Will Consumers Put their Money Where their Mouth Is?: U.S. Consumers Willingness-to Pay for Nutritional, Taste and Visual Attributes in Grass-fed versus Grain-finished Beef

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A. Problem Statement

In the United States, the demand for beef produced using non-conventional methods such as "antibiotic-free," "hormone-free," "grass-finished" or "pasture beef" is growing. Much of this growth can be attributed to consumers becoming increasingly concerned about the safety, health content and production methods used to produce their meat. The majority (85%) of beef raised and sold at retail outlets in the United States is grain-finished in a feedlot on a high-concentrate (often corn/maize) diet using growth hormones and/or antibiotics (Beef Board, 2004; Feuz et al., 2004). Conversely, grass-finished beef typically comes from animals that were pasture-fed throughout their lives. The majority of grass-finished beef that is marketed in the U.S. is imported from countries such as Australia, New Zealand and South American countries (e.g. Uruguay) where grass is in greater abundance and can be grown year-round (Beef Board, 2004; Boland et al., 2007).

In response to the growing demand for grass-finished beef, and given the potential for market premiums due to the relatively small domestic supplies, some U.S. producers are interested in producing and marketing grass-finished beef. Previous research, has suggested that market niches and premiums may exist for grass-finished beef in the United States (Sitz et al., 2005; Schupp and Smith, 1976; Umberger et al., 2002). For example, Umberger et al. (2002) found that 23% of consumers who sampled (in blind taste tests) and bid on pairs of grain-finished and grass-finished beef steaks were willing to pay a 63% premium for the grass-finished steak. Using similar paired-comparisons

and blind taste tests, Sitz et al. (2005) found that 19% of consumers preferred and were willing to pay an average premium of 64% for the grass-finished steak. Unfortunately, neither of these previous consumer taste preference studies provided consumers with visual or labeling information regarding the production attributes of the meat. We do not know if those consumers who preferred the taste of the grass-finished meat are the same consumers who would purchase the meat when presented with visual information, such as labels explaining the production practices used to produce the steaks.

It is important to note that when evaluating and forming perceptions about the quality of a meat product, consumers use *cues* which they are exposed to when visually inspecting and consuming products. The two broad categories of product-quality cues are *intrinsic* and *extrinsic cues*. Intrinsic cues are product characteristics that cannot be changed unless the physical properties of the product are changed (Caswell et al., 1998; Northern, 2000; Oude Ophuis and Van Trijp, 1995; Umberger, 2007). Fat content (marbling or leanness), color and cut are intrinsic cues used to determine meat quality. The other category of cues, extrinsic cues, can be changed without altering the physical properties of the meat product. Extrinsic cues include informational labels such as brands, nutrition panels and certifications indicating the production processes used to produce the product (e.g. antibiotic and/or hormone use, grass-finishing, organic).

These intrinsic and extrinsic cues are used by consumers to ascertain the quality or presence of *search, experience* and *credence attributes*. Meat attributes such as color, fat content, brand and price are *search* attributes, which can be determined prior to consumption and at the point of purchase. Food safety and the flavor of meat are examples of *experience* attributes, as one can determine the safety or flavor during or

after consuming the product. Process and production attributes of meat (e.g. grass-finished) are *credence* attributes, because even though they may be present, the consumer can not determine their presence before, during or after consumption. Intrinsic cues are only able to provide consumers with information regarding search and experience attributes. On the other hand, extrinsic cues, such as labels and certifications, are necessary marketing tools used to indicate experience and credence attributes of potential value to consumers (Caswell, 1998; Caswell and Mojduszka, 1996; Becker, 2000; Darby and Karni, 1973; Grunert, 1997; Nelson, 1970; Northern, 2000; Umberger, 2007).

When considering whether a potential niche or target market for grass-finished beef exists, marketers must first understand the interrelationship and relative importance/ value to consumers of all three categories of product attributes. Consumers tend to use only visual cues such as color, fat content and labeling information to make purchasing decisions for meat (Grunert, 1997; Umberger, 2007). Although some consumers may like the taste of grass-finished beef, in a retail setting, consumers typically do not have the opportunity to taste the meat they visually examine. Therefore, it might be important to provide consumers with cooked samples of the product allowing them to taste the product in the retail setting. Conversely, taste or flavor may not be as important to another consumer who is interested in only the production methods inherent in the meat product.

Little information is known regarding the impact on consumer preferences of labeling information related to the non-taste attributes which may be associated with grass-finished beef. Consumers may be more receptive to grass-fed beef if they are provided with extrinsic cues regarding the unique credence attributes of the beef product.

For example, in some studies, grass-finished beef has been shown to contain higher levels of "good fats" such as omega-3 fatty acids (Daley et al., 2005; Duckett et al., 1993). Research by McCluskey et al. (2005) suggests that labeling information indicating higher levels of omega-3 fatty acids in grass-finished beef may increase the probability of consumers choosing grass-finished products (McCluskey et al., 2005).

Additionally, other studies have associated grass-finished or pasture-finished meat with improved animal welfare, and/or environmentally-friendly production practices. Grass-fed beef companies may need to label their product with information that leaves consumers with the perception that grass-finished beef provides more potential consumption benefits than conventional grain-finished beef. In order for firms to successfully differentiate and target market their grass-finished beef products, additional research is necessary to determine what factors increase the likelihood of consumers purchasing grass-finished beef products. This research uses unique experimental auctions to provide insight on product attributes that are most important when marketing grass-finished beef.

B. Objectives

The primary objective of this research is to determine the factors influencing consumers' preferences and willingness to pay for grass-finished beef steaks. Specifically, we will determine the product attributes (experience attributes such as taste/flavor versus credence-type, information attributes) and socio-demographic factors which are most helpful in predicting consumers' preferences and premiums for grass-finished versus

grain-finished beef. Additionally, we will determine the potential premiums for grass-finished beef when consumers are presented with different types of information.

C. Procedures

Consumer Surveys and Experimental Auctions

In 2005 and 2006, 250 U.S. consumers from Clemson, South Carolina and Athens, Georgia were recruited to participate in experimental auctions designed to measure the impact of taste and labeling information on consumer preferences and WTP for grass-finished (GRASS) versus grain-finished (GRAIN) beef. Qualifying consumers were provided with basic information on the experimental procedures and were informed that they would be paid $50 for their participation in the research. Interested consumers were scheduled to participate in one of 12 sessions conducted in each location. Upon arrival at the research facilities, consumers were first paid the $50 promised to them for their participation. They then completed surveys describing their socio-demographic characteristics, meat-purchasing behavior, eating preferences, knowledge and preferences regarding various labeling claims and beef characteristics.

After consumers completed all surveys, the subsequent evaluation and auction procedures were explained. This portion of the research was designed to elicit consumers' preferences and willingness-to-pay premiums for grass-finished steaks (versus conventional steaks) when presented with different types of information. The willingness-to-pay values in this study were elicited using a variant of the Vickrey auction called a random *n*th-price auction (Shogren et al. 2001). Non-random, Vickrey or *n*th-price auctions have been used in numerous food attribute valuation studies (see, for

example Buhr et al. (1993); Lusk et al. (2001); Melton et al.(1996); Menkhaus et al. (1992); Umberger et al. (2002); Sitz et al. (2005)) as they have been shown to be an efficient method for eliciting bid differentials (Umberger and Feuz, 2004). Furthermore, they tend to be less hypothetical than traditional contingent valuation methods (Fox et al., 1995).

Previous research has discovered that in practice, when multiple-rounds of auctions are conducted (as in the case of this research), non-random *n*th-price auctions may not be demand-revealing (Kagel et al., 1987; Knetsch et al., 2001; Lusk, 2003; Shogren et al., 1994). Thus, this unique variant of the *random n*th-price auction (originally proposed by Shogren et al. (2001)) was designed and used in an attempt to reduce the potential for strategic bidding, to keep bidders engaged in multiple rounds and to elicit consumers' demand for quality-differentiated beef steaks.

In an effort to provide consumers across panels and locations with consistent instructions, a moderator read a standardized script outlining the evaluation and auction procedures to consumers. It was explained to participants that they would be placing bids in $/pound for steaks that they would be evaluating through taste tests, visual appraisal, or both taste tests and visual appraisal. Participants were informed that although they would be providing bids in $/pound for each steak in the pair, only one steak auction in each pair could be binding, and only one of the six-paired-auctions would be binding. So participants knew that if they were "winners," they would only potentially have to pay an "upgrade premium" for one steak. However, consumers did not know whether they would actually need to pay a premium until all six of the paired-auctions were completed and the binding auction was announced.

Additionally, because the auction was an *n*th-price auction, participants were told that the premium would either be the second-, third-, or fourth-highest premium submitted for that steak. Therefore, it was explained to consumers that when they bid on a pair of steaks, steak A and steak B, the premium for steak A would be calculated by subtracting the bid they submitted for Steak B from the bid submitted for Steak A (premium for steak A = bid steak A – bid steak B). Thus, their premiums for each steak would determine whether or not they were winners.

To familiarize them with the auction processes, consumers participated in practice auctions using candy bars and cans of soda. After completing the surveys, hearing the auction procedures and completing practice auctions, all participants in the panel session were moved into taste panel booths. Consumers were reminded of the auction procedures and were asked to not speak with other panelists until they had completed all six-paired-comparisons. They were also reminded to completely fill out all of their forms and to ask the moderators for assistance if they did not understand anything. A practice taste test and auction was conducted to "warm-up" panelists to the taste panel and auction procedures. The panelists were then told that the following auctions were potentially binding and were reminded that it was in their best interest to place truthful bids. The following steps were completed for each of the 24 taste panels:

***Step 1) Blind Taste Tests*:** consumers were provided with pairs of samples from striploin steaks to taste and to evaluate. Unbeknownst to the consumers, the steak samples differed primarily in the feeding practices used to produce the beef: one sample was grain-finished (GRAIN) and the other sample was grass-finished (GRASS). Steaks were of similar USDA quality grades and tenderness, and were cooked to a specific

degree of doneness. Participants were guided by the moderator to write down the number of each steak sample on their taste rating sheet, and then to taste each sample and to provide ratings on the sample's tenderness, juiciness and overall acceptability. The second steak sample in the pair was then presented and consumers repeated the procedures. After tasting both samples (GRASS and GRAIN) consumers then simultaneously participated in Paired Auction 1 (PA1), providing bids in $/pound for both samples in the pair.

After both rating forms and both bid sheets were collected from PA1, participants were then given and asked to taste, evaluate and participate in Paired Auction 2 (PA2) where they bid on a second pair of GRASS versus GRAIN steak samples. Aside from the taste information, in both PA1 and PA2 consumers were provided with no other information about the samples. The paired steak samples differed from PA1 to PA2, however, each pair contained one GRAIN steak and one GRASS steak, and all efforts were made to control for marbling (USDA Quality Grades) and tenderness within a paired comparison.

***Step 2) Visual Evaluations with No Taste Information*:** After completing the first two sensory evaluations and paired auctions, PA1 and PA2, consumers were then asked to visually evaluate three pairs of strip loin steaks, each presented in clear plastic over-wrapped Styrofoam containers. The steaks in each pair consisted of a GRASS and a GRAIN steak of similar USDA Quality grades. In the first visual, paired auction, Paired Auction 3 (PA3), no information was provided – consumers only visually evaluated and bid on the steaks in the clear over-wrapped containers. Thus, in PA3 consumers were not told of any possible differences between the two steaks.

In the second visual evaluation and paired auction, Paired Auction 4 (PA4), labels were added to the steak packages that provided consumers with some information regarding the production methods used to produce the steaks. In every case all of the information was truthful information and could be verified to the consumers through auditable records. In PA4, consumers were informed that both steaks were USDA inspected and that the GRAIN steak was "*Corn-fed beef, USDA inspected*" while the GRASS steak was "*Natural, Grass-Fed Beef, raised without supplemental hormones or antibiotics; traceable to the farm where it was produced; and USDA Inspected*."

In the third paired visual evaluation, Paired Auction 5 (PA5), consumers were given the following *additional* health information about the GRASS beef steak: *"62% lower in fat content than Corn-fed beef, 65% lower in saturated fat than Corn-fed beef, Greater concentrations of Omega-3 Fatty Acids and Conjugated Linoleic Acid (CLA's)*." The omega-3 fatty acids and CLA's had been previously measured by food chemists so the statement actually could be made that their levels of these nutrients were higher for GRASS steaks. After all three pairs of visual evaluations and auctions (PA3, PA4, PA5) were completed, consumers were moved back to the taste panel booths.

***Step 3) Taste Test with Complete Information*:** In this final step, consumers were provided with a pair of steaks to taste using methods similar to those in PA1 and PA2. However, consumers were also provided with complete information regarding the production practices, traceability and health information relevant for each steak, similar to PA5. Furthermore, the steaks they tasted were from the same strip loins as those visually evaluated in PA5. Thus, while tasting the steaks, consumers were again shown the steaks and reminded of the information that matched each steak. Therefore, in this

final evaluation step consumers bid on steaks after both visual and taste evaluation and with all available information.

Throughout the evaluation and auction process moderators checked all paperwork to make sure panelists were correctly filling them out. After PA6 the panelists were paid their $50, the binding steak auction was announced, participants were presented with their steaks, and premiums from "winning" participants were collected.

Empirical Analysis

As mentioned previously, a primary goal of this research was to determine the information, attributes and demographics that influence consumers' preferences and willingness to pay a premium for GRASS beef versus GRAIN beef. Each consumer submitted a bid for each steak in the six pairs they evaluated. Therefore, by evaluating each consumer's bid for each steak they evaluated in each pair, we can determine if the consumer is willing to pay a premium for the GRASS steak when presented with the information specific to the paired comparison. Each consumer's premium (*GrassPremium*) for the GRASS steak in the each pair can be represented by the following equation:

(1) $GrassPremium_{ij} = BidGRASS_{ij} - BidGRAIN_{ij}$.

Where *BidGRASS* is the i^{th} consumer's bid in $/pound for the GRASS steak in the j^{th} paired comparison. The *GrassPremium*s for each paired comparison and for all consumers were averaged to determine the impact of different sets of information on willingness-to-pay and preferences for GRASS beef. The average premiums are discussed in the results section of this paper.

A two-step Cragg model was estimated using LIMDEP to determine the factors influencing preferences and willingness to pay for GRASS beef. The data used in the empirical estimation was only from PA3-PA6. The observations from PA1 and PA2 were eliminated to specifically isolate the impact of taste information when consumers were in a setting that closely simulated a retail setting. The first step of the estimated Cragg model is a probit model used to determine the factors that increase the probability a consumer would be willing to pay a positive premium for GRASS beef. The following equation was estimated:

(2) $PREF\_GRASS_{ij}$ = f(*PRODUCTION_INFO, HEALTH_INFO, TASTE_INFO, MEAT_EXPEND, NOHORM_ANTI, SAFETYGRASS, FEMALE, AGE, AGINVOLVE, CHILDREN, EDUCATION, VRYSAFEOZ, VRYSAFEUSA*).

$PREF\_GRASS_{ij}$ equals one if $GrassPremium_{ij}$ is greater than zero and is positive, and $PREF\_GRASS_{ij}$ equals zero otherwise. *PRODUCTION_INFO*, *HEALTH_INFO*, and *TASTE_INFO* are dummy variables used to indicate whether the premium is from a paired comparison where production information, health information or taste information was provided. *PRODUCTION_INFO* is equal to one when the premium was elicited in PA4, PA5 or PA6 and is equal to zero otherwise. *HEALTH_INFO* is equal to one when the premium was elicited in PA5 or PA6 and is equal to zero otherwise. *TASTE_INFO* is equal to one when the premium was elicited in PA6 and is equal to zero otherwise.

MEAT_EXPEND is a continuous variable indicating the consumer's best estimate ($/week) of the amount of money their family/household spends on meat in an average week. This is a behavioral variable included to determine if consumers' expenditures on meat influence whether they are more or less likely to prefer Grass beef. *NOHORM_ANTI, SAFETYGRASS, VRYSAFEOZ, VRYSAFEUSA* are all psychographic

variables. *NOHORM_ANTI* is the consumer's perceived importance of production practices which do not use growth hormones or antibiotics, as indicated using a five-point Likert scale where one is equal to "not at all important" and five is equal to "extremely important." *SAFETYGRASS* is an indicator variable equal to one only if the consumer indicated that they believed GRASS beef was safer than conventional beef and is equal to zero otherwise. *VRYSAFEOZ* and *VRYSAFEUSA* are variables indicating consumers' perceived safety of meat originating from Australia and the United States, respectively.

The variables *AGINVOLVE, FEMALE,* and *CHILDREN* are demographic variables equal to one if either the consumer or their immediate family is currently or has previously been involved in production agriculture, the consumer is female, and the consumer has dependent children living in their household, respectively. *AGE* and *EDUCATION* are also demographic variables. However, *AGE* is a continuous variable indicating the consumer's age in years, and *EDUCATION* is a categorical variable indicating the highest level of education completed by the consumer.

The second step of the Cragg model used a truncated regression procedure and was estimated separately from the probit model. This regression was used to determine the factors that increased consumers' premium for GRASS beef in the auctions. Only consumers who were willing to pay a positive premium for GRASS steaks were included in the estimation of the following equation:

(3) $GRASS\_WTP_{ij}$ = f(*PRODUCTION_INFO, HEALTH_INFO, TASTE_INFO, MEAT_EXPEND, PRICE_DRIVE, NOHORM_ANTI, SAFETYGRASS, FEMALE, AGE, STUDENT, AGINVOLVE, CHILDREN, HI_INCOME, EDUCATION, VRYSAFEOZ, VRYSAFEUSA*).

If *GrassPremium* was greater than zero and positive, then $GRASS\_WTP_{ij}$ was equal to the *GrassPremium* submitted by the i^{th} consumer in the j^{th} paired comparison. However, if*GrassPremium* was equal to zero or was negative then $GRASS\_WTP_{ij}$ equaled zero. *PRICE_DRIVE* was an additional behavioral variable equal to one if the consumer indicated that price was the primary driver of their meat shopping decisions. *STUDENT* and *HI_INCOME* were additional demographic dummy variables with values indicating that the consumer was currently a full-time student and the consumer's annual household income before taxes was $70,000/year or more, respectively. All other variables were as previously explained in equation 2.

D. Results

In total, 225 individuals participated in the experiments. The majority of participants were Caucasian (80%), married (59.6%), and female (57.2%), with slightly more than a third (38.1%) having children at home. The average age was 42 years and the mean annual household income was $50,890. Most respondents indicated that they had completed high school and received some collegiate training. Attitudes were elicited concerning the importance consumers placed on certain beef attributes. On average, the humane treatment of animals (71.5%), traceability (66.8%) and no growth hormones (57.4%) were the most, second most and third most important attributes respectively, of the 11 different product attributes examined. On average, 54.6%, 48.3% and 40.0% of consumers indicated a belief that the nutritional value, eating quality and food safety, respectively, of grass-finished beef was higher than conventional beef.

In the experimental auctions, the average bids for the GRASS beef steaks were slightly less ($4.82/pound) than the GRAIN beef ($4.85/pound). (See table 2.) These

mean values do not tell the whole story; in each of the paired comparisons there were segments of consumers who preferred and who were willing to pay a premium for the GRASS beef. In table 2, four rows of bid results are provided for each of the paired comparisons: the average bid for the GRASS steak, the average bid for the GRAIN steak, the *GrassPremium* for the GRASS steak averaged over all consumers, and the *GrassPremium* for the GRASS steak averaged over only those consumers who preferred the GRASS steak. *GrassPremium*s were calculated using equation 1.

In PA1 and PA2 where panelists performed sensory/taste evaluations only, consumers discounted GRASS steaks by $0.19/pound and $0.36/pound, respectively. The negative premiums for GRASS can likely be attributed to the fact that on average, consumers perceive and rated the palatability of the GRASS steaks significantly lower than the GRAIN steaks on flavor and juiciness. However, it is interesting to note that a substantial segment of consumers, 35.7% and 36.6% of those participating in PA1 and PA2, respectively, preferred and were willing to pay a premium for the GRASS steak in blind taste tests. The size of these segments is larger than those found in similar research discussed earlier and conducted by Umberger et al. (2002) and the Sitz et al. (2005).

In PA3, consumers visually compared the GRASS and GRAIN steaks with no taste or labeling information. The average bid for the GRASS steaks were $0.41/pound less than the GRAIN steaks. Comments from consumers indicated that some consumers perceived the GRASS steak to be smaller and different in color. Although the GRASS steak could have been perceived to be slightly smaller, panelists were instructed to provide bids for the steaks on a per pound basis. Still, 37.1% of consumers preferred and were willing to pay a premium for the GRASS steak.

In PA4 consumers were provided with information relevant to the production methods and traceability levels available for each steak. This information appears to have increased the number of consumers preferring GRASS steaks to 53.1%, an increase in market size by 16%. Furthermore, the average bid for GRASS steaks increased, and was greater than the average GRAIN bid, raising the premium for GRASS to an average premium of $0.04/pound.

In PA5, panelists were also provided with additional information regarding the nutritional content of the GRASS steak relative to the GRAIN steak. The addition of nutritional information caused more consumers to shift their preferences away from GRAIN to GRASS, and in PA5, the majority (62.9%) of consumers indicated a preference for GRASS beef. In response, the premiums for GRASS beef increased by $0.63/pound to an average premium of $0.67/pound. Nutritional information obviously had a positive impact on the experimental market for GRASS.

In the final step, PA6, consumers were presented with production, nutrition, and taste information. After tasting, some consumers shifted their preferences – consequently, the market share for GRASS declined from PA5 to PA6 with only 46.0% of consumers preferring GRASS in PA6. Consumers' average premiums for GRASS also decreased from PA5 by $0.64/pound to only $0.03/pound. After further exploring the data, it was discovered that 28.6% (12.7%) of consumers who preferred the GRASS (GRAIN) product in PA5, changed their preference to the GRAIN (GRASS) steak after having the opportunity to taste both steaks in PA6. Only 58.7% of consumers' preferences remained consistent from PA5 to PA6. These results seem to indicate that even though positive information on health and production attributes may encourage

some consumers to purchase a GRASS product; if they take the product home, cook it, consume it and then dislike the taste, they may not purchase the meat again. Conversely, taste information can also have a positive impact on GRASS preferences for some consumers, as indicated by the 12.7% of consumers who switched from preferring GRAIN in PA5 to preferring GRASS in PA6.

Empirical Results

The maximum likelihood estimates and marginal effects from the random effects probit model are provided in table 3. The variables *PRODUCTION_INFO, NOHORM_ANTI, SAFETYGRASS, FEMALE,* and *VRYSAFEOZ* were all positive and statistically significant. When consumers were presented with information indicating that the steak was produced without the use of hormones or antibiotics they were 17.1% more likely to purchase GRASS beef. Consumers who gave a high preference rating to production methods using no hormones and antibiotics, who believed the food safety of grass-finished beef was higher than conventional beef, and who believed that meat originating from Australia was safe were 4.5%, 14.1% and 11.7% more likely to prefer GRASS steak. Furthermore, females were 10.0% more likely to prefer GRASS steaks.

Conversely, the variables *TASTE_INFO* and *AGINVOLVE* were the only two statistically significant variables with a negative sign. Previous or current involvement in production agriculture and information on the palatability of beef provided through taste tests reduced the likelihood that consumers would prefer GRASS beef by 17.1% and 17.6%, respectively. One hypothesis for the significant and negative sign on *AGINVOLVE* is that consumers with experience and knowledge of production agriculture are biased towards conventional or traditional production methods. The negative sign on

the *TASTE_INFO* variable corresponds to the change in average *GrassPremium*s from PA5 to PA6, as shown in table 2. Considering the bid averages for PA4 to PA6 (table 2), it is also not surprising that when production information (*PRODUCTION_INFO)* and positive health information (*HEALTH_INFO)* are provided, consumers were more likely to prefer GRASS beef. However, given the large increase in *GrassPremium* from PA4 to PA5 it is interesting that the coefficient on *HEALTH_INFO* was not significant.

The second hurdle of the estimated Cragg model used a truncated regression to determine the impact of information, behavioral, psychographic and demographic variables on consumers' premiums for GRASS steaks. The results of this estimation are displayed in table 4. Not surprisingly, the significant variables are somewhat different than the probit estimation. Only five independent variables were significant: *HEALTH_INFO, TASTE_INFO, CHILDREN, HI_INCOME* and *VRYSAFEUSA*. Although *PRODUCTION_INFO* was a significant variable and had the largest marginal effect when predicting consumers preferences for GRASS, it was not a significant explanatory variable in this willingness-to-pay model.

Given the average bids and *GrassPremiums* elicited in PA5, it is not surprising that *HEALTH_INFO* has the largest, significant and positive coefficient in the willingness-to-pay estimation. The presence of positive health information greatly increased the premiums for GRASS beef in the experiments. Furthermore, this health information may have caused some consumers who did not like the taste of the GRASS steak as much as the GRAIN steak in PA6 to still bid a premium for the GRASS steak. Likewise, the negative sign and size of the *TASTE_INFO* coefficient was not unexpected

given the change in the *GrassPremiums* between PA5 and PA6 when consumers were allowed to both visually evaluate and taste the meat.

As expected, the presence of children (*CHILDREN)* in the household had a negative effect on premiums for GRASS steaks. However, the negative sign on the coefficient indicating the consumer was in the highest income categories (*HI_INCOME)* was not as expected. The positive sign of the coefficient on *VRYSAFEUSA* may be attributed to the fact that consumers who believed U.S. meat to be safer were also interested in GRASS beef because it was said to be "traceable to the farm where it was produced". Similar to the probit estimation, alternative models were run using other psychographic, behavioural and demographic information as independent variables; however, these other variables were not statistically significant or were highly correlated with other independent variables.

E. Conclusions

The results suggest that an economically viable market for GRASS beef exists in the United States. Previous GRASS beef budget work ascertained that a 10% premium is likely the minimum premium needed for GRASS production to be economically viable. Even though the mean premium for GRASS beef was only $0.04/pound, a considerable number of panelists were willing to pay at least a 10% premium for the GRASS product with both full production, nutritional and taste information. Information about production process had a positive impact on premiums for the GRASS beef. However, it appears that health aspects are more important to consumers, on average, than the absence of antibiotics or supplemental hormones and traceability. Labeling information such as nutritional content and production processes is vital for maintaining and growing niche

markets for grass-fed beef in the United States. This information will help agribusinesses who are interested in producing and marketing grass-fed beef develop targeted marketing strategies.

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Table 1. Select Summary Statistics of Demographic, Behavioural and Psychographic Information.

	Mean	Standard Deviation	Minimum	Maximum	N
MEAT_EXPEND	34.53	25.15	0	200	213
PRICE_DRIVE	0.33	0.53	0	4	213
SUPPORT LOCAL	2.56	1.13	1	5	198
NOHORM_ANTI	2.75	1.28	1	5	206
TRACEABILITY	3.09	1.27	1	5	203
EATING QUALITY GRASS	0.48	0.50	0	1	205
SAFETYGRASS	0.40	0.49	0	1	195
NUTRITIONAL VALUE GRASS	0.55	0.50	0	1	196
FEMALE	0.57	0.50	0	1	209
BLACK	0.16	0.37	0	1	207
HISPANIC	0.01	0.12	0	1	207
NONCAUCASIAN	0.17	0.38	0	1	213
AGEYRS	41.59	13.80	18	81	206
STUDENT	0.13	0.34	0	1	207
AGINVOLVE	0.26	0.44	0	1	208
CHILDREN	0.39	0.49	0	1	205
INCOME	7.08	3.74	1	12	190
HI_INCOME	0.29	0.45	0	1	213
EDUCATION	3.98	0.53	2	5	207
VRYSAFEUSA	4.32	0.72	2	5	210
VRYSAFECANADA	3.70	0.89	1	5	205
VRYSAFEMEXICO	2.42	0.77	1	5	203
VRYSAFEOZ	3.34	0.92	1	5	206
VRYSAFENZ	3.27	0.91	1	5	206
VRYSAFBRAZIL	2.79	0.86	1	5	206
VRYSAFEARGENTINA	2.78	0.90	1	5	206
VRYSAFEJAPAN	3.04	1.07	1	5	205

Table 2. Average GRASS Bids, GRAIN Bids, and *GrassPremium*s.

	Mean	Standard Deviation	Minimum	Maximum	N
All Observations					
Average GRASS Bid	4.816	2.188	0	13	1278
Average GRAIN Bid	4.852	2.090	0	15	1278
Average *GrassPremium*	-0.036	1.858	-10	10	1278
Average *GrassPremium* bid by GRASS-Preferring Consumers (45.2%)	0.650	1.077	0	10	1278
PA1: Taste Tests					
GRASS BID	4.141	2.060	0	10	213
GRAIN BID	4.336	2.154	0	10	213
AVERAGE *GrassPremium*	-0.194	1.818	-6	10	213
Average *GrassPremium* bid by GRASS-Preferring Consumers (35.7%)	0.543	1.161	0	10	213
PA2: Taste Tests					
GRASS BID	4.089	2.200	0	12	213
GRAIN BID	4.446	2.301	0	15	213
AVERAGE *GrassPremium*	-0.357	2.006	-10	7	213
Average Premium for GRASS bid by GRASS-Preferring Consumers (36.6%)	0.491	1.006	0	7	213
PA3: Visual Evaluations with No Information					
GRASS BID	4.615	2.086	0	10	213
GRAIN BID	5.021	2.080	0	12	213
AVERAGE *GrassPremium*	-0.409	1.656	-9	5	213
Average *GrassPremium bid* by GRASS-Preferring Consumers (37.1%)	0.421	0.762	0	5	213
PA4: Visual Evaluations with Production Information					
GRASS BID	5.132	1.993	0	11	213
GRAIN BID	5.092	1.978	0	12	213
AVERAGE *GrassPremium*	0.041	1.719	-6	5	213
Average *GrassPremium* bid by GRASS-Preferring Consumers (53.1%)	0.678	0.932	0	5	213
PA5: Visual Evaluations with Production and Health Information					
GRASS BID	5.724	2.169	0	13	213
GRAIN BID	5.055	1.909	0	10	213
AVERAGE *GrassPremium*	0.669	1.873	-6	7	213
Average *GrassPremium* bid by GRASS-Preferring Consumers (62.9%)	1.100	1.297	0	7	213
PA6: Visual Evaluation, Production, Health Information and Taste Test					
GRASS BID	5.196	2.153	0	11	213
GRAIN BID	5.162	1.960	0	11	213
AVERAGE *GrassPremium*	0.034	1.866	-10	8	213
Average *GrassPremium* bid by GRASS-Preferring Consumers (46.0%)	0.668	1.094	0	8	213

Table 3. Random Effects Binary Probit Model Results: Maximum Likelihood Estimates and Marginal Effects**.**

Variable	Coefficient	Standard Error		Marginal Effects	Standard Error	
Constant	-1.275	1.079		-0.385	0.326	
PRODUCTION_INFO	0.565	0.181	**	0.171	0.055	**
HEALTH_INFO	0.305	0.215		0.092	0.065	
TASTE_INFO	-0.583	0.162	**	-0.176	0.049	**
MEAT_EXPEND	0.001	0.005		0.000	0.002	
NOHORM_ANTI	0.150	0.074	**	0.045	0.022	**
SAFETYGRASS	0.468	0.208	**	0.141	0.063	**
FEMALE	0.331	0.193	*	0.100	0.058	*
AGE	-0.003	0.007		-0.001	0.002	
AGINVOLVE	-0.566	0.207	**	-0.171	0.063	**
CHILDREN	0.166	0.199		0.050	0.060	
EDUCATION	-0.007	0.210		-0.002	0.063	
VRYSAFEOZ	0.388	0.211	*	0.117	0.064	*
VRYSAFEUSA	0.122	0.277		0.037	0.084	
Rho	0.428	0.061**	**			
N	740					
Log likelihood function	-439.579					
Restricted log likelihood	-470.868					
Chi squared	62.578					
Degrees of Freedom	1					
Prob[ChiSqd > value]	0.000					

*, ** correspond to significance at the α = 10% and 5% levels, respectively.

Table 4. Maximum Likelihood Estimates from the Truncated Regression, Limited Dependent Variable Model.

	Coefficient	Standard Error	t-ratio	P-value	
Constant	-0.726	1.545	-0.470	0.639	
PRODUCTION_INFO	0.374	0.428	0.873	0.383	
HEALTH_INFO	1.066	0.353	3.019	0.003	**
TASTE_INFO	-0.612	0.340	-1.802	0.072	*
MEAT_EXPEND	0.008	0.006	1.354	0.176	
PRICE_DRIVE	0.297	0.233	1.272	0.203	
NOHORM_ANTI	0.022	0.120	0.184	0.854	
SAFETYGRASS	-0.257	0.288	-0.895	0.371	
FEMALE	-0.388	0.277	-1.401	0.161	
AGE	-0.018	0.013	-1.433	0.152	
STUDENT	0.432	0.447	0.967	0.333	
AGINVOLVE	-0.344	0.351	-0.981	0.327	
CHILDREN	-0.928	0.331	-2.803	0.005	**
HI_INCOME	-0.588	0.353	-1.669	0.095	*
EDUCATION	0.199	0.300	0.662	0.508	
VRYSAFEOZ	0.041	0.296	0.139	0.890	
VRYSAFEUSA	0.775	0.451	1.718	0.086	*
Sigma	1.594	0.139	11.444	0.000	**
N					
Log likelihood function	-466.484				

*, ** correspond to significance at the α = 10% and 5% levels, respectively.