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AGRICULTURAL PRODUCER RESPONSES TO CHANGES IN CONSUMER DEMAND FOR PRODUCTION PROCESS ATTRIBUTES

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ABSTRACT

AGRICULTURAL PRODUCER RESPONSES TO CHANGES IN CONSUMER DEMAND FOR PRODUCTION PROCESS ATTRIBUTES

By

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Livestock producers can respond to increasing consumer demand for production process attributes by providing verifiable information on the practices employed. Consumer willingness to pay data was used to inform producer decision making regarding choosing verification entities for production processes attributes. A conceptual model was developed to aid producers in using consumer demand data to make decisions regarding provision of verified attributes. Analysis was conducted to determine whether evidence of social desirability bias was found when comparing estimates of consumer value for verified attributes across direct and indirect questioning. Statistically significant evidence of social desirability bias was found. Indirect questioning may yield more accurate representations of consumer value than direct questioning when estimating value for production process attributes for livestock products. Producer willingness to change was assessed for rbST-free milk production. Welfare impacts were calculated for dairy producers when conventional milk production systems, which allow the use of rbST, are eliminated from the producer choice set. Statistically significant welfare impacts were found for both dairy producers who did and did not use rbST prior to the elimination of the conventional system from the producer choice set.

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CHAPTER 1: GENERAL INTRODUCTION

American consumers today are interested in the production practices employed in food production and have paid mounting attention to processes like irradiation, antibiotic use, hormone use, and pesticide use (Naygo, 1996). It is becoming routine for consumers to incorporate concerns such as those for animal welfare, animal handling techniques, potential environmental impacts from use of substances such as pesticides or herbicides, and perceived social impacts into decisions regarding food purchases.[1]

Focusing on livestock products, including eggs, meat, and milk, consumers are increasingly interested in the living conditions, housing of, and handling techniques used for the animals.[2] Analyses regarding the animal welfare implications of production systems are abundant, such as the use of cages for laying hens (Matheny and Leahy, 2007), gestation crates used in pork production (Matheny and Leahy, 2007), systems used for milk production with dairy cattle (Morrow, 2002), and production systems used for rearing veal calves (Matheny and Leahy, 2007). It seems likely that consumers will continue to include information regarding animal handling techniques and animal welfare-related information in their purchasing decisions as information regarding these topics becomes increasingly abundant and easily accessed.

Consumer demand for production process attributes in livestock products has led to a need to inform consumers regarding the production practices employed on farms. Producers, marketers, and retailers can develop and implement labeling schemes to

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[1] Perceived social impacts would include locally grown food, whether food was produced by a family farm, whether laborers and employees throughout the supply chain were paid a livable wage, whether it was produced in the United States, etc.

[2] For the purposes of this analysis livestock products which are focused upon include food products only. Fiber production from livestock is not included in this analysis due to critical differences in consumer sentiment towards and production methods associated with food production versus fiber production.

provide additional information on product or production process attributes. Providing information to the consumer via labeling, however, is only valuable if consumers trust and use the information. Verification is only valuable if it increases consumer confidence in the validity of the information provided. Livestock producers are left to decide which avenue to pursue in order to gain consumer confidence that the claims they are making are indeed true.

Producers can maximize profit through their selection of verified production process attributes to provide to the market. Alternatively, if a specific production process attribute is already present in the systems used on an operation, producers can maximize profit by selecting from alternative verification methods used to communicate that attribute to the consumer. The decision facing producers regarding how to verify their production processes is not a simple case of selecting the verification process with the lowest cost to the producer. It is conceivable that the verification method in which consumers place the highest value (e.g., a federal government system) is too costly for producers to pursue, while a relatively lower valued program or verification party (e.g., a private third-party) in the eyes of consumers provides higher net returns for producers. Producers are facing decisions in the market regarding how to communicate about their products to consumers. As verification of production process attributes continues to grow in response to consumer demand for increased information, livestock producers will be faced with decisions regarding how to verify their processes and communicate with consumers in a way that the consumer trusts.

Producers are facing decisions beyond how to verify their products or how to label products to provide information that consumers want. In some cases producers are

forced to respond to changes in the market due to legislative or market pressures. Looking at market pressures for change, as consumers place pressure upon major retailers to provide products with specific attributes, those retailers in turn place pressure on their suppliers. In many cases related to food product attributes, those suppliers are livestock producers. Livestock producers face pressure from retailers to adopt (disadopt) practices and processes which consumers like (dislike) or have expressed preference for (against). If a practice is prohibited for use by regulation, or is essentially prohibited for use through market pressures, meaning that retailers will not accept the product from producers if a certain practice was used in its production, then producers face welfare impacts of having their choice set of practices reduced.

This dissertation proceeds as follows, beginning with estimation of consumer demand in Chapter II. Chapter II seeks to provide insight into the consumer valuation for verification of common production process attribute claims, providing an in-depth look at willingness to pay for verified attributes provided through different verifying entities. Chapter III presents an analysis of the producers' decisions on which verification source to employ when verifying the same claims investigated in Chapter II. Chapter III provides analysis in which producers' optimal verification decision is solved for under different sets of circumstances. Chapter IV uses survey data from Michigan dairy producers to provide in-depth information regarding producer preferences for milk production without rbST. Welfare impacts on Michigan dairy farmers of having rbST use in milk production removed from their choice set are analyzed.

CHAPTER 2: CONSUMER WILLINGNESS TO PAY FOR LIVESTOCK PRODUCTION PROCESS VERIFICATION

2.1 Introduction

Consumers are increasingly sensitive to the processes employed in food production. Livestock products, in particular, evoke consumer sentiment regarding the handling and rearing of livestock animals. Specifically, consumers are concerned about the treatment of livestock or welfare of animals used to produce meat and milk products (Frewer et al., 2005). Beyond animal welfare concerns, consumers are considering other production process attributes, such as environmental impacts, food safety implications, and social implications of production methods, when selecting food products for purchase.

Consumers will select the bundle of food products which provides them with the largest utility, as long as he or she is able to accurately determine the quality attributes of the food products (Caswell, 1998). Since the quantity and quality of the information available regarding the attributes of a food product will aid in making purchasing decisions, the confidence a consumer has that the information regarding a food product attribute is correct will affect consumer preferences for food products. Consumer confidence in the information available may depend on several factors including the specific livestock product, which attribute is verified, and the source of verification information.

Caswell and Mojduszka (1996) categorize food product attributes as either search, experience, or credence attributes. Caswell and Mojduszka (1996) classify an attribute as a search attribute if consumers are able to identify quality before purchase through either inspection or research, while an experience attribute is one in which consumers are able to determine the quality after the product is purchased and consumed, but not prior to

purchase. In contrast a credence attribute is one in which quality cannot be assessed even after the product is purchased and consumed (Caswell and Mojduszka, 1996). Specific to livestock rearing, claims surrounding animal rearing, handling, and housing practices all encompass credence attributes of the production processes used. Livestock production has many challenges associated with verification of production process attributes due to the multi-stage rearing process in many species, transfer of ownership throughout an animal's life, and complicated production systems which may differ with the stage of life of the animal. Communicating animal welfare aspects of production systems to consumers is complicated by lack of ability to verify claims through livestock product testing. To maintain consumer confidence the burden of proof lies with the producers to ensure that consumers believe producer claims.

A number of recent studies have assessed consumer willingness to pay (WTP) for animal welfare attributes in meat products (Carlsson, Frykblom, and Lagerkvist, 2007a-b; Lijenstolpe, 2008; Lusk, Norwood, and Pruitt, 2006; Tonsor, Olynk, and Wolf, 2009). Lusk and Norwood (2009) used direct questioning versus indirect questioning. Fisher (1993) determined that indirect questioning reduced social desirability bias for variables which were subject to social influence. Recently, Lusk and Norwood (2009) sought to determine if indirect questioning could reduce social desirability bias, or consumers incentive to self-report answers on a socially sensitive topic, specifically farm animal welfare, in a way that conforms to social norms.

Beyond animal welfare attributes, questions remain regarding consumer preferences and WTP to verify claims regarding production process attributes. The WTP for the actual production process attribute itself has been estimated in previous studies, however the WTP

for verification must also be considered. The WTP for verification can be assessed solely by verification source, however it is more complete to assess the WTP by verification source for specific attributes. For example, the WTP for verification of no antibiotic use claims by a consumer group versus by the USDA. This approach assessing both the verifying entity and the verified attribute allows flexibility in which consumers may place different values on claims where those values may also differ based on verifying entity.

Consumer demand for production process attributes has led to a need to inform consumers regarding food production practices. Producers, marketers, and retailers can develop and implement labeling schemes to provide additional information on product or production process attributes. Labeling of attributes for which consumers have some positive WTP will only prove valuable if consumers trust the information being provided. Verification is only valuable in this sense if it increases consumer confidence in the validity of the information provided. Given that consumer purchase decisions are affected by information available on a particular product and perceived quality of that information, verification of claims regarding production process attributes may enable increased consumer confidence.

The objective of this study is to estimate consumer WTP for verification of production process attribute claims by different verifying parties and over different livestock products. Four different production process attributes are included in this analysis, namely individual crates/stalls, pasture access, antibiotic use, and certified trucking/transport. Verification by a private third-party group, a consumer group, the USDA in their Process Verified Program (PVP),[3] and the producer his or herself (self

[3] The Grain Inspectors, Packers and Stockyards Administration (GIPSA) PVP has official procedures in place for verification of products assigned to GIPSA and services associated with marketing these

verification) is investigated for two livestock products, namely pork chops and milk. This analysis also makes a contribution by analyzing the potential social desirability bias in how consumers report their own values for animal welfare attributes. Identification of consumer WTP for verification by various parties can inform producer and marketer choice regarding verifying programs. Analysis regarding potential social desirability bias in self-reported values for animal welfare production process attributes aids in guiding future data collection techniques for consumer WTP assessments and in informing producers and marketers as to potential biases which may exist in consumer valuation estimates.

Background and Prior Research

Several studies have analyzed changing consumer preferences for food product attributes, and the WTP for certain attributes. Several studies have sought to determine what consumers are willing to pay for or to avoid certain attributes (McCluskey et al., 2003; Grannis and Thilmany, 2002; Roosen, Lusk, and Fox, 2003; Burton et al., 2001; Lusk, Roosen, and Fox, 2003; Roosen, 2003; Alfnes, 2004; Tonsor et al., 2005). Several studies have also sought to investigate products which incorporated animal friendly attributes, such as Lusk, Nilsson, and Foster (2007) and Nilsson, Foster, and Lusk (2006). Analyses have included focuses on how consumers value antibiotic use in pork production (Lusk, Norwood, and Pruitt, 2006), the impacts of generic advertising on pork demand (Capps and Park, 2002), and consumer preferences regarding the use of gestation crates in pork production (Tonsor, Olynk, and Wolf, 2009). In analyzing consumer valuation for

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products (USDA, 2007). Verification services through GIPSA are voluntary and provided to producers, marketers, processors, and other associated service providers of agricultural products for a fee (USDA, 2007).

attributes in milk production, Bernard and Bernard (2009) analyzed consumer WTP for organic, rbST-free, no antibiotics used, and conventional milk.

Producers can choose to verify claims themselves (self verification) via videotaping processes or documenting production processes. Producers could also seek third-party verification by consumer groups, such as the Certified Humane Raised and Handled® program by the Humane Farm Animal Care Program, a private firm, or through the USDA PVP. Prior analyses have urged movement towards verification of production process claims in livestock products. For example, Bernard and Bernard (2009) suggested movement towards verification of rbST-free and no antibiotic use claims in milk in a schematic such as that used in the National Organic Program. This analysis seeks to determine WTP by consumers for verification of various livestock production process claims by various verifying parties across two different livestock products. The authors are unaware of a previous analysis which examined WTP by consumers for alternative verification entities across multiple production process attributes (or in investigating a single production process attribute).

2.2 Survey Instrument and Choice Experiment

To collect information about consumer valuation of verification by various parties, consumer perceptions regarding animal welfare, animal handling systems, and production processes used in livestock rearing, an online consumer survey of representative consumers from throughout the United States was conducted.[4] A total of 1,334 respondents completed the survey; 669 respondents completed the survey with a choice experiment for pork chops and 665 respondents completed the survey with a choice experiment for milk. The survey

[4] The survey instrument, with the pork chop choice experiment, is presented in Appendix 1.

instrument was designed to elicit consumer preferences regarding valuation for and preferences surrounding verification of claims regarding livestock rearing techniques. In addition to questions surrounding preferences for animal rearing techniques and verification of claims regarding production processes employed, socio-demographic information about each respondent was collected.

The surveys were conducted through Decipher, Inc., a marketing research services provider which specializes in online survey programming, data collection, data processing and reporting, and custom technology development. Decipher, Inc. targeted one adult per household who was familiar with the food consumption patterns of the household. The average age of survey respondents was 52.7 and 52.6 years for respondents who completed the pork chops and milk choice experiments, respectively. Seventy percent of pork chop experiment respondents were female while 72% of milk respondents were female. The average household size for both pork chop and milk respondents was 2.03 adults and 0.46 kids.

Choice Experiment

Choice experiments allow researchers to estimate tradeoffs among alternatives by replicating realistic purchasing situations and allowing multiple attributes to be evaluated (Lusk, Roosen, and Fox, 2003). Consumer WTP was estimated for verification by various parties for four different attributes over two different livestock products. Appendix 2 shows the definitions of the attributes and verifying entities provided to survey respondents in preparation for the choice experiment. Each consumer surveyed was randomly allocated to

participate in a choice experiment for only one of the livestock products, in order to reduce potential survey fatigue.

Social desirability bias reflects the fact that people often have incentives to provide answers to self-reported questions about happiness, well-being, health, and attitudes that deviate from true answers in order to comply with what is socially acceptable (Lusk and Norwood, 2009). Given that animal welfare and the treatment of livestock animals used in food production can be an emotional issue, it is conceivable to think that consumers might exhibit some bias when answering questions related to animal welfare attributes. Each survey respondent considered 14 total choice experiment scenarios. Seven scenarios asked the survey respondent to select their preferred alternative from two livestock products and a no purchase option (direct questioning) and seven scenarios repeated the same choices but asked participants to select what they believe the average American would choose (indirect questioning). Survey participants were randomly selected for the ordering of direct and indirect choice experiment scenarios, resulting in half of respondents completing direct questioning before indirect questioning and half of respondents completing indirect questioning first. Direct questioning, or asking people what they would select, and indirect questioning, or asking what people think others would select, allows testing for social desirability bias (Lusk and Norwood, 2009).

Fisher (1993) compared direct and indirect questioning in an effort to determine the ability of indirect questioning to reduce social desirability bias and found that indirect questioning reduced social desirability bias on those variables which were subject to social influence (and had no significant effect on socially neutral variables).

Lusk and Norwood (2009) tested indirect questioning as a method to mitigate social desirability bias, on the topic of farm animal well-being. They assessed that the main assumption behind the use of indirect questioning is that while people want to answer in ways that are seen as socially acceptable, they are relatively unconcerned with making other people look good. We investigated social desirability bias through the use of direct and indirect questioning in consumer choice experiments. Testing for statistically significant evidence of social desirability bias across different livestock products and attributes allows us to not only identify bias existence, but to begin to understand whether the bias may be different across products or attributes.

Five aspects of animal rearing were incorporated into the choice experiments. Consumers were given information regarding whether individual crates/stalls were permitted or not permitted, pasture access was required or not required, antibiotic use was permitted or not permitted, certified trucking/transport was required or not required, and whether the certification entity was the USDA-PVP, self certification, private third party, or a consumer group. In addition to the five aspects of animal rearing and verification, consumers were presented with three different price levels for each livestock product. Boneless pork chops were offered at three different price levels ($3.24/lb, $3.99/lb, or $4.79/lb) which were selected to be consistent and comparable with prices that consumers were facing for these products in retail stores at the time the survey was administered. An example scenario from the pork chop attributes choice experiment is presented in Appendix 3. In choice sets presented identically to those above, milk was offered at $2.99/gallon, $3.99/gallon, and $4.99/gallon. The attributes and attribute levels evaluated in the choice experiments for both pork chops and milk are summarized in Table 2a.

Table 2 a. Pork chop and milk attributes and attribute levels evaluated in choice experiments

Product Attribute	Milk Attribute Levels	Pork Chop Attribute Levels
Price	\$2.99/gallon \$3.99/gallon \$4.99/gallon	\$3.24/lb \$3.99/lb \$4.79/lb
Individual Crates/Stalls	Not permitted Permitted	
Antibiotic Use	Not required Required	
Certified Trucking/Transport	Not required Required	
Certification Entity	Self Certification Consumer Group Private, 3rd Party USDA-PVP	

Each consumer was randomly presented with one of four types of information: a) *Base Information,* b) *Consumer Group Information,* c) *Industry Information*, or d) *Industry and Consumer Group Information.* Appendix 2 contains copies of each of these information treatments for both the pork and milk surveys.

The choice experiments were simulated shopping experiences which did not include the exchange of real livestock products or money, although the instructions included stated *"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 information was provided to survey participants as part of a strategy of "cheap-talk"

aimed to reduce hypothetical bias in the choice experiment simply by informing participants of this bias prior to their participation (Lusk, 2003).

2.3 Research Methods

Random Utility Theory

Choice experiments involve asking individuals to choose from alternative bundles of attributes, as opposed to rating or ranking them (Adamowicz et al., 1998). Random utility theory, which frequently underlies analysis utilizing choice experiments assumes economic agents seek to maximize their expected utility subject to the choice set that they are given. However, the individual's utility is considered a random variable because the researcher has incomplete information (Manski, 1977). Let utility be the sum of observable and unobservable components $U_{jt} = V_{jt} + \varepsilon_{jt}$, where U_{jt} is the latent, unobservable utility for the j-th alternative in choice scenario t, V_{jt} is the observable, systematic portion of utility determined by the attributes, and ε_{jt} is the random component of utility, independently and identically distributed over all alternatives and choice scenarios. The probability that alternative j will be selected is the probability that the added utility from this selection is greater than (or equivalent to) choosing another alternative presented in the choice experiment. The utilities associated with each alternative are not directly observable because they include an unobserved component, therefore researchers have determined the probability of selecting alternative j as $\mathrm{P}(j) = \mathrm{P}(v_j + \varepsilon_j \geq v_k + \varepsilon_k;\ j \neq k\ \ \forall_j \in N)$, where N is the total set of alternatives available to the participant (Boxall and Adamowicz, 2002; Adamowicz et al., 1998). The resulting probability that alternative j is selected can be

expressed as $P(j) = \frac{e^{\mu\beta Xj}}{\sum_{k \in N} e^{\mu\beta X_k}}$ where μ is a scale parameter which is inversely related to the variance of the error term (Lusk, Roosen, and Fox, 2003) and β is a vector of parameters (Boxall and Adamowicz, 2002; Adamowicz et al., 1998).[5]

Assuming the systematic component of the total utility U_{jt} is linear in parameters the specification of the general model is, $V_j = \beta_1 x_{j1} + \beta_2 x_{j2} + ... + \beta_n x_{jn}$ where x_{jn} is the *n*-th attribute for alternative *j* and β_n is a vector of parameters associated with the *n-th* attribute of the *j*-th alternative. The βs are utility parameters to be estimated in the model. Multinomial logit models assume that homogeneous preferences exist for the product attributes.

Random Parameters Logit

Recent literature and research suggests that consumers possess heterogeneous preferences, therefore employing a model that allows heterogeneous preferences is appropriate (Lusk, Roosen, and Fox, 2003; Alfnes, 2004; and Tonsor et al., 2005). Two common methods which allow preference heterogeneity are latent class models and random parameters logit (RPL) (also called mixed logit). The RPL model allows for random taste variation within the surveyed group of consumers. The RPL is free of the independence of irrelevant alternatives assumption and allows correlation in unobserved factors over time (Revelt and Train, 1998; Train, 2003; Tonsor et al., 2005). Through the use of the RPL we

[5] The scale parameter μ is assumed to equal one for the remainder of this analysis following similar analyses because it is unidentifiable in any given data set (Lusk, Roosen, and Fox, 2003).

are able to directly estimate the heterogeneity in consumer preferences across the evaluated attributes. The random utility of the consumer (*U*) is underlying the RPL model. Following Tonsor et al. (2005), the utility of attribute *j* for individual *i* in choice set *t* in the RPL model is generally presented as follows, $U_{ijt} = v_{ijt} + \lfloor u_{ij} + \varepsilon_{ijt} \rfloor$, where v_{ijt} is the systematic portion of the utility function, u_{ij} is an error term which is distributed normally over consumers and alternatives (but not choice sets), and ε_{ijt} is the stochastic error, independently and identically distributed over all consumers, attributes and choice sets. A panel set of data is described here, in which the cross-sectional element is the consumer, *i*, and the time series component is the choice scenario *t* (Alfnes, 2004; Tonsor et al., 2005).[6] In the random parameter logit model described here, the probability that consumer *i* chooses alternative *j* in choice set *t* is $\mathrm{P}(U_{ijt} \geq U_{ikt})$, over all possible *k* attributes. Under the assumption that v_{ijt} is linear in parameters the utility function can be expressed as, $v_{it} = \beta_{i1}x_{1it} + \beta_{i2}x_{2it} + \ldots + \beta_{ij}x_{ijt}$ where x_{ijt} is the *j*-th attribute for choice set *t* and β_j is a vector of preference parameters associated with the *j*-th attribute of the *t*-th alternative of the *i*-th consumer (Alfnes, 2004; Tonsor et al., 2005).

The RPL model estimated in this analysis necessarily included the interaction terms between attributes and verifying entities because a production practice attribute was never presented to choice experiment participants without a certifying party also being presented. In order to address the objective of determining WTP values for consumers across not only different verification parties, but also across different attributes being verified by different

[6] Model estimation was done in NLOGIT 4.0 using the program's panel data capabilities.

verification parties, interaction terms were included. The model estimated specified the systematic portion of utility as:

$$v_j = \beta_1(Cons) + \beta_2(Price) + \beta_3(Private) + \beta_4(Consumer) + \beta_5(USDA) +$$
$$\beta_6(Self\_Pasture) + \beta_7(Private\_Pasture) + \beta_8(Consumer\_Pasture) + \beta_9(USDA\_Pasture) +$$
$$\beta_{10}(Self\_Indiv) + \beta_{11}(Private\_Indiv) + \beta_{12}(Consumer\_Indiv) + \beta_{13}(USDA\_Indiv) +$$
$$\beta_{14}(Self\_Anti) + \beta_{15}(Private\_Anti) + \beta_{16}(Consumer\_Anti) + \beta_{17}(USDA\_Anti) +$$
$$\beta_{18}(Self\_CTruck) + \beta_{19}(Private\_CTruck) + \beta_{20}(Consumer\_CTruck) + \beta_{21}(USDA\_CTruck)$$

where, *Cons* is a constant included to capture the disutility associated with not having the good (milk or pork chops) in the consumer's choice set (*Cons* =1 if option C is selected, *Cons*=0 otherwise) and *Price* is the price of the good in the choice set. *Private, Consumer,* and *USDA* are effects coded dummy variables for verification by a private third-party, consumer group, and USDA relative to self verification. *Self_Pasture, Private_Pasture, Consumer_Pasture,* and *USDA_Pasture* are effects coded interaction terms between the verification entity and pasture access. *Self_Indiv, Private_Indiv, Consumer_Indiv,* and *USDA_Indiv* are effects coded interaction terms between the verification entity and individual housing in crates or stalls. *Self_Anti, Private_Anti, Consumer_Anti,* and *USDA_Anti* are effects coded interaction terms between the verification entity and the use of antibiotics. *Self_CTruck, Private_ CTruck, Consumer_ CTruck,* and *USDA_ CTruck* are effects coded interaction terms between the verification entity and the use of certified trucking. Interaction terms are identifying the verified attributes in the choice experiment. An example of the interpretation of these interaction terms is that the WTP associated with *Consumer_Anti* can be interpreted as the WTP for consumer group verified antibiotic-free production, as opposed to not having the antibiotic-free production certified by a consumer

group. Effects coding was used to avoid confounding effects of attribute levels with the opting out option presented to consumers.[7]

The β coefficients on all of the explanatory variables except for *Cons* and *Price* are specified to vary normally across consumers. In this analysis, given the scenarios being assessed, it is possible that consumers may have both positive and negative WTP values for verified animal welfare attributes. The random parameters are assumed to be drawn from a normal distribution which allows the flexibility for WTP estimates to be either positive or negative (Tonsor et al., 2005; Lusk, Roosen, and Fox, 2003). The random parameter for alternative j is given by $B_j = \overline{B}_j + \sigma_j + \mu_{ij}$ where $\overline{B}_j$ is the mean estimate across all consumers, σ_j is a diagonal matrix of coefficient standard errors, and μ_{ij} is a vector of independent normal decisions for each individual consumer (Lusk, Roosen, and Fox, 2003; Tonsor et al., 2005).

The coefficients estimated from a random utility model have little interpretive value themselves. Mean WTP estimates for the RPL models are generally calculated by taking the negative ratio of the estimated coefficient on the verified attribute to the price coefficient. The coefficient on the verified attribute k is multiplied by two in the WTP ratio in this analysis due to the effects coding (Lusk, Roosen, and Fox, 2003). The WTP for verified attribute k in this analysis was calculated as, $WTP_k = -\left(\frac{2*\beta_k}{\beta_c}\right)$ where β_k is the coefficient on a verified attribute[8] and β_c is the coefficient on price. If the standard

[7] In effects coding, rather than the typical 0,1 dummy variable coding, the attributes take on a value of 1 when applicable, a value of -1 when the base category applies, and zero otherwise (Tonsor, Olynk, and Wolf, 2009).

[8] In this context, β_k would be, more specifically, the coefficient on the interaction term between an attribute and a verification entity (a verified attribute as defined in the text) or just the verification entity

deviations of the attribute constants are not statistically different from zero, the estimated mean WTP can be interpreted as being representative for the entire surveyed consumer group. In this case the RPL interpretation reverts to that of the standard multinomial logit, as it is not revealing significant heterogeneity in the group. Evidence of preference heterogeneity exists if the standard deviations are statistically significant, in which case the mean WTP estimates calculated cannot be interpreted as being representative for the entire sample.

In order to consider statistical variability in estimates of WTP a 95% confidence interval for mean WTP values was calculated using the delta method. A variety of methods exist to determine confidence intervals on the WTP estimates, including the delta, Fieller, Krinsky Robb, and bootstrap methods, although the four methods have been found to be reasonably accurate and to yield similar results to one another (Hole, 2007). The delta method estimates the variance of a non-linear function of two or more random variables by taking a first-order Taylor series expansion around the mean value of the variable and calculating the variance on that newly created random variable (Greene, 2003). Following Hole (2007), the delta estimate of the variance of a WTP estimate is given by:

$$\text{var}(\hat{WTP}_k) = \begin{bmatrix} (\hat{WTP}_{\beta_k})^2 \text{var}(\hat{\beta}_k) + (\hat{WTP}_{\beta_c})^2 \text{var}(\hat{\beta}_c) \\ +2 * \hat{WTP}_{\beta_k} * \hat{WTP}_{\beta_c} * \text{cov}(\hat{\beta}_k \hat{\beta}_c) \end{bmatrix}$$ where, $\hat{WTP}_{\beta_k}$ and $\hat{WTP}_{\beta_c}$ are

the partial derivates of the estimated WTP for verified attribute k with respect to β_k and

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alone. By construction, the attributes themselves are not included in the model without being interacted with a verification entity because for the purposes of this analysis it is the verification of the attributes that is focused upon, as opposed to a WTP by consumers for the attributes themselves. Moreover, verification is necessarily included because by the construction of the choice experiment, or by design, it was impossible to have an attribute present without a verification entity verifying that the production process attribute being claimed was actually present. This matches "the real world" as it is unlikely a product could be marketed with the discussed animal welfare claims and not be participating in a verification or certification system as well.

β_C respectively. Once the variance of the WTP estimate is calculated, confidence intervals can be calculated in the standard way.

2.4 Results and Discussion

The model was estimated under each of the information treatments (see Appendix 4), for each product, and separately for direct and indirect questioning treatments. Subsequently a log likelihood ratio test was used to determine if the data from the four information treatments can be pooled.[9] Consumer responses were found to be insensitive to the information treatment they received as we failed to reject the null hypothesis that we can pool observations across consumers receiving the four different information treatments. This finding is similar to that of Lusk, Norwood, and Pruitt (2006) and Tonsor, Olynk, and Wolf (2009). As a result the models presented throughout this analysis result from pooled models of observations across the four information treatments.

To assess whether observations from indirect and direct questioning could be pooled for either livestock product, a log likelihood ratio test was employed. We rejected the null hypothesis of pooling of data across direct and indirect questioning for both pork chops and milk. Therefore, throughout this analysis indirect questioning and direct questioning are treated separately and estimates are presented separately for direct questioning versus indirect questioning. Additional log likelihood tests were employed

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[9] The log likelihood ratio test, which follows a χ^2 distribution with K(M-1) degrees of freedom (Wooldridge, 2002) is $-2(LL_j - \sum LL_i)$, where LL_j is the unrestricted pooled sample log likelihood value and LL_i are the log likelihood values for each of the information treatment groups. K is the number of parameters in the model and M is the number of information treatments.

to determine if data from survey respondents receiving indirect and direct questioning in differing orders could be pooled. All consumers completing the survey were asked to participate in the choice experiment through direct and indirect questioning, although half of the respondents completed indirect questioning first and direct questioning second while the other half completed direct questioning first and indirect questioning second. We rejected the null hypothesis of pooling across orders of questioning through log likelihood testing for the direct questioning data for milk. For indirect questioning in milk and pork chops as well as direct questioning in pork chops we failed to reject the null hypothesis that we can pool across ordering of questioning (whether indirect questioning first and direct questioning second, or vice versa). Throughout the analysis observations are pooled across the order of questioning for indirect questioning in pork chops and milk and for direct questioning in pork chops. As a result of pooling across orders of questioning being rejected for direct questioning in milk, the direct questioning coefficients and WTP estimates for milk are presented for those respondents who saw direct questioning first and indirect questioning second. Observations from respondents who completed indirect questioning first were eliminated from the data set used to analyze direct questioning in milk.

Table 2b displays the parameters estimated in the RPL model for pork chops. Table 2c presents the indirect questioning results for all those survey respondents who completed the survey with respect to milk and the direct questioning results for those survey respondents who completed the direct questioning portion of the choice experiment first.[10] A large number of the estimated means for random pork chop and

[10] It was concluded through likelihood ratio testing that direct questioning for milk production process attributes was sensitive to the order in which direct and indirect questioning choice experiments were

milk attribute parameters were statistically significant in these models. In random utility models the interpretation of individual coefficients is generally discouraged (Scarpa and Del Giudice, 2004). The coefficients were used to compute estimates of consumer WTP, which are discussed below.

presented to the consumer. Direct questioning coefficients for milk presented throughout this analysis are for those consumers who answered direct questioning choice sets before indirect questioning choice sets. Direct questioning data for those milk survey respondents who completed direct questioning choice sets second were omitted from these results.

Table 2 b. Parameters (standard errors) for pork chops from random parameters logit

Variable	Direct Questioning Coefficient Estimates (n=669)	Direct Questioning Standard Deviation Estimates	Indirect Questioning Coefficient Estimates (n=669)	Indirect Questioning Standard Deviation Estimates
Opt out	-1.5876 (1.1046)		-1.6068 (1.0270)	
Price	-0.4960* (0.1638)		-0.4028* (0.1648)	
Private	0.7030 (0.4447)	0.0533 (0.1416)	1.5409* (0.4498)	0.0831 (0.1424)
Consumer	0.3469 (0.2128)	0.0635 (0.1434)	0.2524 (0.2066)	0.0846 (0.1162)
USDA	-0.8371* (0.2916)	0.8124* (0.0980)	-1.4937* (0.3020)	1.0390* (0.0926)
Self verified pasture access	0.3016* (0.0930)	0.3895* (0.0673)	0.0823 (0.0903)	0.3135* (0.0697)
Private party verified pasture access	-0.3208 (0.2083)	1.3943* (0.0720)	-0.6642* (0.2049)	1.2235* (0.0720)
Consumer group verified pasture access	0.3298* (0.1436)	0.6725* (0.0667)	0.3509* (0.1422)	0.6650* (0.0571)
USDA verified pasture access	0.9514* (0.1263)	0.4935* (0.0593)	1.2687* (0.1342)	0.5134* (0.0530)
Self verified individual crates/stalls	0.2310* (0.1207)	0.3895* (0.0673)	0.5355* (0.1235)	0.3135* (0.0697)
Private party verified individual crates/stalls	0.0737 (0.2114)	1.3943* (0.0720)	0.2481 (0.2043)	1.2235* (0.0720)
Consumer group verified individual crates/stalls	0.2715* (0.1583)	0.6725* (0.0667)	-0.0074 (0.1575)	0.6650* (0.0571)
USDA verified individual crates/stalls	0.4313* (0.0853)	0.4935* (0.0593)	0.5203* (0.0898)	0.5134* (0.0530)
Self verified antibiotic use	-0.0757 (0.1494)	0.3895* (0.0673)	0.0798 (0.1524)	0.3135* (0.0697)
Private party verified antibiotic use	-0.3303 (0.2470)	1.3943* (0.0720)	-0.6912* (0.2446)	1.2235* (0.0720)
Consumer group verified antibiotic use	-0.0194 (0.1224)	0.6725* (0.0667)	0.0576 (0.1145)	0.6650* (0.0571)
USDA verified antibiotic use	0.7228* (0.1107)	0.4935* (0.0593)	0.8596* (0.1140)	0.5134* (0.0530)
Self verified certified trucking/transport	0.1830* (0.0961)	0.3895* (0.0673)	-0.0500 (0.0956)	0.3135* (0.0697)
Private party certified trucking/transport	-0.9791* (0.3308)	1.3943* (0.0720)	-1.4114* (0.3235)	1.2235* (0.0720)
Consumer group certified trucking/transport	-0.3845* (0.1383)	0.6725* (0.0667)	-0.2937* (0.1354)	0.6650* (0.0571)
USDA verified certified trucking/transport	-0.0610 (0.1195)	0.4935* (0.0593)	-0.2628* (0.1247)	0.5134* (0.0530)

Notes: Presented models (log likelihoods of -3,858 and -3,911, respectively) were estimated using NLOGIT 4.0, with Halton draws, and 500 replications for simulated probability. Standard errors are presented in parentheses. Asterisk (*) indicates statistical significance at the 0.05 level.

Table 2 c. Parameters (standard errors) for milk from random parameters logit

Variable	Direct Questioning Coefficient Estimates (n=332)	Direct Questioning Standard Deviation Estimates	Indirect Questioning Coefficient Estimates (n=665)	Indirect Questioning Standard Deviation Estimates
Opt out	-2.5293* (1.1994)		-2.4644* (0.9063)	
Price	-0.2537 (0.1658)		-0.9584* (0.1303)	
Private	0.8250 (0.6004)	0.0819 (0.1580)	1.7760* (0.4745)	0.2330 (0.1569)
Consumer	0.0988 (0.3137)	0.0143 (0.2014)	-0.5370* (0.2231)	0.1578 (0.1761)
USDA	-0.5879 (0.3942)	0.6659* (0.1361)	-1.1811* (0.3062)	0.8700* (0.0939)
Self verified pasture access	0.5114* (0.1270)	0.3433* (0.1173)	0.0973 (0.0871)	0.2474* (0.0978)
Private party verified pasture access	0.1579 (0.2768)	1.1915* (0.0921)	-0.7788* (0.2362)	1.4425* (0.0775)
Consumer group verified pasture access	0.7760* (0.2213)	0.6828* (0.0813)	0.5608* (0.1453)	0.6172* (0.0625)
USDA verified pasture access	1.3089* (0.1822)	0.4993* (0.0746)	1.0268* (0.1399)	0.5495* (0.0543)
Self verified individual crates/stalls	0.4369* (0.1663)	0.3433* (0.1173)	0.2392* (0.1244)	0.2474* (0.0978)
Private party verified individual crates/stalls	-0.0438 (0.2746)	1.1915* (0.0921)	-0.2073 (0.2460)	1.4425* (0.0775)
Consumer group verified individual crates/stalls	0.0371 (0.2234)	0.6828* (0.0813)	-0.0373 (0.1619)	0.6172* (0.0625)
USDA verified individual crates/stalls	0.3432* (0.1160)	0.4993* (0.0746)	0.4891* (0.0920)	0.5495* (0.0543)
Self verified antibiotic use	0.2815 (0.2021)	0.3433* (0.1173)	-0.0118 (0.1517)	0.2474* (0.0978)
Private party verified antibiotic use	-0.2908 (0.3192)	1.1915* (0.0921)	-1.0151* (0.2689)	1.4425* (0.0775)
Consumer group verified antibiotic use	0.2262 (0.1795)	0.6828* (0.0813)	0.2520* (0.1232)	0.6172* (0.0625)
USDA verified antibiotic use	0.4089* (0.1559)	0.4993* (0.0746)	0.5167* (0.1168)	0.5495* (0.0543)
Self verified certified trucking/transport	0.1260 (0.1299)	0.3433* (0.1173)	0.0846 (0.0950)	0.2474* (0.0978)
Private party certified trucking/transport	-0.4645 (0.4223)	1.1915* (0.0921)	-1.5351* (0.3454)	1.4425* (0.0775)
Consumer group certified trucking/transport	-0.2338 (0.1927)	0.6828* (0.0813)	-0.2010 (0.1428)	0.6172* (0.0625)
USDA verified certified trucking/transport	0.0733 (0.1720)	0.4993* (0.0746)	-0.0244 (0.1314)	0.5495* (0.0543)

Notes: Presented models (log likelihoods of -2,313 and -3,764, respectively) were estimated using NLOGIT 4.0, with Halton draws, and 500 replications for simulated probability. Standard errors are presented in parentheses. Asterisk (*) indicates statistical significance at the 0.05 level.

In all four of the models estimated all of the explanatory variables except for *Cons* and *Price* are specified to vary normally across consumers. All of the random parameters except for *Private* and *Consumer* were estimated to have statistically significant standard deviation parameters in all four of the models estimated, as is indicated in Tables 2b and 2c. The statistically significant standard deviation parameters are evidence of preference heterogeneity in which case the mean WTP estimates calculated cannot be interpreted as being representative for the entire sample.

Willingness-to-Pay

Mean estimates of consumer WTP were calculated for direct and indirect questioning for pork chops and milk and are presented in Table 2d and Table 2e, respectively. With regards to direct estimates for WTP for pork, values are significantly different than zero for the majority of estimates. When looking at WTP for verification of pasture access, consumers had a higher WTP for verification of this attribute by the USDA than for verification by self, private third-party, or a consumer group. The same relationship exists for verification of individual stalls/crates for livestock housing and for verification of no antibiotic use, in which consumers had a higher WTP for verification through USDA than for the other verifying entities. Clearly, USDA verification of the attributes included in the analysis (all attributes except for certified trucking or transport) had the highest value to the consumer when compared to verifying those same attributes by a different verification entity.

Table 2 d. Willingness-to-pay for direct and indirect questioning for pork chops

Variable	WTP		
	Direct Questioning (n=669)	**Indirect Questioning** (n=669)	**Evidence of Social Desirability Bias**
Private	$2.84*	$7.65*	No
Consumer	$1.40*	$1.25*	No
USDA	$(3.38)*	$(7.42)*	No
Self verified pasture access	$1.22*	$0.41	No
Private party verified pasture access	$(1.29)*	$(3.30)*	No
Consumer group verified pasture access	$1.33*	$1.74*	No
USDA verified pasture access	$3.84*	$6.30*	No
Self verified individual crates/stalls	$0.93*	$2.66*	No
Private party verified individual crates/stalls	$0.30	$1.23*	No
Consumer group verified individual crates/stalls	$1.09*	$(0.04)	No
USDA verified individual crates/stalls	$1.74*	$2.58*	No
Self verified antibiotic use	$(0.31)	$0.40	No
Private party verified antibiotic use	$(1.33)*	$(3.43)*	No
Consumer group verified antibiotic use	$(0.08)	$0.29	No
USDA verified antibiotic use	$2.91*	$4.27*	No
Self verified certified trucking/transport	$0.74*	$(0.25)	Yes
Private party certified trucking/transport	$(3.95)*	$(7.01)*	No
Consumer group certified trucking/transport	$(1.55)*	$(1.46)*	No
USDA verified certified trucking/transport	$(0.25)	$(1.30)*	No

Asterisk (*) indicates statistical significance at the 0.05 level. It was determined that there was evidence of social desirability bias if 95% confidence intervals surrounding direct questioning and indirect questioning estimates did not overlap and the absolute value of the direct willingness to pay estimate was greater than the absolute value of the indirect willingness to pay estimate.

Table 2 e. Willingness-to-pay for direct and indirect questioning for milk

Variable	WTP		
	Direct Questioning (n=332)	**Indirect Questioning** (n=665)	**Evidence of Social Desirability Bias**
Private	$6.50	$3.71*	No
Consumer	$0.78	$(1.12)*	No
USDA	$(4.63)	$(2.46)*	No
Self verified pasture access	$4.03*	$0.20*	Yes
Private party verified pasture access	$1.24	$(1.63)*	No
Consumer group verified pasture access	$6.12*	$1.17*	Yes
USDA verified pasture access	$10.32*	$2.14*	Yes
Self verified individual crates/stalls	$3.44*	$0.50*	No
Private party verified individual crates/stalls	$(0.35)	$(0.43)	No
Consumer group verified individual crates/stalls	$0.29	$(0.08)	No
USDA verified individual crates/stalls	$2.71*	$1.02*	No
Self verified antibiotic use	$2.22	$(0.02)	No
Private party verified antibiotic use	$(2.29)	$(2.12)*	No
Consumer group verified antibiotic use	$1.78	$0.53*	No
USDA verified antibiotic use	$3.22*	$1.08*	No
Self verified certified trucking/transport	$0.99	$0.18	No
Private party certified trucking/transport	$(3.66)	$(3.20)*	No
Consumer group certified trucking/transport	$(1.84)	$(0.42)*	No
USDA verified certified trucking/transport	$0.58	$(0.05)	No

Asterisk (*) indicates statistical significance at the 0.05 level. It was determined that there was evidence of social desirability bias if 95% confidence intervals surrounding direct questioning and indirect questioning estimates did not overlap and the absolute value of the direct willingness to pay estimate was greater than the absolute value of the indirect willingness to pay estimate.

As was true in pork, the WTP estimates for verification by the USDA were higher than those for self, private third-party, or consumer groups for verification of

pasture access and antibiotic use. Verification of the use of certified trucking did not follow the pattern of the other four attributes. Looking at direct questioning, for certified trucking in pork the mean WTP for self verification was $0.74/lb. Verification of certified trucking by USDA had a WTP that was not statistically different than zero, while verification by private party and consumer group both had negative WTP values for direct questioning. Direct questioning in milk revealed WTP for verification by each of the four entities which was not statistically different from zero.

Comparing the point estimates in milk and pork chops provided support for the notion that consumer WTP for verification of production process attribute claims was different depending on the livestock product in question. Further, looking at WTP estimates, it was apparent that the WTP for verification varied depending on the specific attribute.

Social Desirability Bias

Given the emotionally charged issue of animal welfare and the increasing consumer concern for how animals raised for food are treated and how their food is produced overall, it is conceivable that consumers exhibit social desirability bias when asked questions regarding animal welfare attributes. Incorporating both direct and indirect questioning in our choice experiment allowed testing of statistically significant evidence of social desirability bias across livestock products. The first step in looking for social desirability bias was to determine if the absolute value of the WTP estimated from direct questioning exceeded the WTP estimated from indirect questioning. Evidence of significant social desirability bias was determined by comparing the 95% confidence

intervals on the direct and indirect WTP estimates for each verified attribute to determine if the confidence intervals were overlapping. If the 95% confidence intervals surrounding the indirect and direct WTP estimates for a given verified attribute did not overlap and the absolute value of the WTP from direct questioning exceeded that of indirect questioning, there was evidence of social desirability bias.[11]

For both pork and milk the sign on the WTP for each attribute was consistent across direct and indirect questioning for WTP point estimates which were statistically different than zero (Tables 2d and 2e). In the case of pork, statistically significant evidence of social desirability bias was found for only one attribute, self verified use of certified trucking or transport. In the case of milk, however, three different attributes were found to have significant evidence of social desirability bias. Interestingly, evidence of statistically significant social desirability bias was found to a greater degree in milk than it was in pork, indicating that the degree that the bias is present may be product-specific. While the degree of bias present when looking at individual attributes differed by product, there was evidence against pooling of observations from direct and indirect questioning for both livestock products through likelihood ratio testing, indicating that differences exist in the data between indirect and direct questioning.

A number of factors are likely determining the degree to which bias is present for specific products. In this specific case of pork chops versus milk production it can be hypothesized that factors such as consumers association with cows versus pigs or the distinction between milk as a livestock product versus pork chops as a meat product

[11] Examination of overlapping 95% confidence intervals is intuitive and allows comparison by visual inspection when confidence intervals are presented. It is acknowledged that comparing of 95% confidence intervals and examining overlap is more conservative than the standard method of significance testing when the null hypothesis is true and falsely fails to reject the null hypothesis more frequently than the standard method when the null hypothesis is false (Schenker and Gentleman, 2001).

may play a role in the evidence of bias which was found. There is potential that the amount of exposure to the livestock species that consumers have or consumer sentiment for a specific species will influence social desirability bias surrounding products from certain species. Widespread consumer exposure to campaigns for milk and dairy products, for example, could result in closer consumer association with or sentiment for dairy cows. Potential other factors include the increased likelihood of consumers seeing cows on pasture versus pigs on pasture, increased perceived familiarity with milk production versus swine production, or different emotional attachment to animals which produce food products versus those which are raised primarily to slaughter for meat. In light of the results found through this analysis, it is possible that consumers, through exposure to campaigns or simply increased exposure to the species versus other livestock species have increased emotional attachment to cows.

Analysis of the WTP estimates for milk from the direct and indirect questioning provides support to the notion that when questioned directly people have a tendency to represent themselves in a way that is socially acceptable. Consistent with Lusk and Norwood (2009), it is likely that the indirect WTP estimates, in the case in which evidence of social desirability bias can be found, are a more accurate reflection of people's actual WTP than the direct questioning WTP estimates.

2.5 Conclusions

Consumers are increasingly interested in how their food is produced and in learning about the production practices used in modern food production. Consumers are particularly interested in attributes of the production practices associated with the use of

livestock. A growing body of literature has reviewed consumer preferences for certain production practice attributes and welfare attributes associated with livestock used for food production. This analysis assessed consumer value for or WTP for the verification of those production practices. Estimates of consumer WTP for verification of four different livestock production process claims across two livestock products were obtained. Consumer WTP estimates differed across verifying entity as well as attributes verified. For example, verification of access to pasture by the USDA had the highest WTP for both pork chops and milk of any verifying entity verifying access to pasture.

Weak evidence of social desirability bias was found in this analysis. Direct and indirect questioning was used to aid in determining if statistically significant evidence of such a bias could be detected. Comparing WTP confidence intervals for direct and indirect questioning in milk revealed evidence of social desirability bias. Given the tendency for people to overstate their own values in order to conform to social norms, and the resulting inflation of WTP estimates that could occur in such a situation, the indirect estimates are likely more indicative of consumers' actual WTP. Potential for social desirability bias to be different, or present to a varying degree, across different livestock products, and therefore livestock species, was found.

Future work may consider verification by specific parties, rather than across the broad and general categories of private third-party and consumer groups, for example. Additional livestock products should be evaluated to further analyze the differences in consumer WTP and social desirability bias across livestock species and products. The incorporation of different production process attributes may yield additional insights

into the attribute types for which consumers have higher WTP for verification through a given party.

Future work related to assessing social desirability bias may include analysis of increased numbers of livestock products. Evidence of social desirability bias was found in this analysis which used online survey techniques for data collection, but further work is necessary regarding the degree of bias which is present depending on the data collection method employed. It is suspected that the degree of social desirability bias present would be higher for phone interviews and higher still for in-person interviews. The impact of the data collection method employed on the evidence of social desirability bias found should be evaluated in future analyses.

CHAPTER 3: CREDENCE ATTRIBUTE VERIFICATION IN LIVESTOCK PRODUCTION

3.1 Introduction

Today's consumers are concerned about the treatment of livestock and welfare of animals used to produce meat and milk products (Frewer et al., 2005). Food product safety and the characteristics of the processes employed in the production of food products are increasingly important in the operation of food systems (Caswell, 1998). Livestock producers can respond to consumer concerns by providing verifiable information regarding production process attributes. Many of the claims regarding process attributes are credence attributes of the production processes. Caswell and Mojduszka (1996) define a credence attribute as an attribute in which quality cannot be assessed even after the product is purchased and consumed (Caswell and Mojduszka, 1996). Producers cannot provide verification of credence attributes through traditional testing methods. This informational asymmetry begs questions surrounding how producers will convey information to consumers.

Information on production processes used must be conveyed by the producer to the consumer through an avenue that consumers trust.[12] Specific to livestock rearing, claims surrounding handling and housing practices are credence attributes of the production processes used. For example, at no point before, after, or during consumption of a pork chop is the consumer able to determine the housing system used to raise the hog. Along the

[12] In reality, the entire supply chain must be convinced of the value of the verification for these production process attributes. On-farm production practices must be verified by (or beginning with) the livestock producer. Consumer willingness to pay was assessed in this analysis because it is ultimately the consumers' preferences and consumer demand which drives what will be produced, or the attributes of what will be produced. It is, however, worth noting that while production practices must be conveyed by the producer to the consumer in a way in which consumers trust, the actual conveying of this information is likely to be through the supply chain, which may include multiple steps, depending on the specific livestock product.

same lines, at no point before, during, or after consumption could a consumer of milk determine if the cows which produced that milk had access to pasture.

Producers can seek to maximize profit through their selection of verified production process attributes to provide to the market. Producers will not decide to supply these production process attributes unless 1) they are required to do so or 2) they find it profitable to supply (Caswell and Mojhuszka, 1996). If a specific production process attribute is already present in the systems used on an operation, producers can seek to maximize profit by selecting from alternative verification methods used to communicate that attribute to the consumer. Tonsor, Olynk, and Wolf (2009) describe ballot initiatives which have passed in several states, which would phase out the use of gestation crates in pork production. In these cases, the individual livestock producer would not seek to determine whether it is economically advantageous to produce without individual crates or stalls. Instead, a producer operating under a ban on the use of gestation crates would maximize expected profit by choosing the optimal verifying entity. Even in the case where the production practice used is predetermined, the profit maximizing choice of verifying entity may not be the lowest cost entity, but will be the verifying party which yields the highest net return to the livestock producer. It is conceivable that the verification method in which consumers place the highest value (e.g., a federal government system) is simply too costly for producers to pursue, while a relatively lower valued program or verification party (e.g., a private third-party) in the eyes of consumers provides higher net returns for producers.

As noted by Hudson and Lusk (2004) willingness to pay (WTP) is usually discussed in the context of consumer utility maximization, although the concept can also be applied to producers. Recently, several studies have assessed producer willingness to change

operational practices. Schulz and Tonsor (2010) identified preferences of U.S. cow-calf producers for traceability systems and found heterogeneity among producers not only in their preferences, but also in the welfare effects of mandating traceability. Norwood et al. (2006) provided information from Oklahoma cattle producers regarding preferences of the design of voluntary checkoff programs. Roe, Sporleder, and Belleville (2004) examined hog producer preferences for hog marketing contract attributes and found producers value window contract ceiling and floor prices differently. Davis and Gillespie (2007) found that hog producers differ in their valuations of autonomy and risk acceptance in selecting from alternative business arrangements. Norwood et al. (2005) conducted a survey to measure crop producers' willingness to pay for manure from livestock operations. These examples demonstrate increasing evaluations of producer preferences and willingness to change with applications being applied to agricultural producers of all levels, from individual farm-level producers to agribusinesses and marketing firms.

It is imperative for producers to understand the preferences of consumers and to consider how animal rearing methods are taken into account in food purchasing decisions. The major focus of much consumer WTP work has been on theoretical issues, methodological questions surrounding estimating WTP, or policy issues rather than on making adoption or pricing decisions of producers (Hudson and Lusk, 2004). Estimates of consumer WTP can be beneficial in decision making for agribusinesses as they move towards serving a more consumer demand driven market (Lusk and Hudson, 2004). Lusk and Hudson (2004) explicitly sought to provide insight into the benefits and challenges of the use of consumer WTP data for decision making in agribusinesses. Estimates of consumer demand could be particularly useful when agribusinesses or agricultural

producers are assessing provision of new products or services. For example, in this analysis it is shown that livestock producers can use estimates of consumer WTP to assess the potential net benefits associated with providing certain verified attributes.

Incorporating both the value and cost of verification programs is essential to selecting the optimal verification method for livestock producers. This approach includes both demand side and supply side cost impacts and this analysis develops and applies a conceptual model for this situation. In particular, we focus on two livestock products (pork chops and milk) and four production process attributes (individual crates or stalls, pasture access, antibiotic use, and certified trucking or transport). The incorporation of consumer demand data, or estimates of WTP, into the decision making of livestock producers is demonstrated. To better match the choices of farmers, this analysis allows producers to select between four potential verifying methods, including self, consumer group, private party, or USDA Producer Verified Program (PVP)[13] verification. Two different decisions can be informed for producers through this analysis. Producers may wish to determine which attributes to adopt concurrent with the decision of how to verify those attributes, or if a producer is already using a production process with certain attributes, they may wish to investigate how to verify those processes. Examples provided throughout this analysis are focused on decision support for the scenario in which a producer is already providing a certain attribute but is seeking how to verify that process attribute. The conceptual application of using WTP estimates to support farm-level decision making is much more widely applicable than the examples provided in this analysis.

[13] The Grain Inspectors, Packers and Stockyards Administration (GIPSA) PVP has official procedures in place for verification of products assigned to GIPSA and services associated with marketing these products (USDA, 2007). Verification services through GIPSA are voluntary and provided to producers, marketers, processors, and other associated service providers of agricultural products for a fee (USDA, 2007).

3.2 Research Design

Estimates of consumer value, or consumer WTP, were included in this analysis in order to calculate estimates of the potential producer benefits of providing a verified attribute. Critical points were sought in order to identify the ranges of costs over which verification by certain entities was optimal for livestock producers. Critical points were first assessed using mean WTP estimates. Then, assuming that livestock producers face heterogeneous cost structures associated with providing verified attributes, or switching processes to provide specific verified attributes, implications of adjustment costs are discussed. For discussion throughout this analysis it is assumed that livestock producers can be broken into two distinct groups, namely low or high adjustment cost groups.[14] Differences in costs to provide a verified attribute could be due to a number of reasons including, but not limited to, economies of scale, economies of scope, or ease of verification due to other farm-specific factors. The two cost groups are used to illustrate the potential impacts of varying relative costs of providing verified attributes on the decisions of livestock producers.

Producer Decision Support Model Specification and Data Utilized

Estimates of consumer WTP for verified production process attributes were obtained for this analysis from Olynk, Tonsor, and Wolf (2009). Four livestock production process attributes, four verifying entities, and two livestock products were included in this analysis. The four livestock production process attributes investigated in this analysis included, whether individual crates/stalls were permitted or not permitted, pasture access was

[14] The low adjustment cost group is expected to have relatively lower adjustment costs associated with verification and adoption of different production processes, while the high adjustment cost group has a relatively higher cost of adjustment and verification.

required or not required, antibiotic use was permitted or not permitted, and whether certified trucking/transport was required or not required. The two livestock products analyzed were pork chops and milk. Throughout the analysis, in order to provide verified attributes to consumers, livestock producers could choose to verify claims themselves (self verification), to use a private third-party, to use a consumer group, or to use the USDA PVP (Olynk, Tonsor, and Wolf, 2009). Self verification can be accomplished through documenting production processes in various ways using video, photographs, or even detailed written records of production practices. Alternatively, consumer groups may have programs in place which may be applicable to livestock producers wishing to provide verified attributes. An example of verification through a consumer group is the Certified Humane Raised and Handled® program by the Humane Farm Animal Care Program. Verification by a private third-party could include products being marketed under a specific brand since many private brands make claims regarding the practices used to produce their product. A livestock producer may choose to sell their meat or milk to be marketed under a specific brand name which makes claims regarding and verifies the production practices used. As another alternative available to livestock producers, the USDA PVP provides verification of program approved claims (USDA, 2007). Table 3a summarizes the product attributes and verification entities included in this analysis.

Table 3 a. Product attributes and certification entities

Product Attributes	**Attribute Levels**
Individual Crates/Stalls	Not permitted Permitted
Pasture Access	Not required Required
Antibiotic Use	Not required Required
Certified Trucking/Transport	Not required Required
Certification Entities	Self Certification Consumer Group Private 3rd party USDA PVP

The livestock producer must choose the verification entity that maximizes profit by taking into account the expected revenue and costs associated with each verification method. The producer's maximization problem is $Max\ [\alpha' X] - [\beta' X]$, where $\alpha = [\alpha_1, \alpha_2, \alpha_3, \alpha_4]$ is the per unit revenue for the producer for participating in verification method i=1, 2, 3, or 4, $X = [x_1, x_2, x_3, x_4]$ is the choice of verification method i, and $\beta = [\beta_1, \beta_2, \beta_3, \beta_4]$ is the per unit cost to the producer of verification method i. Taking the first order condition of the producer's maximization problem with respect to the choice variable, X, yields the optimal condition that $\alpha' = \beta'$, or that the marginal revenue must equal the marginal cost for the producer.[15,16] Solving the producer's maximization problem yields a decision rule of the form $X^*(\alpha, \beta)$.

[15] Note that this maximization problem is solved considering each combination of livestock production process attributes (pasture access, individual crates/stalls, antibiotic use, and certified trucking or transport) and verifying entity (self verification, private third-party verification, consumer group, and USDA PVP). If the problem is constrained to making a decision regarding verifying a specific attribute, such as the use of crates in pork production in our example application, the maximization problem is reduced to selecting the optimal verifying party from the four potential verifiers.

Consumer WTP estimates for verification of key production process attributes by specific verifying entity were taken from Olynk, Tonsor, and Wolf (2009). The values for α, which were obtained from random utility models, identify the WTP of consumers for verified attributes in pork chops or milk (Olynk, Tonsor, and Wolf, 2009). A total of 1,334 respondents completed the survey: 669 respondents completed the survey with a choice experiment for pork chops and 665 respondents completed the survey with a choice experiment for milk (Olynk, Tonsor, and Wolf, 2009). The information and definitions provided to consumers participating in the survey with regards to the production process attributes and verifying entities are presented in Appendix 2.

The consumer WTP values were adjusted according to the portion of retail value expected to be conveyed through the supply chain to the livestock producer to obtain α, the per unit revenue associated with providing a verified attribute. Estimates of the farmers' share of the retail value of the livestock products must be incorporated in this analysis because the consumer WTP estimates are providing estimates of the total value to consumers, while the livestock producer receives only a portion of this amount. The estimate of the farmers' share of the retail pork and milk (using whole milk sold in gallons) value used in this analysis was 28.1% and 53%, respectively (USDA, 2009). It is assumed throughout this analysis that the farmers' share of the retail value of the verification (the increase in value due to verification) will be the same as the share of the retail value which the producer receives on the product overall.[17] For example, using the data from pork

[16] This simplified framework assumes that the volume impacted is not sufficient to influence prices and that all cross-price impacts (both within a firm's product line and in aggregate markets) are zero.
[17] This estimate of the farmers' share of the retail value is likely conservative because it is likely that those producers seeking voluntary verification of production process attributes would also be seeking other ways to obtain a larger share of the retail value. In other words, while the averages for farmers' share of retail value are used in this analysis, the farmers engaging in verification of process attributes are likely obtaining a higher than average share of the retail value due to the increased likelihood to

chops, in the case of consumer group verified pasture access the estimate of consumer WTP was $1.74 per lb, while the portion that the livestock producer is expected to receive is only $0.49 per lb, as can be seen in Table 3b.[18]

participate in other activities (beyond this verification) which increase their share of the retail value. The average value is used throughout this analysis as a conservative estimate of the farmers' share of the retail value.

[18] In Table 3b the farmers' share of the retail value is presented as the maximum cost that farmers could absorb to rationally provide a verified attribute. Conceptually, the total farmers' share of the retail value is the most that a farmer could spend to provide the attribute (without incurring a loss to do so).

Table 3 b. Consumer willingness to pay (WTP) and share of WTP to livestock producer

Livestock Product	Pork Chops		Milk	
Verified Attribute	**Consumer Value from Indirect Questioning**	**Breakeven Producer Cost To Provide Verified Attribute**	**Consumer Value from Indirect Questioning**	**Breakeven Producer Cost To Provide Verified Attribute**
Self verified pasture access	$0.41	$0.00	$0.20*	$0.11
Private party verified pasture access	$(3.30)*	$0.00	$(1.63)*	$0.00
Consumer group verified pasture access	$1.74*	$0.49	$1.17*	$0.62
USDA verified pasture access	$6.30*	$1.77	$2.14*	$1.14
Self verified individual crates/stalls	$2.66*	$0.75	$0.50*	$0.26
Private party verified individual crates/stalls	$1.23*	$0.35	$(0.43)	$0.00
Consumer group verified individual crates/stalls	$(0.04)	$0.00	$(0.08)	$0.00
USDA verified individual crates/stalls	$2.58*	$0.73	$1.02*	$0.54
Self verified antibiotic use	$0.40	$0.00	$(0.02)	$0.00
Private party verified antibiotic use	$(3.43)*	$0.00	$(2.12)*	$0.00
Consumer group verified antibiotic use	$0.29	$0.00	$0.53*	$0.28
USDA verified antibiotic use	$4.27*	$1.20	$1.08*	$0.57
Self verified certified trucking/transport	$(0.25)	$0.00	$0.18	$0.00
Private party certified trucking/transport	$(7.01)*	$0.00	$(3.20)*	$0.00
Consumer group certified trucking/transport	$(1.46)*	$0.00	$(0.42)*	$0.00
USDA verified certified trucking/transport	$(1.30)*	$0.00	$(0.05)	$0.00

Indirect estimates of consumer value (WTP) are taken from Olynk, Tonsor, and Wolf (2009). Asterisk (*) indicates statistical significance at the 0.05 level. The farm shares of the retail value used for pork chops and milk throughout this analysis were 28.1% and 53%, respectively (USDA, 2009). Breakeven producer costs for the verified attributes are provided for those attributes for which there was positive and statistically significant mean WTP identified, otherwise the verified attribute is dropped from the analysis as the cost of providing the attribute would always exceed the value of provision to the livestock producer.

It is conceivable to think that consumers might exhibit some bias when answering questions related to animal welfare attributes because animal welfare can be a socially charged issue. Social desirability bias reflects the fact that people often have incentives to provide answers to self-reported questions about happiness, well-being, health, and attitudes that deviate from true answers in order to comply with what is socially acceptable (Lusk and Norwood, 2009). Due to the tendency for people to overstate their own values in order to conform to social norms, and the resulting inflation of WTP estimates that could occur in such a situation, the indirect estimates of WTP are likely to be more indicative of consumers' actual WTP than direct estimates.[19] Olynk, Tonsor, and Wolf (2009) found evidence of social desirability bias. Estimates of WTP obtained through indirect questioning were used throughout this analysis due to the recognition that direct questioning may lead to inflated values of consumer WTP due to the presence of social desirability bias and in an effort to provide conservative estimates of consumer demand to support producer decision making. Point estimates of consumer WTP obtained through indirect questioning for pork chops and milk can be seen in Table 3b.

Reliable cost estimates for providing verified attributes were unavailable. Given the wide range of producer costs for verifying the production process attributes through the four different potential verifying entities, identification of critical values at which the optimal verifying entity changes can aid in supporting decisions across a wide range of producers. To support producer decision making, critical points for relative costs to the livestock producer between verification methods (verifying through different entities) that

[19] Fisher (1993) compared direct and indirect questioning in an effort to determine the ability of indirect questioning to reduce social desirability bias and found that indirect questioning reduced social desirability bias on those variables which were subject to social influence (and had no significant effect on socially neutral variables). Specifically focusing on the topic of farm animal well-being, Lusk and Norwood (2009) have tested indirect questioning as a method to mitigate social desirability bias.

change the optimal producer verification method choice were identified. Through this analysis, decision rules regarding the verifying entity which would be optimal for ranges of relative costs will be identified for each of the livestock products and production process attributes included. Such rules will enable producers to incorporate their own information to determine the optimal verification program and ensure that the results are applicable over a wide range of producer cost structures.

Percent of consumers willing to pay at different levels

Point estimates of consumer WTP values and the variance of those WTP estimates were used to identify the distribution of consumer WTP, 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. Producer decision making can be more completely informed by analyzing the distribution of consumer WTP values, rather than relying on a single WTP estimate. Analyzing the percentage of consumers that have a WTP higher than some predetermined level can aid in determining the share of the market that producers can seek to serve. Producers can utilize their own cost estimates to determine the segment of the consumer population that has a WTP high enough to provide a return to providing the verified attribute. Producers must, however, also recognize that as the WTP for verified attributes increases, so does the number of producers who are willing and able to provide that attribute.

3.3 Results and Discussion

Estimates of consumer WTP for verification of various livestock production process attributes were used to establish the potential benefits to livestock producers associated with providing verified attributes. Consumer WTP for verified attributes differed across both livestock species and attributes. As a result the critical points in producer verification costs at which a producer should switch verifying entities also differed by both the livestock product and the attribute in question.

The producer decision support mechanism described in this analysis can be used in two different manners. Producers can use such a mechanism to determine which verified attributes to adopt or to determine how to verify production process attributes which already exist on their operation. Results presented here assume that producers are already providing the production process attribute in question and are seeking to determine the profit maximizing verification method to verify the specific attribute. This use of the mechanism for decision support described above is rather limiting, as it only applies to those producers who are providing the attribute in question. However there are several groups of producers who fall into this category of needing to select the optimal verifying entity for a predetermined attribute, whether the attribute is legislatively determined, determined by retailers providing market access, or producers have simply already chosen a certain production system for other reasons. The presented model could easily be applied to producers evaluating the value in changing on-farm production practices following similar logic.

Critical Points Identified

The simplest criteria for whether or not producers may want to verify a specific production process attribute is whether or not the mean estimate for consumer WTP is positive. Table 3b highlights mean WTP estimates for pork chops and milk and the farm share of the retail value of the WTP. In the case of pork chops, mean estimates of WTP were negative and significant at the 0.05 level for private verification of pasture access and antibiotic use, as well as for verification of certified trucking or transport by private third-party, consumer group, and USDA PVP. Clearly if the mean WTP was negative, a producer would not rationally voluntarily spend money to provide the verified attribute. Self verified pasture access, consumer verified individual stall or crates, self verified antibiotic use, consumer group verified antibiotic use, and self verified certified trucking or transport had mean WTP estimates for pork chops which were not different from zero at the 0.05 significance level. For those attributes for which the mean WTP estimate was not different from zero, the maximum amount that the producer could spend on verification was also assumed to be zero, again because a rational producer would not spend a positive amount to provide an attribute for which consumers did not have a positive value.

When assessing mean estimates of WTP for milk, negative WTP estimates which were significant at the 0.05 level were observed for private party verification of pasture access, antibiotic use, or certified trucking or transport, and consumer group verification of certified trucking or transport. Mean estimates of WTP which were not statistically different from zero at the 0.05 level for milk production were private party or consumer

group verification of individual crates or stalls, self verified antibiotic use, and self or USDA PVP verified certified trucking or transport.

Operating under the assumption that swine producers in question already have access to pasture for their pigs, the question remains as to which verifying entity is the best choice for a producer. In order to obtain critical points, or the points at which producers should switch verification entities in order to obtain optimal returns, the ordering of costs of verification must be known. It was assumed that self verification was the least costly, consumer group and private third-party are the next most costly verification entities, and that USDA PVP is the most costly verification entity. Using the mechanism described above, and assuming that the cost for consumer group verification of pasture access was \$0.01 as a starting point[20], the optimal decision for the producer would be to switch to USDA PVP verification if it could be obtained for less than \$1.29/lb. Regardless of other verification options presented as competing options, the producer should not incur costs of over \$0.49/lb for providing consumer group verification of pasture access. Alternatively, assuming consumer group verification costs \$0.15/lb, participation in an USDA PVP is optimal if feasible for less than \$1.43/lb, otherwise consumer group verification is the optimal choice.

Verification of individual crates or stalls for the production of pork chops presents an interesting case because even if the cost of verification through self, private party, and USDA PVP were \$0.01/lb, the optimal verification method would be self verification, which would return \$0.74/lb in profit to verifying, compared to \$0.72/lb for USDA PVP,

[20] Note that while the cost of self verification relative to other verification entities was assumed to be the lowest, in the case of self verified pasture access for swine production, consumer WTP estimates were not different than zero. Therefore, the analysis for pasture access for swine begins with consumer group verification of pasture access.

and $0.34/lb for private party verification. In this case, self verification is optimal under the assumption that self verification is the lowest cost option.

Verification of antibiotic use in the production of pork chops presents a case in which the only statistically significant evidence of positive consumer demand is for verification by USDA PVP. If USDA PVP verification can be obtained for less than $1.20/lb, USDA PVP verification becomes the optimal decision. If USDA PVP verification cannot be obtained for less than $1.20/lb verification through any of the four potential entities included here is not optimal.

Looking at verification of production process attributes in milk production, USDA PVP verification has the highest value to consumers for each attribute. In the case of verifying pasture access, if self verification costs $0.01/gallon, the producer should switch to consumer group verification if it can be obtained for less than $0.52/gallon or USDA PVP verification if it can be obtained for less than $1.04/gallon. For verification of individual crates or stalls, assuming self verification costs $0.01/gallon, the producer should switch to USDA PVP verification if it can be obtained for less than $0.29/gallon. In the case of verifying the use of antibiotics for milk production, the producer's decision is between consumer group verification and USDA PVP verification, as these are the two verification entities with positive mean WTP values. In this case, if it is assumed that consumer group verification costs $0.01/gallon, the producer should switch to USDA PVP verification if it can be obtained for less than $0.30/gallon. As it is unlikely that consumer group verification could be obtained for $0.01, the starting value for consumer group verification cost was updated to $0.10 for comparison. If verification by consumer

group costs $0.10, then the producer should switch to USDA PVP verification if it can be obtained for less than $0.39.

Statistical evidence of positive consumer demand for verification of certified trucking or transport was not found for any of the four verifying entities included in this analysis for either pork chops or milk. This suggests a rational producer would not pay any positive amount to provide this verified attribute given the lack of positive consumer demand.

Incorporating distribution of consumer WTP values

Using the distributions obtained surrounding these mean consumer WTP values, the percent of consumers that would be willing to pay more than a specified amount for verification of a given attribute can be determined. As heterogeneity is expected in the cost structures of livestock producers, it is illustrative to think about the high cost and low cost producers outlined earlier. Table 3c shows the percent of consumers with total WTP greater than specified values for verified pork chop attributes in $0.50/lb increments of consumer WTP. For interpretation from the livestock producers' perspective, it is the farm share of the consumer WTP that is enlightening.

Table 3 c. Percent of consumers with willingness to pay (WTP) greater than specific increments for verified pork chop attributes with statistical evidence of positive consumer demand

Consumer WTP	**$0.00**	**$0.50**	**$1.00**	**$1.50**	**$2.00**	**$2.50**	**$3.00**	**$3.50**	**$4.00**
Farm Share of Retail WTP Value	**$0.00**	**$0.14**	**$0.28**	**$0.42**	**$0.56**	**$0.70**	**$0.84**	**$0.98**	**$1.12**
Verified Attribute	**Percent (%) of Consumers Willing to Pay More than the Above-Stated WTP**								
Consumer group verified pasture access	100.00	100.00	99.77	82.31	16.20	0.19	0.00	0.00	0.00
USDA verified pasture access	99.74	99.50	99.07	98.35	97.19	95.43	92.86	89.32	84.65
Self verified individual crates/stalls	100.00	99.99	99.73	97.41	86.57	60.52	28.35	7.90	1.22
Private party verified individual crates/stalls	99.92	96.95	72.36	24.64	2.47	0.06	0.00	0.00	0.00
USDA verified individual crates/stalls	100.00	100.00	99.99	99.40	91.20	57.68	16.71	1.68	0.05
USDA verified antibiotic use	100.00	99.98	99.91	99.58	98.46	95.38	88.64	76.77	60.08

Only those verified attributes for which statistically significant evidence of positive mean WTP was found are included here for further analysis regarding the distribution of consumer WTP values. The farm share of the retail value used for pork chops throughout this analysis was 28.1% (USDA, 2009).

Using Table 3c, for example, 92.86%, 16.71%, and 88.64% of consumers have a WTP greater than $3.00/lb for USDA PVP verified pasture access, individual crates/stalls, and antibiotic use, respectively. A more intuitive way for producers to interpret these numbers is to assess the percent of consumers which are willing to pay more than the cost of the verification. This allows producers to assess the farm share of a given WTP value and determine if their cost of providing the attribute is less than that

farm share of the WTP. For example, a high cost producer with a cost of providing self verified individual crates or stalls approaching $0.98/lb can take note that only 7.90% of consumers have the WTP of $3.50/lb which is needed to provide $0.98/lb payment at the farm level. A low cost producer, however, may be able to provide self verified individual crates or stalls for nearly $0.28/lb, at which point 99.73% of consumers possess a WTP greater than the $1.00/lb necessary to provide $0.28/lb income at the farm level. Complicating the decisions facing these producers is the fact that likely far fewer producers can provide the attribute at $0.28/lb than can provide the attribute at $0.98/lb. Not only is the segment of the consumer market which is willing to pay the $3.50/lb far smaller than the portion willing to pay $1.00/lb, but the number of producers seeking to provide the attribute at this higher price is also likely much larger.

Table 3d shows the percent of consumers with total WTP greater than specified values for verified milk attributes in $0.20 or $0.10 increments of consumer WTP.[21] Farm share of retail WTP are shown in Table 3d to allow comparison similar to that presented for pork chops.

[21] Increments of $0.20 or $0.10 were used for the verified attributes in milk rather than the $0.50 increments in pork chops due to the different WTP distributions observed in the milk analysis.

Table 3 d. Percent of consumers with willingness to pay (WTP) greater than specific increments for verified milk attributes with statistical evidence of positive consumer demand

Consumer WTP ($0.20 increments)	**$0.00**	**$0.20**	**$0.40**	**$0.60**	**$0.80**	**$1.00**	**$1.20**	**$1.40**	**$1.60**	**$1.80**
Farm Share of Retail WTP Value	**$0.00**	**$0.11**	**$0.21**	**$0.32**	**$0.42**	**$0.53**	**$0.64**	**$0.74**	**$0.85**	**$0.95**
Verified Attribute	**Percent (%) of Consumers Willing to Pay More than the Above-Stated WTP**									
USDA verified individual crates/stalls	100.00	100.00	100.00	100.00	100.00	85.58	0.00	0.00	0.00	0.00
Consumer group verified pasture access	100.00	100.00	100.00	100.00	100.00	100.00	16.06	0.00	0.00	0.00
USDA verified antibiotic use	100.00	100.00	100.00	100.00	100.00	99.72	0.00	0.00	0.00	0.00
USDA verified pasture access	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Consumer WTP ($0.10 increments)	**$0.00**	**$0.10**	**$0.20**	**$0.30**	**$0.40**	**$0.50**	**$0.60**	**$0.70**	**$0.80**	**$0.90**
Farm Share of Retail WTP Value	**$0.00**	**$0.05**	**$0.11**	**$0.16**	**$0.21**	**$0.27**	**$0.32**	**$0.37**	**$0.42**	**$0.48**
Verified Attribute	**Percent (%) of Consumers Willing to Pay More than the Above-Stated WTP**									
Self verified individual crates/stalls	100.00	100.00	100.00	100.00	100.00	48.57	0.00	0.00	0.00	0.00
Self verified pasture access	100.00	100.00	63.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Consumer group verified antibiotic use	100.00	100.00	100.00	100.00	92.80	0.00	0.00	0.00	0.00	0.00

Only those verified attributes for which statistically significant evidence of positive mean WTP was found are included here for further analysis regarding the distribution of consumer WTP values. The farm share of the retail value used for milk throughout this analysis was 53% (USDA, 2009).

Interestingly, 100% of consumers have a WTP high enough (WTP of greater than $1.00/gallon) to have a farm share of the retail WTP of $0.53/gallon for consumer group verified pasture access, although only 16.06% are willing to pay the $1.20/gallon required to provide a farm share of WTP of $0.64/gallon. This large drop in the segment of the consumer population which is willing to pay this additional $0.20/gallon for this verified attribute can provide valuable information to producers who are making decisions regarding which verified attributes to provide on their operation. If a dairy producer is unable to provide consumer group verification for less than $0.53/gallon, the segment of consumers with WTP enough to justify the cost to the producer is shrinking quickly beyond this price point. Additionally, the portion of producers that can produce this attribute is increasing as the price increases, resulting in more competition to serve this shrinking consumer segment.

3.4 Conclusions

The use of consumer WTP estimates in farm-level decision making regarding the provision of verified attributes was demonstrated in this analysis. A key contribution of this work is to demonstrate the link between consumer demand assessments and livestock producer decision making. Critical points in verification program costs at which the optimal program for a producer changes were illustrated. Distributions of consumer WTP were used to determine the percent of consumers with WTP greater than specific cutoff points. Acknowledging the heterogeneous cost structures across farms associated with providing these verified attributes, it was demonstrated that the size of consumer

segments with WTP at various levels can be identified. Producer decisions can be informed regarding whether or not to provide verified attributes if it is known that only 2% of consumers have a WTP sufficiently high enough to support the provision of the verified attribute versus 98% having a WTP high enough. Producers from all different cost structures can benefit from this analysis. Low cost producers are clearly more likely to engage in the provision of verified attributes and to have larger consumer segments with WTP high enough to support the provision of that verified attribute. High cost producers can also benefit by observing that, depending on their costs of provision and the percent of consumers with a WTP sufficiently high enough to cover the costs of providing that verified attribute, that they should not adopt unprofitable verification strategies.

The producer decision support tool described in this analysis can be used in two distinct ways: 1) to inform producer decision making regarding which production process attributes to adopt and how to verify those attributes; and 2) to aid producers who are already employing certain production processes which are desirable to consumers in deciding which verifying method is optimal. In both cases the consumer value or consumer WTP must be incorporated into the decision. The data regarding costs, however, is quite different for the two uses described. In order to determine adoption of and verification of production process attributes, accurate cost data must be obtained for not only verifying the attribute to the consumer, but also for the actual costs associated with altering the production processes. More data is necessary regarding the actual production-related costs associated with these production processes. These costs are expected to vary widely across farms, although cost estimates for production with access

to pasture, for example, would aid in creating baseline assumptions for analyses regarding the adoption and verification of such production systems. In addition to verification costs varying across farms, it is expected that the costs of verification will vary even within the entities as they have been defined in this analysis. Costs for verification by private party, for example, are expected to differ depending on the specific party.

Four specific production process attributes for two food products were assessed in this analysis. Continued research should include analysis of increased numbers of attributes across a wider range of livestock products. Even across the four production process attributes included in this analysis there exist substantial differences in the optimal producer decision regarding verification. In the case of verifying pasture access for swine the producer must compare costs of verifying through a consumer group versus USDA PVP to select the optimal verifying entity. In the case of certified trucking for both milk and pork chops, however, the producer's optimal decision is to not provide the verified attribute because no statistical evidence of positive consumer demand was found.

While it is demonstrated that producer decision making can be informed by estimates of consumer WTP for specific verified attributes in pork chops and milk, it should also be acknowledged that actual on-farm decision making regarding marketing or provision of value-added verified attributes are made on a wider scope than a single product, such as pork chops or fluid milk. Pork producers, for example, would want to consider consumer demand for various pork products, rather than WTP for attributes of a pork chop solely. In general, consumer demand analyses focus on assessments of demand surrounding individual products, but for the purposes of on-farm decision making the marketing of an entire hog (or carcass) is considered rather than marketing of individual

pork products. Clearly the single-product analysis may be an oversimplification of reality, although the degree to which this is true is likely dependent on the specific livestock product and species. Future research could incorporate analyses of consumer WTP across a number of pork products, rather than just pork chops. Potential analysis might include assessments of consumer WTP across a number of the higher end cuts of pork to determine if the consumer value placed upon verification of these cuts is sufficient to elicit producers to verify production processes used to raise their hogs when equivalent premiums on lower valued products may not exist.

Potential extensions of this model could include increased flexibility to assess multiple attribute decisions jointly, rather than assessing verification decisions for individual production process attributes. Considerations such as economies of scale and scope to verify multiple attributes may become increasingly important in this case. The potential for multiple verifiers also becomes an issue when assessing verification of multiple process attributes concurrently, either due to consumer preferences for certain verifiers to verify specific attributes but not other attributes, or due to other on-farm or verifier-specific cost considerations. As verification of production process attributes becomes increasingly common across all products, not just livestock products, and the market for verified attributes becomes more developed, model extensions such as those highlighted above should be investigated.

CHAPTER 4: SURVEY OF MILK PRODUCTION PRACTICES REGARDING THE USE OF RBST IN MICHIGAN

4.1 Introduction

Dairy producers in many parts of the U.S. have recently assessed the adjustments they were willing to make to satisfy changing retailer, and ultimately consumer, preferences. Consumers are increasingly interested in the production processes used in food production. As retailers react to changes in consumer tastes and preferences dairy farmers may be forced to alter their practices in order to continue to serve markets (Cook-Mowery, Olynk, and Wolf, 2009). Changes in production practices used on farms in production systems can largely be attributed to market pressures rather than changes in legislation as the ability of consumer groups to influence firms on issues relating to animal handling is increasing (Hudson and Lusk, 2004).

A particular case in which market pressures led to wide-scale changes in the production processes employed is the case of recombinant bovine somatotropin (rbST) use and milk production. The Food and Drug Administration approved rbST, also called recombinant bovine growth hormone (rbGH), in November 1993 for commercial use to increase milk production in dairy cattle. In February 1994 rbST was first commercially available in the U.S. Controversy continues today over the use of rbST in milk production. Several major U.S. retailing chains have moved towards procurement of milk supplies from cows not treated with rbST. Looking specifically at Michigan, a major retailer decision which sparked change for cooperatives and producers throughout the state was the Kroger Company's announcement via press release on August 1, 2007 that it would transition to selling rbST-free fluid milk by

February 2008 (Press Release, The Kroger Company, 2007). This decision led to a chain of events occurring in the Michigan milk market as cooperatives and individual producers adjusted to meet changing demands. These changes in the Michigan milk market offered a chance to elicit producer sentiments and beliefs (via a survey mechanism) in the face of major industry adjustments.

Recent literature has investigated methods of assessing individuals' preferences surrounding purchasing decisions, adoption of or participation in industry programs, or to determine values associated with situation-specific attributes, such as preferences for contract or program design. Consumer utility maximization frequently underlies willingness to pay (WTP) analyses, although the concept can also be applied to producers (Hudson and Lusk, 2004). Recently, several studies have assessed producer willingness to change (WTC), which encompasses both the concepts of WTP and willingness to accept (WTA) for operational practices in agriculture (Schulz and Tonsor, 2010). Norwood et al. (2005) conducted a survey to measure crop producers' WTP for manure from livestock operations. Roe, Sporleder, and Belleville (2004) examined hog producer preferences for hog marketing contract attributes and found producers value window contract ceiling and floor prices differently. Norwood et al. (2006) provided information from Oklahoma cattle producers regarding preferences of the design of voluntary check-off programs. Davis and Gillespie (2007) found that hog producers differ in their valuations of autonomy and risk acceptance in selecting from alternative business arrangements. Beyond assessment of producer WTC, a recent study by Schulz and Tonsor (2010) sought to determine the producer welfare implications of changes in options or choices available to producers. Schulz and Tonsor (2010) identified

preferences of U.S. cow-calf producers for traceability systems and found heterogeneity among producers not only in their preferences, but also in the welfare effects of mandating traceability. These examples demonstrate increasing evaluations of producer preferences and WTC with applications to agricultural producers.

Much debate has followed regarding why consumers are expressing demand for rbST-free milk. Regardless of the reasons that retailers and consumers are demanding milk produced without the use of rbST, producers must respond to changes in consumer demand. This article presents analyses of the situation of Michigan dairy producers who faced major change to meet demand for rbST-free milk. Dairy producer preferences surrounding selling milk rbST-free and herd size growth were two key factors in the choice experiment used in this analysis. The distribution of welfare effects due to the movement away from rbST use in milk production is assessed. A key component of this analysis is to determine the welfare effects of the disadoption of rbST on producers with varying farm characteristics.

4.2 Survey Instrument and Choice Experiment

A survey was developed to obtain information from Michigan dairy producers regarding preferences for changes in milk production practices, specifically regarding a movement towards rbST-free milk. The survey was mailed to 1,200 dairy farms in Michigan in December of 2007, with reminder postcards sent approximately two weeks later. The survey instrument used is presented in Appendix 5. In the survey introduction, dairy farmers were told, "Recently, there has been a movement towards milk labeled "rbST-free" for beverage consumption. Several Michigan retailers have

requested milk from cows not supplemented with rbST beginning February 1, 2008. With this in mind, please answer the following questions." Many questions on the survey incorporated preferences for or against rbST-free milk production. The timing of the survey was such that these questions were posed not only hypothetically on the survey, but were also being faced by producers in the Michigan dairy industry.

Dairy farms were selected randomly to receive surveys from all those permitted to sell milk in Michigan. A total of 258 surveys were returned, resulting in a 21.5% response rate. Only those respondents who were actively operating dairy farms in 2007 and chose to participate in the choice experiment portion of the survey were included in this analysis, resulting in 183 usable responses. The survey respondents were mostly male, averaged approximately 49 years old, and had, on average, 229 cows on their operation. Distribution of dairy farm sizes of survey respondents roughly approximated the distribution of dairy farm sizes in Michigan in 2007 (NASS, 2009). Summary statistics of selected dairy producer and farm characteristics of the 183 dairy producers included in the analysis are provided in Table 4a. Specific to the use of rbST on Michigan dairy farms, 67% of respondents indicated that they had tried rbST on milk cows at some point. In comparison, only 37% of respondents indicated that they had used rbST in 2007. Therefore, several respondents indicated that while they had tried rbST in the past, they had disadopted prior to 2007.

Table 4 a. Selected dairy producer demographics and operation characteristics

Variable	Description	Summary Statistics
Gender	Gender of respondents	95% male
Age	Average age of respondents	49.2
2007 Herd Size	Number of milking and dry cows in the herd at the time of the survey	229 cows
Production Cost ($/cwt)	Average cost of production ($/cwt) for the past year (dairy herd only, not including calves, heifers, or crops)	$12.75/cwt
2007 rbST use	Percent of herds having using rbST at any time in 2007	37 %
rbST use ever	Percent of herds which have ever tried rbST on milk cows	67%
Next generation	Percent of respondents that indicated that the next generation was coming back to the farm	53%

Choice Experiment

Choice experiments involve asking individuals to choose from alternative bundles of attributes, as opposed to rating or ranking them (Adamowicz et al., 1998). Choice experiments simulate real-life situations and permit multiple attributes to be evaluated, thereby allowing estimation of tradeoffs among different alternatives (Lusk, Roosen, and Fox, 2003). Each dairy producer completed a choice experiment designed to simulate decisions regarding milk production in the upcoming years using a given milk price, corn price (to proxy feed cost), production practice, and on-farm milk production trend.

In response to each situation producers were asked to respond with which production option they would select given that they expected the situation presented to be an accurate prediction of the dairy industry environment in January 2013. In

each of the presented situations, producers were asked to select either one of two production options or to stop milking cows under the given conditions. In this particular choice experiment dairy producers were presented with a set of five or six dairy industry scenarios, each of which involved selecting a preferred alternative from two possible situations and an option to stop milking cows altogether.[22] Scenarios presented to producers in the choice experiment included information on future milk prices, corn prices, production practices, and milk production trends. Producers were faced with either a high, medium, or low milk price, which were characterized as $18.00 per cwt, $15.00 per cwt, or $12.00 per cwt, respectively. Producers were shown either a high corn price of $3.50 per bushel or a low corn price of $2.00 per bushel. Two possible production practices were included, conventional, which was presented in the survey as, "Conventional (rbST ok) means the milk was produced using practices typical for the industry potentially including the use of rbST/rbGH on a portion of the herd," or rbST-free, which was identified in the survey instrument as, "rbST-free is the same as conventional except you voluntarily choose not to use rbST." Three possible milk production trends included increasing milk production at 1.5% per year (typical status quo trend increase in milk per cow with constant herd size), increasing herd milk production 25% per year (minor expansion), and increasing herd milk production 100% per year (major expansion).

[22] Following Tonsor et al. (2005), the choice experiment was divided into blocks to ease respondent fatigue. Two versions of the survey were mailed to producers, one version had five scenarios and the other had six scenarios.

Income Over Feed Cost Calculation

Most choice experiment research involves WTP and WTA calculations which determine the change in cost that keeps utility unchanged given a change in an attribute level. In other words, such calculations find the amount of a given attribute that equates the marginal benefit and the marginal cost of a change. Generally price or some money metric is included in choice experiments to allow for interpretation of the tradeoffs of the utility associated with an amount of money and an attribute level. The choice experiment used in this analysis included both an input price (corn price ($/bu)) and an output price (milk price ($/cwt)).

Unlike consumer WTP studies where a single purchase price can be assigned, in this analysis both input and output prices are expected to affect producer preferences. Dairy producer profitability depends on the relationship between input and output prices. The income over feed cost (IOFC) was used in the analysis of the choice experiment because it incorporates both output and input price changes. In order to incorporate both the input and output costs into a single money metric that could be included in the analysis of the choice experiment IOFC was calculated for each scenario. The IOFC was calculated as the price received for one hundred pounds of milk minus the feed cost to produce one hundred pounds of milk. The milk price ($/cwt) was given in each choice experiment scenario. The feed cost to produce one cwt of milk was calculated using the information provided to producers in the choice experiment and average Michigan feed component prices.

The cost for 100 pounds of feed (as fed) was calculated using the average price for hay, and incorporating corn price and estimated resulting soybean price

presented to producers in the choice experiment for a representative dairy ration was calculated as[23]:

$$\left[\frac{(\text{Corn Price (\$/bu)})}{56} * 51 + \frac{(\text{Soybean Price (\$/bu)})}{60} * 8 + \frac{(\text{Hay Price (\$/ton)})}{2000} * 41\right]$$

Then, in order to determine the cost of 100 pounds of dry matter, each of the feeds included in the ration above was divided by percent of dry matter from the Nutrient Requirements of Dairy Cattle: Seventh Revised Edition (2001). The percent of dry matter used for corn, soybeans, and hay was 88%, 90%, and 88%, respectively. The average hay price for Michigan in 2007 was $124/ton (USDA, 2009). Soybean price ($/bu) was assumed to be 2.4 times the corn price presented in the scenario (Wolf, 2008). The production of milk from dry matter intake of the cow, called dairy or feed efficiency, is defined as the yield of milk per unit of dietary dry matter consumed (Britt et al., 2003). A feed efficiency value of 1.4 was used throughout this analysis (Britt et al., 2003), which can be interpreted as a pound of dietary dry matter consumed yields 1.4 pounds of milk. In our analysis this value means that it takes 0.7143 pounds of dry matter fed to produce a pound of milk. Incorporating the dry matter conversions and the feed efficiency parameter, as well as the average hay price ($/ton) for 2007 and estimated soybean price ($/bu), the IOFC calculated for each scenario was:

[23] It is unlikely that any farm will actually have this exact feed price, but corn, soybeans, and hay are common sources of energy, protein, and forage in dairy rations (Wolf, 2007).

$$\text{Milk Price (\$/cwt)} - \left[\frac{\left(\frac{(\text{Corn Price (\$/bu)})}{56} * 51 \right)}{0.88} + \frac{\left(\frac{((\text{Corn Price} * 2.4)\ (\$/\text{bu}))}{60} * 8 \right)}{0.90} + \frac{\left(\frac{(\$124/\text{ton})}{2000} * 41 \right)}{0.88} \right] * 0.7143$$

4.3 Research Methods

Random utility theory frequently underlies analyses utilizing choice experiments. Random utility theory is built upon the assumption that economic agents seek to maximize their expected utility subject to the choice set they are presented. The individual's utility is considered a random variable because the researcher has incomplete information (Manski, 1977). Let utility be the sum of observable and unobservable components $U_{jt} = V_{jt} + \varepsilon_{jt}$, where U_{jt} is the latent, unobservable utility for the j-th alternative in choice scenario t, V_{jt} is the systematic, observable portion of utility determined by the attributes and their values, and ε_{jt} is the random, unobservable component of utility, independently and identically distributed over all alternatives and choice scenarios. The probability that alternative j will be selected is the probability that the added utility from this selection is greater than (or equivalent to) choosing another alternative presented in the choice experiment. The utilities

associated with each alternative are not directly observable because they include an unobserved component, therefore researchers have determined the probability of selecting alternative j as $P(j) = P(v_j + \varepsilon_j \geq v_k + \varepsilon_k;\ j \neq k\ \ \forall_j \in N)$, where N is the total set of alternatives available (Boxall and Adamowicz, 2002 and Adamowicz et al., 1998). The probability that alternative j is selected by the producer can be expressed as $P(j) = \dfrac{e^{\mu\beta Xj}}{\sum_{k \in N} e^{\mu\beta X_k}}$ where μ is a scale parameter which is inversely related to the variance of the error term (Lusk, Roosen, and Fox, 2003) and β is a vector of parameters (Boxall and Adamowicz, 2002; Adamowicz et al., 1998).[24]

Assuming the systematic component of the total utility U_{jt} is linear in parameters the specification of the general model is $V_j = \beta_1 x_{j1} + \beta_2 x_{j2} + ... + \beta_n x_{jn}$ where x_{jn} is the n-th attribute for alternative j and β_n is a vector of parameters associated with the n-th attribute of the j-th alternative. The βs are utility parameters to be estimated in the model.

Random Parameters Logit

The (random parameters logit) RPL model allows for random taste variation within the surveyed group of producers. Through the use of the RPL we are able to directly estimate the heterogeneity in dairy producer preferences across those attributes included in the choice experiment. The utility of attribute j for individual i in choice set t

[24] The scale parameter μ is typically set equal to one in such analyses because it is unidentifiable in any given data set (Lusk, Roosen, and Fox, 2003). The remainder of this analysis assumes the scale parameter, μ ,is equal one.

in the RPL model is presented as follows, $U_{ijt} = v_{ijt} + \lfloor u_{ij} + \varepsilon_{ijt} \rfloor$, where v_{ijt} is the systematic portion of the utility function, u_{ij} is an error term which is distributed normally over producers and alternatives (but not choice sets), and ε_{ijt} is the stochastic error, independently and identically distributed over all producers, attributes and choice sets (Tonsor et al., 2005). A panel data set is described here, in which the cross-sectional element is the producer, *i*, and the time series component is the choice scenario *t* (Alfnes, 2004 and Tonsor et al., 2005).[25] In the random parameter logit model the probability that producer *i* chooses alternative *j* in choice set *t* is $\mathrm{P}(U_{ijt} \geq U_{ikt})$, over all possible *k* attributes. Under the assumption that v_{ijt} is linear in parameters the utility function can be expressed as $v_{ijt} = \beta_{i1} x_{1it} + \beta_{i2} x_{2it} + \ldots + \beta_{ij} x_{ijt}$ where x_{ijt} is the *j*-th attribute for choice set *t* and β_j is a vector of preference parameters associated with the *j*-th attribute of the *t*-th alternative of the *i*-th producer (Alfnes, 2004; Tonsor et al., 2005; and Schulz and Tonsor, 2010).

The RPL model estimated in this analysis specified the systematic portion of utility as:

$$v_j = \beta_1(Cons) + \beta_2(IOFC) + \beta_3(Cons\_Generation) + \beta_4(Cons\_2007Size) + \beta_5(Cons\_2007rbST) + \beta_6(MilkProd) + \beta_7(rbSTFree) + \beta_8(rbST\_Age) + \beta_9(rbST\_2007rbST) + \beta_{10}(rbST\_2007Size)$$

where, *rbSTFree* is identifying the production practice, whether conventional or rbST free, both as identified above. Interactions between operator age (*Age*), *2007rbST*, and *2007Size* with *rbSTFree*, namely *rbSTFree_Age*, *rbSTFree_2007rbST*, and *rbSTFree_2007Size*, were also included. The variable *2007rbST* indicated whether the

[25] Model estimation was done in NLOGIT 4.0 using the program's panel data capabilities.

farm used rbST at any point during 2007 and *2007Size* is the herd size in 2007. *MilkProd* is the increase in herd milk production presented in the choice experiment which could be an increase of 1.5% per year, an increase of 25% per year, or an increase of 100% per year. *Cons* is a constant included to capture producer sentiment regarding stopping milking cows (exiting the dairy industry or opting out) and *Cons*=1 if option C is selected (or *Cons*=0 otherwise), and *IOFC* is the income over feed cost that is calculated as described above incorporating the corn price and milk price presented to the dairy producers in the choice experiment. Three variables are interacted with *Cons* to produce *Cons_Generation*, *Cons_2007Size,* and *Cons_2007rbST*, which are opting out interacted with whether or not there is a next generation expected to return to the farm (*Generation*=0 if next generation not expected, *Generation*=1 if next generation is expected), the herd size in 2007 (*2007Size*), and whether or not the herd used rbST in 2007 (*2007rbST*=0 if rbST not used in 2007, *2007rbST*=1 if rbST used in 2007), respectively.

To examine preference heterogeneity the β coefficients on *Cons*, *rbSTFree*, and *MilkProd* are specified to vary normally across producers. The RPL model estimates both the mean and standard deviation of the utility coefficients assumed to vary across producers. If the estimates of the standard deviation parameters are significant, there is evidence of preference heterogeneity for that attribute. Given the dairy industry scenarios and industry attributes being analyzed, it is possible that producers may have both positive and negative preferences for the dairy industry attributes. The random parameters are assumed to be drawn from a normal distribution which allows the flexibility for value estimates to be either positive or negative (Tonsor et al., 2005; Lusk,

Roosen, and Fox, 2003). The preference for attribute j is given by $B_j = \overline{B}_j + \sigma_j + \mu_{ij}$ where $\overline{B}_j$ is the mean estimate across all producers, σ_j is a diagonal matrix of coefficient standard errors, and μ_{ij} is a vector of independent normal decisions for each individual producer (Lusk, Roosen, and Fox, 2003; Tonsor et al., 2005).

Individual estimated coefficients in a random utility model have little interpretive value. Relative combinations of select coefficients, however, can provide insights on producer preferences. As in Schulz and Tonsor (2010), willingness to change (WTC) is used to generally capture both WTA and WTP terms which are broadly used in the literature. The WTC in this analysis is generally given by $WTC = \frac{MU}{MU_{IOFC}}$, which is evaluated at the mean values of the independent variables (Schulz and Tonsor, 2010), and where MU is the mean marginal utility of dairy farm and industry attributes and MU_{IOFC} is the marginal utility of income over feed cost.

Producer Welfare Analysis

The use of rbST has not been legislatively prohibited in Michigan, although due to the decisions of key retailers in the state the use of rbST in fluid milk production in Michigan was rapidly disadopted in late 2007 and early 2008. Given that rbST was essentially removed as a technology available for use in Michigan through market forces, a key question to ask is how producers were impacted by no longer having rbST available for use. Prior to the changes by retailers towards rbST-free milk dairy producers could choose between conventional production (in which rbST use was allowed), voluntary rbST-free production, or to decide to no longer milk

cows and exit the dairy industry. Given the options available to dairy producers, in the realm of rbST use on farms, after the decisions by retailers to move away from rbST use producers had two of the three options remaining available, rbST-free production or to stop milking cows.

Welfare impacts were estimated for producers when conventional production, in which the use of rbST was okay, was eliminated as an option for dairy producers in Michigan. Small and Rosen (1978) showed that expected maximum utility from making a choice from a particular choice set is given by $CV = \ln\left(\sum e^{Vj}\right) + C$, where C is Euler's constant and V_j is as previously defined. The welfare impact when moving from one situation denoted by CV^0 to a situation denoted by CV^1 is $1/(MU_{IOFC})$ x $[(CV^1)-(CV^0)]$. This calculation represents the maximum per choice occasion that producers would be willing to pay to have the choices in situation 1 versus situation 0 (Lusk, Norwood, and Pruitt 2006). Throughout this analysis the welfare impacts per choice occasion are converted to a per cow per year basis for ease of interpretation. This welfare measure captures producer value of autonomy, thereby including more than just the differences in perceived costs associated with disadoption (Key, 2005). Welfare impacts for those producers which did not use rbST in 2007 were compared to the impacts for those producers who did use rbST in 2007. Welfare impacts for producers with combinations of different herd sizes and rbST use in 2007 were also determined.

A combinational technique suggested by Poe, Giraud, and Loomis (2005) was used to test if welfare impacts differed among dairy producer situations described above

(e.g., dairy producers using rbST in 2007 versus those not using rbST in 2007). Following Krinsky and Robb (1986), 1,000 observations were drawn from a multivariate normal distribution which was parameterized with the coefficients estimated in the RPL model and the variance-covariance matrix resulting from the same model. The difference between two simulated welfare series was evaluated by calculating the difference for all possible combinations in the two series. Poe, Giraud, and Loomis (2005) determined that the complete combinatorial approach, which provides an exact measure of the difference of two distributions, is the preferred method to estimating the significance of the difference between two distributions. Therefore, the complete combinatorial test is employed to test the significance of the difference among welfare impacts throughout this analysis.

4.4 Results and Discussion

The estimated coefficients of the RPL model used in this analysis are shown in Table 4b.[26]

[26] The use of a multinomial logit model was rejected in favor of the RPL model described in this analysis through the likelihood ratio test.

Table 4 b. Estimated coefficients for random parameters logit model

Variable	Coefficient estimate	Standard deviation estimate
Milk Production Growth	-0.0133* (0.0031)	0.0271* (0.0039)
rbST Free	2.7648* (0.8294)	1.1163* (0.2999)
Opt Out	6.8600* (0.6319)	2.2361* (0.3205)
Opt Out * Next Generation	-2.6397* (0.5330)	
Opt Out * 2007 Herd Size	-0.0009 (0.0011)	
Opt Out * 2007 rbST Use	-1.4929* (0.6014)	
Income Over Feed Cost	0.6875* (0.0499)	
rbST Free * 2007 Herd Size	0.0007 (0.0005)	
rbST Free * 2007 rbST Use	-2.5802* (0.4246)	
rbST Free * Age	-0.0326* (0.0152)	

Notes: Presented model (log likelihood of -617.78) was estimated using NLOGIT 4.0, with Halton draws, and 500 replications for simulated probability. Standard errors are presented in parentheses. Asterisk (*) indicates statistical significance at the 0.05 level.

All coefficient estimates in the model were individually significant at the 0.05 level, except for the coefficients on the interaction between herd size and opting out of milking cows and herd size and rbST-free production. In random utility models the interpretation of individual coefficients is generally discouraged (Scarpa and Del Giudice, 2004), although signs of coefficients can be indicative of general directions of producer preferences. For instance the sign on rbST-free production is positive, indicating a preference for such production for the representative producer. However, as expected, the sign on the interaction between rbST-free production and having used rbST in 2007 is negative, indicating that if a producer was using rbST in 2007 they hold a preference against rbST-free production (in favor of conventional production as

defined in this analysis). The coefficients were used to compute estimates of producer WTC and welfare impacts, which are discussed below.

Evidence of preference heterogeneity exists if the standard deviations are statistically significant, in which case the mean WTC estimates calculated cannot be interpreted as being representative for the entire sample of producers. All three of the variables specified to vary normally across producers had statistically significant standard deviation parameters (Table 4b). These statistically significant standard deviation parameters reveal significant preference heterogeneity across producers in these variables which is not captured by interaction terms or other explanatory variables. Using the estimated coefficients and standard deviations on milk production growth and rbST-free production, the percent of producers for which utility was positive or negative can be determined, by evaluating independent variables at their mean values (Train, 2003). Thirty-one percent of producers had positive utility associated with milk production growth. Preferences for rbST-free production offer an interesting comparison because 37% of producers had a negative preference for rbST-free production, while the remaining 63% had a positive preference for rbST-free production. In other words, when controlling for rbST use in 2007, 2007 herd size, and producer age, 37% of producers had preferences for conventional milk production. From Table 4a, it can be seen that 37% of producers surveyed were using rbST in 2007. Therefore, it is not surprising that the percent of producers with a preference against the rbST-free production is the same as the percent of producers using rbST in 2007, prior to the market movement away from rbST use. Additionally, while only 37% of producers surveyed used rbST in 2007,

67% of producers indicated they had used rbST on milk cows at some point in the past. Therefore, many producers had already disadopted rbST prior to 2007 for other reasons.

Willingness to Change

Estimates of WTC were calculated to determine producer preferences for change related to milk production growth and rbST-free production. Table 4c displays WTC values with 95% confidence intervals, when independent variables are evaluated at their means.

Table 4 c. Dairy producer willingness to change (WTC)

Producer Group Characteristics	**Variable**	**WTC**
All Producers	Milk Production Growth	($0.02) [($0.03), ($0.01)]
All Producers	rbST Free	$0.54 [($0.07), $1.12]

Estimates are $/cwt of milk sold and simulated 95% confidence intervals (identified using 1,000 Krinsky-Robb simulations) are presented in brackets.

The WTC estimates calculated indicate that the average dairy producer would require additional payment of $0.02 per cwt to be indifferent to milk production growth. In other words, a preference against milk production growth, although at a very small value, is observed. The WTC on rbST estimated is not significant at the 0.05 significance level, indicating that the average producer has a WTC which is not different than zero.

Producer Welfare Impacts

Table 4d displays the welfare impacts for producers of going from a situation in which conventional, rbST free, and exiting the industry were options to the producer to a scenario in which the option of conventional production is eliminated.

Table 4 d. Welfare effects on dairy producers

Producer Group Characteristics	$/cwt per choice scenario	Annual per cow welfare impacts for cow production level:		
		190 cwt/year	210 cwt/year	230 cwt/year
All Producers	-$0.23	-$43.70	-$48.30	-$52.90
Producers using rbST in 2007	-$0.32	-$60.80	-$67.20	-$73.60
Producers not using rbST in 2007	-$0.18	-$34.20	-$37.8	-$41.40
Producers using rbST in 2007 (assuming herd size of 100 cows)	-$0.31	-$59.90	-$65.10	-$71.30
Producers using rbST in 2007 (assuming herd size of 500 cows)	-$0.33	-$62.70	-$69.30	-$75.90
Producers not using rbST in 2007 (assuming herd size of 100 cows)	-$0.18	-$34.20	-$37.80	-$41.40
Producers not using rbST in 2007 (assuming herd size of 500 cows)	-$0.20	-$38.00	-$42.00	-$46.00

Mean estimates of annual welfare impacts are for going from a situation in which conventional production, rbST free production, and exiting the industry are options available to the dairy producer to a situation in which conventional production is eliminated from those options.

Welfare impacts quantified here go beyond the costs of disadoption perceived by the producer, because they also include producer valuation for autonomy and control over decision making for their operation. The welfare calculation used here represents the maximum that producers would be willing to pay to have the choices in one situation versus another (Lusk, Norwood, and Pruitt 2006). Using survey data a maximum

WTP by producers of $0.23/cwt per choice occasion was estimated. Using a milk price of $15.00/cwt, this $0.23/cwt is about 1.5% of the milk price received. In other words, the average producer, with a production level of 210 cwt/year, would be equally well-off to give up $48.30/cow/year or to have conventional milk production option removed from their choice set.

Table 4d also shows the welfare impacts for producers with different characteristics. Assuming a farm with a production level of 210 cwt/cow/year, a producer using rbST in 2007 has a welfare loss of $67.20/cow/year to lose conventional production from their choice set. A producer who was not using rbST in 2007 has a welfare loss of $37.80/cow/year to lose conventional production from their choice set. The welfare impacts on both producer groups were statistically significant. Therefore, even those producers who were not using rbST in 2007 were willing to pay to keep conventional milk production, in which rbST use was accepted, in their choice set for available production practices. Recall that these welfare values capture not only the costs of disadoption, or perceived lost income from disadoption, but also the producer valuation of autonomy. Although only 37% of producers were using rbST in 2007 and they had higher mean welfare losses than those producers who were not using rbST in 2007, all producers, whether using rbST in 2007 or not have statistically significant estimated welfare losses.

Herd size and rbST use in 2007 were investigated jointly as farm characteristics to determine differential welfare impacts of having conventional production removed from the choice set of dairy producers for a herd size of 100 cows that was on rbST in 2007, a herd size of 100 cows that was not on rbST in 2007, a

herd size of 500 cows that was on rbST in 2007, and a herd size of 500 cows that was not on rbST in 2007. For a producer with a herd of 500 cows that was using rbST in 2007 the welfare loss was $0.33/cwt/choice scenario or, for a cow producing 210 cwt/year in this situation, the welfare loss was $69.30/cow/year. Welfare loss estimates are shown in Table 4d for each of the four herd size and rbST use scenarios described above.

The complete combinatorial test prescribed by Poe, Giraud, and Loomis (2005) was used to determine if the welfare impacts on producers with different characteristics were statistically different from one another. In the case of producers using rbST in 2007 versus those not using rbST in 2007, we reject the null hypothesis (at the 0.05 significance level) that the two groups have the same welfare impacts. Recognition of the heterogeneity of welfare impacts across producers, depending on whether or not a producer used rbST prior to the disadoption of rbST by the market, is important for determining the impacts of such market change on the industry. In this case, as expected, those producers forced to make adjustments had larger welfare impacts than those not forced to make adjustments. Still, those not making adjustments had statistically significant welfare losses due to the loss of a choice of production system, even though it was a system that they had not used in the year preceding the change.

Further tests for heterogeneous welfare impacts were conducted to determine if welfare impacts differed across other groups of producers investigated in this analysis, specifically groups differing by herd size and rbST use concurrently. As stated above, heterogeneous welfare impacts were found when looking at producers

on rbST versus not on rbST in 2007. The null hypothesis of homogenous impacts was also rejected when distinguishing small producers (herd size of 100 cows) and large producers (herd size of 500 cows) by whether or not they used rbST in 2007. Heterogeneous welfare impacts were found across small producers when distinguishing by rbST use in 2007 versus those not using rbST in 2007. Similarly, heterogeneous welfare impacts were found across large producers when distinguishing based upon rbST use in 2007. When comparing farm size and rbST use we failed to reject the null hypothesis of homogenous welfare impacts when comparing large producers on rbST in 2007 versus small producers on rbST in 2007, large producers not on rbST in 2007 versus small producers not on rbST in 2007, and large producers not on rbST in 2007 versus small producers on rbST. Heterogeneous welfare impacts were found when comparing large producers on rbST in 2007 versus small producers not on rbST in 2007. Overall, heterogeneous welfare impacts were highlighted in all cases where producers were distinguished based on rbST use, except when comparing large producers not on rbST in 2007 versus small producers on rbST in 2007.

4.5 Conclusions

Changes in consumer tastes and preferences led retailers throughout the U.S. to seek to provide fluid milk which is produced without the use of rbST to their customers. In order to supply this changing retailer demand milk cooperatives and dairy producers adjusted the production practices used, namely whether rbST use is permitted. Conventional production systems have allowed rbST use in milking cows. Now,

rbST free production claims which have been adopted by an increasing number of cooperatives, and therefore individual dairy producers, have essentially eliminated conventional production from the choice set of many dairy farms. While the use of rbST has not been eliminated through legislative channels, the market has effectively limited the choice set of producers.

This analysis sought to identify Michigan dairy producer preferences for rbST free milk production. Random parameters logit models revealed heterogeneous preferences for rbST free production. Willingness to change values for rbST free production were not statistically different than zero for the representative producer. Statistically significant welfare impacts, however, were found for the representative producer. Welfare impacts of eliminating conventional production, in which rbST use was accepted in the market, were calculated. Eliminating conventional production from the choice set of producers had a negative welfare impact on the representative producer of $48.30/cow/year (assuming 210 cwt/year production level).

Welfare impacts were further investigated for producers who were using rbST in 2007 versus those who were not using rbST in 2007. In addition to analysis for producers using and not using rbST in 2007, herd size was incorporated to determine the welfare impacts for producers with differing herd sizes and rbST use. Statistically significant welfare impacts were found in all of these described scenarios. Evidence of heterogeneity in welfare impacts was identified across producers. The removal of rbST from producers' choice sets for production practices had different welfare effects for producers with differing rbST use characteristics.

Forced disadoption of practices, in the case of rbST in milk production, was shown to have heterogeneous welfare effects. Similar analyses could be completed for welfare analyses of producers facing potential disadoption of other practices, such as tail docking or individual crates. While disadoption of practices is often discussed as an adjustment issue for a given subset of producers, the significant welfare loss for all producers was highlighted in this analysis. Implications of heterogeneous welfare effects must be recognized when production systems are eliminated from producers' options, whether via legislative channels or through market changes.

CHAPTER 5: SUMMARY

Consumers are increasingly interested in how their food is produced and in learning about the production practices used in modern food production. This dissertation incorporated three different analyses related to producer response to changing consumer tastes and preferences surrounding production process attributes in livestock. The three components of this analysis were to assess consumer value for WTP for the verification of production practices, develop a conceptual framework for incorporating consumer values and consumer WTP into producer decisions, and to highlight the heterogeneous welfare impacts for producers when the set of potential production practices facing producers shrinks.

Estimates of consumer WTP for verification of four different livestock production process claims across two livestock products were obtained. Weak evidence of social desirability bias was found in this analysis. Given the tendency for people to overstate their own values in order to conform to social norms, and the resulting inflation of WTP estimates that could occur in such a situation, the indirect estimates are likely more indicative of consumers' actual WTP. Further analysis regarding the data collection method, whether via mail survey, internet survey, or in-person interviews would provide valuable insight into the prevalence of social desirability bias by data collection method.

The use of consumer WTP estimates in farm-level decision making regarding the provision of verified attributes was demonstrated. A key contribution of this work is to demonstrate the link between consumer demand assessments and livestock producer

decision making. Acknowledging the heterogeneous cost structures across farms associated with providing these verified attributes, it was demonstrated that the size of consumer segments with WTP at various levels can be identified. Producers from all different cost structures can benefit from this analysis. Other agricultural producers, beyond livestock producers, can benefit from this concept. Consumer demand data can be incorporated into producer decision making, which could be particularly helpful when producers are making decisions regarding provision of new attributes, goods, or services.

Heterogeneous welfare impacts were found across dairy producers when rbST was eliminated from the producers' choice set. Changes in consumer tastes and preferences led retailers throughout the U.S. to seek to provide fluid milk which is produced without the use of rbST to their customers. Dairy producers adjusted the production practices used, meaning whether rbST use is permitted, in order to meet this changing demand. Conventional production systems have allowed rbST use in milking cows. Now, rbST free production claims which have been adopted by an increasing number of cooperatives, and therefore individual dairy producers, have essentially eliminated conventional production from the choice set of many dairy farms. While the use of rbST has not been eliminated through legislative channels, the market has effectively limited the choice set of producers. Statistically significant welfare impacts, however, were found for the representative producer. The removal of rbST from producers' choice sets for production practices had different welfare effects for producers with differing rbST use characteristics. While disadoption of practices is often discussed as an adjustment issue for a given subset of producers, the significant welfare loss for all producers was highlighted in this analysis.

APPENDICES

APPENDIX 1: SURVEY INSTRUMENT

This is a survey designed to obtain information from U.S. consumers regarding food consumption. *Your participation in this survey is entirely voluntary and your responses will be kept in strict confidence.* **If you have any questions, comments, or concerns regarding this survey, please contact Dr. Glynn Tonsor by email (gtonsor@msu.edu) or by phone (517-353-9848).**

1. I am: Male Female

2. I am _____ years old (fill-in the blank or drop down).

3. Our annual pre-tax, household income is:
   -- drop down menu with 10 ranges: 1) Less than $20,000; 2) $20,000 - $39,999; etc. up to 10) $180,000 or more

4. The best description of my educational background is:
   a. Did not graduate from high school
   b. Graduated from high school, Did not attend college
   c. Attended College, No Degree earned
   d. Attended College, Associates or Trade Degree earned
   e. Attended College, Bachelor's (B.S. or B.A.) Degree earned
   f. Graduate or Advanced Degree (M.S., Ph.D., Law School)
   g. Other (please explain):
      _____

5. There are ____ adults and ____ children living in my household (please fill-in the two blanks)

6. My state of residence is: _____ (drop down menu of 50 states)

7. Which best describes your race?
   a. White, Caucasian
   b. Black, African American
   c. Asian, Pacific Islander
   d. Mexican, Latino
   e. American Indian
   f. Other (please describe): _____

8. How much thought have you given to voting on upcoming public ballot/referendums and /or elections?
    a. Quite a lot
    b. Some
    c. Only a little
    d. None
    e. Don't know

9. How often would you say you vote?
    a. Always
    b. Nearly always
    c. Part of the time
    d. Seldom
    e. Never
    f. Don't know

10. Do you, yourself, plan to vote in upcoming public elections and ballot/referendums on November 4th?
    a. Yes
    b. No
    c. Don't know

11. Most households consume an average of 21 meals (7 days, 3 meals per day) in a typical week. How many of these 21 meals consumed by your household normally include the following?
    a. Beef _____ meals
    b. Pork _____ meals
    c. Poultry (chicken and turkey) _____ meals
    d. Other meats _____ meals
    e. Eggs _____ meals
    f. Meals with neither a meat dish/entrée nor eggs _____ meals

        i. If 0 is the response on a, b, c, and d ask the following two questions:
            1. Do you consider yourself a vegetarian?
                a. Yes
                b. No
            2. Do you consider yourself a vegan?
                a. Yes
                b. No

12. How much beverage milk does your household consume in a typical week?

☐ None	☐ < 0.5 gallons
☐ 0.5 – 1.0 gallons	☐ 1.1 – 2.0 gallons
☐ 2.1 - 3.0 gallons	☐ > 3.0 gallons

13. How much would you estimate your household spends each week for total food consumption including at home, in restaurants, take-outs, etc.?
$_____/week (please provide your best estimate).

14. Over time U.S. consumers have consumed an increasing portion of food away from the home (e.g., eating out at restaurants rather than preparing food to consume at home). What portion of your household's total food expenditures would you estimate to occur away from the home?
    a. Drop down of 10 ranges (0%-10%, 11%-20%,..., 91%-100%)

15. Consumers purchase food from many sources. Please allocate the proportion of your household's total food expenditures across each of the following parties:

Supermarket Retailers (e.g., Kroger, Safeway, Wal-Mart)	%_____
Targeted Retailers (e.g., Whole Foods, Foods for Living)	%_____
Convenience Stores (e.g., 7-Eleven)	%_____
Farmers Markets / Direct from farmers	%_____
Others (*please describe*):	%_____
	(Sum to 100%)

16. When was the last time you visited a farm with animals/livestock being raised for milk, meat, or egg production?
    a. I have never visited such a farm
    b. Over 10 years ago
    c. 6-10 years ago
    d. 1-5 years ago
    e. Within the last year

17. Please circle the number of each pet you currently have in your household:
    a. Dogs 0 – 1 – 2 - 3 – 4 or more
    b. Cats 0 – 1 – 2 - 3 – 4 or more
    c. Other (please describe): _____

18. How often do you read the information on meat, egg, or milk product packaging in making your purchasing decisions?
    a. Always
    b. Usually
    c. Sometimes
    d. Rarely
    e. Never
        i. If the respondent did NOT choose *never* in the previous question, follow-up with:
            1. Please indicate all of the following pieces of information that you assess in reviewing meat, egg, or milk product packaging:
                a. Nutritional information
                b. Price
                c. Food Safety information
                d. Animal welfare information
                e. Other production practice information (besides animal welfare)
                f. Product expiration or "sell-by" date
                g. Other (please describe) _____

19. Please indicate if you have reduced consumption over the past three years of the following products because of concerns with the well-being and handling of farm animals.

Pork	YES	NO
Poultry (chicken and turkey)	YES	NO
Egg	YES	NO
Beef	YES	NO
Milk	YES	NO

If yes to any of the 5, then follow up with (showing only the rows for which a Yes was given):

	If yes, reduced by roughly what % (please give your best estimate):
Pork	
Poultry (chicken and turkey)	
Egg	
Beef	
Milk	

20. Please rank the following animal industry segments and production stages in order of animal welfare/handling concerns (where 1 indicates your highest level of concern and 4 indicates your lowest level of concern):
    a. Farmer / On-the farm production
    b. Transportation / Hauling and moving of animals between farms or to points of sale
    c. Auction Markets / Locations where animals change ownership
    d. Processors / Locations of animal slaughter and meat processing

21. Please rate the following statements in terms of your agreement (by circling one number for each statement):

"Low meat or milk prices are more important than the well-being of farm animals."
"The average American thinks that low meat or milk prices are more important than the well-being of farm animals."
"I consider the well-being of farm animals when I make decisions about purchasing meat or milk."
"The average American considers the well-being of farm animals when I make decisions about purchasing meat or milk."
"It is important to me that animals on farms are well cared for."
"It is important to the average American that animals on farms are well cared for."
"I believe that farmers face a trade-off between on-farm productivity and animal welfare efforts."
"The average American believes that farmers face a trade-off between on-farm productivity and animal welfare efforts."
"I believe that factory farms are less likely to have sound animal welfare practices."
"The average American believes factory farms are less likely to have sound animal welfare practices."

22. Below you will find a list of statements. Please read each carefully and decide if the statement describes you or not. If it describes you, check the word "true;" if not, check the word "false."

"I sometimes litter."
"I always admit my mistakes openly and face the potential negative consequences."
"In traffic I am always polite and considerate of others."
"I have tried illegal drugs (for example, marijuana, cocaine, etc.)."
"I always accept others' opinions, even when they don't agree with my own."
"I take out my bad moods on others now and then."
"There has been an occasion when I took advantage of someone else."
"In conversations I always listen attentively and let others finish their sentences."
"I never hesitate to help someone in case of emergency."
"When I have made a promise, I keep it – no ifs, ands or buts."
"I occasionally speak badly of others behind their back."
"I would never live off other people."
"I always stay friendly and courteous with other people, even when I am stressed out."
"During arguments I always stay objective and matter-of-fact."
"There has been at least one occasion when I failed to return an item that I borrowed."
"I always eat a healthy diet."
"Sometimes I only help because I expect something in return."

23. Listed below are various sources you may look to for information on animal welfare. Please indicate (by circling the appropriate number from the scale below) how accurate you consider the animal welfare information provided by each of the following sources:

SOURCE	Very Inaccurate						Very Accurate
Federal Governmental Agencies	1	2	3	4	5	6	7
State Governmental Agencies	1	2	3	4	5	6	7
University Scientists/Researchers	1	2	3	4	5	6	7
United Egg Producers (UEP)	1	2	3	4	5	6	7
U.S. Poultry & Egg Association	1	2	3	4	5	6	7
National Pork Producers Council (NPPC)	1	2	3	4	5	6	7
National Cattlemen's Beef Association (NCBA)	1	2	3	4	5	6	7
National Milk Producers Federation (NMPF)	1	2	3	4	5	6	7
The Humane Society of the U.S. (HSUS)	1	2	3	4	5	6	7
People for the Ethical Treatment of Animals (PETA)	1	2	3	4	5	6	7

24. Which one of these sources do you *most frequently* use in obtaining information on animal welfare?
    a. Federal Governmental Agencies
    b. State Governmental Agencies
    c. University Scientists/Researchers
    d. United Egg Producers (UEP)
    e. U.S. Poultry & Egg Association
    f. National Pork Producers Council (NPPC)
    g. National Cattlemen's Beef Association (NCBA)
    h. National Milk Producers Federation (NMPF)
    i. The Humane Society of the U.S. (HSUS)
    j. People for the Ethical Treatment of Animals (PETA)
    k. Other (please describe):

    _____

25. Which form of media do you *most frequently* use in obtaining information on animal welfare?
    a. Government web-sites
    b. University web-sites
    c. United Egg Producers (UEP) web-site
    d. U.S. Poultry & Egg Association web-site
    e. National Pork Producers Council (NPPC) web-site
    f. National Cattlemen's Beef Association (NCBA) web-site
    g. National Milk Producers Federation (NMPF) web-site
    h. The Humane Society of the U.S. (HSUS) web-site
    i. People for the Ethical Treatment of Animals (PETA) web-site
    j. Television news
    k. Newspapers/magazines
    l. Radio
    m. Other (please describe):

26. How much ability does each of the following parties have to influence and assure proper animal welfare practices?

	Very Low Ability						Very High Ability
Farmer/Grower	1	2	3	4	5	6	7
Meat or Milk Processor	1	2	3	4	5	6	7
Retail Grocer	1	2	3	4	5	6	7
Food Service Restaurant	1	2	3	4	5	6	7
Consumer – Food Purchaser	1	2	3	4	5	6	7
Government Inspectors/Regulators	1	2	3	4	5	6	7
The Humane Society of the U.S. (HSUS)	1	2	3	4	5	6	7
People for the Ethical Treatment of Animals (PETA)	1	2	3	4	5	6	7
Animal Industry Representative Groups	1	2	3	4	5	6	7

27. How much do you agree that the following practices seriously reduce the welfare of farm animals?

	Very strongly agree						Very strongly disagree
Castration (neutering; loss of sexual function) of male hogs/pigs	1	2	3	4	5	6	7
Castration (neutering; loss of sexual function) of male dairy cattle	1	2	3	4	5	6	7
Castration (neutering; loss of sexual function) of male beef cattle	1	2	3	4	5	6	7
Docking (removal) tails of hogs/pigs	1	2	3	4	5	6	7
Docking (removal) tails of dairy cows/cattle	1	2	3	4	5	6	7
Docking (removal) tails of beef cows/cattle							
Housing calves in cages/crates	1	2	3	4	5	6	7
Housing sows/gilts in cages/crates	1	2	3	4	5	6	7
Housing laying hens in cages/crates	1	2	3	4	5	6	7
Confining hogs/pigs indoors	1	2	3	4	5	6	7
Confining dairy cows/cattle indoors	1	2	3	4	5	6	7
Confining beef cows/cattle indoors	1	2	3	4	5	6	7
Confining hens/chickens indoors	1	2	3	4	5	6	7

28. Please rank the following species in order of concern you have regarding current animal welfare/handling practices (1 being most concerned and 5 being the least concerned):
    a. Beef cattle (livestock raised for beef)
    b. Dairy cattle (livestock raised for milk)
    c. Swine/hogs (livestock raised for pork)
    d. Broilers (chicken/turkeys raised for poultry)
    e. Laying hens (chickens producing eggs)

29. Please rank the following societal issues in order of importance to you (1 being most important and 7 being the least important):
    a. Human Poverty
    b. U.S. Health Care System
    c. Food Safety
    d. The Environment
    e. Financial Well-Being of U.S. Farmers
    f. Food Prices
    g. Well-Being of Farm Animals

While considering your answers to the remaining questions, please bear in mind that there may be many issues that you feel strongly about and, in principle, might be willing to pay something toward. However, your budget is limited and payment toward one issue means that there is less money available to you to contribute to other issues.

30. There has been a recent increase in media attention to handling of animals at livestock auction markets (facilities where animals are transacted and change ownership) as well as at processing plants (slaughter or packing plants where animals are processed, generating products for human consumption). Suppose the next time you go to vote, there is a related referendum on the ballot. If the referendum passes, mandatory USDA (United States Department of Agriculture) surveillance of animal handling at livestock auction markets and processing facilities in the U.S. will increase by **X%**. Please answer as if you were actually voting on a real referendum.

    Would you vote (circle answer) **FOR** or **AGAINST** the referendum?

31. Suppose you were told that the referendum, if it passes, would result in a **Y%** increase in **YOUR** federal income taxes. Would you then change your vote to "**AGAINST?**"
    i. Yes, I would change my vote to "**AGAINST**" the referendum
    ii. No, I would maintain my vote "**FOR**" the referendum

HERE ONE OF FOUR TOTAL INFORMATION TREATMENTS (BASE INFORMATION, INDUSTRY INFORMATION, CONSUMER GROUP INFORMATION, OR INDUSTRY/CONSUMER GROUP INFORMATION) IS INSERTED

32. Would you be in favor of mandatory labeling of all pork that was produced by farms using gestation crates/stalls?
    a. **YES** OR **NO**
    b. *If yes*, would you still prefer the mandatory labeling if it resulted in an **X%** increase in the price you paid for pork?

33. Do you believe the average American would be in favor of mandatory labeling of all pork that was produced by farms using gestation crates/stalls?
    a. **YES** OR **NO**
    b. *If yes*, do you believe the average American would still prefer the mandatory labeling if it resulted in an **X%** increase in the price they paid for pork?

34. Would you be in favor of mandatory labeling of all eggs that were produced by farms using laying hen cages?
    a. **YES** OR **NO**
    b. If yes, would you still prefer the mandatory labeling if it resulted in an **Y%** increase in the price you paid for eggs?

35. Do you believe the average American would be in favor of mandatory labeling of all eggs that were produced by farms using laying hen cages?
    a. **YES** OR **NO**
    b. If yes, do you believe the average American would still prefer the mandatory labeling if it resulted in an **Y%** increase in the price they paid for eggs?

36. Would you be in favor of mandatory access to grass pasture for all dairy cows used to produce milk in the U.S.?
    a. **YES** OR **NO**
    b. If yes, would you still prefer mandatory access to grass pasture if it resulted in an **Z%** increase in the price you paid for milk?

37. Do you believe the average American would be in favor of mandatory access to grass pasture for all dairy cows used to produce milk in the U.S.?
    a. **YES** OR **NO**
    b. If yes, do you believe the average American would still prefer the mandatory outdoor access to grass pasture if it resulted in an **Z%** increase in the price they paid for milk?

38. Suppose the next time you go to vote, there is a referendum on the ballot. If the referendum passes, law will require farmers nationally to confine calves raised for veal, egg-laying hens, and pregnant pigs only in ways that allow these animals to lie down, stand up, fully extend their limbs, and turn around freely. Please answer as if you were actually voting on a real referendum.
    Would you vote (circle answer) **FOR** or **AGAINST** the referendum?

The final portion of this survey presents you with multiple different sets of hypothetical pairs of boneless pork chops that could be available for purchase in a retail store where you typically shop. Besides the attributes listed below, each boneless pork chop is produced in the U.S. and possesses the same characteristics (e.g., similar color, freshness, packaging date, etc.). Prices vary for each product. For each pair of boneless pork chops, please select the one you would purchase or neither, if you would not purchase either boneless pork chop. For your information in interpreting alternative boneless pork chops:

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

Certified Trucking/Transport refers to the use of certified trucking and transportation methods that enhance the care and welfare of animals during transport:

- **Required** means the animal was raised on an operation using certified trucking and transportation methods,
- **Not Required** indicates that no claims regarding trucking and transportation methods 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),
- **Self Certification** mean the label is backed by a producer's participation in a certification and verification program managed by the industry itself,
- **Private, 3rd Party** means the label is backed by a producer's participation in a certification and verification program managed by a private, third

party company that is neither associated with the livestock industry nor any consumer groups,

- **Consumer Group** means the label is backed by a producer's participation in a certification and verification program managed by a consumer group interested in animal welfare and handling issues

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. **Please place an "X" in the "I choose" box, below the option that you would choose from each of the following scenarios:**

Choice Set1

Attribute	Option A	Option B	Option C
Price ($/lb)	$3.24	$3.99	
Individual Crates/Stalls	Not permitted	Permitted	*I choose not to purchase either of these two products.*
Pasture Access	Not required	Required	
Antibiotic Use	Not permitted	Permitted	
Certified Trucking/Transport	Required	Not required	
Certification Entity	Self Certification	USDA-PVP	
I choose ...			

Choice Set2

Attribute	Option A	Option B	Option C
Price ($/lb)	$4.74	$4.74	
Individual Crates/Stalls	Permitted	Permitted	*I choose not to purchase either of these two products.*
Pasture Access	Not required	Required	
Antibiotic Use	Not permitted	Not permitted	
Certified Trucking/Transport	Required	Required	
Certification Entity	Consumer Group	Self Certification	
I choose ...			

Choice Set3

Attribute	Option A	Option B	Option C
Price ($/lb)	$3.99	$4.74	
Individual Crates/Stalls	Not permitted	Not permitted	*I choose not to purchase either of these two products.*
Pasture Access	Required	Required	
Antibiotic Use	Permitted	Not permitted	
Certified Trucking/Transport	Not required	Not required	
Certification Entity	Self Certification	Consumer Group	
I choose ...			

Choice Set4

Attribute	Option A	Option B	Option C
Price ($/lb)	$4.74	$3.99	
Individual Crates/Stalls	Not permitted	Permitted	*I choose not to purchase either of these two products.*
Pasture Access	Not required	Not required	
Antibiotic Use	Permitted	Not permitted	
Certified Trucking/Transport	Not required	Not required	
Certification Entity	USDA-PVP	Self Certification	
I choose ...			

Choice Set5

Attribute	Option A	Option B	Option C
Price ($/lb)	$3.99	$3.99	
Individual Crates/Stalls	Permitted	Not permitted	*I choose not to purchase either of these two products.*
Pasture Access	Not required	Required	
Antibiotic Use	Not permitted	Not permitted	
Certified Trucking/Transport	Not required	Required	
Certification Entity	Private, 3rd Party	USDA-PVP	
I choose ...			

Choice Set6

Attribute	Option A	Option B	Option C
Price ($/lb)	$3.24	$4.74	
Individual Crates/Stalls	Permitted	Permitted	*I choose*
Pasture Access	Required	Not required	*not to*
Antibiotic Use	Permitted	Not permitted	*purchase*
Certified			*either of*
Trucking/Transport	Not required	Required	*these two*
Certification Entity	Private, 3rd Party	USDA-PVP	*products.*
I choose ...			

Choice Set7

Attribute	Option A	Option B	Option C
Price ($/lb)	$3.99	$3.99	
Individual Crates/Stalls	Not permitted	Permitted	*I choose*
Pasture Access	Required	Not required	*not to*
Antibiotic Use	Not permitted	Permitted	*purchase*
Certified			*either of*
Trucking/Transport	Not required	Required	*these two*
Certification Entity	Consumer Group	Private, 3rd Party	*products.*
I choose ...			

The previous set of questions asked you to indicate choices ***you would make***. We are now interested in what you believe ***the average American would select***, if faced with the same set of alternatives. **Please place an "X" in the "Average American would choose" box, below the option that you believe the Average American would choose from each of the following scenarios:**

Choice Set1

Attribute	**Option A**	**Option B**	**Option C**
Price ($/lb)	$3.24	3.99	*Average*
Individual Crates/Stalls	Not permitted	Permitted	*American*
Pasture Access	Not required	Required	*would*
Antibiotic Use	Not permitted	Permitted	*choose*
Certified			*not to*
Trucking/Transport	Required	Not required	*purchase*
Certification Entity	Self Certification	USDA-PVP	*either of*
			these two
			products.
Average American would choose …			

Choice Set2

Attribute	**Option A**	**Option B**	**Option C**
Price ($/lb)	$4.74	$4.74	*Average*
Individual Crates/Stalls	Permitted	Permitted	*American*
Pasture Access	Not required	Required	*would*
Antibiotic Use	Not permitted	Not permitted	*choose*
Certified			*not to*
Trucking/Transport	Required	Required	*purchase*
Certification Entity	Consumer Group	Self Certification	*either of*
			these two
			products.
Average American would choose …			

Choice Set3

Attribute	**Option A**	**Option B**	**Option C**
Price ($/lb)	$3.99	$4.74	*Average*
Individual Crates/Stalls	Not permitted	Not permitted	*American*
Pasture Access	Required	Required	*would*
Antibiotic Use	Permitted	Not permitted	*choose*
Certified			*not to*
Trucking/Transport	Not required	Not required	*purchase*
Certification Entity	Self Certification	Consumer Group	*either of*
			these two
			products.
Average American would choose …			

Choice Set4

Attribute	Option A	Option B	Option C
Price ($/lb)	$4.74	$3.99	*Average American would choose not to purchase either of these two products.*
Individual Crates/Stalls	Not permitted	Permitted	
Pasture Access	Not required	Not required	
Antibiotic Use	Permitted	Not permitted	
Certified Trucking/Transport	Not required	Not required	
Certification Entity	USDA-PVP	Self Certification	
Average American would choose ...			

Choice Set5

Attribute	Option A	Option B	Option C
Price ($/lb)	$3.99	$3.99	*Average American would choose not to purchase either of these two products.*
Individual Crates/Stalls	Permitted	Not permitted	
Pasture Access	Not required	Required	
Antibiotic Use	Not permitted	Not permitted	
Certified Trucking/Transport	Not required	Required	
Certification Entity	Private, 3rd Party	USDA-PVP	
Average American would choose ...			

Choice Set6

Attribute	Option A	Option B	Option C
Price ($/lb)	$3.24	$4.74	*Average American would choose not to purchase either of these two products.*
Individual Crates/Stalls	Permitted	Permitted	
Pasture Access	Required	Not required	
Antibiotic Use	Permitted	Not permitted	
Certified Trucking/Transport	Not required	Required	
Certification Entity	Private, 3rd Party	USDA-PVP	
Average American would choose ...			

Choice Set7

Attribute	Option A	Option B	Option C
Price ($/lb)	$3.99	$3.99	*Average American would choose not to purchase either of these two products.*
Individual Crates/Stalls	Not permitted	Permitted	
Pasture Access	Required	Not required	
Antibiotic Use	Not permitted	Permitted	
Certified Trucking/Transport	Not required	Required	
Certification Entity	Consumer Group	Private, 3rd Party	
Average American would choose ...			

39. What percentage of time do you think animals in the each industry are:

Swine/hog industry	% of time 0-20	21-40	41-60	61-80	81-100
individually confined in crates, stalls, or cages					
provided access to grass pasture					
transported by trucking and transportation methods certified to enhance care and welfare of animals					
administered antibiotics					

Poultry industry	% of time 0-20	21-40	41-60	61-80	81-100
individually confined in crates, stalls, or cages					
provided access to grass pasture					
transported by trucking and transportation methods certified to enhance care and welfare of animals					
administered antibiotics					

Dairy industry	% of time 0-20	21-40	41-60	61-80	81-100
individually confined in crates, stalls, or cages					
provided access to grass pasture					
transported by trucking and transportation methods certified to enhance care and welfare of animals					
administered antibiotics					

Thank you for your time in completing this survey. Your input will strengthen our research and help us obtain more accurate conclusions. If you wish to add any comments please feel free to do so here:

APPENDIX 2: 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

Certified Trucking/Transport refers to the use of certified trucking and transportation methods that enhance the care and welfare of animals during transport:

- **Required** means the animal was raised on an operation using certified trucking and transportation methods,
- **Not Required** indicates that no claims regarding trucking and transportation methods 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),
- **Self Certification** mean the label is backed by a producer's participation in a certification and verification program managed by the industry itself,
- **Private, 3rd Party** means the label is backed by a producer's participation in a certification and verification program managed by a private, third party company that is neither associated with the livestock industry nor any consumer groups,
- **Consumer Group** means the label is backed by a producer's participation in a certification and verification program managed by a consumer group interested in animal welfare and handling issues

APPENDIX 3: EXAMPLE CHOICE SET SCENARIO FOR PORK CHOPS

Pork Chop Attribute	Option A	Option B	Option C
Price ($/lb)	$3.24	$3.99	
Individual Crates/Stalls	Not permitted	Permitted	*I choose not to purchase either of these two products.*
Pasture Access	Not required	Required	
Antibiotic Use	Not permitted	Permitted	
Certified Trucking/Transport	Required	Not required	
Certification Entity	Self Certification	USDA-PVP	
I choose ...			

APPENDIX 4: INFORMATION SCHOCKS

1) BASE INFO:

Use of Gestation Crates in Pork Production
Gestation crates (also called gestation stalls) refer to metal crates (approximately 7 feet long and 2 feet wide) that house female breeding stock in individually confined areas during an animal's approximately four-month pregnancy.

Access to Grass Pasture in Milk Production
Dairy cow housing systems vary from confinement operations with cows housed in barns and fed at bunks to grazing dairies that do not confine cows. The typical US dairy has some of both systems with grazing occurring when climate is favorable and housing available in inclement weather. Organic production requires access to pasture when weather permits.

2) INDUSTRY INFO:

Use of Gestation Crates in Pork Production
Gestation crates (also called gestation stalls) refer to metal crates (approximately 7 feet long and 2 feet wide) that house female breeding stock in individually confined areas during an animal's approximately four-month pregnancy.

The American Veterinary Medical Association (AVMA) supports the use of sow housing that "minimizes aggression and competition between sows; protects sows from detrimental effects associated with environmental extremes, particularly temperature extremes; reduces exposure to hazards that result in injuries; provides every animal with daily access to appropriate food and water; and facilitates observation by caretakers of individual sow appetites, respiratory rates, urination and defecation and reproductive status." The National Pork Producers Council (NPPC) supports this position of AVMA.

Access to Grass Pasture in Milk Production
Dairy cow housing systems vary from confinement operations with cows housed in barns and fed at bunks to grazing dairies that do not confine cows. The typical US dairy has some of both systems with grazing occurring when climate is favorable and housing available in inclement weather. Organic production requires access to pasture when weather permits.

The National Milk Producer's Federation supports access to pasture as part of the National Organic Program provided it is "size neutral."

3) CONSUMER GROUP INFO:

Use of Gestation Crates in Pork Production

Gestation crates (also called gestation stalls) refer to metal crates (approximately 7 feet long and 2 feet wide) that house female breeding stock in individually confined areas during an animal's approximately four-month pregnancy.

The Humane Society of the U.S. (HSUS) states that gestation crates are "individual metal enclosures so restrictive that the pigs cannot turn around." Moreover, HSUS states "Crated sows suffer a number of significant welfare problems, including elevated risk of urinary tract infections, weakened bones, overgrown hooves, lameness, behavioral restriction, and stereotypes. Due to concerns for the welfare of intensively confined sows, legislative, industry, and corporate policies are increasingly phasing out the use of gestation crates."

Access to Grass Pasture in Milk Production

Dairy cow housing systems vary from confinement operations with cows housed in barns and fed at bunks to grazing dairies that do not confine cows. The typical US dairy has some of both systems with grazing occurring when climate is favorable and housing available in inclement weather. Organic production requires access to pasture when weather permits.

The Humane Society of the U.S. (HSUS) states that cows confined to cement-floored barns have a higher incidence of lameness. HSUS further states that cows prefer lying and resting on soft surfaces like wood chips or straw rather than hard surfaces like concrete or gravel.

4) INDUSTRY & CONSUMER GROUP INFO:

Use of Gestation Crates in Pork Production

Gestation crates (also called gestation stalls) refer to metal crates (approximately 7 feet long and 2 feet wide) that house female breeding stock in individually confined areas during an animal's approximately four-month pregnancy.

The American Veterinary Medical Association (AVMA) supports the use of sow housing that "minimizes aggression and competition between sows; protects sows from detrimental effects associated with environmental extremes, particularly temperature extremes; reduces exposure to hazards that result in injuries; provides every animal with daily access to appropriate food and water; and facilitates observation by caretakers of individual sow appetites, respiratory rates, urination and defecation and reproductive status." The National Pork Producers Council (NPPC) supports this position of AVMA.

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intensively confined sows, legislative, industry, and corporate policies are increasingly phasing out the use of gestation crates."

Access to Grass Pasture in Milk Production
Dairy cow housing systems vary from confinement operations with cows housed in barns and fed at bunks to grazing dairies that do not confine cows. The typical US dairy has some of both systems with grazing occurring when climate is favorable and housing available in inclement weather. Organic production requires access to pasture when weather permits.

The National Milk Producer's Federation supports access to pasture as part of the National Organic Program provided it is "size neutral."

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APPENDIX 5: PRODUCER SURVEY INSTRUMENT

Confidential Survey – For Research Purposes Only

This is a survey designed to obtain information from Michigan dairy producers regarding possible changes in milk production practices. We are very interested in your input. *Your participation in this survey is entirely voluntary and your responses will be kept in strict confidence.* If you wish to comment on any questions please feel free to use the space at the end of the survey. Although we would like you to answer all of the questions (note there are questions on both sides of each page), you may choose to skip any question. This will help us conduct the best research and draw appropriate conclusions regarding Michigan dairy producers.

Recently, there has been a movement towards milk labeled "rbST-free" for beverage consumption. Several Michigan retailers have requested milk from cows not supplemented with rbST beginning February 1, 2008. With this in mind, please answer the following questions.

1. How big is your milking herd (milking and dry cows) today? _____ head

2. How big was your milking herd five years ago? _____ head

3. How big do you expect your milking herd to be five years from today? _____ head

4. How many pounds of milk were sold by your operation in 2006? _____ pounds

5. On average, over the past year, how much did it cost you to produce a hundredweight of milk? Include labor, feed, overhead (dairy herd cost only, not calves, heifers or crops)_____ $/cwt

6. What was your use of rbST (*bovine somatotropin*) in the past year (2007)?

☐ Not used at all	☐ Stopped using during 2007
☐ <25 % of eligible milk cows	☐ 25-50% of eligible milk cows
☐ 51-75% of eligible milk cows	☐ 76-100% of eligible milk cows

If you have used rbST at any time in the past year, please answer questions 7 - 9. If you did not use rbST in 2007, please skip to question 10.

7. What is your herd's average production response from rbST? _____ lbs/cow/day

8. What criteria are used to determine which cows are given rbST? (check all that apply)

☐ Milk production level
☐ Cow age
☐ Milk price
☐ Feed cost
☐ Other (specify) _____

9. If you discontinue use of rbST, how much do you think it would cost your operation in annual foregone profits? ☐ $0

☐ Less than $5,000
☐ $5,000-$9,999
☐ $10,000-$14,999
☐ $15,000-$19,999
☐ $20,000-$29,999
☐ $30,000-$39,999
☐ $40,000-$49,999
☐ $50,000-$74,999
☐ $75,000-$99,999
☐ $100,000 or more

10. If you are NOT currently using rbST, have you ever tried rbST on milk cows?
☐ Yes ☐ No

11. If you used rbST any time in the past, when did you stop? _____ (year)

12. If you used rbST any time in the past, why did you stop? (check all that apply)

☐ Not large enough production response
☐ Concerned about consumer reaction
☐ Not profitable
☐ Too difficult to administer
☐ Mastitis concerns
☐ Other
(specify)_____

13. There may be an array of reasons some consumers have expressed desire for milk produced without the use of rbST. Please check the one reason from the following options that you believe is most likely or prevalent:

☐ *Quality perceptions*: Belief that milk generated using rbST is of lower quality.
☐ *Food safety perceptions*: Belief that there are potential food safety issues using rbST.
☐ *Animal welfare*: Belief that cows should not be injected with rbST.
☐ *Farm size issues*: Belief that milk should be produced on small farms.
☐ Other (please list/explain):

_____

14. Please rate your concerns regarding the following issues surrounding the movement away from rbST in beverage milk in Michigan:

    a. Cost implications for MI milk producers

       Not concerned 1 – 2 – 3 – 4 – 5 Very concerned

    b. Competition implications for MI milk producers with milk producers in other US states

       Not concerned 1 – 2 – 3 – 4 – 5 Very concerned

    c. Inadequate compensation for MI milk producers to forego use of rbST

       Not concerned 1 – 2 – 3 – 4 – 5 Very concerned

    d. Milk price implications and consumer demand for fluid milk

       Not concerned 1 – 2 – 3 – 4 – 5 Very concerned

15. Please respond to the following statements (circle one answer for each statement):

    a. The use of rbST detrimental to the welfare of cows.
       Strongly disagree 1 – 2 – 3 – 4 – 5 Strongly agree

    b. All things considered, labeling "rbST-free" milk products is good for U.S. consumers.
       Strongly disagree 1 – 2 – 3 – 4 – 5 Strongly agree

    c. Prior to this survey, how aware were you of the recent rbST labeling issues?
       Totally unaware 1 – 2 – 3 – 4 – 5 Very aware

16. Please rate your level of agreement with the following statements regarding comparisons of operations using rbST to those that do not use rbST:

    a. Feed efficiency is increased using rbST.

       Strongly disagree 1 – 2 – 3 – 4 – 5 Strongly agree

    b. rbST is more profitable on large herds.

       Strongly disagree 1 – 2 – 3 – 4 – 5 Strongly agree

    c. Herds with rbST produce less manure per hundredweight of milk.

       Strongly disagree 1 – 2 – 3 – 4 – 5 Strongly agree

17. Different parties/entities may be actively supporting rbST-free milk. How much do you think each of the following parties is the source of increasing pressure on the dairy industry to adjust its use of rbST? Please allocate the proportion of overall pressure generated by each of the following parties:

Retailers: Restaurants		
Retailers: Grocery Stores		
Consumer Lobby Groups		
"Average" Consumers		
Others (please describe below)		(Sum to 100%)

18. If all beverage milk in Michigan is produced by cows not supplemented with rbST, how do you think the resulting benefits and costs will be distributed throughout the milk supply chain? Please allocate the percentages each of the following market participants captures:

Benefits:		**Costs:**	
Consumers	_____	Consumers	_____
Retailers	_____	Retailers	_____
Processors	_____	Processors	_____
Cooperatives	_____	Cooperatives	_____
Farmers	_____	Farmers	_____

We now have a few short questions to gather demographic and production practice information from you. These questions are used to ensure our sample is representative of Michigan milk producers. Please remember that your responses are anonymous and will be held strictly confidential.

19. I am: ☐ Male ☐ Female

20. I am _____ years old.

21. How many years have you been milking cows?

☐ Less than 5 years ☐ 16-20 years
☐ 6-10 years ☐ 21-25 years
☐ 11-15 years ☐ 25 years

22. How many more years do you expect your operation to be milking cows?

☐ Less than 5 years ☐ 16-20 years
☐ 6-10 years ☐ 21-25 years
☐ 11-15 years ☐ 25 years

23. Do you expect the next generation to continue operation of your dairy farm?

☐ Yes ☐ No

24. Approximately, what is the average age of your operation's facilities for milking cows?

- ☐ Less than 5 years
- ☐ 6-10 years
- ☐ 11-15 years
- ☐ 16-20 years
- ☐ 21-25 years
- ☐ 25 years

25. Please estimate your annual pre-tax household income:

- ☐ Less than $25,000
- ☐ $25,000-$49,999
- ☐ $50,000-$74,999
- ☐ $75,000-$99,999
- ☐ $100,000-$124,999
- ☐ $125,000 or more

26. Approximately what portion of your household income is from off-farm sources?

- ☐ Less than 20%
- ☐ 20%-39%
- ☐ 40%-59%
- ☐ 60%-79%
- ☐ 80% or more

27. The best description of my educational background is:

- ☐ Did not attend college
- ☐ Attended College, No Bachelor's (B.S. or B.A.) Degree
- ☐ Bachelor's (B.S. or B.A.) College Degree
- ☐ Graduate or Advanced Degree (M.S., Ph.D., Law School)
- ☐ Other: _____

28. How likely do you think it is that consumers who have expressed support for milk labeled "rbST-free" also support the following adjustments:

a. Ban the use of antibiotics
Very unlikely 1 – 2 – 3 – 4 – 5 Very likely

b. Ban all supplemental hormones (e.g., synchronization programs)
Very unlikely 1 – 2 – 3 – 4 – 5 Very likely

c. Ban confinement operations
Very unlikely 1 – 2 – 3 – 4 – 5 Very likely

d. Require access to pasture for milk cows
Very unlikely 1 – 2 – 3 – 4 – 5 Very likely

29. What portion of your operation's labor is supplied by non-family, paid employees?

- ☐ less than 25%
- ☐ 26-50%
- ☐ 51-75%
- ☐ Over 75%

30. If you are planning to discontinue rbST use, please briefly describe any actions to replace the milk produced with rbST (e.g., add cows, go to 3X, extended photo period, ration changes, etc):

_____

_____

The final portion of this survey presents you with 5 different situations that might represent future milk prices, corn prices, and corresponding production practices you may adopt in the future. If you expected each these situations to be accurate predictions of the dairy industry environment on January 2013 (5 years from now), which production option would you select? That is, given these milk and corn prices, which combination of production practice (Conventional or rbST-free) and milk production (Trend Increase in milk per cow with a constant herd size, 25% Increase, or 100% Increase) would you select? For each pair of situations please select the one you would prefer, or neither if you stop milking cows under those conditions. For your information in interpreting each situation:

Milk price is either **high** ($18/cwt), **medium** ($15/cwt), or **low** ($12/cwt).

Corn Price is either **high** ($3.50/bu) or **low** ($2.00/bu).

Production Practice is the method used in producing the milk where:

- **Conventional** (rbST ok) means the milk was produced using practices typical for the industry potentially including the use of rbST/rbGH on a portion of the herd,
- **rbST-Free** is the same as conventional except you voluntarily choose not to use rbST.

Milk production on your operation can **increase 1.5% per year** (status quo trend increase in milk per cow with constant herd size), **increase herd milk production 25%** (minor expansion), or **increase herd milk production 100%** (major expansion).

It is important that you make your selections like you would if you were actually facing these choices in your milk production decisions. **Please place an "X" in the "I choose" box, below the option that you would choose from each of the following 5 scenarios:**

1 Scenario 1

	Option A	Option B	Option C
Milk price ($/cwt)	$18.00	$18.00	
Corn price ($/bu)	$2.00	$2.00	Stop milking cows
Production Practice	Conventional	rbST-Free	
Herd Milk Production	Trend	100%	
I choose ...	☐	☐	☐

2 Scenario 2

	Option A	Option B	Option C
Milk price ($/cwt)	$15.00	$12.00	
Corn price ($/bu)	$2.00	$2.00	Stop milking cows
Production Practice	Conventional	Conventional	
Herd Milk Production	Trend	25%	
I choose ...	☐	☐	☐

3 Scenario 3

	Option A	Option B	Option C
Milk price ($/cwt)	$15.00	$18.00	
Corn price ($/bu)	$2.00	$3.50	Stop milking cows
Production Practice	rbST-Free	rbST-Free	
Herd Milk Production	25%	25%	
I choose ...	☐	☐	☐

4 Scenario 4

	Option A	Option B	Option C
Milk price ($/cwt)	$12.00	$15.00	
Corn price ($/bu)	$3.50	$3.50	Stop milking cows
Production Practice	Conventional	rbST-Free	
Herd Milk Production	Trend	25%	
I choose ...	☐	☐	☐

5 Scenario 5

	Option A	Option B	Option C
Milk price ($/cwt)	$15.00	$12.00	
Corn price ($/bu)	$3.50	$3.50	Stop milking cows
Production Practice	rbST-Free	rbST-Free	
Herd Milk Production	Trend	100%	
I choose ...	☐	☐	☐

Thank you for your time in completing this survey. Your input will strengthen our research and help us obtain more accurate conclusions. After taking a quick moment to double-check that you have answered each question, please mail us your completed survey using the enclosed, postage-paid envelope. If you wish to add any comments please feel free to do so.

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