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Estimating Consumer Willingness to Pay for Country-of-Origin Labeling

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Consumer willingness to pay for a mandatory country-of-origin labeling program is assessed. A consumer survey was conducted during 2002 in several grocery stores in Boulder, Denver, and Fort Collins, Colorado. Econometric results indicate that surveyed consumers are willing to pay an average of $184 per household annually for a mandatory country-of-origin labeling program. Respondents were also willing to pay an average of $1.53 and $0.70 per pound more for steak and hamburger labeled as "U.S. Certified Steak" and "U.S. Certified Hamburger," which is equivalent to an increase of 38% and 58%, respectively, over the initial given price.

Key words: beef, consumer preferences, country-of-origin labeling, dichotomous choice, willingness to pay

Introduction

The recent food safety scares in Europe and Japan, as well as increasing standards of living in the United States, have raised U.S. consumers' interests in information about the safety, origin, and production processes used to produce their food. Food retailers, processors, and producers are exploring various labeling options to provide consumers with information about the safety, origin, and process attributes of food products (Caswell). Both producer and consumer groups have considered country-of-origin labeling of beef products sold in the United States to be an alternative that would enable consumers to choose U.S.-produced beef (Brester and Smith).

The Tariff Act of 1930 requires labels identifying the country of origin on all fresh and frozen beef products imported into the United States. However, under the existing system, the label does not need to accompany the product after it has been repackaged (Becker). Therefore, beef handlers are not required to specify to subsequent buyers whether the beef (fresh or frozen) is a U.S.-produced or an imported product. The implementation of a more stringent, mandatory country-of-origin labeling system for all meat products sold in the United States has been debated for several years by agricultural producers, meat industry organizations, and consumer advocacy groups [U.S. Department of Agriculture/Food Safety and Inspection Service (USDA/FSIS)].

A number of arguments have emerged for and against country-of-origin labeling of fresh and frozen beef products. According to Becker, arguments in favor include the idea

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that country-of-origin labeling would give U.S. producers the opportunity to create a competitive niche market, as long as consumers select U.S. beef over imported beef. As in the debate over genetically modified foods, labeling advocates believe consumers have "the right to know" where their meat products originate. For example, a national survey sponsored by the National Cattleman's Beef Association found 78% of the 1,000 American consumers polled support country-of-origin labeling (*Supermarket News*). Finally, proponents of a mandatory labeling policy argue that the costs associated with this labeling policy, as Becker pointed out, are minimal.

In contrast, arguments against country-of-origin labeling include the concern that a label is an unnecessary trade barrier. Some trade officials worry that other countries would retaliate against the United States if country-of-origin labeling were implemented, and U.S. meat exports could suffer a large reduction. Other opponents of labeling believe a country-of-origin labeling program would be difficult to implement because many beef products are processed by combining beef originating from various countries. A recent U.S. Congressional study determined that the potential costs associated with implementation of a country-of-origin labeling system would outweigh the potential benefits, because approximately 15% of the beef sold in the United States is imported (USDA/FSIS). Consequently, industry compliance costs could be high, with consumers bearing the additional costs of mandatory labeling. Finally, labeling adversaries argue that many U.S. consumers may develop a preference for international, imported beef (as happened with Japanese cars in the 1980s), resulting in a reduction of the U.S. beef market share.

Regardless of the debate surrounding country-of-origin labeling, Title X, Section 10816 of the Farm Security and Rural Investment Act of 2002 (the 2002 Farm Bill) includes a program mandating the U.S. Secretary of Agriculture to provide guidelines for voluntary labeling of meat, fruits and vegetables, fish, and peanuts by September 30, 2002. Furthermore, the 2002 Farm Bill requires this voluntary program to become mandatory by 2004. The bill states, "...for a commodity to be labeled a USA product, it must be born, raised, and processed in the United States" (U.S. Senate, Farm Bill Conference Summary).

While the new Farm Bill mandates country-of-origin labels on all perishable products, very little research has been conducted to assess the economic impact of country-of-origin labels. Given the currently unanswered questions surrounding country-of-origin labeling for beef and other perishable products, the objectives of this study are twofold: (*a*) to determine consumers' preferences for country-of-origin labels on beef products, and (*b*) to calculate the market premium, if any, for U.S.-labeled beef versus nonlabeled or imported beef. The testable hypotheses are whether the premiums for the mandatory country-of-origin program, "U.S. Certified Steak," and "U.S. Certified Hamburger" are statistically different from zero. The premiums may also vary statistically among beef products. Finally, the sociodemographic characteristics of consumers willing to pay a premium for U.S.-labeled steaks may differ from those who are willing to pay a premium for U.S.-labeled ground beef or hamburger.

Previous Studies

Previous marketing research has examined the effect of country-of-origin labels on consumers' behavior toward nonfood products. Erickson, Johansson, and Chao conducted

research to determine whether country-of-origin affected consumers' beliefs when evaluating cars. Their results suggest an image variable does affect belief formation rather than attitude.

American consumers' images of foreign products were also studied by Howard to determine how "made-in" stereotypes were formed. He concluded consumers' attitudes in relation to the quality of an automobile manufactured in a specific country produced a "halo effect" for all products originating from that country. A similar "halo effect" was found when examining the role of country image on consumers' preferences for television sets and automobiles (Han). Another study examined Southeast Asian consumers to determine their perceptions regarding American and Japanese Imports (Strutton and Pelton). Using discriminate analysis, Strutton and Pelton found consumers had different perceptions of U.S. and Japanese imports.

Thus, in an international context, a factor to consider when evaluating country-of-origin labels is the image of the country itself. For example, consumers often "statistically discriminate" against imports, such as textiles or electronics from developing countries (Chiang and Masson). Location choice may act as a signal for product quality, in the sense that high country-specific costs (minimum wages, environmental taxes, lay-off plans, and others) signal high product quality (Haucap, Wey, and Barmbold). Country-of-origin effects have significant implications for international trade and consumers' perception of quality products.

While the studies discussed above analyze consumers' behavior toward country-of-origin labels, few studies have examined consumers' perceptions associated with country-of-origin labels on agricultural products. Schupp and Gillespie (2001a) sampled beef processors, retailers, and restaurants in Louisiana to identify why beef-handling firms would either support or reject a mandatory country-of-origin labeling policy. Findings revealed supporters of the policy felt their consumers would find the label valuable, while opponents of the policy thought mandatory labeling simply meant more government intervention.

In a companion study by Schupp and Gillespie (2001b), Louisiana households were surveyed to find consumers' degree of support for mandatory country-of-origin labeling of beef in grocery stores and restaurants. Over 80% of the respondents supported a compulsory labeling program. Although these studies show beef handlers' and consumers' support of mandatory labeling, they do not shed light on whether consumers would be willing to pay the additional costs associated with the mandatory labeling policy.

In the consumer economics literature, a willingness-to-pay study by Quagrainie, Unterschultz, and Veeman compared a popular beef product from Alberta with a similar product produced elsewhere in Canada. Based on their findings, a 15% reduction in the price of the non-Alberta meat product would be necessary in order for consumers to be indifferent between the two sources. In another study, Loureiro and McCluskey report that Spanish consumers were willing to pay a premium for fresh meat products labeled with a "protected geographical identification" (PGI) label, "Galician Veal," which is regulated by the European Union. While consumers were willing to pay a premium for the beef with a "Galician Veal" label, the premium varied depending upon the cut and quality of beef.

Using blind taste tests, Umberger et al. found consumers could discern taste differences and were willing to pay a significant premium of $0.70 per pound on average for corn-fed beef raised in the United States versus grass-fed beef raised in and imported

from Argentina. However, 23% of the consumers preferred and were willing to pay a $1.36 per pound premium for the Argentine grass-fed beef.

Despite their conclusions that consumers are willing to pay a premium for geographically labeled products, these studies likely are not representative of local consumers' preferences for country-of-origin labels. The current research seeks to resolve questions regarding consumers' preferences and willingness to pay for country-of-origin labeling of beef.

Theoretical Background

The consumer's decision process is modeled using a random utility framework. Consumer utility, $U(y, x, m)$, is assumed to have three arguments: whether the beef product has a label denoting country of origin (y), other product attributes as well as consumer characteristics which may affect consumer choice (x), and the consumer income level (m). The variable y is an indicator variable equal to one if the product carries a label, and zero otherwise. The consumer is willing to pay c dollars to switch to a labeled product, which will make utility at least as great as it would be without a label. Mathematically, c is represented as:

$$U(0, x_0, m) \leq U(1, x_1, m - c), \tag{1}$$

where the 0 and 1 subscripts denote the choice of nonlabeled and country-of-origin labeled products, respectively. The consumer's utility function is unknown as some components are unobservable, and thus can be considered random variables from the researcher's standpoint. Therefore, utility is decomposed into an unobservable part and an error term, ε_j. Mathematically, $U(y, x_j, m) = V(y, x_j, m) + \varepsilon_j$. The random error term ε_j is assumed to be independently and identically distributed with a mean of zero. The consumer's decision to pay c dollars in terms of utility can be represented as:

$$V(0, x_0, m) + \varepsilon_0 \leq V(1, x_1, m - c) + \varepsilon_1, \tag{2}$$

which can be expressed in a probability framework as:

$$P(WTP \geq c) = P(V_0 + \varepsilon_0 \leq V_1 + \varepsilon_1) = P(\varepsilon_0 - \varepsilon_1 \leq V_1 - V_0). \tag{3}$$

This theoretical model sets the groundwork for the specific empirical models that follow. In the current study, a binary choice model approach is chosen to analyze the decision of paying for a mandatory country-of-origin labeling for all beef products, and for two individual beef products labeled as "U.S. Certified."

Methodology

In assessing consumers' willingness to pay (WTP) for a mandatory labeling program, and for "U.S. Certified Steak" and "U.S. Certified Hamburger," survey respondents provided "Yes"/"No" answers to the survey valuation questions. To analyze these dichotomous choices, separate logit models were used based on the following logistic probability function:

$$(4) \qquad P_i = F(WTP_i) = \frac{1}{1 + e^{-WTP_i}} = \frac{1}{1 + e^{-(\mathbf{X}_i'\beta)}}, \quad i = 1, ..., n,$$

where P_i is the probability that the ith consumer will make a certain choice (answer = "Yes"), given the observed level of sociodemographic characteristics, food safety attitudes, and information conditions contained in $\mathbf{X}_i$, and β is a conformable vector of parameters. Therefore, if (1) represents the probability a consumer will answer "Yes" to the question asking whether he or she will pay a premium for mandatory country-of-origin labeling, then $1 - P_i$ will be the probability associated with answering "No." Thus,

$$(5) \qquad 1 - P_i = \frac{1}{1 + e^{WTP_i}}.$$

To estimate the odds ratio in favor of answering "Yes" versus "No," the ratio of both probabilities must be calculated:

$$(6) \qquad \frac{P_i}{1 - P_i} = \frac{1 + e^{WTP_i}}{1 + e^{-WTP_i}} = e^{WTP_i} = e^{\mathbf{X}_i'\beta}.$$

By taking the natural log of (6), the odds ratio in favor of those respondents answering "Yes" becomes a linear function of $\mathbf{X}_i$, where $\mathbf{X}_i$ is a vector of subjective consumer preferences when buying beef, and of sociodemographic characteristics. This expression can be written as:

$$(7) \qquad \text{Log}\left(\frac{P_i}{1 - P_i}\right) = WTP_i = \mathbf{X}_i'\beta.$$

The parameter vector β cannot be interpreted as the direct effects on the probability of supporting mandatory labeling; rather, the parameters measure the change in the odds ratio for a change in a unit of an explanatory variable. In order to estimate the effects on the probabilities directly, the marginal effects must be estimated (Maddala).

The underlying statistical model is based on a latent and continuous unobservable variable (WTP_i^*) which, in the context of the labeling analysis, could be interpreted as consumers' concerns about source verification. The observable variable, which is modeled by the researcher, is the response to the dichotomous choice. Thus, the latent model is represented by:

$$(8) \qquad WTP_i = I_{(0,\infty)}(WTP_i^*),$$

where $I_{(0,\infty)}$ is an indicator variable that restricts the observable WTP to the positive domain, and $WTP_i^* = \mathbf{X}_i'\beta + \varepsilon_i$. Therefore,

$$(9) \qquad WTP_i = \begin{cases} 1 \\ 0 \end{cases} \text{ if } WTP_i^* = \mathbf{X}_i'\beta + \varepsilon_i \begin{cases} > \\ \leq \end{cases} 0.$$

The ε_i are i.i.d. unobservable random variables, following a logistic distribution with mean zero and variance of $\pi^2/3$. A "Yes" response is observed if and only if the latent variable is greater than zero. Conversely, a "No" response is observed when the latent variable (consumers' concerns) is less than or equal to zero.

Data

A consumer survey was pre-tested with focus groups in early March 2002, and then was conducted in late Spring 2002 in grocery stores located in Denver, Fort Collins, and Boulder, Colorado. Customers of the grocery stores were randomly selected for the survey by soliciting every third customer entering the store. In order to collect a representative sample, including multiple segments of the shopping population, the survey was conducted in different supermarket chains and during both weekends and weekdays. Consumers were interviewed in eight different stores in the three Colorado cities. To enhance consumer participation, interviewers were instructed to wear Colorado State University T-shirts, thereby conveying the survey's association with a respected academic institution.

Following procedures similar to those used by Lusk et al. in their valuation study of steak tenderness, survey data were collected in grocery stores. This allows data to be obtained directly from the actual decision makers. In total, 243 consumers were surveyed. Sixty-five percent of the individuals who were approached and asked by the interviewers to fill out a survey were willing to complete it. The majority of respondents were the primary food shoppers of the household (89%), Caucasian (89%), and female (65%). The respondents' average age was about 40 years, and 40% of all respondents had children under the age of 18 living in their household. The mean income of the sample was calculated to be between $50,000 and $60,000 per household for 2001, and average education was a junior college degree. Summary statistics and a description of the variables are presented in table 1. The survey sample is comparable to the Colorado population (U.S. Bureau of the Census) in terms of education, number of children per household, and household size. However, this sample includes fewer minorities and a higher percentage of female respondents. The high proportion of females is desirable because they are the primary food shoppers in most households.

As with all surveys, the ability of the sample to represent the population is a concern, and the effect of sample choice on the results concerning willingness to pay for country-of-origin labels is impossible to measure. There may also be some degree of sample selection bias, implying that individuals who were more concerned with food safety and source assurance labels, or were more willing to support university research projects, elected to participate in the survey.

The survey elicited information regarding respondents' purchasing behavior and attitudes about beef products, beef qualities consumers find most desirable, food safety attitudes, whether or not respondents would be willing to pay a certain amount per year in taxes to support a mandatory country-of-origin labeling program, and whether they would pay a given premium for steak and hamburger labeled as "Certified U.S. Beef." Sociodemographic characteristics were elicited in the last part of the survey.

Summary statistics for beef attributes important to consumers are reported in table 2. Freshness, food safety inspection, and a high quality grade are the three attributes ranked the highest on a five-point Likert scale (where 1 = not at all desirable and 5 = extremely desirable). The importance of beef being raised locally ranks as one of the least important attributes. Additionally, table 3 shows that 23% of the consumers sampled indicate price is the main driving force of their shopping decisions, while for 41% of the consumers, the driving force of shopping decisions is quality. For the remainder of the sample (25%), health and food safety issues are the primary driving

Table 1. Summary Statistics for the Demographic Variables (N = 243)

Variable Name	Description (Coding)	Mean	Standard Deviation
Age	1 = 18 to 21 2 = 22 to 24 3 = 25 to 29 4 = 30 to 34 5 = 35 to 39 6 = 40 to 44 7 = 45 to 49 8 = 50 to 54 9 = 55 to 59 10 = 60+ years	5.98	2.78
Gender	1 if female; 0 if male	0.65	0.53
Beef Shopper	Cross-product of the indicator variable that represents whether the respondent is a main shopper, and how many times he/she eats beef per week	2.49	2.72
Education	1 = elementary 2 = some high school 3 = high school diploma 4 = some college 5 = junior college 6 = B.A. or B.S. degree 7 = graduate school	5.48	1.52
Kids	1 if children < 18 living in the household; 0 otherwise	0.40	0.50
Family Size	Number of family members living in the household	2.11	1.13
Income	2001 annual household income: 1 = < $20,000 2 = $20,000 to $29,999 3 = $30,000 to $39,999 4 = $40,000 to $49,999 5 = $50,000 to $59,999 6 = $60,000 to $69,999 7 = > $70,000	5.54	3.05
Race	1 if Caucasian; 0 otherwise	0.89	0.32

forces. Thus, overall, the majority of our sample is comprised of consumers who are quality and food-safety seekers.

Following the National Oceanic and Atmospheric Administration (NOAA) 1993 panel recommendations (Arrow et al.), a dichotomous choice question was used to elicit the WTP for the mandatory country-of-origin labeling program, as well as the individual premiums for steak and hamburger labeled as "Certified U.S. Beef." Yet, we acknowledge the existence of controversy surrounding the accuracy of different elicitation or referendum formats. In particular, recent literature explores whether the dichotomous choice suffers from anchoring and yea-saying. Anchoring, or starting-point bias, may occur when respondents "anchor" their stated WTP value to the bid if it represents a reasonable value. Nevertheless, following Frykblom and Shogren's conclusion that problems with the dichotomous choice might be due to how the survey is framed, and not to the dichotomous choice itself, we implemented a dichotomous choice voting question intended to elicit true preferences.

Table 2. Summary Statistics for Consumer Information and Perception Attributes

Attribute	Description	Mean	Standard Deviation
Local	Importance of the beef being raised locally	2.35	1.30
Source Assurance	Importance of knowing who produced the beef	3.84	1.30
Brand	Importance of carrying a premium brand	3.54	1.26
Fresh	Importance of freshness	4.74	0.67
Lean	Importance of beef being lean	4.27	0.95
High Quality	Importance of beef products carrying a high quality grade	4.40	0.87
Tenderness Assurance	Importance of knowing the meat is tender	3.99	1.11
Nutritional Value	Importance of carrying a label about the nutritional value of the beef product	1.93	1.07
Food Safety	Importance of beef being food safety inspected	4.61	0.84
Organic	Importance of the use of organic practices when raising beef	3.44	1.34
Visual Presentation	Importance of good visual presentation of beef	4.12	1.00
Trade-off for Food Safety vs. Price Variable	Price is most important = 1; Food safety is most important = 10	7.09	2.85

Note: All attributes (except the final one) are measured on a five-point Likert scale, where 1 = not at all desirable and 5 = extremely desirable.

Table 3. Consumer Profile: Driving Forces of Shopping Decisions and Knowledge About the Origin of Beef

Characteristic	Description	Percent
Price	Consumers who consider price as the primary driving force of their shopping decisions	22.6
Quality	Consumers who consider quality as the primary driving force of their shopping decisions	41.2
Health	Consumers who consider food safety and health-related issues to be the driving force of their shopping decisions	25.1

Notes: All three characteristics were measured with binary variables. Percentages do not add up to 100% because only the most relevant driving forces of respondents' shopping decisions are presented.

Specifically, consumers were asked the following:

> *Suppose that you could vote in a referendum regarding "country-of-origin" labeling. If implementation of this mandatory country-of-origin labeling program for beef would cost your household $ [bid]/year, what would your position be with respect to this mandatory labeling program?*
>
> [*a*] *In favor of a mandatory program.*
> [*b*] *Opposed to a mandatory labeling program.*

In this question, the random bids assigned to consumers ranged from $10/year up to $250/year.

The next questions elicited consumer WTP for steak and hamburger labeled as "Certified U.S. Beef." The interviewer asked the following:

> *Now, assume that the costs of traceability required to label a steak as "Certified U.S. Beef" is $[bid]/pound of steak in addition to the traditional $4.00/pound price. Would you be willing to pay this premium to guarantee that your beef is "Certified U.S. Beef"?*
>
> [*a*] *Yes* [*b*] *No*

A similar question was presented to the customer to elicit WTP for a "Certified U.S. Beef" hamburger, with the regular price of hamburger set at $1.20/pound.

In both the steak and hamburger cases, the bid amounts were percentage values in increments of 5% over the initial value of the product, adding up to a maximum premium of 75%. The mean initial prices for both steak and hamburger correspond with the retail mean prices of different qualities of steak and hamburger sold in several supermarkets in the area at the time the survey was conducted.

Empirical Specification

To simplify the comparison of the results among models, a set of common explanatory variables was used to explain the three independent decisions. The following logit model was estimated to model consumers' desire for mandatory country-of-origin labeling of beef products, as well as their willingness to pay a premium for "Certified U.S. Steak" and "Certified U.S. Hamburger":

$$(10) \qquad WTP_i^* = \alpha_0 + \beta_1 Bid_i + \beta_2 BeefShopper_i + \beta_3 Female_i + \beta_4 Income_i + \beta_5 Education_i + \beta_6 Kids_i + \beta_7 FoodSafety_i + \varepsilon_i,$$

where Bid_i represents the random amount the consumer was asked to pay, $BeefShopper_i$ is a cross-product variable indicating whether the respondent is the main shopper of the household and the number of times per week beef is consumed at home, $Female_i$ is an indicator variable denoting whether the respondent is a female, $Income_i$ indicates the respondent's household level of income, $Education_i$ denotes the level of education, $Kids_i$ indicates whether there are children under 18 years of age living in the household, and $FoodSafety_i$ represents the subjective importance placed by the respondent on food safety and quality assurance when buying beef with respect to the price paid.[1] Finally, ε_i is the error term that follows a logistic distribution. Note, all variables enter the model in their linear form, because nonlinear transformations were not statistically significant in any of the logit models.

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[1] Trade-off questions were used to elicit consumer preferences about food safety and quality assurance with respect to price. These types of questions allow researchers to obtain a better approximation of the latent consumer preferences, because without the trade-off, most consumers tend to report that food safety is very important to them. The question used in the survey to correspond with this variable is:

> *When you are purchasing beef and other beef products, what is the importance of food safety and quality assurance versus price on a scale from 1 to 10, where 1 means price is most important, and 10 means food safety and quality assurance is most important?*
>
> 1 2 3 4 5 6 7 8 9 10

Econometric Results

Before estimating the three logit models, preliminary tests of specifications were conducted on each logit equation.[2] In order to choose between a logit or a probit functional form, both nonlinear regressions were run with the same index functions. As suggested by Davidson and MacKinnon (p. 522), a likelihood-ratio test with one degree of freedom was conducted. In the three cases examined here, the likelihood-ratio tests did not provide enough statistical evidence for the selection of one model over the other. Therefore, the logit functional form was adopted because of the simple interpretation of the odds ratio.

Furthermore, following Davidson and MacKinnon (pp. 526–27), several tests for multiplicative heteroskedasticity were conducted. The heteroskedasticity was assumed to be a function of a set of variables $\mathbf{w}$, which were chosen from the explanatory variables included in the logit model. The intuition of this test is that if the homoskedastic specification is correct, then any additional regressor w_i has no explanatory power.

Each of the individual t-tests associated with the new estimates was examined, as well as the likelihood-ratio test between the homoskedastic and heteroskedastic logits. In particular, assuming $\text{Var}[\varepsilon_i] = [\exp(\gamma'(\mathbf{w}_i)^2)]$, where $\mathbf{w}_i = (Income_i, Education_i, FoodSafety_i)$, the γ vector was not statistically different from zero in any of the three estimated logit models. The likelihood-ratio statistic for testing the homoskedasticity assumption in the context of the first logit (annual WTP is modeled for the mandatory labeling program) was $\chi^2 = 3.25$, while the 95% critical $\chi^2_{[3]}$ value was 7.82. The likelihood-ratio statistics for the second and third logits (WTP is modeled for the "U.S. Certified Steak" and for "U.S. Certified Hamburger," respectively) were 8.34 and 6.84.[3] Consequently, no conclusive evidence was found to confirm the presence of this form of multiplicative heteroskedasticity. Because the exact form of heteroskedasticity is seldom known, other potential forms of heteroskedasticity were also tested, and no statistical evidence supported the presence of heteroskedastic variances.

An additional concern was that some of the explanatory variables included in the model were endogenous. In particular, the variable *FoodSafety* may be subject to the same influences as the response variable. To test whether *FoodSafety* is an endogenous variable, the Rivers and Vuong two-step endogeneity test was conducted in each of the three logit models (see details in Wooldridge, pp. 472–78). To implement this test, the reduced-form residuals were obtained by regressing *FoodSafety* on all explanatory variables, as well as some proxies or instrumental variables that capture the effect of the *FoodSafety* variable. The instrumental variables used to represent *FoodSafety* were a subset of attitudinal variables—in particular, the importance of food safety certification, and the importance of nutritional value (both Likert-scale variables with values ranging from 1 to 5). When the residuals obtained from the OLS regression were added as an

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[2] The possibility that the error terms were correlated across the individual WTP equations was investigated (in particular those from the WTP for individual labeled beef products). To test this conjecture, a bivarite probit for the WTP questions related to the labeling of the particular products was estimated, but unfortunately convergence of the algorithm was not achieved. Although different sets of starting values were used, such as those from ordinary least squares (OLS) and also individual probit estimates, the optimization procedure failed to converge because the correlation coefficient was outside the range of −1 and 1. Given that the bivariate specification did not converge, the trivariate specification was not estimated. Therefore, the estimation of the different WTP regressions was done individually (choosing a logit versus a probit model). In any case, and independent of whether or not the error terms are correlated, the estimates are still consistent.

[3] Although the likelihood-ratio test slightly exceeds the critical value, the individual t-tests associated with the heteroskedastic parameters are not statistically significant at any conventional level.

explanatory variable in the original logit model, the *t*-test on the residuals yielded 0.93 for the first logit, 0.24 for the second logit, and 0.68 for the third logit. Therefore, results from this test indicated the *FoodSafety* variable passed the Rivers and Vuong two-step endogeneity test for the three logits, and *FoodSafety* could be considered as an exogenous explanatory variable.

Tables 4 and 5 present the coefficients and the marginal effects for the willingness-to-pay equations used to model the consumer's willingness to pay (*a*) for a mandatory country-of-origin labeling program, (*b*) a premium for "Certified U.S. Steak," and (*c*) a premium for "Certified U.S. Hamburger." Marginal effects were calculated by evaluating and estimating the changes in the probabilities of paying a premium when an indicator or Likert-scale variable passes from one integer to the next, holding the rest of the variables at their mean levels.

For the Likert-scale variables, there exist various ways of reporting the results. Here, because all marginal effects obtained from a given Likert-scale variable were monotonic, increasing or decreasing at an almost constant rate, the mean of the marginal effects was calculated by adding up each of the individual marginal effects obtained when passing from one integer value to the next (holding the rest of the variables at their mean levels), and dividing by the total number of integers for each of the Likert-scale variables. Asymptotic variance-covariance or standard errors were calculated employing the delta method (see Greene, p. 124).

The models fit reasonably well, and all three provide percentages of correct predictions above 60% (table 4). Additionally, the corresponding likelihood-ratio tests indicate the overall significance of the coefficients in the three models. All coefficients and marginal effects carry the expected sign, except *Income* in all three equations, and *Education* in the hamburger equation. Consumers with higher education and income were expected to be more willing to support a mandatory country-of-origin labeling program, and to be more likely to pay a premium for "Certified U.S." meat products. Negative marginal effects of income may suggest that wealthier consumers already consider their meat supply safe, and do not place much value on labeling of origin. In particular, the reduction on the average probability of a consumer paying a premium for each increment on the income level for the "U.S. Certified Hamburger" equation is about 0.019 (table 5). The *Education* variable has a positive and statistically significant marginal effect only for the "Certified U.S. Steak" equation. Thus, an increment of one level of education increases, on average, the probability of paying a premium for "U.S. Certified Steak" by 0.047 (table 5). Thompson reported similar results in a review of studies about organic products, in which the education variable had a negative effect.

As expected, the *Bid* or randomly assigned amount (price for the program or the particular good) carries a negative and statistically significant marginal effect. As demand theory predicts, the higher the premium or amount requested to pay, the lower the probability a consumer would be willing to pay such a premium. Thus, if the bid amount goes up by $1, the probability of the respondent paying for the "U.S. Mandatory Labeling Program" decreases by 0.001 (table 5). Similar reductions in participants' WTP occur when the premiums for "U.S. Certified" steak and hamburger are increased. For "U.S. Certified Steak," if the bid amount increases by $0.01/pound, the probability of paying the premium decreases by 0.094, while the probability of paying $0.01/pound extra for "U.S. Certified Hamburger" decreases by 0.161. Thus, the impact of increasing the premium on participants' WTP is largest for "U.S. Certified Hamburger," which was the lowest priced item.

Table 4. Logit Estimates for WTP Equations: Mandatory Labeling Program for Beef; for "U.S. Certified Steak"; and for "U.S. Certified Hamburger"

	Mandatory Labeling Program		"U.S. Certified Steak"		"U.S. Certified Hamburger"	
Variable	Coefficient	*t*-Value	Coefficient	*t*-Value	Coefficient	*t*-Value
Constant	-0.222	-0.239	-1.754***	-2.112	0.700	0.412
Bid	-0.007***	-2.837	-0.383*	-1.884	-0.765*	-1.841
BeefShopper	0.146*	1.811	0.143**	2.009	0.130*	1.709
Female	1.052***	2.960	0.503*	1.671	0.838**	2.572
Income	-0.052	-0.803	-0.094*	-1.677	-0.105*	-1.709
Education	0.108	0.931	0.228**	2.193	-0.040	-0.369
Kids	-0.229	-1.195	0.136**	0.777	0.266	1.341
FoodSafety	0.143**	2.305	0.144**	2.471	0.040	0.495
Log Likelihood	-100.74		-121.64		-111.84	
Restricted Log Likelihood	-116.24		-133.97		-122.30	
Likelihood-Ratio Test, $\chi^2_{[7]}$	31.00		24.66		20.91	
% of Correct Predictions	75.6%		62.6%		68.6%	

Note: Single, double, and triple asterisks (*) denote statistical significance at least at $\alpha = 0.10$, 0.05, and 0.001, respectively.

Table 5. Marginal Effects for WTP Equations: Mandatory Labeling Program for Beef; for "U.S. Certified Steak"; and for "U.S. Certified Hamburger"

	Mandatory Labeling Program		"U.S. Certified Steak"		"U.S. Certified Hamburger"	
Variable	Coefficient	*t*-Value	Coefficient	*t*-Value	Coefficient	*t*-Value
Constant	-0.039	-0.370	-0.332	-1.606	0.165	0.918
Bid	-0.001***	-3.125	-0.094*	-1.862	-0.161*	-1.756
BeefShopper	0.022**	2.316	0.032*	1.808	0.024	1.437
Female	0.212***	4.647	0.125*	1.671	0.186**	2.551
Income	-0.008	-1.082	-0.020	-1.424	-0.019*	-1.731
Education	0.018	1.341	0.047*	1.816	-0.007	-0.303
Kids	-0.042*	-1.900	0.034	0.777	0.058	1.397
FoodSafety	0.026***	3.430	0.031**	2.134	0.008	0.629

Notes: Single, double, and triple asterisks (*) denote statistical significance at least at $\alpha = 0.10$, 0.05, and 0.001, respectively. Standard errors were calculated using the delta method.

The effects of the sociodemographic variables are as expected. The fact that the respondent is the main shopper of the household who additionally eats beef at home during a given week (*BeefShopper*) increases in a statistically significant way the probability he/she will be willing to pay a premium for the "U.S. Mandatory Labeling Program" and for "U.S. Certified Steak" by about 0.022 and 0.032, respectively (table 5). Moreover, females are more likely to pay a premium for the mandatory country-of-origin labeling program, as well as for the individual labeled products. The presence of children in the household (*Kids*) carries a negative and statistically significant marginal effect when modeling the WTP equation for "U.S. Mandatory Country-of-Origin Labeling." In particular, the probability of paying a premium for such labeling decreases by 0.042.

Consumers expressing concern about food safety are more likely to pay for a general mandatory labeling program and for "U.S. Certified Steak." Thus, *FoodSafety* carries a positive and statistically significant marginal effect for the "U.S. Mandatory Country-of-Origin Labeling Program," and for "U.S. Certified Steak." As reported in table 5, the average probability of paying a premium for the former increases by 0.026, and by 0.031 for the latter when the *FoodSafety* variable increases from one integer to the next (in the range from 1 to 10).

Willingness-to-Pay Estimates

Willingness-to-pay estimates (Hanemann) for the mandatory country-of-origin labeling program, as well as for the two individual "U.S. Certified" meat products, were obtained as:

$$E(WTP) = \frac{1}{\hat{\beta}_1} \ln\left(\frac{1 + e^{\hat{\alpha}}}{1 + e^{\hat{\alpha} - \hat{\beta}_1 Bid_{MAX}}}\right). \tag{11}$$

In this expression, $\hat{\alpha}$ denotes the grand constant, which is the sum of all the products of the estimated coefficients (except the one corresponding to the bid amount) times the mean values of their corresponding explanatory variables. Bid_{MAX} is the highest bid amount, and $\hat{\beta}_1$ is the estimated coefficient associated with the bid amount. Results from the logit model were used to generate the confidence intervals of the welfare estimates calculated in (11) by a bootstrapping technique (Park, Loomis, and Creel). This technique employs the estimates of the parameter vector, denoted by $\hat{\beta}$, and the estimated variance-covariance matrix, denoted by $\hat{\Sigma}_\beta$. Multiple random draws to create a new parameter vector $\hat{\beta}$ are made from a multivariate normal distribution with variance-covariance $\hat{\Sigma}_\beta$ and mean $\hat{\beta}$. For each of these draws, the WTP is calculated using equation (11). Mean WTP values and their respective confidence intervals are presented in table 6.

In the three cases examined here, the mean WTP estimates are statistically different from zero—implying consumers in this sample are very receptive toward country-of-origin labeling. The mean WTP estimate for the mandatory country-of-origin labeling program has been calculated as $183.77/year. Although this estimate is fairly large, it reflects the fact that many respondents were willing to pay for the program even when bids were as high as $200 and $250/year.[4] The premium for "U.S. Certified Steak" was calculated as $1.53/pound over the original base price of $4/pound, while the premium for hamburger labeled as "U.S. Certified Hamburger" was estimated at $0.70/pound over the $1.20/pound regular price. In percentage terms, the premium for "U.S. Certified Steak" is about 38.3% of the initial value, while for "U.S. Certified Hamburger" it is about 58.3%. The higher percentage premium for "U.S. Certified Hamburger" may occur because the initial price of hamburger is set lower than that of steak.

[4] Another approach to representing the mean WTP for the mandatory labeling program is to translate the cost of a mandatory labeling program to a weekly basis of $3.53/week ($183.77/year divided by 52 weeks). The $3.53/week cost would imply that a consumer would need to purchase 2.3 pounds of steak or 5 pounds of hamburger, and be willing to pay a $1.53/pound premium for steak purchases or a $0.70/pound premium for hamburger purchases to achieve the annual payment of $183.77.

Table 6. Willingness-to-Pay Estimates and Confidence Intervals

Program	Mean WTP	90% Confidence Interval
Mandatory Country-of Origin Labeling Program	$183.77/year	{$138.30, $591.20}
Premium for steak labeled as "U.S. Certified Beef"	$1.53/pound	{$1.32, $6.44}
Premium for hamburger labeled as "U.S. Certified Beef"	$0.70/pound	{$0.53, $2.40}

Note: Confidence intervals are constructed based on 4,000 draws.

Conclusions

This analysis has investigated consumer response and consumer willingness to pay for a mandatory country-of-origin labeling program, as well as for steak and hamburger labeled as "U.S. Certified Beef." A consumer survey was conducted in several grocery stores in three different Colorado cities in 2002. Sociodemographic differences between the consumers who are willing to pay a premium for "U.S. Certified Steak" versus those who are willing to pay for "U.S. Certified Hamburger" are readily observable. Results indicate respondents in this study were very concerned about source verification and labeling issues, and as a consequence, are willing to pay a high premium for the mandatory country-of-origin labeling program. Respondents were also willing to pay an average of 38% to 58% more for individual products labeled as "U.S. Certified Steak" and "U.S. Certified Hamburger."

Logit results suggest females, those who are the primary shoppers in their household, and those who are concerned about food quality and food safety issues, are more likely to support mandatory country-of-origin labeling. Respondents who are the main shoppers and additionally eat beef in their household are also more likely to pay for this mandatory labeling program. Additionally, wealthier consumers are less likely to pay for mandatory country-of-origin labeling for hamburger.

Future research may focus on comparing consumer perceptions toward different country-of-origin labels. It will also be interesting to determine whether these findings hold in a more diverse and larger sample, and at a different point in time. This survey was conducted following the recent food safety scares in Japan and Europe. Therefore, due to the timing of the survey, consumers may have been more concerned about quality assurance and source verification issues than in other circumstances. It is further recognized that because of the disaster of September 11, 2001, respondents may have experienced a more positive or patriotic reaction toward a labeling policy which is intended to signal "U.S. Certified Beef."

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