chewed 1) Tenderness is guaranteed: The steak is labeled "guaranteed tender" 2) No guarantee of tenderness: The label says nothing about tenderness of meat

Source: Mennecke et al., 2007

the RUM model appealing to theorists and practitioners alike.

The logit model is in the class of RUM models. It is widely used because of its ease of interpretation and the availability of a closed form solution for the choice probabilities (Train, 2003). However, despite its widespread use and application, logit models have their limitations. These limitations include the fact that it does not allow for random taste variation and the substitution pattern is restricted. Another model that belongs to the same class of extreme value distribution but overcomes many of the limitations of the logit model is the Mixed logit or Random Parameters Model. The Random Parameters Logit Model can be used to approximate any random utility model because of its flexibility.

In this section, we describe the basic form of the RUM model and how it relates to and aids the understanding of individual preferences. We will also show how this model can be used to estimate consumer willingness to pay (WTP) for attributes of interest. One of the benefits of estimating a RUM model is the ability to estimate consumer WTP (in dollars) for each of the attributes of the goods studied. This estimate is particularly useful for the introduction of new products to the market and aids cost benefit analysis.

Basic Model

As stated earlier, the basic model estimated in this paper is a RUM model that assumes that agents make a choice between alternatives at each choice occasion that maximizes their utility. The basic model assumes that the utility that an individual i receives from consuming a steak j at choice occasion t is a function of the attributes of the steak including the price, and an idiosyncratic error component ε_{ijt}. ε_{ijt} is assumed to be *iid* extreme value.

That is:

$$U_{ijt} = X_{ij}\beta' + P_{ij}\theta + \varepsilon_{ijt}$$

For $i = 1, 2, \cdots N$; $j = 1, 2, \cdots J$ and $t = 1, 2, \cdots T$. X_{ij} is a vector of observed attributes for choice j and P_{ij} is the price of alternative j that individual i faces. In this study, all the individuals are faced with the same price level. The major difference between the conditional logit and random parameters model is the assumption on the parameters of the model and its implication for consumer preference. With this preference representation, the probability that an individual i at choice occasion t will choose alternative j over another alternative k (for $j \neq k$) can be defined as:

$$\mathbf{Pr}(U_{ijt} > U_{ikt}) \equiv \mathbf{Pr}(U_{ijt} - U_{ikt} > \mathbf{0})$$

$$= Pr\left[\left\{(X_{ij} - X_{ik})\beta' + (P_j - P_k)\theta + (\varepsilon_{ijt} - \varepsilon_{ikt})\right\} > 0\right]$$

$$= Pr\left[(\varepsilon_{ijt} - \varepsilon_{ikt}) > \left\{(X_{ij} - X_{jk})\beta' + (P_j - P_k)\theta\right\}\right]$$

Conditional Logit. Given the basic model specified above, the conditional logit specification assumes that utility is linear in parameters and that the parameters are fixed. Given that the difference between two extreme values is distributed logistic, this specification implies that the probability of choosing alternative j is the logit choice probability with

$$P(j \, is \, chosen) = \frac{\exp(X_{ij}\beta + P_j\theta)}{\sum_k (X_{ik}\beta + P_k\theta)}$$

As stated earlier, the logit probabilities have desirable properties but have a number of limitations. One of the popular limitations is that it exhibits the property of Independence from Irrelevant Alternatives (IIA). The IIA property assumes that the relative odds of choosing an alternative j over k is not dependent on other alternatives available or what the attributes for the other alternatives are (Train, 2003).

The Random Parameters Logit Model. The random parameters logit (RPL) model is usually considered as a generalization of the standard conditional logit model over the parameter distribution. RPL models allow preferences for quality attributes to vary in the population, which induces correlation across alternatives. In contrast to the conditional logit model, the RPL model allows the parameters of the model to vary across individuals. In addition, the RPL model does not suffer from the familiar IIA property of the conditional logit described above. RPL model can also be used to capture possible heterogeneity of preferences for the quality attributes in our experimental survey. Though the parameter on price can also be allowed to vary across individuals, it is usually assumed to be constant in practice (Train, 2003).

RPL model specifies that the utility derived from alternative j by individual i at choice occasion t can be defined as:

$$U_{ijt} = X_{ij}\beta'_i + P_{ij}\theta + \varepsilon_{ijt}$$

where β_i is a vector of coefficients of the observed attributes that vary over individuals in the population with density $f(\beta)$ reflecting heterogeneity of individual taste regarding the attributes of the steak. β_i denotes the value that the individual places on each attribute and also reflects individual preference for the attributes. Different distribution can be assumed for $f(\beta)$ depending on the alternative of interest and is usually specified as continuous. Some of the popular densities used include normal, lognormal, uniform, and triangular density. For this study, we assume a normal density with mean b and variance Ω.

Conditional on the random parameter β_i, the probability of choosing alternative j over all other alternatives is given as $P_{ij}(\beta_i) = \frac{\exp(X_{ij}\beta_i + P_j\theta)}{\sum_k (X_{ik}\beta_i + P_k\theta)}$. However, since β_i is unknown, it will have to be integrated out to get the unconditional choice probability defined as:

$$P_{ij}(\beta_i) = \int \frac{\exp(X_{ij}\beta_i + P_j\theta)}{\sum_k (X_{ik}\beta_i + P_k\theta)} \phi(\beta|b,W)d\beta$$

where $\phi(\beta|b, W)$ is the normal density with mean b and covariance W (Train, 2003).

The assumption of normality for the distribution of the attributes and the fixed price coefficient also plays a role in the estimation of willingness to pay. The assumption also makes the distribution of willingness to pay estimates to be normal.

The unconditional probability defined above is approximated through simulation for a given

b and *W*. Simulation is needed because the probability does not have a closed form solution. The simulated probabilities will be inserted in the log-likelihood function, which is maximized with respect to *b* and *W*. As suggested by Train (2003), Standard Halton draws are used in the simulation instead of random draws to increase accuracy of estimation. Five thousand draws per individual are used for the model.

Estimation Results

Table 3 presents the estimation results for both conditional logit and random coefficient models in the corresponding columns. Before describing the results, it is important to further clarify the attributes of the steaks presented in the survey. We re-categorized some of the levels of the

attributes in the choice based experiment to tailor the levels of the attributes in the survey to reflect current policy questions and/or to avoid duplication of attributes.

Specifically, the levels of the region of origin of the cattle attribute are aggregated as follows: The initial categories of "local producer" and "producer from quality region" are aggregated into "U.S. producer", while the categories "Mexican producer," "Australian producer," and "Canadian producer" are aggregated into "non U.S. producer". The "No growth promoter used" category including "with or without certified organic claims" were combined and re-categorized into "no growth hormone use claim". The base cases are defined appropriately.

Finally, the respondents were provided with a hypothetical price that varies by percentage

Table 3. Conditional and Random Parameters Logit Model (RPL) Results with All Normal Distribution Parameters Except Price that is Fixed

		Conditional		RPL	
Attributes		Parameters	t-Statistics	Parameters	t-Statistics
Production Attributes					
Traceable to birth	Mean	0.162	9.3592	0.1025	7.1181
	Standard deviation			0.056	0.8500
Traceable to feedlot	Mean	0.0404	2.289	0.0273	1.8450
	Standard deviation			0.0809	1.8139
Non U.S. producer	Mean	−0.0584	−4.099	−0.0546	−3.7570
	Standard deviation			0.1691	6.2635
No growth promotants	Mean	0.0333	2.3531	0.0208	1.6000
	Standard deviation			0.1317	4.3600
Grass-fed	Mean	0.1457	8.3853	0.0937	6.5524
	Standard deviation			0	0.0000
Mix of grass and	Mean	−0.0297	−1.706	−0.0218	−1.5034
grain fed	Standard deviation			0.0001	0.0010
Family farm	Mean	−0.0026	−0.1808	−0.0091	−0.7165
	Standard deviation			0.0631	1.0600
Product Attributes					
Select steak	Mean	−0.131	−7.9199	−0.1053	7.0200
	Standard deviation			0.1119	3.3403
Tenderness guaranteed	Mean	−0.0678	−4.7836	−0.0484	−3.8720
	Standard deviation			0.0625	−1.0647
Other breeds except	Mean	−0.0036	−0.2505	−0.0101	−0.7710
angus	Standard deviation			0.0412	0.4280
Cost of Steak					
Price	Mean	−0.0292	−2.8944	−0.0272	−3.0909
	Standard deviation			-	-
Constant	Mean	0.3907	3.6093	-	-
	Standard deviation			-	-
Log-likelihood		−58,835		−33,814	

points — average price, 10% below average, and 10% above average instead of a specific price for the steak. This is reasonable considering the national scope of the study and the variation in the price of steak in the national market. In the estimations, the average price of the steak is set to $10 per retail pound which is a reasonable average price per pound for the United States. However, since respondents were only provided an average hypothetical price, any average price assumed for the analysis will primarily be a scaling of this amount. We should note that the parameter estimates for price and WTP estimates will be conditional on the assumed average price of $10 and percentage change should be used in interpreting the WTP.[3]

The estimated parameters in both the logit and RPL models have the same sign but differ slightly in magnitudes (the same magnitude for the cost of steak as expected). The magnitudes of the parameters are mostly lower in absolute value in the random coefficients model. Except for the coefficients on tenderness attributes, the parameters have the expected signs. As a point of reference, consumers prefer choice steak over select, which is consistent with the existing premium in the market place and USDA grading system. This is in contrast to Mennecke et al. (2007) that found higher utility for select cut steak using the same data. As was highlighted earlier in the introduction, though the two papers used the same data, the model adopted in our paper can be seen as a generalization of Mennecke et al. (2007) that allows for possible correlation between the attributes. One possible explanation for the sign on tenderness attribute in the survey may be because of how it was described in the survey. The attribute was described as more of a "tenderness label" rather than actual tender guarantee (refer to Table 2 for the description of the attributes). There is no indication in the description that the alternative (no guarantee of tenderness) is tender or not, except that it does not carry the label. This might explain why consumers are not willing to pay for the label once we condition on the other attributes.

We also find that consumers value cattle that are grass-fed relative to grain-fed and are willing to pay more for this attribute. This is in contrast to Mennecke et al. (2007) that found no valuation for grass-fed cattle. Also, in contrast to Mennecke et al. (2007), we do not find a strong valuation for family farm attributes over corporate farm. As stated earlier, the model used in this study differs from that of Mennecke et al. (2007) by estimating the effect of each attribute conditional on the other attributes.

One of the main advantages of estimating the RPL model over the conditional logit model is that it provides information about the heterogeneity of consumers' preferences over the attributes (Lusk, Roosen, and Fox, 2003). When heterogeneity in preference for the attributes exists, the estimated mean (*b*) of the RPL model will be relatively different from the results of the multinomial logit model and the standard deviation (*W*) will be statistically different from zero. The results, as presented in Table 3, indicate that consumers are relatively homogenous in their preference for the majority of the production attributes such as grass fed beef and traceability, and yet heterogeneous in others such as choice versus select, growth hormone free beef, and U.S. origin. The observed heterogeneity reflects the diverse attitudes of consumers in the United States toward these attributes. Consumer preference for growth hormone free beef, for example, largely depends on the education level and knowledge of the consumer.

In order to quantify consumers' valuation of these attributes, WTP values are estimated. For a particular attribute, WTP value indicates the necessary increase in price of the steak to offset the additional utility obtained from having that attribute. From Table 4, WTP estimates are calculated by taking the ratio of the coefficient of the attribute of interest and the price coefficient (the negative of price coefficient in our case since the cost of the steak is a disutility). That is, the WTP for attribute j is $WTP_j = -\frac{\beta_j}{\theta}$ holding all other attributes constant. The estimate of WTP specified here is of the simple form and has a closed form solution given the assumption of constant marginal utility of income. This can be done because the attributes enter the utility function linearly for both the conditional

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Table 4. Willingness to Pay (WTP) as Ratio of Population Means per Steak Based on Random Parameters Logit Estimates for Selected Production Attributes

Selected Production Attributes	WTP Calculated from Parameter Mean	WTP Mean from 10,000 Draws	2.5% Lower Tail	2.5% Upper Tail	St. Dev. from 10,000 Draws
Traceable to birth	3.77	3.78	2.74	4.82	0.53
Traceable to feedlot	1.00	1.00	−0.10	2.08	0.55
Non U.S. producer	−2.01	−2.00	−3.07	−0.96	0.53
No growth promotants w/o organic	0.76	0.76	−0.16	1.69	0.48
Grass-fed	3.44	3.45	2.42	4.48	0.52
Mix of grass and grain	−0.80	−0.80	−1.83	0.25	0.53

model and the RPL model. Since the price coefficient is measured in monetary units (dollar per steak), the ratio gives the dollar value of the WTP estimates. The willingness to pay estimates are lower (therefore, more conservative) in the RPL model relative to the conditional logit model. We take the RPL model as our basis for the WTP estimates because it fits the data better than the conditional logit model as indicated by the higher log-likelihood value in Table 3.

Table 4 presents the WTP estimates and their corresponding confidence intervals for the production attributes in Table 3 except for family farm. There is no strong evidence that consumers in our sample value if the steak came from a family farm versus corporate farm once we control for the other attributes. The confidence intervals were computed from simulations following Krinsky and Robb (1986) method using 10,000 draws. From Table 4, traceability to birth has the highest magnitude of WTP mean estimate of 38% of the price ($3.77) with confidence interval of 27% ($2.74) in the lower tail and 48% ($4.82) in the upper tail. Beef from grass fed cattle also has a high willingness to pay value that is 34% of the price. In addition, U.S. consumers are willing to pay 20% less for beef from cattle raised and slaughtered outside of the United States ($2.01 discount) and about 1% less for beef from cattle fed on a mixture of grass and grain ($0.80 discount). Finally, the "no growth promotant use" attribute shows about 1% premium ($0.76) over those beef products that do not offer this attribute.

Discussion and Conclusion

This study provides evidence on U.S. consumers' willingness to pay for a variety of quality attributes in beef products. The WTP estimates are obtained by estimating a random coefficients model using data from a national sample of 1,145 consumers who participated in a choice-based conjoint experiment. The findings indicate that the credence attributes, specifically traceability, source information, and feeding method are a potential source of differentiation. This information can be utilized in agribusiness firms' production and marketing planning and decisions. The preference by consumers for the attributes in this study is elicited using a conjoint based experiment similar to a market scenario and not a blind taste experiment. Thus willingness to pay estimates reported is also conditional on this.

The results point out that the consumers' awareness for the credence attributes, particularly traceability, have been increasing. Previously, the WTP for traceability is estimated as 7% of the price in Hobbs et al. (2005), and 7.7% of the price in Dickinson and Bailey (2002). These studies are based on experimental auction methods. In addition, Loureiro and Umberger (2007) estimate the premium for traceability from 20% to 28% of the price. Consistent with the latter study, which is also based on a choice-based conjoint experiment, we find the premium for traceability as 37.7% of the price and can vary from 27.4% to 48.2% of the average price. Yet, the voluntary National Animal Identification System traceability of live animals program

is one for which Congress is willing to cut funding and much of the industry had been slow to adopt. The relatively higher premium in our study and Loureiro and Umberger (2007) could be partly due to the hypothetical nature of choice experiments compared with the experimental auction based methods. Nevertheless, this hypothetical bias is expected to be small when determining marginal WTP for a change in product quality (Lusk and Hudson, 2004). The results indicate that though a USDA priority, the elimination of the know your farmer/know your food initiative might not necessarily be beneficial to agriculture if consumers are willing to pay for traceability.

In addition, the claim that the beef product is sourced from a non U.S. producer is discounted by 20% vis-à-vis the claim that the beef product is sourced from a U.S. producer. This is qualitatively consistent with the findings in Loureiro and Umberger (2007).[4] They estimated the WTP for country of origin labeling (COOL) as $2.60 (27.2% to 38.0% of the price) – a value that is also larger than the WTP for traceability in their study. We find a higher valuation for traceability by consumers conditional on providing specific information on source of origin (U.S. producer versus non U.S. producer).[5]

However, we find that a steak that carries a "tenderness guaranteed" label has a lower willingness to pay relative to one that does not carry the label. Though this result raises a red flag, we should note that consumers should value

actual tenderness guarantee with known tenderness levels as used in the survey in Lusk, Roosen, and Fox (2003) differently than the one of labeling used in this study. We therefore have little evidence to conclude that consumers value a steak that is not tender over one that is.

Finally, we find a premium of about 34% of the price for grass-fed beef, but not a premium for other production attributes such as raised on small farms. The grass-fed result is higher than the value reported in Umberger et al. (2002) and Umberger, Boxall, and Lacy (2009). Umberger et al. (2002) using an experimental auction procedure, found that only 23% of the consumers were willing to pay a premium of $1.36 for the grass-fed beef. The experimental auction experiment was a blind taste panel providing no information on the origin or production process for the beef to the consumer. However, Umberger, Boxall, and Lacy (2009) found that providing more information on the nutritional content and production process for the steak resulted in increased premium and higher percentage of consumers willing to pay a premium for grass-fed beef. The result in Umberger, Boxall, and Lacy (2009) showed a positive premium for grass-fed beef over grain-fed when the consumers only have visual evaluation and/or when they go through a taste test. They reported a premium that ranges from about 1% when only production information is provided to the consumers to a premium of about 12% when production and health information is provided.

Grass-fed beef can appeal to health, environment, and animal welfare conscious consumers. Several health benefits (in relation to lower concentration of saturated fats and higher concentration of omega-3 fatty acids, conjugated linoleic acid, and vitamins A and E) have been claimed for grass-fed beef (see Thilman, Grannis and Sparling, 2003; Time, 2006). In order to know if consumers are aware of the differences in the associated attributes of grass-fed versus grain-fed beef, respondents were asked in our survey to answer: (1) if the steak from grain-fed and/or grass-fed contain chemicals that are harmful or does not apply to either feed type and (2) if the steak from grain-fed and/or grass-fed is healthier to eat. Twenty-four percent of the respondents feel that grain-fed steak is healthier to

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[4] The finding that consumers prefer domestic products over foreign originated ones is also verified in the studies for Europe such as Grunert (1997) and Mesias et al. (2005).

[5] Loureiro and Umberger (2007) also included a food safety inspection attribute in their study and reported the highest WTP ($8.1) for this attribute such that it even exceeded the average price of the product. They conclude that food safety assurance is the main component of WTP of U.S. consumers rather than the geographic origin. The survey data we used did not include a food safety assurance variable. However, this variable may have not been captured accurately in Loureiro and Umberger's study. Unless a violation of federal safety rules is detected, raw meat products are shipped out bearing the USDA's mark for wholesomeness. However, this mark does not mean a certified assurance of safety for consumption and can be misinterpreted by consumers.

eat while 48% feel that there is no health difference between grass-fed and grain-fed steak. Twenty percent of the sample feels that grain-fed cattle might contain chemicals that are harmful in contrast to 10% for grass-fed. Eleven percent of the respondents think that steak from grain-fed cattle may contain harmful chemicals and that grass-fed is healthier to eat. In general, there is no difference in the response to these questions by gender but there seems to be differences by age. Sixty-three percent of those that think grain-fed steak contains chemicals and grass-fed steak is healthier to eat are older than 40. Similar to our result, Lusk and Parker (2009) found that almost 40% of people would most prefer grass feeding as the method to improve fatty acid content in ground beef.

Most cattle finished in Australia, New Zealand, and South American countries are grass-fed (Umberger et al., 2002). In the United States, pure pastured-raised beef (another term for grass-fed beef) still represents less than 1% of the nation's beef supply but its market share is expected to grow more than 20% in the next decade (Time, 2006). The premium found in our study is consistent with this expected trend and can encourage U.S. producers in regions with abundant forage to consider producing and marketing beef products based on this production method.

To sum up, our findings confirm that consumers are moving away from commodity beef and are willing to pay a premium for select credence attributes. The participants surveyed in this analysis expressed WTP estimates which are greater for traceability and grass-fed beef and a bit lower for U.S. origin compared with those surveyed in previous studies. The attributes that this random sample of consumers place high value on are those that the Congress proposes to de-emphasize (traceability) and they place no significant value on USDA is what they are promoting (family farm versus corporate farm).[6] Regardless of the value consumers place on attributes in

surveys such as this, restricting the ability of buyers to pay differentiated prices for livestock will limit the ability to bring the attributes to consumers without a significant increase in transaction costs. Policy decisions made by Congress or agencies do impact consumer choices and producer opportunities and the findings in this paper do not show evidence in support of the proposed policy that will likely make it more difficult for retailers, wholesalers, and packers to pay differentiated prices for beef attributes that consumers are willing to pay for and producers are willing to produce. This analysis of a random sample of consumers can provide insight to the unintended consequences resulting from policy decisions.

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[6] In the United States, the Final Rule for the implementation of mandatory COOL for all covered commodities (beef, pork, lamb, etc.) except wild and farm-raised fish and shellfish went into effect on March 16, 2009, which had been postponed by Congress twice until September 2008.

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