Journal of Agricultural and Resource Economics 38(3):397–417 ISSN 1068-5502

Consumer Preferences for Verified Pork-Rearing Practices in the Production of Ham Products

Melissa G. S. McKendree, Nicole Olynk Widmar, David L. Ortega, and Kenneth A. Foster

A hypothetical choice experiment was conducted to determine consumers' willingness to pay for three verified production practice attributes (pasture access, antibiotic use, and individual crates/stalls) in smoked ham and ham lunchmeat. These attributes were verified by the USDA Process Verified Program (PVP), a retailer, or the pork industry. Willingness to pay for verified attributes varied across attributes and verifying entity for both products. Consumers were willing to pay the most for attributes verified by the USDA-PVP. No statistical differences, relative to the product price level, were found across products for the same attribute-verifier combination.

Key words: animal welfare, consumer demand, credence attribute, ham, lunchmeat, verification, willingness to pay

Introduction

Today's markets for goods and services—especially food products—look vastly different than they did twenty or even ten years ago. Although consumers are further removed from the farm than in the past, they are increasingly interested in agricultural and food production practices. Potentially, part of this interest is sparked by the ease of information exchange though the Internet, social media, or detailed product labeling. To satisfy the demands of increasingly well-informed, heterogeneous consumers, differentiated products with attributes such as environmentally friendly, hormone-free, produced on a family farm, free range, and a variety of others fill supermarket shelves. A segment of consumers have been purchasing these products and demonstrating their willingness to pay (WTP) for food production process attributes.

Caswell (1998) identified that consumers will choose the bundle of food products that provides them with the largest utility if they can accurately determine the quality attributes of those food products. Additionally, the information available regarding the food product, such as the attributes possessed by the product and who verifies the attribute, can send different quality signals to the consumer. Food product attributes can be categorized as search, experience, or credence attributes (Caswell and Mojduszka, 1996). A search attribute is one that allows a consumer to identify the quality before purchase through research or inspection. An experience attribute allows a consumer to determine the quality only after purchase or consumption. The quality of a credence attribute cannot be measured even after the product is purchased and consumed.

Arguably, the attributes that consumers are becoming more interested in are credence attributes. Livestock product attributes, in particular, conjure consumer sentiment about the treatment and welfare of animals in the production processes for meat and milk products (Frewer et al., 2005).

Melissa G. S. McKendree is a research assistant in the Department of Agricultural Economics at Purdue University. Nicole Olynk Widmar is an assistant professor in the Department of Agricultural Economics at Purdue University. David L. Ortega is an assistant professor in the Department of Agricultural, Food, and Resource Economics at Michigan State University. Kenneth A. Foster is a professor in and the department head of the Department of Agricultural Economics at Purdue University.

Review coordinated by Hayley Chouinard.

Norwood and Lusk (2011) recognize that "ultimately, it is consumers, not farmers, who decide how farm animals are raised" (p. 355). This is exemplified by the popularization of animal protection organizations, such as People for the Ethical Treatment of Animals (PETA) and the Humane Society of the United States (HSUS), as well as the changing political landscape of food and agricultural markets. According to Hudson and Lusk (2004), changes in production practices can be largely attributed to market pressures rather than changes in legislation. This pressure is due to the increasing ability of consumer groups to influence issues relating to animal handling (Hudson and Lusk, 2004). The pork industry, and specifically animal housing, has been an arena for animal welfare and care debates (Norwood, 2012; Norwood and Lusk, 2011; Tonsor and Wolf, 2011; Tonsor, Wolf, and Olynk, 2009). Ballot initiatives (Norwood, 2012; Tonsor, Wolf, and Olynk, 2009), state legislation (Norwood and Lusk, 2011), and market efforts (Schweikhardt and Browne, 2001) have demonstrated effectiveness in the past for changing production processes and have been used to ban the use of gestation crates in some states. Although the debate over gestation crates has received widespread media attention, there is no clear national consensus regarding animal well-being (Tonsor and Wolf, 2010). Due to the relatively limited information available regarding consumer preferences for livestock rearing practices, this study evaluates credence attributes of pig production, specifically pasture access, individual crates/stalls, and antibiotic use.

Livestock products have been the focus of much discussion as today's sophisticated shoppers and their preferences for livestock production process attributes are changing. The use of choice experiments to estimate consumer WTP for livestock product attributes has been well documented in the empirical literature. Different methods and experimental settings have been used, including in-person interviews/auctions (Gracia, Loureiro, and Nayga, 2009), point-of-purchase interviews/auctions (Lind, 2007), mail surveys (Nilsson, Foster, and Lusk, 2006; Carlsson, Frykblom, and Lagerkvist, 2007; Tonsor, Olynk, and Wolf, 2009), phone surveys (Lusk and Norwood, 2008), and Internet surveys (Olynk and Ortega, 2013; Wolf, Tonsor, and Olynk, 2011; Gao and Schroeder, 2009; Olynk, Tonsor, and Wolf, 2010a; Tonsor, Wolf, and Olynk, 2009). Additionally, both nonhypothetical—where money is actually exchanged to purchase a product—and hypothetical—where no money or product is exchanged—choice experiments have been conducted (Dickinson and Bailey, 2002; Lusk and Norwood, 2009; Tonsor, Wolf, and Olynk, 2009; Gao and Schroeder, 2009; Olynk and Ortega, 2013). Simulated shopping and choice experiments help industries develop a better understanding of consumer demands and preferences. Furthermore, choice experiments allow the opportunity to investigate products that may not yet be available to consumers.

Most livestock species, but not all livestock products, have been considered in the choice experiment literature. When investigating pork chops and milk, Olynk, Tonsor, and Wolf (2010a) found differences in WTP across livestock species (dairy cows versus pigs) as well as evidence of differing levels of social desirability bias across species. Therefore, consumers could have varying levels of affinity across livestock species, potentially impacting how consumers believe specific species should be treated. Additionally, WTP estimates have been found to vary across products, even when they are from the same species. In a study by Olynk and Ortega (2013), consumers were willing to pay more for the same verified attributes in yogurt than ice cream, although both are made from milk that comes from dairy cows. Their analysis further investigates the idea that WTP estimations can differ across products produced from the same species. Could this variation in WTP amongst products from the same animal also be true for ham products? Olynk and Ortega (2013) hypothesized that consumers' higher WTP for yogurt might be partially attributed to the perception by consumers that yogurt could be "closer to the cow" or more natural (less processed) than ice cream. Possible other factors could be the "eating occasion" for yogurt versus ice cream, perceptions of healthfulness of the various products, and whether the product is a staple diet item, dessert, snack, or associated with special occasions. Pork and dairy products are likely differentiated from one another in the minds of consumers by a key production process, specifically slaughter.

Dairy products, like yogurt and ice cream, are produced from milk, which does not require slaughter for harvest; pork products, like all meats, however, do require slaughter.

Smoked ham and ham lunchmeat were selected for this analysis because they are both pork products that involve some degree of processing. These products were selected for their similarities (i.e., both processed pork products, potentially the same "cut of meat") and differences (i.e., eating occasion, when and how they are consumed). Smoked ham and ham lunchmeat are both cooked, but cold when purchased in a supermarket. The products are also eaten at different occasions and in different ways; lunchmeat is generally consumed "on the go" at lunchtime, often cold and on a sandwich, whereas smoked ham is often heated and served as a main course at a meal.

This study estimates consumer demand for verified production process attribute claims for ham products through the use of a choice experiment. The objectives of this analysis are to determine consumer WTP for smoked ham and ham lunchmeat production process attributes and to compare WTP estimates across smoked ham and ham lunchmeat to discern whether consumers have varying demand for these attributes across ham products. Specifically, production process attributes investigated include pasture access, individual crates/stalls, and antibiotic use. Because these production process attributes are credence attributes, and therefore cannot be confirmed by the consumer (either before or after purchase), these attributes were stated to be certified by either the USDA Process Verified Program (PVP),[1] the pork industry, or a retailer. It is hypothesized that consumers' WTP for production process attributes will vary across pork products. Determining the differences in WTP for production process attributes in smoked ham and ham lunchmeat will benefit pork producers, retailers, producer and/or consumer groups, and all members of the pork marketing channel. Identification of attribute value in the consumer market informs sound decision making surrounding which attributes to produce, who should verify them, and the anticipated size of the market at various price points.

Survey Instrument and Choice Experiment

To gain a better understanding of consumer valuation of pork-industry production practices during purchasing decisions, an online survey was administered in summer 2012 to a representative sample of U.S. households. A total of 798 respondents completed the survey. The goal was to collect information about consumer preferences for animal welfare, animal handling systems, and production practice attributes in livestock products as well as the value created through verification of these attributes by different parties. Questions were also designed to elicit general information about households' demographic characteristics, purchasing behaviors, and preferences towards livestock products, with specific interest in smoked ham and ham lunchmeat. To the best of our knowledge, this is the first study to estimate WTP for production practice attributes in smoked ham and ham lunchmeat using choice experiments conducted online with a representative sample of the U.S. population.

Internet surveys are becoming more popular due to their low costs and speedy completion times (Louviere et al., 2008; Gao and Schroeder, 2009; Olynk, Tonsor, and Wolf, 2010a; Tonsor and Wolf, 2011; Olynk and Ortega, 2013). Internet surveys were found not to exhibit nonresponse bias by Hudson et al. (2004). Similarly, Fleming and Bowden (2009) and Marta-Pedroso, Freitas, and Domingos (2007) found no significant differences when comparing results between web-based surveys and conventional mail and in-person interview surveys. When looking specifically at choice experiments, Olsen (2009) found no significant differences in mean WTP estimates between Internet surveys and mail surveys.

[1] The Grain Inspectors, Packers, and Stockyard Administration (GISPA) PVP has official procedures in place for verifying products assigned to GISPA and services associated with marketing these products (U.S. Department of Agriculture, Grain Inspection, Packers and Stockyards Administration, 2007). Verification services through GISPA are voluntary and available for a fee to producers, marketers, processors, and other associated service providers of agricultural products (U.S. Department of Agriculture, Grain Inspection, Packers and Stockyards Administration, 2007).

Table 1. Summary Statistics for Survey Respondent Demographic Information

Variable	Respondents Completing Ham Lunchmeat CE			Respondents Completing Smoked Ham CE		
	Freq (%)	Mean	Std Dev	Freq (%)	Mean	Std Dev
Female		0.51	0.50		0.53	0.50
Age		46.28	16.24		46.81	15.90
Adults per household		1.93	0.82		1.94	0.99
Total children per household		0.53	0.95		0.46	0.87
Under 3		0.11			0.09	
4–6		0.08			0.07	
7–9		0.08			0.08	
10–12		0.09			0.08	
13–15		0.10			0.10	
16–18		0.09			0.05	
Annual pre-tax income						
Less than $20,000	17%			22%		
$20,000–$39,999	30%			32%		
$40,000–$59,999	23%			20%		
$60,000–$79,999	12%			13%		
$80,000–$99,999	8%			7%		
$100,000–$119,999	5%			2%		
$120,000–$139,999	2%			2%		
$140,000–$159,999	4%			5%		
Educational Background						
Did not graduate from high school	3%			4%		
Graduated from high school, did not attend college	23%			23%		
Attended college, no degree earned	26%			25%		
Attended college, associates or trade degree earned	14%			15%		
Attended college, bachelor's degree (B.S. or B.A.) earned	23%			23%		
Graduate or advanced degree (M.S., Ph.D., law school)	11%			9%		
Other	2%			1%		
Vegetarian	4%			4%		
Vegan	2%			2%		

Decipher, Inc., a marketing research services provider that specializes in online survey programming, data collection, data processing, and custom technology development, was used to administer the survey. Participants were recruited from a large opt-in panel by Survey Sampling International. The sample was representative of the U.S. population,[2] and every participant was at least eighteen years of age and familiar with their household's food purchasing behaviors. Table 1 details respondents' demographic information for those who completed the survey with the choice experiment for smoked ham and those who completed the choice experiment for ham lunchmeat. For comparison, the U.S. Census Bureau (2013) reported that the average number of persons per household in the U.S. was 2.60. Additionally, the U.S. population is approximately 50.8% female, with a median household income of $52,762 (U.S. Census Bureau, 2013). Furthermore, 85.4%

[2] The sample was recruited to be representative in terms of state of residence, gender, age, pre-tax income and education level.

Table 2. Smoked Ham and Ham Lunchmeat Attributes and Attribute Levels Evaluated in Choice Experiments

Product Attribute	Smoked Ham Attribute Levels	Ham Lunchmeat Attribute Levels
Price	\$1.69/lb	\$2.49/lb
	\$5.79/lb	\$6.74/lb
	\$9.89/lb	\$10.99/lb
Individual Crates/Stalls	Not Permitted	
	Permitted	
Pasture Access	Not Required	
	Required	
Antibiotic Use	Not Permitted	
	Permitted	
Certification Entity	USDA-PVP	
	Retailer Certification	
	Industry Certification	

of Americans twenty-five years and older are at least a high school graduate and 28.2% have a Bachelor's degree or higher.

Choice Experiment

In choice experiments, participants select a product from a set of options by evaluating each product's set of characteristics, closely mimicking real-world purchasing situations and allowing for the assessment of tradeoffs among product attributes. Hypothetical choice experiments are simulated shopping experiences (without the actual exchange of money or products) that are designed to estimate consumers' WTP for livestock production attributes across various certification agencies. Consumers' WTP for verification by various parties of three different attributes across two different pork products were estimated. To reduce survey fatigue, the survey respondents were randomly assigned to complete either the smoked ham or ham lunchmeat choice experiment, resulting in 399 respondents completing each. The choice sets allowed participants to choose between purchasing one of two product alternatives or neither based on the price level, three production practice attributes, and the certification entity identified (table 2). Participants received information on whether individual crates/stall were not permitted or permitted, pasture access was required or not required, antibiotic use was not permitted or permitted, and whether the certification entity was the USDA-PVP, a retailer, or the pork industry. Appendix A details the attribute and verification entity definitions shown to survey respondents in preparation for and available during the choice experiment (via a link shown in all choice sets in the survey). In addition, the choice experiment presented three different price levels for each product; smoked ham price levels were \$1.69/lb., \$5.79/lb., or \$9.89/lb. and ham lunchmeat price levels were \$2.49/lb., \$6.74/lb., or \$10.99/lb. In the market, smoked ham and lam lunchmeat prices vary greatly due to differences in quality, brand, attributes offered, or prepackaged versus deli counter options, for example. Prices were chosen to be comparable and consistent with retail prices at the time the survey was conducted in 2012. Examples of smoked ham and ham lunchmeat choice sets can be found in Appendix B.

A main effects plus two-way interaction design was used to determine choice scenarios (Lusk and Norwood, 2005). The SAS *OPTEX* procedure was utilized to identify an experimental design maximizing D-efficiency (86.48). The final choice design resulted in twenty-four choice sets, which were blocked into three groups of eight to keep the survey manageable for participants (Tonsor

et al., 2005; Olynk and Ortega, 2013). Therefore, each survey respondent was shown eight choice sets (each with two alternatives and a "no purchase" option) for either ham lunchmeat or smoked ham. The choice set order was randomized to lessen ordering impacts (Loureiro and Umberger, 2007; Olynk, Tonsor, and Wolf, 2010a).

Because hypothetical choice experiments are simulated shopping experiences and there is no actual exchange of products or money, the following instructions were given to participants:

> The experience from previous similar surveys is that people often state a higher willingness to pay than what one actually is willing to pay for the good. It is important that you make your selections like you would if you were actually facing these choices in your retail purchase decisions, noting that allocation of funds to these products means you will have less money available for other purchases.

This statement is part of a "cheap-talk" strategy to reduce hypothetical bias by informing participants of the bias before their participation in the choice experiment (Lusk, 2003).

Theoretical Framework and Research Methods

Random Utility Theory

The assumption that economic agents seek to maximize their expected utility subject to the choice sets they are presented is central to the idea of random utility theory. In this experiment, consumers were presented with three alternatives: two ham products (with the relevant production process attributes presented in differing levels) and a no purchase option. Instead of asking consumers directly what value they would assign to a given ham product, consumers were asked to select their preferred choice from among the three options presented. This attribute-based method is based on Lancastrian consumer theory (Lancaster, 1966), which posits that the utility of a product can be stratified into separate utilities for their product attributes (see McFadden, 1973). Based on Manski (1977), an individual's utility is a random variable because the researcher has incomplete information. In random utility theory, utility (U_{it}) is obtained from selecting alternative i from a finite set of alternatives contained in choice set C in situation t. Therefore, utility can be characterized by the following equation:

$$U_{it} = V_{it} + \varepsilon_{it}, \tag{1}$$

where V_{it} is the deterministic portion of utility dependent upon the attributes of the alternative and ε_{it} is the stochastic component of utility, which is independently and identically distributed over all alternatives and choice scenarios. A consumer will select alternative i if the utility for selecting i is greater than the utility from alternative j, $U_{it} > U_{jt}\ \forall\ i \neq j$. Accordingly, the probability of selecting alternative i is given by

$$P_{it} = P(V_{it} + \varepsilon_{it} > V_{jt} + \varepsilon_{jt},\ \forall\ i \neq j,\ \forall\ j \in C). \tag{2}$$

The probability that alternative i is selected is given by

$$P_{it} = \frac{e^{\mu V_{it}}}{\sum_{j \in C} e^{\mu V_{jt}}}, \tag{3}$$

where μ is a scale parameter inversely related to the variance of the error term (Lusk, Roosen, and Fox, 2003; Olynk, Tonsor, and Wolf, 2010a). Similar to other recent works, the scale parameter, μ, was assumed to be equal to one because it is unidentifiable in any given dataset (Lusk, Roosen, and Fox, 2003; Olynk, Tonsor, and Wolf, 2010a).

Under the assumption that the systematic portion, V_{it}, is linear in parameters, the specification of the general model can be expressed as

$$V_{it} = \beta_1 \boldsymbol{x}_{it} + \ \ldots \ + \beta_k \boldsymbol{x}_{it}, \tag{4}$$

where $\boldsymbol{x}_{it}$ is a vector of attributes found in the ith alternative, and βs are parameters associated with the attributes of the ith alternative.

Multinomial logit models assume that consumers have homogeneous preferences for product attributes; however, this model will provide poor estimates if consumers possess heterogeneous preferences (Schulz and Tonsor, 2010; Olynk, Tonsor, and Wolf, 2010a). Therefore, employing a more general approach that allows for heterogeneous preferences, such as the random parameters logit model, is appropriate (Lusk, Roosen, and Fox, 2003; Alfnes, 2004; Tonsor et al., 2005).

Random Parameters Logit

Random parameters logit (RPL), also called mixed logit, is a way to account for heterogeneity in consumer preferences. By using the RPL model, we are able to directly estimate the heterogeneity in consumer preferences across the evaluated attributes. In the RPL model, the random utility (U_{nit}) of alternative i of individual n in situation t is

$$U_{nit} = v_{nit} + [u_{ni} + \varepsilon_{nit}], \tag{5}$$

where v_{nit} is the systematic portion of the utility function, u_{ni} an error term that is distributed normally over individuals and attributes (but not choice sets), and ε_{nit} is the stochastic error that is independently and identically distributed over individuals, attributes, and choice sets.

Following Olynk and Ortega (2013), the subsequent model for the systematic portion of utility is

$$\begin{aligned} v_{it} \quad = \quad & \beta_1 Price_{it} + \beta_2 USDA\_Pasture_{it} + \beta_3 Retailer\_Pasture_{it} + \beta_4 Industry\_Pasture_{it} + \\ & \beta_5 USDA\_Anti_{it} + \beta_6 Retailer\_Anti_{it} + \beta_7 Industry\_Anti_{it} + \beta_8 USDA\_Indiv_{it} + \\ & \beta_9 Retailer\_Indiv_{it} + \beta_{10} Industry\_Indiv_{it} + \beta_{11} OptOut_t, \end{aligned} \tag{6}$$

where *Price* is the price of the good (smoked ham or ham lunchmeat) in the choice set and *OptOut* is a constant used to describe the disutility of not having the good in the consumer's choice set. *Industry_Indiv*, *Retailer_Indiv*, and *USDA_Indiv*, are effects-coded interaction terms between the verification entities (where *Industry* is pork-industry certification, *Retailer* is third-party retailer certification, and *USDA* is USDA-PVP certification) and individual housing in crates or stalls. *Industry_Pasture*, *Retailer_Pasture*, and *USDA_Pasture* are effects-coded interaction terms between the verification entities and pasture access. *Industry_Anti*, *Retailer_Anti*, and *USDA_Anti* are effects-coded interaction terms between the verification entities and antibiotic use. An interpretation of *Industry_Indiv* is the willingness to pay for pork-industry-verified individual crates or stalls in production as opposed to not having production with individual crates or stalls verified by an industry group.[3]

The β coefficients on all explanatory variables, with the exception of *Price* and *OptOut* were specified to vary normally across consumers. It is hypothesized that consumers may have positive or negative preferences for any of the verified attributes investigated. In order to allow WTP estimates to be either positive or negative, the random parameters were assumed to be drawn from a normal

[3] The interaction terms are necessary because it is impossible in this experimental design to have an attribute present without having verification from a verification entity that the claimed attribute is truly present in the product. A single verification entity was presented for each product shown; this verification entity was then interacted with each of the attributes to result in a verified attribute, following previous work by Olynk, Tonsor, and Wolf (2010a) and Olynk and Ortega (2013).

distribution (Lusk, Roosen, and Fox, 2003; Tonsor et al., 2005). Because RPL does not exhibit the independence from irrelevant alternatives property of the standard logit model, general patterns of correlated taste parameters can arise (Revelt and Train, 1998). Let $\boldsymbol{\beta}$ be defined as a $k \times 1$ vector of all the attribute coefficients, $\boldsymbol{\eta}$ is a $(k-2) \times 1$ vector of the random attribute coefficients found in $\boldsymbol{\beta}$ and specify $\boldsymbol{\eta} \sim N(\overline{\eta}, \Omega)$. The resulting random coefficient vector is expressed as $\boldsymbol{\eta} = \overline{\eta} + L\boldsymbol{M}$, where L is a lower triangular Cholesky factor of Ω such that $LL' = \Omega$, and $\boldsymbol{M}$ is a vector of independent standard normal deviates (Revelt and Train, 1998). If some of the estimates of the Cholesky matrix Ω show statistical significance, the data is supportive of dependence in tastes and the model allows for a better understanding of correlations in preferences across attributes (Scarpa and del Giudice, 2004).

Due to the effects coding of the interaction terms, mean WTP estimates can be calculated as follows:

$$WTP_k = -\left(\frac{2 \times \beta_k}{\beta_1}\right), \tag{7}$$

where β_k is the coefficient on the verified attribute and β_1 is the coefficient on price. Instead of the usual 0, 1 dummy variable, in effects coding the attributes take on a value of 1 when applicable, a value of -1 when the base category applies, and 0 otherwise (Tonsor, Olynk, and Wolf, 2009; Olynk, Tonsor, and Wolf, 2010a). As a result of effects coding, the coefficient on the verified attribute k is multiplied by 2 in the WTP ratio (Lusk, Roosen, and Fox, 2003; Tonsor, Olynk, and Wolf, 2009). Point estimates of consumer WTP values and the variance of those WTP estimates were used to determine the distribution of consumer WTP values under the assumption that WTP estimates are normally distributed (Alfnes, 2004). This analysis allows the percentage of consumers that have a higher WTP than some critical level to be estimated (Olynk, Tonsor, and Wolf, 2010b).

In order to account for statistical variability in the model, the delta method is used to construct 95% confidence intervals. There are numerous methods available to estimate confidence intervals for WTP estimates, including delta, Fieller, Krinsky-Robb, and bootstrap methods. Hole (2007) found all of these methods to be reasonably accurate and yield similar results to one another. The delta method is used to estimate the variance of a nonlinear function of two or more random variables. This is done by taking a first order Taylor series expansion around the mean value of the variables and calculating the variance for this expression (Greene, 2003; Hole, 2007). Following Hole (2007), the delta estimate of the variance of the WTP estimates is

$$\begin{aligned} var(\widehat{WTP_k}) &= [(\widehat{WTP_{\beta_k}})^2 var(\widehat{\beta_k}) + (\widehat{WTP_{\beta_1}})^2 var(\widehat{\beta_1}) + \\ &\quad 2 \times \widehat{WTP_{\beta_k}} \times \widehat{WTP_{\beta_1}} \times cov(\widehat{\beta_k}, \widehat{\beta_1})] \\ &= \left[\left(\frac{-1}{\widehat{\beta_k}}\right)^2 var(\widehat{\beta_k}) + \left(\frac{\widehat{\beta_k}}{\widehat{\beta_1^k}}^2\right) var(\widehat{\beta_1}) + 2\left(\frac{-1}{\widehat{\beta_1}}\right)\left(\frac{\widehat{\beta_k}}{\widehat{\beta_1^2}}\right) cov(\widehat{\beta_k}, \widehat{\beta_1})\right], \end{aligned} \tag{8}$$

where $\widehat{WTP_{\beta_k}}$ and $\widehat{WTP_{\beta_1}}$ are the partial derivatives of the estimated WTP values for attribute k with respect to β_k and β_1. Once the variance estimates are derived, the confidence intervals can be computed in the standard way.

Results and Discussion

This study examined consumer preferences for livestock products and general food purchasing behaviors. Average weekly household food expenditure reported was $132.77 (average household of 1.93 adults and 0.50 children). In 2011, the average American household spent approximately $124

each week on food expenditure (Bureau of Labor Statistics, 2012).[4] The majority of respondents reported purchasing and consuming the ham products investigated in this analysis. Eighty-eight percent of survey respondents consumed lunchmeat, and 63% of lunchmeat-purchasing households indicated that ham was their first or second most frequently purchased variety of lunchmeat. Of those households that reported purchasing lunchmeat, most consumed less than one pound a week. Specifically, 1% reported not consuming any lunchmeat in a typical week, 37% consumed less than 8 oz. per week, 40% consumed 8 oz. to 16 oz. per week, and 22% consumed more than 16 oz. per week. Smoked ham was purchased by 84% of households in this study. The most popular types of smoked ham purchased were half a ham, ham steaks or ham cubes, and spiral-cut bone-in ham. Nearly half, 46%, of ham-consuming households purchased smoked ham at least once per month, 2% purchased it five to eleven times per year, 16% three to four times per year, 28% one to two times per year and 7% did not purchase smoked ham during the typical year. Ham was reportedly consumed at regular meals by 41% of ham-consuming households, at major holidays by 44%, and at gatherings other than major holidays by 15%.

Willingness to Pay

The coefficients of the parameters estimated in the RPL model for smoked ham and ham lunchmeat are displayed in table 3. All parameters except for pork-industry-verified individual crates/stalls in smoked ham were found to be statistically significant. Interpretation of individual coefficients is discouraged in random utility models; however, the coefficients were used to estimate WTP means and confidence intervals. All explanatory variables except for *Opt Out* and *Price* were specified to vary normally across the sample. In both models, all of the random parameters have statistically significant standard deviations (table 3). Furthermore, both smoked ham and ham lunchmeat models had random parameters with statistically significant diagonal elements in the Cholesky matrix, which indicates the presence of preference heterogeneity (Appendix C). Consequently, the mean WTP estimates cannot be interpreted as being representative of the whole sample.

The results of mean WTP estimates and 95% confidence intervals for smoked ham and ham lunchmeat are presented in table 4. When interpreting these values, this number represents the value consumers place on verification of this attribute in its most resource intensive/stringent case at the retail level (table 2, Appendix A). For example, WTP values for USDA-verified pasture access should be interpreted as the dollars per pound the consumer is willing to pay for the USDA-PVP to certify that the animal was raised on an operation certified to provide animals with access to grass pasture (when weather permits). Further, retailer-verified antibiotic use indicates the dollars per pound the consumer would be willing to pay for a retailer to certify that the animal was raised on an operation certified to not administer antibiotics to animals. The pork-industry-verified individual crates/stalls attribute specifies the dollars per pound the consumer is willing to pay to have a pork-industry program certify that the animal was raised on an operation certified to not confine animals in individual crates, stalls, or cages.

The mean WTP estimations for the pasture access credence attribute were highest when verified by the USDA-PVP program, compared to retailer or pork-industry verification, for both smoked ham and ham lunchmeat. Further, for smoked ham, USDA-verified pasture access had the highest mean WTP ($4.34/lb.) of all the attribute-verifier combinations investigated. For smoked ham, pasture access verified by a retailer or the pork industry had mean WTP estimates of $2.85/lb. and $2.76/lb. For ham lunchmeat, mean WTP estimates were the highest for USDA verification ($3.56/lb.), followed by pork-industry certification ($2.96/lb.) and retailer certification ($2.77/lb.).

[4] Bureau of Labor Statistics (2012) reported annual food spending of $6,458 for the average household. Assuming that annual spending was evenly allocated throughout the year, the weekly expenditure reported here was calculated by dividing the $6,458 evenly over fifty-two weeks.

Table 3. Parameters (Standard Errors) for Smoked Ham and Ham Lunchmeat from Correlated Random Parameters Logit

	Smoked Ham		Ham Lunchmeat	
Variable	**Coefficient Estimates (n=399)**	**Standard Deviation Estimates**	**Coefficient Estimates (n=399)**	**Standard Deviation Estimates**
Price	−0.2266***		−0.2551***	
	(0.0098)		(0.0097)	
USDA-verified pasture access	0.4913***	0.3525***	0.4545***	0.3489***
	(0.0564)	(0.0487)	(0.0641)	(0.0557)
Retailer-verified pasture access	0.3229***	0.5579***	0.3529***	0.6000***
	(0.0744)	(0.0826)	(0.0845)	(0.0847)
Pork-industry-verified pasture access	0.3129***	0.5546***	0.3772***	0.4912***
	(0.0872)	(0.0977)	(0.0919)	(0.1016)
USDA-verified antibiotic use	0.4801***	0.6021***	0.5166***	0.5117***
	(0.0654)	(0.0869)	(0.0726)	(0.0978)
Retailer-verified antibiotic use	0.3536***	0.8289***	0.3098***	0.6081***
	(0.0769)	(0.0919)	(0.0789)	(0.0892)
Pork-industry-verified antibiotic use	0.3812***	0.6674***	0.3209***	0.8871***
	(0.0811)	(0.1059)	(0.0928)	(0.1306)
USDA-verified individual crates/stalls	0.3418***	0.6776***	0.4265***	0.6146***
	(0.0656)	(0.0800)	(0.0650)	(0.0786)
Retailer-verified individual crates/stalls	0.1969***	0.4031***	0.2779***	0.6105***
	(0.0756)	(0.0912)	(0.0814)	(0.1004)
Pork-industry-verified individual crates/stalls	0.0305	0.6228***	0.1612*	0.5029***
	(0.0755)	(0.1059)	(0.0702)	(0.0909)
Opt out	−3.0697***		−3.4057***	
	(0.1430)		(0.1567)	

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% level.

Similar results were found when examining the WTP estimates for verification of antibiotic use. For both smoked ham and ham lunchmeat, the WTP mean was highest for USDA-verified antibiotic use, then pork-industry certification and retailer certification.

Individual crates/stalls has the largest variation across verifiers in mean WTP estimates. The WTP for pork-industry-verified individual crates/stalls was found to be not statistically different from zero for smoked ham. USDA and retailer verification of individual crates/stalls were significant in the smoked ham model, with a higher mean WTP for USDA verification. All three verification/attribute combinations for individual crates/stalls were significant for the ham lunchmeat model. The ordering from highest to lowest WTP by verification entity in ham lunchmeat was USDA, retailer, and industry. The lowest WTP in the ham lunchmeat model was for pork-industry-verified individual crates/stalls.

Analysis of the percentage of consumers with a higher WTP than various specified levels can provide additional insight beyond the mean WTP estimates alone. Appendix D details the percentage of consumers willing to pay more than various specified levels, in twenty-five cent increments. Using

Table 4. Mean Willingness-to-Pay Estimates and 95% Confidence Intervals for Smoked Ham and Ham Lunchmeat

Variable	Smoked Ham		Ham Lunchmeat		P-Value Comparing WTP between Smoked Ham and Ham Lunchmeat[a]
	Mean WTP Est.	WTP 95% Confidence Interval Estimates	Mean WTP Est.	WTP 95% Confidence Interval Estimates[a]	
USDA-verified pasture access	$ 4.34	[3.83, 4.85]	$ 3.56	[3.07, 4.06]	0.9709
Retailer-verified pasture access	$ 2.85	[2.23, 3.47]	$ 2.77	[2.15, 3.39]	0.7182
Pork-industry-verified pasture access	$ 2.76	[1.98, 3.54]	$ 2.96	[2.23, 3.68]	0.5818
USDA-verified antibiotic use	$ 4.24	[3.68, 4.80]	$ 4.05	[3.51, 4.59]	0.8460
Retailer-verified antibiotic use	$ 3.12	[2.44, 3.80]	$ 2.43	[1.80, 3.05]	0.8660
Pork-industry-verified antibiotic use	$ 3.37	[2.66, 4.07]	$ 2.52	[1.81, 3.22]	0.9050
USDA-verified individual crates/stalls	$ 3.02	[2.44, 3.60]	$ 3.34	[2.83, 3.86]	0.5951
Retailer-verified individual crates/stalls	$ 1.74	[1.07, 2.41]	$ 2.18	[1.55, 2.80]	0.4484
Pork-industry-verified individual crates/stalls	$ 0.27	[-0.38, 0.92]	$ 1.26	[0.73, 1.80]	0.1564

Notes: 95% confidence intervals were found using the delta method Hole (2007). [a] A complete combinatorial test was performed on the attribute WTP/average price of each product ($5.79 for smoked ham and $6.74 for lunchmeat). Interpretation is such that a p-value of less than 0.05 would indicate statistical signficance at the 5% level.

the distributions obtained surrounding mean WTP values, the percentage of consumers who would be willing to pay more than a specified amount for verification of each attribute can be determined. Analysis of the percentage of consumers willing to spend various amounts can provide insight to producers and marketers regarding the size of the potential market for various verified attributes.

Investigating the overlap of the 95% confidence intervals of the WTP estimates across verifiers for an attribute can be used to determine whether there are statistical differences across WTP estimates for the same attribute verified by a different entity for the same product.[5] In both the smoked ham and ham lunchmeat models, the confidence intervals for USDA-verified individual crates/stalls are higher and do not overlap with the retailer-verified or pork-industry-verified individual crates/stalls. Therefore, consumers potentially prefer the USDA to verify the individual crates/stalls attribute over a retailer or the pork industry. Additionally, because the pork-industry-verified individual crates/stalls WTP mean estimate in the smoked ham model can be interpreted as zero, retailer certification is also preferred over pork-industry certification for individual crates/stalls in smoked ham. This large variation in WTP values for individual crates/stalls could possibly be attributed to pig housing being hotly debated in the media. Potentially, consumers view the government (USDA) as a more neutral and trustworthy organization to verify non-use of individual crates/stalls. Figure 1 illustrates survey respondents' concern for various pork-industry practices. In this survey, when asked which pork-industry practices reduced the welfare of pigs, many consumers in the sample expressed concern about housing methods, namely using gestation crates,[6] confining hogs indoors, housing sows in group pens,[7] and the use of farrowing crates.[8]

[5] Examining the overlap of 95% confidence intervals is an intuitive method that allows for visual comparison when confidence intervals are presented. Schenker and Gentleman (2001) show that the comparison of overlap in 95% confidence intervals is more conservative than the standard methods of significance testing when the null hypothesis is true and falsely rejects the null hypothesis more frequently than the standard methods when the null hypothesis is false.

[6] Participants were shown the following definition for use of gestation crates: A crate or cage in which a sow is individually confined during the animal's four-month pregnancy until the time of farrowing (giving birth to piglets).

[7] Participants were shown the following definition for group pen: A pen in which a group of sows is placed during the animal's four-month pregnancy until the time of farrowing (giving birth to piglets).

[8] Participants were shown the following definition for farrowing crate: A crate or cage in which a sow is individually confined at time of farrowing (giving birth to piglets).

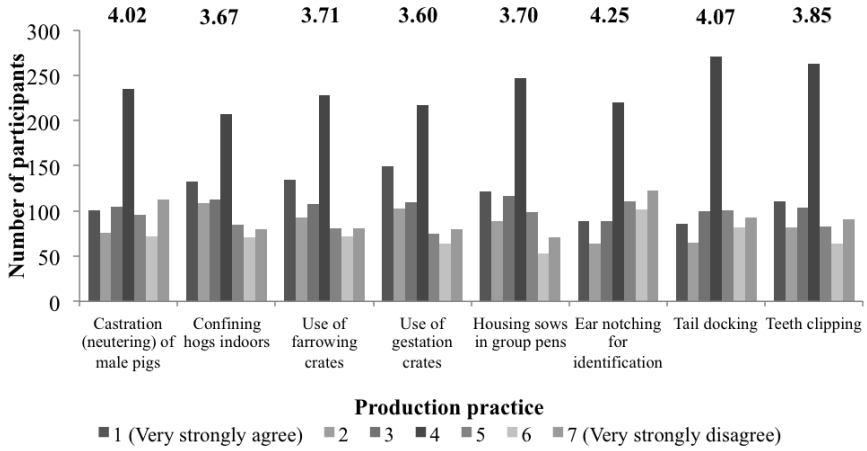

Figure 1. Survey Respondents' Agreement that Practice Reduces the Welfare of Pigs

Comparisons of Willingness to Pay across Ham Products

A complete combinatorial method proposed by Poe, Giraud, and Loomis (2005) was used to determine whether there was a statistical difference between the WTP estimates for the same verified attribute across smoked ham and ham lunchmeat. The test was conducted using the ratio of the WTP estimate to the average product price ($5.79 for smoked ham and $6.74 for lunchmeat). No significant differences in WTP for verified attributes were found across products, as indicated by the nonsignificant p-values in table 4. Therefore, this analysis does not support the hypothesis that statistical differences exist in WTP values across the ham products evaluated. This result differs from those of Olynk and Ortega (2013), who found statistical differences across WTP estimates (in all but one case) for the same verified attributes across ice cream and yogurt, concluding that consumers had different preferences for ice cream and yogurt, even though both are produced from milk.

Several reasons for the differences between the ham and lunchmeat versus yogurt and ice cream findings can be hypothesized. Smoked ham and ham lunchmeat are potentially more similar in the minds of consumers than ice cream and yogurt. Smoked ham and ham lunchmeat both have "ham" in their name, which may therefore create more of an association between the products because of common terminology. Furthermore, the terminology "ham" could lead the consumer to associate smoked ham and ham lunchmeat more with the pig (the animal itself) than ice cream and yogurt are associated with the dairy cow. Neither ice cream nor yogurt have "dairy" as part of their name, perhaps allowing more differentiation between the dairy products and the cow itself. When smoked ham and ham lunchmeat are purchased, they are potentially closer to one another in the store than ice cream (freezer section) and yogurt (refrigerated dairy section). Fifty-three percent of lunchmeat-consuming households indicated that they purchased prepacked lunchmeat, which is often located in the processed meats case or very close to the meats section itself. Forty-seven percent of lunchmeat-consuming households reportedly purchased lunchmeat primarily from the deli counter, which is increasingly located within the prepared foods section of the supermarket. However, it is acknowledged that a great deal of variation exists in supermarket layouts and consumer association of deli foods versus meat products depending on consumer perceptions and even geographic location.

Data regarding how lunchmeat and smoked ham products were consumed was collected. Lunchmeat was consumed on a sandwich 75% of the time, by itself 10% of the time, in a salad 7% of the time, along with a snack 7% of the time, or another way not listed 1% of the time. Smoked ham was reportedly consumed as the main course 74% of the time, used in a casserole 11% of the time, as an ingredient 11% of the time, or used in some other way 3% of the time. Although

differences exist in eating occasion across smoked ham and ham lunchmeat (cold at lunchtime on a sandwich versus usually served warm as a main dish) these differences could not be as great as those of ice cream and yogurt. Ice cream is usually served as a sweet dessert, whereas yogurt is commonly viewed as a healthy snack, breakfast food, or as part of lunch. Potentially, consumers view smoked ham and ham lunchmeat as being equally "healthy." Finally, a major difference between dairy and meat (in this case, ham) products that cannot be overlooked is the necessity for slaughter to produce meat. Both smoked ham and ham lunchmeat (as all meats) require the slaughter of the animal. It can be hypothesized that this necessity for slaughter places meats closer together in the mind of the consumer than other product categories. In contrast, neither yogurt nor ice cream necessitates the slaughter of an animal for their production. Whether slaughter groups meat products together in the consumers' mind with reference to animal welfare attributes is beyond the scope of this analysis, but the possibility of meats being more closely associated with one another than dairy products are associated with one another is presented as a possible explanation for the differences between the findings in this analysis and previous work on dairy products.

Conclusions

Evidence of quickly changing food markets can be easily discerned when looking at the vast number of products with numerous attributes available on supermarket shelves today. This study investigated three verified credence attributes—pasture access, antibiotic use, and individual crates/stalls—for smoked ham and ham lunchmeat. Hypothetical choice experiments were conducted online and analyzed using the random parameters logit model framework to determine WTP estimates. Participants were willing to pay the most for USDA verification for all three attributes in both products. Differences across certification entities existed, leading to questions about consumers' trust in the pork industry (as a verifier), with the recognition that pork housing has been widely debated in the media. No statistical differences were found when comparing WTP values across smoked ham and ham lunchmeat. This finding is contrary to past studies that have compared WTP estimates for processed dairy products, potentially showing differences for preferences between meat and dairy products.

"Humans *chose* to raise farm animals, and the emphasis is placed on the word chose because that choice is still ours to make" (Norwood and Lusk, 2011, p. 8). It is important to recognize that consumers choose how they want animals for meat or milk production to be raised with money: "Prices tell farmers what to produce" (Norwood and Lusk, 2011, p. 45). If consumers are willing to pay the necessary price to cover the cost of producing livestock products with desired attributes, then a market for these goods will be created. Therefore, WTP analyses and identification of preferences for different cuts of meat, with varying levels of processing, and livestock products, from all livestock and poultry species, should be conducted to better understand how to satisfy consumer demands in the marketplace. Additionally, costs for these production systems will need to be estimated to determine whether offering these attributes is feasible.

Past WTP studies have focused on less processed and finite sets of meat cuts. This study contributes to the literature by analyzing two previously unstudied pork products to allow for a more complete view of the pig. Although statistical differences were not found across the two ham products investigated, if potential differences in consumers' WTP across cuts of meat from the same animals are not investigated, producers could potentially over-invest in credence attributes. For example, a positive willingness to pay for verified pasture access in pork chops only represents one cut of pork. What is the total consumer value for that attribute for the whole carcass?

[Received May 2013; final revision received October 2013.]

References

Alfnes, F. "Stated Preferences for Imported and Hormone-Treated Beef: Application of a Mixed Logit Model." *European Review of Agricultural Economics* 31(2004):19–37.

Bureau of Labor Statistics. "Consumer Expenditures—2011." 2012. Available online at http://www.bls.gov/news.release/cesan.nr0.htm.

Carlsson, F., P. Frykblom, and C. J. Lagerkvist. "Consumer Willingness to Pay for Farm Animal Welfare: Mobile Abattoirs versus Transportation to Slaughter." *European Review of Agricultural Economics* 34(2007):321–344.

Caswell, J. A. "How Labeling of Safety and Process Attributes Affects Markets for Food." *Agricultural and Resource Economics Review* 27(1998):151–158.

Caswell, J. A., and E. M. Mojduszka. "Using Informational Labeling to Influence the Market for Quality in Food Products." *American Journal of Agricultural Economics* 78(1996):1248–1253.

Dickinson, D. L., and D. Bailey. "Meat Traceability: Are U.S. Consumers Willing to Pay for It?" *Journal of Agricultural and Resource Economics* 27(2002):348–364.

Fleming, C. M., and M. Bowden. "Web-Based Surveys as an Alternative to Traditional Mail Methods." *Journal of Environmental Management* 90(2009):284–292.

Frewer, L. J., A. Kole, S. M. A. Van de Kroon, and C. de Lauwere. "Consumer Attitudes Towards the Development of Animal-Friendly Husbandry Systems." *Journal of Agricultural and Environmental Ethics* 18(2005):345–367.

Gao, Z., and T. C. Schroeder. "Effects of Label Information on Consumer Willingness-to-Pay for Food Attributes." *American Journal of Agricultural Economics* 91(2009):795–809.

Gracia, A., M. L. Loureiro, and R. M. Nayga. "Valuing Animal Welfare Labels with Experimental Auctions: What Eo We Learn from Consumers?" International Association of Agricultural Economists, 2009.

Greene, W. H. *Econometric Analysis*. Upper Saddle River, NNJ: Prentice Hall, 2003, 5th ed.

Hole, A. R. "A Comparison of Approaches to Estimating Confidence Intervals for Willingness to Pay Measures." *Health Economics* 16(2007):827–840.

Hudson, D., and J. Lusk. "Activists and Corporate Behavior in Food Processing and Retailing: A Sequential Bargaining Game." *Journal of Agricultural and Resource Economics* 29(2004):79–93.

Hudson, D., L. H. Seah, D. Hite, and T. Haab. "Telephone Presurveys, Self-Selection, and Non-Response Bias to Mail and Internet Surveys in Economic Research." *Applied Economics Letters* 11(2004):237–240.

Lancaster, K. J. "A New Approach to Consumer Theory." *Journal of Political Economy* 74(1966):132–157.

Lind, L. W. "Consumer Involvement and Perceived Differentiation of Different Kinds of Pork: A Means-End Chain Analysis." *Food Quality and Preference* 18(2007):690–700.

Loureiro, M. L., and W. J. Umberger. "A Choice Experiment Model for Beef: What US Consumer Responses Tell Us about Relative Preferences for Food Safety, Country-of-Origin Labeling and Traceability." *Food Policy* 32(2007):496–514.

Louviere, J. J., T. Islam, N. Wasi, D. Street, and L. Burgess. "Designing Discrete Choice Experiments: Do Optimal Designs Come at a Price?" *Journal of Consumer Research* 35(2008):360–375.

Lusk, J. L. "Effects of Cheap Talk on Consumer Willingness-to-Pay for Golden Rice." *American Journal of Agricultural Economics* 85(2003):840–856.

Lusk, J. L., and F. B. Norwood. "Effect of Experimental Design on Choice-Based Conjoint Valuation Estimates." *American Journal of Agricultural Economics* 87(2005):771–785.

———. "A Survey to Determine Public Opinion about the Ethics and Governance of Farm Animal Welfare." *Journal of the American Veterinary Medical Association* 233(2008):1121–1126.

———. "Bridging the Gap between Laboratory Experiments and Naturally Occurring Markets: An Inferred Valuation Method." *Journal of Environmental Economics and Management*

58(2009):236–250.
Lusk, J. L., J. Roosen, and J. A. Fox. "Demand for Beef from Cattle Administered Growth Hormones or Fed Genetically Modified Corn: A Comparison of Consumers in France, Germany, the United Kingdom, and the United States." *American Journal of Agricultural Economics* 85(2003):16–29.
Manski, C. F. "The Structure of Random Utility Models." *Theory and Decision* 8(1977):229–254.
Marta-Pedroso, C., H. Freitas, and T. Domingos. "Testing for the Survey Mode Effect on Contingent Valuation Data Quality: A Case Study of Web Based versus In-Person Interviews." *Ecological Economics* 62(2007):388–398.
McFadden, D. "Conditional Logit Analysis of Qualitative Choice Behavior." In P. Zarembka, ed., *Frontiers in Econometrics,* Economic Theory and Mathematical Economics. New York: Academic Press, 1973, 105–142.
Nilsson, T., K. Foster, and J. L. Lusk. "Marketing Opportunities for Certified Pork Chops." *Canadian Journal of Agricultural Economics* 54(2006):567–583.
Norwood, F. B. "The Private Provision of Animal-Friendly Eggs and Pork." *American Journal of Agricultural Economics* 94(2012):509–514.
Norwood, F. B., and J. L. Lusk. *Compassion, by the Pound: The Economics of Farm Animal Welfare*. New York: Oxford University Press, 2011.
Olsen, S. B. "Choosing between Internet and Mail Survey Modes for Choice Experiment Surveys Considering Non-Market Goods." *Environmental and Resource Economics* 44(2009):591–610.
Olynk, N. J., and D. L. Ortega. "Consumer Preferences for Verified Dairy Cattle Management Practices in Processed Dairy Products." *Food Control* 30(2013):298–305.
Olynk, N. J., G. T. Tonsor, and C. A. Wolf. "Consumer Willingness to Pay for Livestock Credence Attribute Claim Verification." *Journal of Agricultural and Resource Economics* 35(2010a):261–280.
———. "Verifying Credence Attributes in Livestock Production." *Journal of Agricultural and Applied Economics* 42(2010b):439–452.
Poe, G. L., K. L. Giraud, and J. B. Loomis. "Computational Methods for Measuring the Difference of Empirical Distributions." *American Journal of Agricultural Economics* 87(2005):353–365.
Revelt, D., and K. Train. "Mixed Logit with Repeated Choices: Households' Choices of Appliance Efficiency Level." *Review of Economics and Statistics* 80(1998):647–657.
Scarpa, R., and T. del Giudice. "Market Segmentation via Mixed Logit: Extra-Virgin Olive Oil in Urban Italy." *Journal of Agricultural and Food Industrial Organization* 2(2004):141–160.
Schenker, N., and J. F. Gentleman. "On Judging the Significance of Differences by Examining the Overlap Between Confidence Intervals." *American Statistician* 55(2001):182–186.
Schulz, L. L., and G. T. Tonsor. "Cow-Calf Producer Preferences for Voluntary Traceability Systems." *Journal of Agricultural Economics* 61(2010):138–162.
Schweikhardt, D. B., and W. P. Browne. "Politics by Other Means: The Emergence of a New Politics of Food in the United States." *Review of Agricultural Economics* 23(2001):302–318.
Tonsor, G. T., N. J. Olynk, and C. A. Wolf. "Consumer Preferences for Animal Welfare Attributes: The Case of Gestation Crates." *Journal of Agricultural and Applied Economics* 41(2009):713–730.
Tonsor, G. T., T. C. Schroeder, J. A. Fox, and A. Biere. "European Preferences for Beef Steak Attributes." *Journal of Agricultural and Resource Economics* 30(2005):367–380.
Tonsor, G. T., and C. A. Wolf. "Drivers of Resident Support for Animal Care Oriented Ballot Initiatives." *Journal of Agricultural and Applied Economics* 42(2010):419–428.
———. "On Mandatory Labeling of Animal Welfare Attributes." *Food Policy* 36(2011):430–437.
Tonsor, G. T., C. A. Wolf, and N. J. Olynk. "Consumer Voting and Demand Behavior Regarding Swine Gestation Crates." *Food Policy* 34(2009):492–498.
U.S. Census Bureau. "State and Country Quick Facts." 2013. Available online at http://quickfacts.census.gov/qfd/states/00000.html.

U.S. Department of Agriculture, Grain Inspection, Packers and Stockyards Administration. "Federal Grain Inspection Service Directive No. 9180.79. Appendix 1: Process Verified Program." 2007. Available online at http://www.gipsa.usda.gov/fgis/insp_weigh/inspwgh/pvp/9180-79.pdf.

Wolf, C. A., G. T. Tonsor, and N. J. Olynk. "Understanding U.S. Consumer Demand for Milk Production Attributes." *Journal of Agricultural and Resource Economics* 36(2011):326–342.

Appendix A: Choice Experiment Definitions

Individual Crates/Stalls refers to the use of practices individually confining animals where:

- **Not Permitted** means the animal was raised on an operation certified to not confine animals in individual crates, stalls, or cages
- **Permitted** indicates that no claims regarding confinement of animals in individual crates, stalls, or cages are being made

Pasture Access refers to the ability of animals to access grass pasture (when weather permits) and not be confined solely to indoor production facilities:

- **Required** means the animal was raised on an operation certified to provide animals with access to grass pasture (when weather permits)
- **Not Required** indicates that no claims regarding access to grass pasture are being made

Antibiotic Use refers to the use of antibiotics on animals where:

- **Not Permitted** means the animal was raised on an operation certified to not administer antibiotics to animals
- **Permitted** indicates that no claims regarding use of antibiotics are being made

Certification Entity refers to the process used in verifying animal welfare and handling claims made on the product label where:

- **USDA-PVP** means the label is backed by a producer's participation in a certification and process verification program (PVP) managed by the United States Department of Agriculture (USDA)
- **Retailer Certification** means the label is backed by a producer's participation in a certification and verification program managed by a private, third party retailer that is neither associated with livestock industry nor any consumer groups
- **Pork Industry Certification** means the label is backed by a producer's participation in a certification and verification program managed by the pork industry itself

Appendix B: Example Choice Set Scenarios for Smoked Ham and Ham Lunchmeat

Table B1. Example Smoked Ham Purchasing Scenario

Attribute	Option A	Option B	Option C
Price ($/lb.)	$9.89	$5.79	
Individual Crates/Stalls	Not Permitted	Not Permitted	I choose not
Pasture Access	Required	Not Required	to purchase
Antibiotic Use	Not Permitted	Not Permitted	either product
Certification Entity	Pork Industry	Retailer Certification	
I Choose:	___	___	___

Table B2. Example Ham Lunchmeat Purchasing Scenario

Attribute	Option A	Option B	Option C
Price ($/lb.)	$6.74	$2.49	
Individual Crates/Stalls	Permitted	Not Permitted	I choose not
Pasture Access	Not Required	Not Required	to purchase
Antibiotic Use	Not Permitted	Not Permitted	either product
Certification Entity	USDA-PVP	USDA-PVP	
I Choose:	___	___	___

Appendix C: Smoked Ham and Ham Lunchmeat Cholesky and Correlation Matrices

Table C1. Smoked Ham Cholesky Matrix

	US_PA	RT_PA	PI_PA	US_AU	RT_AU	PI_AU	US_IC	RT_IC	PI_IC
US_PA	0.3525***								
RT_PA	−0.4324***	0.3525***							
PI_PA	−0.4017***	−0.1482	0.3525***						
US_AU	−0.1601***	−0.5342***	−0.1303	0.1858***					
RT_AU	−0.2183**	−0.7041***	0.0734	−0.3223***	0.1858***				
PI_AU	−0.2434**	−0.5587***	−0.0430	−0.1742	−0.0858	0.1858***			
US_IC	−0.3181***	−0.1360	−0.4010***	−0.2600***	0.0949	−0.3194***	0.0006		
RT_IC	−0.1489	0.0531	−0.0370	−0.0128	−0.2480***	−0.2157***	0.1670	0.0006	
PI_IC	−0.4656***	−0.0047	0.0520	0.1537	−0.0072	0.2928***	0.1438	0.1955*	0.0006

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% level.

Table C2. Smoked Ham Correlation Matrix

	US_PA	RT_PA	PI_PA	US_AU	RT_AU	PI_AU	US_IC	RT_IC	PI_IC
US_PA	1.0000	−0.7750	−0.7243	−0.2660	−0.2633	−0.3647	−0.4694	−0.3693	−0.7476
RT_PA	−0.7750	1.0000	0.3926	−0.3545	−0.3326	−0.2463	0.2370	0.3695	0.5747
PI_PA	−0.7243	0.3926	1.0000	0.2921	0.4739	0.4468	0.0175	0.1739	0.5967
US_AU	−0.2660	−0.3545	0.2921	1.0000	0.6844	0.7731	0.3127	−0.0086	0.2637
RT_AU	−0.2633	−0.3326	0.4739	0.6844	1.0000	0.8740	0.4223	−0.1483	0.1121
PI_AU	−0.3647	−0.2463	0.4468	0.7731	0.8740	1.0000	0.3283	−0.0312	0.3416
US_IC	−0.4694	0.2370	0.0175	0.3127	0.4223	0.3283	1.0000	0.3801	−0.0147
RT_IC	−0.3693	0.3695	0.1739	−0.0086	−0.1483	−0.0312	0.3801	1.0000	0.1112
PI_IC	−0.7476	0.5747	0.5967	0.2637	0.1121	0.3416	−0.0147	0.1112	1.0000

Table C3. Ham Lunchmeat Cholesky Matrix

	US_PA	RT_PA	PI_PA	US_AU	RT_AU	PI_AU	US_IC	RT_IC	PI_IC
US_PA	0.3489***								
RT_PA	−0.4881***	0.3489***							
PI_PA	−0.3365**	0.0798	0.3489***						
US_AU	−0.2380***	0.3532***	−0.0318	0.2818***					
RT_AU	−0.2638***	0.4395***	−0.0489	0.1588*	0.2818***				
PI_AU	−0.4920***	0.3877***	0.3032**	−0.3719***	−0.2912**	0.2818***			
US_IC	−0.2374***	0.0771	−0.3214***	−0.1217	−0.3608***	−0.2138**	0.1466**		
RT_IC	−0.2426**	0.1689*	−0.0739	−0.1618*	−0.2156**	−0.4308***	0.0106	0.1466**	
PI_IC	−0.2589***	0.0177	−0.1822*	−0.1490	−0.0851	−0.2919***	0.1108	−0.0627	0.1466**

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% level.

Table C4. Ham Lunchmeat Correlation Matrix

	US_PA	RT_PA	PI_PA	US_AU	RT_AU	PI_AU	US_IC	RT_IC	PI_IC
US_PA	1.0000	−0.8135	−0.6849	−0.4651	−0.4338	−0.5547	−0.3862	−0.3974	−0.5149
RT_PA	−0.8135	1.0000	0.6517	0.7798	0.7732	0.7054	0.3872	0.4842	0.4394
PI_PA	−0.6849	0.6517	1.0000	0.3866	0.3575	0.6937	−0.0865	0.2311	0.1011
US_AU	−0.4651	0.7798	0.3866	1.0000	0.8495	0.3075	0.1898	0.2374	0.1232
RT_AU	−0.4338	0.7732	0.3575	0.8495	1.0000	0.2674	−0.0235	0.1492	0.1222
PI_AU	−0.5547	0.7054	0.6937	0.3075	0.2674	1.0000	0.2555	0.3029	0.1725
US_IC	−0.3862	0.3872	−0.0865	0.1898	−0.0235	0.2555	1.0000	0.7609	0.8051
RT_IC	−0.3974	0.4842	0.2311	0.2374	0.1492	0.3029	0.7609	1.0000	0.7800
PI_IC	−0.5149	0.4394	0.1011	0.1232	0.1222	0.1725	0.8051	0.7800	1.0000

Appendix D: Percentage of Consumers Willing to Pay at Different Specified Levels

Table D1. Percentage of Consumers with Willingness to Pay (WTP) Greater than Specific Increments for Verified Attributes with Statistical Evidence of Positive Consumer Demand for Smoked Ham and Ham Lunchmeat

	Smoked Ham														
	>$1.00	>$1.25	>$1.50	>$1.75	>$2.00	>$2.25	>$2.50	>$2.75	>$3.00	>$3.25	>$3.50	>$3.75	>$4.00	>$4.25	>$4.50
USDA-verified pasture access	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	90%	1%
Retailer-verified pasture access	100%	100%	100%	100%	100%	100%	100%	85%	7%	0%	0%	0%	0%	0%	0%
Pork-industry-verified pasture access	100%	100%	100%	100%	100%	100%	95%	53%	7%	0%	0%	0%	0%	0%	0%
USDA-verified antibiotic use	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	45%	0%
Retailer-verified antibiotic use	100%	100%	100%	100%	100%	100%	100%	100%	84%	14%	0%	0%	0%	0%	0%
Pork-industry-verified antibiotic use	100%	100%	100%	100%	100%	100%	100%	100%	100%	82%	15%	0%	0%	0%	0%
USDA-verified individual crates/stalls	100%	100%	100%	100%	100%	100%	100%	100%	58%	0%	0%	0%	0%	0%	0%
Retailer-verified individual crates/stalls	100%	100%	98%	46%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Ham Lunchmeat														
	>$1.00	>$1.25	>$1.50	>$1.75	>$2.00	>$2.25	>$2.50	>$2.75	>$3.00	>$3.25	>$3.50	>$3.75	>$4.00	>$4.25	>$4.50
USDA-verified pasture access	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	84%	0%	0%	0%	0%
Retailer-verified pasture access	100%	100%	100%	100%	100%	100%	100%	56%	1%	0%	0%	0%	0%	0%	0%
Pork-industry-verified pasture access	100%	100%	100%	100%	100%	100%	100%	93%	38%	2%	0%	0%	0%	0%	0%
USDA-verified antibiotic use	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	74%	0%	0%
Retailer-verified antibiotic use	100%	100%	100%	100%	100%	96%	24%	0%	0%	0%	0%	0%	0%	0%	0%
Pork-industry-verified antibiotic use	100%	100%	100%	100%	100%	98%	55%	4%	0%	0%	0%	0%	0%	0%	0%
USDA-verified individual crates/stalls	100%	100%	100%	100%	100%	100%	100%	100%	100%	91%	1%	0%	0%	0%	0%
Retailer-verified individual crates/stalls	100%	100%	100%	100%	96%	24%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Pork-industry-verified individual crates/stalls	100%	57%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%