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Consumers' Preferences for Citrus Fiber-Added Ground Beef

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Abstract

Adding fiber to ground beef can increase the health benefits of consuming ground beef products and can provide new market opportunities for the beef industry. The current study analyzes the impact of consumers' preferences for citrus fiber-added ground beef after offering consumers samples of 1%, 3%, and 5% citrus-added ground beef meatballs. The results of the current study show that there is a market for citrus fiber-added ground beef, but the price premium is not high. Current consumers of organic and grass-fed beef, and those who are concerned about the fat content of ground beef are the potential target customers for the sale of citrus fiber-added ground beef.

Keywords: ground beef, citrus fiber, consumer preferences, willingness-to-pay (WTP)

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Introduction

Red meat, such as beef, is a nutritious food for human consumption that has high-quality protein, rich in B vitamins and minerals, such as iron (Aberle et al. 2001). However, many studies associate the consumption of meat products with coronary heart disease (CHD), obesity, and diabetes (Micha et al. 2010; Lajous et al. 2011). Therefore, ground beef and other beef products are commonly considered unhealthy food choices for humans due to the presence of saturated fats that increase the risk of high cholesterol levels. Another important factor related to the human diet, especially in the US, is the low consumption of dietary fiber. Dietary fiber is a necessary food ingredient that promotes health by reducing cholesterol and the risk of heart disease. Earlier studies have suggested that dietary fiber intake causes a decrease in total cholesterol and low-density lipoprotein in plasma through the excretion of bile acids (Gallaher et al. 1992). Dietary fiber also lowers the risk of colon cancer (Kritchersky 1990; Rodriguez et al. 2006).

Before producers decide whether or not to manufacture citrus fiber-added ground beef meatballs and supply them to consumers, producers must consider the potential economic profits and costs. Consumers' willingness-to-pay for different ground beef attributes, such as organic or local, has been analyzed in the literature. However, no previous study has analyzed consumers' willingness-to-pay for citrus fiber-added ground beef meatballs. The current study analyzes consumers' preferences for such meatballs. Adding fiber to ground beef can increase the health benefits of consuming ground beef products and can provide new market opportunities for the beef industry. This will positively impact human health while increasing the sales and profits for beef production. The citrus fiber used for this study is obtained through a relatively easy procedure. Peel of citrus is washed, dried, and then grounded. This powder is then mixed into the ground beef. Using the $0.54 / ounce unit price for citrus fiber powder, the cost of adding citrus fiber is $0.09, $0.27, and $0.45, respectively for 1%, 3%, and 5% citrus fiber added ground beef per pound. The results of the current study can be used by producers, Extension educators, and also by policymakers in determining whether government support is needed to promote the production of healthy ground beef products.

Using a consumer panel of 160 surveys, the current study analyzed consumers' willingness-to-pay for citrus fiber-added ground beef. The results showed that consumers are willing to pay a positive price premium for citrus fiber-added ground beef, but the price premium is not very high. Low-fat content was found to be the most influential factor, having a positive impact on the price premium. Hence, targeting consumers for whom low-fat content is an essential attribute will increase the chances of getting a price premium for citrus fiber-added ground beef. On the other hand, consumers concerned about price are less likely to pay a price premium. The remainder of this article is organized as follows: in the next section, we provide a review of the literature. Then, the data and econometric model are presented. Subsequently, the factor analysis method used for the econometric analysis is explained. Finally, the results are delineated and conclusions posited.

Literature Review

Food quality attributes can be classified as; search, experience, and credence attributes (Anderson and Anderson 1991). Search attributes are those that can be observed prior to consuming the product, such as price and color (Bureau and Marette 2000). Experience attributes

can only be observed after consuming the product, such as taste and texture (Bureau and Marette, 2000). Lastly, credence attributes are those that cannot be known for sure, even after consuming the product, such as organic and locally grown (Bureau and Marette 2000).

Previous studies looked at the impact of nutritional information (i.e., the credence attributes) on consumers' willingness-to-pay for meat products. Yang and Woods (2013) analyzed consumers' willingness-to-pay for ground bison. Bison meat has better nutritional value (including higher protein and lower fat) than chicken, beef, and pork. Their results showed that consumers informed about the better nutritional value of bison are willing to pay more. Yang and Woods (2013) found that this nutritional information variable had higher marginal effects in the regression analysis than the demographic, income, and location variables, signifying the importance of nutritional information on consumers' willingness-to-pay a price premium.

Wang et al. (2011) analyzed the impact of information on consumer preferences for grass-fed and organic meat products. Their results showed that information about the attributes of grass-fed beef and organic beef are especially influential on consumers who do not have preexisting information about these types of beef. Thus, consumers' willingness-to-pay increases with information if the consumers do not have preexisting knowledge. Wang et al. (2011) also found that if attributes related to taste (i.e., experience attributes) are seen as necessary by consumers, then they are less likely to pay a price premium for grass-fed and organic ground beef over conventional ground beef. On the other hand, if the manner in which beef is raised (i.e., credence attributes) is important to consumers, then they are more likely to pay a price premium for grass-fed and organic ground beef over conventional ground beef. Wang et al. (2011) found that none of the variables related to demographics are statistically significant for consumers' willingness-to-pay for organic ground beef.

Grannis et al. (2000) used a survey conducted in the Rocky Mountain region to analyze consumers' willingness-to-pay for natural beef products. Their results found that consumers ranked "no use of hormones" and "no antibiotics" as the most critical attributes for ground beef. In contrast, the attribute "locally grown" was ranked the lowest for ground beef. Sixty-seven percent of the respondents indicated that they would be willing to pay a 12% premium to buy natural ground beef over conventional ground beef. However, there was not a perfect linear relationship between consumers' ranking of the importance of "no use of hormones" or "no antibiotics" and the price premium to be paid for natural ground beef. However, it was found that consumers who have eaten natural ground beef in the past are more likely to pay a price premium than consumers who have not eaten natural ground beef. Hence, previous experience with non-traditional beef products might lead to a higher price premium.

Jensen et al. (2014) analyzed consumer preferences in Tennessee for beef products labeled "Tennessee beef." The results showed that consumers in Tennessee, on average, are willing to pay a 20% price premium to buy ground beef labeled "Tennessee beef." This study also found that customers ranked consuming safe, healthy, and nutritious food higher than keeping the food prices low. This result signified the importance of safe and nutritious ground beef for consumers. Freshness and product safety are found to positively influence consumers' willingness-to-pay a price premium to buy ground beef labeled "Tennessee beef." Demographic variables, such as age, education, and income, are not statistically significant factors impacting the willingness-to-pay for ground beef labeled "Tennessee beef" over conventional ground beef. Jensen et al.

(2014) also found that consumers' preferences varied by region. Lastly, the consumers who stated that they did not consume ground beef cited health concerns as the major reason.

Gao and Schroeder (2007) analyzed the impact of additional information on consumers' willingness-to-pay for different food quality attributes. Their results showed that when consumers indicated a willingness-to-pay for attributes, such as locally raised beef, consumers might actually be referring to quality attributes that were not listed on the survey. Therefore, a consumer might associate locally raised beef with better nutritional values (thus indicating a willingness-to-pay) that might or might not be correct about locally raised beef. Hence, it is essential for food companies to provide information on the nutritional benefits of their food products.

Overall, some studies found a positive price premium for beef products with different food quality attributes, but other studies did not. Thus, it is difficult to make a generalization, as these studies targeted certain regions; consumers' preferences might differ in other regions (Gedikoglu and Parcell 2014; Jensen et al. 2014). Hence, there is a need to conduct a study on consumers' willingness-to-pay for fiber added ground beef to measure the price premium that consumers might pay for this product.

Data

Data for the current study was collected through a three-day consumer panel comprised of 161 students, staff, and faculty at the University of Missouri. The panels were given four different samples of ground beef meatballs containing either zero, 1%, 3%, or 5% added citrus fiber. The percentages chosen were determined through a texture profile that included a physico-chemical analysis. Five percent is the maximum amount of citrus powder that ground beef can absorb without becoming crumbly.

The Food and Drug Administration recommends 25 grams of dietary fiber per day for adults and children (Food and Drug Administration 2015). Based on the authors' calculations, a typical five ounce serving of meatballs containing 1% added citrus fiber contains 4.7% of the daily recommended dietary fiber consumption. A five-ounce serving size of meat balls with 3% and 5% added citrus fiber contains 14.14% and 23.57% fiber, respectively. Consequently, meatballs containing higher levels of citrus fiber provide greater health benefits. Each participant was given a sample from each category of the fiber-added meatballs, plus a sample of meatballs with nothing added. Participants were advised that the samples only differed in respect to the percentage of citrus fiber added. Hence, all other characteristics of the meatballs were the same across the samples. Consumers were then given a survey asking them to rank different attributes of the meatballs. The survey analyzed their willingness-to-pay a price premium over conventional ground beef prices that contain the three levels of added citrus fiber (see Appendix for the survey).

The survey provided information about the benefits of citrus fiber, stating: "Citrus powder is rich in both soluble and insoluble dietary fiber. Consuming food with dietary fiber can help with maintaining a healthy weight and lowering [the] risks of diabetes and heart disease." To measure consumers' willingness-to-pay for citrus fiber-added ground beef, the specific question in the survey asked: "Suppose that you are in a grocery store buying ground beef. The price of conventional ground beef chuck (with 80% lean and 20% fat) is $4.48/lb. What price premium

per pound over the price of conventional ground beef chuck [$4.48/lb.] would you be willing to pay for ground beef chuck with the following attributes?" For each percentage of added citrus fiber (i.e., 1%, 3%, and 5%), the following choices were given: (1) no price premium, (2) $0.45 (10% price premium), (3) $0.90 (20% price premium), (4) $1.35 (30% premium), and (5) $1.80 (40% price premium).

Table 1 provides the summary statistics and description of the variables for a sample size of 160. The taste attribute was ranked the highest by the survey respondents. This attribute was followed by texture. These two attributes were ranked higher than the price attribute, which was ranked as the third most influential factor when purchasing ground beef. The credence attributes were ranked the lowest. The highest-ranked credence attribute was the low-fat content, followed by the beef being a product of the U.S.A. Organic beef, locally grown beef, and grass-fed beef were not ranked as important qualities influencing consumers' decision to purchase. Overall, the survey provided some evidence that search, experience, and credence attributes are ranked differently. Our results suggest that producers might want to analyze local consumer preferences instead of focusing on national trends. For example, there is an increasing interest nationally in organic and grass-fed beef, but these attributes were not ranked as important by the survey respondents in the current study. Hence, instead of investing in these costly production practices, the beef producers in Mid-Missouri might be better off selling their products labeled as a product of the U.S.A.

Table 1. Variable Names, Description, Means, and Standard Deviations (N = 160)

Variable	Description	Mean	Standard Deviation
Price	[1]Range: 0 = Not Important; 1 = Somewhat Important; 2 = Very important	1.44	0.58
Taste		1.83	0.41
Color		1.43	0.58
Texture		1.63	0.60
Product of U.S.A.		1.06	0.75
Organic Beef		0.54	0.66
Locally Grown Beef		0.66	0.68
Grass-fed Beef		0.68	0.69
Low Fat Content		1.25	0.72
Dependent Variables			
Willingness-to-pay for 1% citrus fiber-added ground beef over conventional ground beef (per lb.)	Range: $0; $0.45; $0.90; $1.35; $1.80	$0.35	$0.43
Willingness-to-pay for 3% citrus fiber-added ground beef over conventional ground beef (per lb.)	Range: $0; $0.45; $0.90; $1.35; $1.80	$0.55	$0.42
Willingness-to-pay for 5% citrus fiber-added ground beef over conventional ground beef (per lb.)	Range: $0; $0.45; $0.90; $1.35; $1.80	$0.65	$0.50

Note. [1]The range is the same for all the independent variables.

Table 2. Distribution of Willingness-to-Pay (WTP) Values (N = 160)

	$0	**$0.45**	**$0.90**	**$1.35**	**$1.80**
WTP for 1% added citrus fiber	48%	34%	11%	4%	1%
WTP for 3% added citrus fiber	22%	45%	21%	9%	1%
WTP for 5% added citrus fiber	23%	29%	30%	11%	5%

The average price premiums for citrus fiber-added beef were $0.35 for 1% citrus fiber, $0.55 for 3%, and $0.65 for 5%. Thus, the highest price premium was for 5% citrus fiber-added ground beef, although it also had the highest standard deviation. Table 2 provides the distribution of willingness-to-pay values for percentages 1, 3, and 5. Fifty-two percent of the survey respondents are willing to pay a price premium to buy 1% citrus fiber-added ground beef. Seventy-eight percent of the respondents are willing to pay extra for 3% citrus fiber-added ground beef and seventy-seven percent for 5% citrus fiber-added ground beef. Overall, the survey data showed there is a demand for citrus fiber-added ground beef. Price premium levels of $0.45 and $0.90 were the highest price premiums chosen by the survey respondents for those who are willing to pay more. A comparison of average price premiums with the cost of adding citrus fiber, $0.09 for 1% citrus fiber, $0.27 for 3%, and $0.45 for 5%, reveals that the average price premium covers the cost of adding citrus fiber for each percentage level. Thus, there are opportunities for beef producers to increase their profits by adding citrus fiber into ground beef.

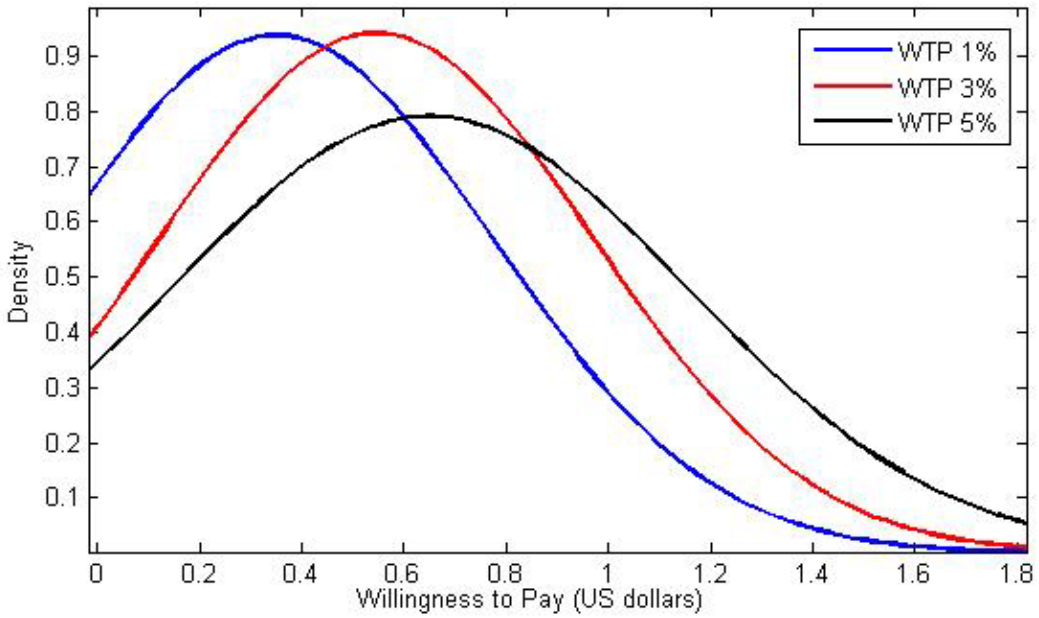

Figure 1. Estimated probability density function for normal distribution of willingness-to-pay (N = 160).

Note. WTP 1% stands for willingness-to-pay for 1% citrus fiber-added ground beef. Similarly, WTP 3% and WTP 5% stand for willingness-to-pay for 3% citrus fiber-added ground beef and willingness-to-pay for 5% citrus fiber-added ground beef, respectively.

In addition to the summary statistics, a probability density function was estimated using MATLAB®, assuming a normal distribution for willingness-to-pay values for three levels of citrus fiber-added ground beef. The results are presented in Figure 1. The distribution for 5% citrus fiber-added ground beef was more widely dispersed than the other two distributions. Distributions for 1% and 3% citrus-added ground beef were more skewed to the right, meaning that they are less likely to obtain high price premiums.

Econometric Model

Econometric analysis was conducted to identify the factors that impacted consumers' willingness-to-pay. There are two alternative econometric procedures for this situation: the ordinary least squares (OLS) model and the ordered probit model. For the OLS model, the dependent variable—willingness-to-pay (WTP)—is assumed to have a continuous distribution. The advantage of this model is that regression coefficients can be easily interpreted in terms of the magnitude of the impact of the independent variables on the dependent variable. However, for the current study, the dependent variable is a categorical variable, which means that the estimated coefficients in an OLS model will cause estimates for the dependent variable to be out of the range given in the survey. In contrast, an ordered probit model takes into account the categorical and increasing structure of the dependent variable. For this study, we provide the results from the ordered probit model.

Ordered Probit Model

To implement the ordered probit model, the random utility from consuming citrus fiber-added meatballs, which is a latent variable, can be represented analytically as (Greene 2008):

$$(1) \quad U_i^* = \mathbf{x}_i' \boldsymbol{\beta}_i + \varepsilon_i$$

where $\mathbf{x}_i'$ is the vector that includes the values for the variables that form the deterministic part of the latent variable; $\boldsymbol{\beta}_i$ is the vector that includes the coefficients to be estimated; ε_i is the error term; and *i* denotes an individual observation. The error term, ε_i, is assumed to have a normal distribution with a mean of zero and a variance of one. The latent variable, U_i^*, is unobserved, but the willingness-to-grow is observed. Let $\mu_1 < \mu_2 < \mu_3 < \mu_4$ be unknown threshold parameters; then the willingness-to-grow is obtained as

$$\begin{aligned} (2) \quad WTP_i = y_i &= \$0 && \text{if } U_i^* \le \mu_1 \\ &= \$0.45 && \text{if } \mu_1 < U_i^* \le \mu_2 \\ &= \$0.90 && \text{if } \mu_2 < U_i^* \le \mu_3 \\ &= \$1.35 && \text{if } \mu_3 < U_i^* \le \mu_4 \\ &= \$1.80 && \text{if } \mu_4 < U_i^* \end{aligned}$$

Given that the error term has a normal distribution, the probability of each outcome for the dependent variable can be represented as

$$
\begin{aligned}
(3)\quad & \Pr\left(y_i = \$0 \middle| \mathbf{x}_i\right) = \Phi\left(\mu_1 - \mathbf{x}_i'\boldsymbol{\beta}_i\right) \\
& \Pr\left(y_i = \$0.45 \middle| \mathbf{x}_i\right) = \Phi\left(\mu_2 - \mathbf{x}_i'\boldsymbol{\beta}_i\right) - \Phi\left(\mu_1 - \mathbf{x}_i'\boldsymbol{\beta}_i\right) \\
& \Pr\left(y_i = \$0.90 \middle| \mathbf{x}_i\right) = \Phi\left(\mu_3 - \mathbf{x}_i'\boldsymbol{\beta}_i\right) - \Phi\left(\mu_2 - \mathbf{x}_i'\boldsymbol{\beta}_i\right) \\
& \Pr\left(y_i = \$1.35 \middle| \mathbf{x}_i\right) = \Phi\left(\mu_4 - \mathbf{x}_i'\boldsymbol{\beta}_i\right) - \Phi\left(\mu_3 - \mathbf{x}_i'\boldsymbol{\beta}_i\right) \\
& \Pr\left(y_i = \$1.80 \middle| \mathbf{x}_i\right) = 1 - \Phi\left(\mu_4 - \mathbf{x}_i'\boldsymbol{\beta}_i\right)
\end{aligned}
$$

where $\Phi(.)$ is the cumulative distribution function for the standard normal distribution (Greene 2008). The log-likelihood function for the entire sample of size *N* can be obtained as (Greene 2008).

$$(4)\quad \ln L = \sum_{i=1}^{N} \sum_{j=0}^{1.80} I(y_i = j) \ln \Pr(y_i = j)$$

The maximum likelihood estimation of the $\boldsymbol{\beta}_i$ coefficients is obtained by taking the derivative of the log-likelihood function with respect to each coefficient included in $\boldsymbol{\beta}_i$ and equating it to zero (Greene 2008).

Marginal Effects for Ordered Probit Regression

The marginal or partial effect of a continuous variable x_k can be calculated as (Wooldridge 2006).

$$(5)\quad \frac{\partial P(y = j|\mathbf{x}_i)}{\partial x_k} = \left[\phi\left(\mu_{j-1} - \mathbf{x}_i'\boldsymbol{\beta}_i\right) - \phi\left(\mu_j - \mathbf{x}_i'\boldsymbol{\beta}_i\right)\right]\beta_k$$

where $\phi(.)$ is the probability density function for the standard normal distribution, which is valued as the mean of the independent variables; this measures the partial impact of the independent variable, x_k, on the probability of having the dependent variable take the value *j*. For a discrete variable, x_k, such as a dummy variable, the partial effect can be calculated as follows:

$$(6)\quad \Phi(B_0 + B_1 x_1 + \ldots + B_j + \ldots + B_k x_k) - \Phi(B_0 + B_1 x_1 + \ldots + B_k x_k)$$

where x_k is equal to 1 in the first parenthesis, and x_k is equal to zero in the second parenthesis.

Factor Analysis

Besides conducting the regression analysis, statistical factor analysis was conducted to identify the variables, related to consumer preferences; those can be grouped together for a focused marketing plan (Sharma and Kumar 2006; Johnson and Wichern 2002). Factor analysis was also used to handle the multicollinearity problem in the regression analysis that resulted from having

highly correlated independent variables (Sharma and Kumar 2006; Johnson and Wichern 2002). The main objective of the factor analysis is to describe the variance-covariance structure of some variables using lower number of unobservable and random quantities, which are called the common factors (Johnson and Wichern 2002). The orthagonal factor analysis model can be structured as follows. The observed values of consumer preferences for citrus fiber-added ground beef attributes can be represented by the observable random vector $\boldsymbol{Z}$, with p components, with mean $\boldsymbol{\mu}$ and covariance matrix $\boldsymbol{\Sigma}$ (Johnson & Wichern 2002). In a factor analysis model, $\boldsymbol{Z}$ is linearly dependent on unobservable random variables, $F_1, F_2, \dots, F_m$, which are called common factors, and p additional sources of variation, $\varepsilon_1, \varepsilon_2, \dots, \varepsilon_p$, which are called errors. The factor analysis model then can be represented as:

$$(7) \quad \boldsymbol{Z} - \boldsymbol{\mu}_{p \times 1} = \mathbf{L}_{p \times m}\mathbf{F}_{m \times 1} + \boldsymbol{\varepsilon}_{p \times 1}$$

where $\mathbf{L}$ is the matrix of factor loadings, which includes the loading of the j^{th} variable of the k^{th} factor l_{jk}. Hence, the factor model model represents the p deviations, $X_1 - \mu_1, X_2 - \mu_2, \dots, X_p - \mu_p$, in terms of random variables $F_1, F_2, \dots, F_m$ and $\varepsilon_1, \varepsilon_2, \dots, \varepsilon_p$, which are unobservable (Johnson & Wichern 2002). We can construct the covariance structure of the orthogonal factor model as follows: $\text{cov}(\boldsymbol{\varepsilon}) = \boldsymbol{\xi}$, where ξ is a diagonal matrix, $\text{cov}(\boldsymbol{Z}) = \boldsymbol{\Sigma} = \mathbf{L}\mathbf{L}' + \boldsymbol{\xi}$, $\text{cov}(\mathbf{F}) = \mathbf{I}$, $\text{cov}(\boldsymbol{\varepsilon}, \mathbf{F}) = \mathbf{0}$. Hence, $\boldsymbol{\varepsilon}$ and $\mathbf{F}$ are independent and the common factors $F_1, F_2, \dots, F_m$ are uncorrelated with each other. The factor loading matrix can be represented as $\text{cov}(\boldsymbol{Z}, \mathbf{F}) = \mathbf{L}$. The estimates of the factor loadings are then found using the principal component method as:

$$(8) \quad \hat{\mathbf{L}} = \left[\sqrt{\widehat{\lambda_1}}\widehat{\mathbf{e}_1} \vdots \sqrt{\widehat{\lambda_2}}\widehat{\mathbf{e}_2} \vdots \cdots \vdots \sqrt{\widehat{\lambda_m}}\widehat{\mathbf{e}_m}\right]$$

where $\widehat{\lambda_k}$ and $\widehat{\mathbf{e}_k}$ are the estimates of the eigenvalue-eigenvector pairs for $\boldsymbol{\Sigma}$ (Johnson & Wichern, 2002). The eigenvalue estimates, $\widehat{\lambda_k}$, represent the contribution of the k^{th} factor to the total sample variance. In the current, study both p and m were 5.

Results

Factor Analysis

Results of the factor analysis are reported in Table 3, in the Kaiser rotated form, which makes interpretation of the factor loadings easier and keeps the model structure unchanged (Johnson and Wichern 2002). Since common factors are unobservable, the interpretation of common factors involves an unavoidable subjective process (Johnson and Wichern 2002). Hence, authors' interpretation of the common factors for this study is also subjective. Organic beef, locally grown beef, and grass-fed beef variables had the highest loadings for factor 1. Factor 2 had the highest factor loading from the variables taste, color, and texture. The variable "product of the U.S.A." had the highest loading for factor 3. Similarly, the price and low-fat content had the highest loadings for factors 4 and 5, respectively. For factor 5, the fact that low-fat content has the highest factor loading among different variables and the other variables have much lower factor loadings, except for the taste variable, we interpret this factor as low-fat content. Since taste variables have higher loadings on factors 2 and 3, and the highest on factor 3, we included the taste variable in interpretation of factor 3. The readers should be careful, as indicated above, the

interpretation of common factors involve a subjective process. Overall, the experience attributes (taste and texture) were grouped into the same factor, whereas the search attributes (price and color) and credence attributes were grouped separately into different factors.

Table 3. Rotated Factor Loadings (N = 160)

Variables	Factor 1 λ=1.80	Factor 2 λ=0.85	Factor 3 λ=0.21	Factor 4 λ=0.17	Factor 5 λ=0.03
Price	-0.25	-0.06	-0.03	0.31	-0.01
Taste	-0.02	0.37	0.02	0.22	0.11
Color	0.04	0.42	0.26	-0.14	-0.04
Texture	0.04	0.57	0.07	0.00	0.02
Product of U.S.A.	0.18	0.23	0.46	-0.01	0.04
Organic Beef	0.74	-0.03	-0.02	-0.02	0.02
Locally Grown Beef	0.64	-0.07	0.30	0.07	-0.07
Grass-fed Beef	0.80	0.09	0.01	-0.06	0.01
Low Fat Content	-0.01	0.19	0.14	0.06	0.19

Regression Analysis

Regression diagnostics were done for multicollinearity, heterogeneity, and endogeneity. The variance inflation factor (VIF) was used to check the multicollinearity among the independent variables. The rule of thumb is that multicollinearity exists for variables with a VIF larger than 10 (Chen et al. 2003). Although the VIF did not detect a multicollinearity problem, significant correlations were detected among the variables. Instead of dropping a correlated variable from the regression and causing biased estimators, factor scores from the factor analysis were used to address the issue without omitting any variables (Sakar et al. 2011; Eyduran et al. 2010; Sangun et al. 2009; see Johnson and Wichern 2002, p. 510 for the calculation of factor scores). Factor scores are reported in Table 4. Heterogeneity robust standard errors were used to prevent the heterogeneity problem in the regression analysis. Lastly, endogeneity was tested to prevent an omitted-variable bias. The Hausman test for endogeneity was conducted (Wooldridge 2006). The Wald test for the null hypothesis, stating that the independent variables are exogenous, could not be rejected at the 10% significance level (Wooldridge 2006). Hence, endogeneity was not a problem for the current study.

Table 4. Factor Score Estimates (N=160)

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Price	-0.043	-0.022	-0.012	0.271	-0.007
Taste	-0.001	0.215	-0.028	0.203	0.087
Color	-0.014	0.233	0.155	-0.137	-0.065
Texture	-0.013	0.389	-0.014	0.011	-0.014
Product of U.S.A.	0.023	0.104	0.336	-0.020	0.044
Organic Beef	0.327	-0.048	-0.109	0.016	0.050
Locally Grown Beef	0.212	-0.139	0.325	0.156	-0.121
Grass-fed Beef	0.457	0.113	-0.162	-0.079	0.039
Low Fat Content	-0.016	0.079	0.089	0.051	0.172

Table 5 reports the results for the ordered probit regressions. As there were three levels of citrus fiber added to the ground beef, there are three regression results to report with respect to willingness-to-pay for 1%, 3%, and 5% citrus fiber-added ground beef. For all three of the regression models, the Wald chi-square test statistics for the overall significance of the regression were significant at the 1% level for the first two regressions and at the 10% level for the third regression, demonstrating that all of the regressions were significant This compensates for the low R-squared values. It is common to obtain small R-squared values in the social sciences as it is difficult to predict consumer behavior (Wooldridge 2006; Gedikoglu and Parcell 2014). However, given that all the regressions were statistically significant, the regressions are all considered to be informative.

Table 5. Results for Ordered Probit Regression Analysis

Variables	WTP for 1Percent CF[1]		WTP for 3 Percent CF[2]		WTP for 5 Percent CF[3]	
	Coeff.	Robust Std. Err.	Coeff.	Robust Std. Err.	Coeff.	Robust Std. Err.
Factor 1 (Organic, Locally Grown, Grass-fed)	0.34***	0.102	0.33***	0.108	0.13	0.095
Factor 2 (Taste, Color, Texture)	-0.05	0.142	0.20	0.145	0.16	0.145
Factor 3 (Product of U.S.A.)	-0.27	0.182	-0.34**	0.173	-0.12	0.164
Factor 4 (Price)	-0.63***	0.236	-0.53**	0.224	-0.14	0.190
Factor 5 (Low Fat Content)	1.20***	0.428	1.11***	0.424	0.92**	0.422
N	160		160		160	
Pseudo R-squared	0.068		0.070		0.024	
Wald chi-square (5)	28.68		25.25		9.91	
p-value for Wald chi-square	0.000		0.000		0.077	

Note. [1]Indicates willingness-to-pay a price premium for 1% citrus fiber-added ground beef over conventional ground beef.
[2] Indicates willingness-to-pay a price premium for 3% citrus fiber-added ground beef over conventional ground beef.
[3]Indicates willingness-to-pay a price premium for 5% citrus fiber-added ground beef over conventional ground beef.
Three asterisks (***) indicate significance at the 1% level, two asterisks (**) at the 5% level, and one asterisk (*) at the 10% level.

Factor 1 had a positive and significant impact on both 1% and 3% citrus fiber-added ground beef. Therefore, as the value of factor 1 increased for a consumer, the consumer became more likely pay a price premium. This result is consistent with the results of Grannis et al. (2000). Factor 2 was not found to be statistically significant for either of the regressions. On the other hand, factor 3 was only statistically significant for 3% citrus fiber-added ground beef. The higher the value of factor 3, the less likely that the consumer was willing to pay a price premium. The coefficients for factor 3 at the 1% and 5% citrus-added levels were also negative but not statistically significant. Factor 4 had a negative and statistically significant impact for both 1% and 3% citrus fiber-added ground beef. This finding is consistent with the results of Yang and

Woods (2013) and Wang et al. (2011). Lastly, as seen by all of the regressions, factor 5 had a positive and highly significant statistically impact on consumers' willingness-to-pay a price premium. This is the only factor found to be significant for all of the regressions. For 5% citrus fiber-added ground beef, factor 5 was the only statically significant variable. Therefore, if producers focus on the low-fat content attribute (i.e., factor 5), they are more likely to obtain a positive price premium for all three levels of citrus fiber-added ground beef. Not finding factors 1 or 4 and finding only factor 5 significant for 5% citrus fiber-added ground beef might indicate "health consciousness," which might be associated with having the highest percentage of citrus-fiber, might be a more important determinant than price or other factors. This result is similar to the results of Jensen et al. (2014) and Yang and Woods (2013), which found that health aspect is more important than price aspect for beef products.

In Table 6, the marginal effects for the ordered probit models are reported for all three regressions. A care should be given, when interpreting the marginal effects for ordered probit.

Table 6. Marginal Effects for Ordered Probit Regression Analysis (N = 160)

	Regression: *Willingness-to-pay for 1% Citrus Fiber-added Ground Beef*				
	Price Premium Levels				
Variables	**$0**	**$0.45**	**$0.90**	**$1.35**	**$1.80**
Factor 1 (*Organic, Locally Grown, Grass-fed*)	-0.135	0.056	0.047	0.022	0.010
Factor 2 (*Taste, Color, Texture*)	0.021	-0.009	-0.007	-0.003	-0.002
Factor 3 (*Product of U.S.A.*)	0.107	-0.045	-0.037	-0.017	-0.008
Factor 4 (*Price*)	0.252	-0.105	-0.088	-0.041	-0.018
Factor 5 (*Low Fat Content*)	-0.477	0.199	0.167	0.077	0.035
	Regression: *Willingness-to-pay for 3% Citrus Fiber-added Ground Beef*				
	Price Premium Levels				
Variables	**$0**	**$0.45**	**$0.90**	**$1.35**	**$1.80**
Factor 1 (*Organic, Locally Grown, Grass-fed*)	-0.093	-0.022	0.066	0.044	0.006
Factor 2 (*Taste, Color, Texture*)	-0.056	-0.014	0.040	0.026	0.004
Factor 3 (*Product of U.S.A.*)	0.094	0.023	-0.066	-0.044	-0.006
Factor 4 (*Price*)	0.148	0.036	-0.105	-0.070	-0.010
Factor 5 (*Low Fat Content*)	-0.311	-0.075	0.219	0.146	0.020

Table 6. *Continued*

	Regression: *Willingness-to-pay for 5% Citrus Fiber-added Ground Beef*				
	Price Premium Levels				
Variables	**$0**	**$0.45**	**$0.90**	**$1.35**	**$1.80**
Factor 1 (*Organic, Locally Grown, Grass-fed*)	-0.039	-0.012	0.021	0.019	0.012
Factor 2 (*Taste, Color, Texture*)	-0.049	-0.015	0.026	0.024	0.014
Factor 3 (*Product of U.S.A.*)	0.038	0.012	-0.020	-0.018	-0.011
Factor 4 (*Price*)	0.044	0.014	-0.023	-0.021	-0.013
Factor 5 (*Low Fat Content*)	-0.279	-0.087	0.148	0.135	0.083

The sign of the marginal effect changes across choices for a variable. For example, in the ordered probit regression, if a variable is found to have a positive impact on the probability of paying a price premium, then the marginal effect for this variable will be negative for $0 and positive for the other price premium levels. Factor 5 (low-fat content) had the highest negative marginal effect of $0 for 1% citrus fiber-added ground beef. On the other hand, factor 4 (the price) had the highest positive marginal effect for $0. However, the marginal effect of factor 5 was almost twice the marginal effect of factor 4. As expected, factor 5 (low-fat content) had both a positive and the largest marginal effect on the positive price premium levels: $0.45, $0.90, $1.35, and $1.80. Therefore, if the low-fat content of ground beef is important to a consumer, it significantly increases the likelihood of paying a positive price premium.

The marginal effects for 3% and 5% citrus fiber-added ground beef show similar patterns. Factor 5 (low-fat content) had the highest negative marginal effect on the willingness-to-pay levels of $0 and $0.45 for both regressions. On the other hand, factor 5 has the highest positive marginal effect on the willingness-to-pay levels of $0.45, $0.90, and $1.35 for both regressions. Regarding factor 4, price, had high positive marginal effects on the willingness-to-pay levels of $0 and $0.45 and high negative positive marginal effects on $0.90, $1.35, and $1.80. As with 1% citrus fiber-added ground beef, the marginal effects for factor 5 (low-fat content) were much higher than those of factor 4 (price). Overall, low-fat content and price (factors 4 and 5) were the most influential factors impacting the willingness-to-pay for citrus fiber-added ground beef. Other factors, such as taste and product origin (U.S.A.) were not as influential as the low-fat content and price.

Conclusion

Beef is a nutritious food for human consumption, with high-quality protein (Aberle et al. 2001). However, consuming beef products is often associated with coronary heart disease, obesity, and diabetes (Micha et al. 2010; Lajous et al. 2011). Therefore, ground beef and other beef products are commonly known as unhealthy food choices, due to the presence of saturated fats being correlated with high cholesterol levels in humans. Another key factor related to the human diet,

especially in the US, is the low consumption of dietary fiber. Dietary fiber is a necessary food ingredient that promotes health by reducing cholesterol and the risks of heart disease. Adding fiber to ground beef can increase the health benefits of consuming ground beef products and can provide new market opportunities for the beef industry. This will positively impact human health while increasing sales and profits for the beef industry.

By using a consumer panel, the current study analyzed consumers' preferences for citrus fiber-added ground beef meatballs. The results showed that consumers were willing to pay a positive price premium, but it was not very high. The average price premium was $0.35, $0.55, and $0.65, respectively, for 1%, 3%, and 5% percent citrus fiber-added ground beef. A comparison of average price premiums with the cost of adding citrus fiber, $0.09 for 1% citrus fiber, $0.27 for 3%, and $0.45 for 5%, revealed that the average price premium covers the cost of adding citrus fiber for each percentage level. Thus, there are opportunities for beef producers to increase their profits by adding citrus fiber into ground beef.

The regression results show that consumers concerned with getting lower fat contents in ground beef are more likely to pay a price premium for citrus fiber-added ground beef. Consequently, targeting these consumers should increase the prospect of getting a positive price premium for citrus fiber-added ground beef. The low-fat content attribute also had a much higher impact on the price premium than the following attributes: organic, grass-fed, and/or locally grown beef. Although targeting consumers who are interested in organic, grass-fed, and/or locally grown beef products increases the likelihood of obtaining a price premium; focusing on consumers concerned with low-fat provides the highest chance for producers to receive a price premium. Hence, product differentiation based on the health attribute can lead to a higher price premium. Price had the highest negative impact on the price premium. Hence, price-concerned consumers are not likely to be buyers of citrus fiber-added ground beef.

In the current study, samples of citrus fiber-added ground beef were presented to the consumers. Thus, reliable data on factors such as taste and texture were obtained, but future research is needed to expand the geographical scope of the study. Internet or mail surveys can be conducted with respondents from a wider geographic region. As the current study was conducted on a university campus, it is expected that the consumers are highly educated. Hence, future studies are needed to include a more heterogeneous sample.

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Appendix. Consumer Survey

Citrus Powder: Citrus powder is rich in both soluble and insoluble dietary fiber. Consuming food with dietary fiber can help with maintaining a healthy weight and lowering [the] risks of diabetes and heart disease.

1. Suppose that you are in a grocery store to buy **ground beef**. The price of a conventional *ground beef chuck* (with 80% lean and 20% fat) is $4.48/lb. What is the price premium per pound *over* the price of conventional ground beef chuck [$4.48/lb.] would you be willing to pay to buy a ground beef chuck with the following attributes? (Please check one for each attribute).

Attributes	**None 0**	**$0.45 1**	**$0.90 2**	**$1.35 3**	**$1.80 or More 4**
Ground Beef Chuck with 1% Citrus Powder	[ ]	[ ]	[ ]	[ ]	[ ]
Ground Beef Chuck with 3% Citrus Powder	[ ]	[ ]	[ ]	[ ]	[ ]
Ground Beef Chuck with 5% Citrus Powder	[ ]	[ ]	[ ]	[ ]	[ ]

2. When purchasing **ground beef**, how important to you are the following attributes? (Please check one for each attribute).

	Extremely Important 2	**Somewhat Important 1**	**Not Important 0**
Price	[ ]	[ ]	[ ]
Taste	[ ]	[ ]	[ ]
Color	[ ]	[ ]	[ ]
Texture	[ ]	[ ]	[ ]
Product of U.S.A.	[ ]	[ ]	[ ]
Organic Beef	[ ]	[ ]	[ ]
Locally grown Beef	[ ]	[ ]	[ ]
Grass-fed Beef	[ ]	[ ]	[ ]
Low Fat Content	[ ]	[ ]	[ ]

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Perceptions of Corporate Social Responsibility of Prominent Fast Food Establishments by University Students

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Abstract

Corporate social responsibility (CSR) can affect the way customers perceive a company and can influence product differentiation. This study assesses university students' perceptions of CSR across eleven prominent fast food restaurants. A total of 550 students responded to in-person surveys administered on the campus of Purdue University. Chipotle and Panera Bread were perceived to be the most socially responsible out of the fast food restaurants studied, receiving mean preference shares of 31% and 30%, respectively.

Keywords: consumer behavior, consumption patterns, corporate social responsibility, fast food perceptions

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Introduction

Food expenditures by consumers away from home are increasing in the United States (BLS 2016; USDA 2016). At the same time, consumers are increasingly demanding more (attributes) from their food, and fast food restaurants have been moving to meet growing demand for social responsibility (Morgan et al. 2016). The European Commission suggested that corporate social responsibility (CSR) is "a concept defining how companies integrate social and environmental concerns in their business operation and how they interact with stakeholders on a voluntary basis," (Manning 2013, 9). A company with the ability to differentiate their products via CSR initiatives or in other ways may be able to attract customers when price competition is high. For example, in a study conducted on restaurant location and competition, Thomadsen (2007) found that McDonald's and Burger King offer lower prices when the restaurants are closer together, but set higher prices as the distance between the individual restaurant locations increases. Price advantages can be gained with two miles to two and one-half miles between the chains, but there is a limit to the increased distance before the restaurant is removed from the target market (Thomadsen 2007). In response to intense price competition, one avenue of product differentiation and competitive advantage could be each chain's CSR initiatives.

Young consumers and university students have the persistent reputation of being avid consumers of fast food. Fryar and Ervin (2013) reported that approximately 15% of caloric intake for young adults came from fast food, whereas, for adults aged forty to fifty-nine, the caloric intake is only 10.5%. Consumption of food away from home is largest, in terms of share of expenditures, for the segment of the population which is eighteen–twenty-five years of age (BLS 2016). A study done at Michigan State University in 1999 found that 40.4% of the students surveyed went to a fast food restaurant three to four times a week, while 25.8% went more than five times (Knutson 2000). In 2005, a study done at a Midwestern university found that 95.1% of the freshman/sophomore undergraduate students surveyed and 91.9% of the junior/senior undergraduate students surveyed reported eating out at fast food restaurants five to eight times a week (Driskell, Kim, and Goeble 2005). Kurkowski et al. (2006), in a study of Vermont residents, found that college students ate fast food 70% more often than non-enrolled adults in the same community. Dingman et al. (2014), in a study at a Southeastern university, found that 23% of the meals consumed by students were from fast food restaurants. Thus, there is considerable evidence in support of the notion that college students are regular consumers of fast food.

Many universities have popular fast food options available on or near the campus, making fast food abundant and accessible for students. For example, Alfred State College, with about 3,700 enrolled students, is proximate to locations for a number of fast food options, including McDonald's, Subway, and Dunkin' Donuts (Alfred State 2016). Texas A&M University, with a total enrollment of about 64,500 students, has locations for Chick-fil-A and Starbucks, among others, on campus (Texas A&M 2016). A study at Michigan State University reported that the campus had restaurants for McDonald's, Subway, Burger King, Taco Bell, and Wendy's on campus, while Arby's and KFC were across the street from campus (Knutson 2000). While the precise offerings may differ, the availability of fast food near (or on) university campuses in the United States is generally quite high. Purdue University, the location of this study, has abundant fast food on or near campus, as well as multiple locations for the same restaurant chains in

various locations around campus. Easy access to fast food options clearly appears to be a part of the university experience for many students.

There is generally little research focused on the consumer base of 'university students' and their expectations about CSR, let alone CSR practiced by fast food restaurants. One study of English and Scottish university students found that, for McDonald's and KFC, respondents were aware that each company had CSR initiatives (Schröder and McEachern 2005). The students were most knowledgeable about each company's *food quality* initiatives, 55%, and 34%, respectively, and their awareness for all CSR initiatives was higher for McDonald's than for KFC (Schröder and McEachern 2005). These university students also had expectations for fast food companies overall; 82% expected companies to have CSR initiatives for *healthy eating*, 73% for *animal welfare*, and 69% for *community activities* (Schröder and McEachern 2005).

The objective of this analysis, then, was to investigate university students' perceptions of CSR for fast food restaurants. This study also aimed to investigate the relationships between student demographics and their relative perceptions of the CSR of fast food restaurants. Improved understanding of these relationships has the potential to improve decision-making and targeted marketing by restaurants, especially those located in college towns. Restaurants may use this information to help determine what CSR initiatives to pursue and how to communicate those initiatives to the students most likely to value them.

Materials and Methods

In August 2016, a single-page paper survey was distributed to university students on the Purdue University's campus[1]. Graduate student researchers collected data over four consecutive days during the first week of classes in the Fall of 2015. Collection occurred each day for three, two-hour time blocks[2]. Five locations around campus were targeted specifically for being resting areas (or areas where students were sitting or stationary) near high traffic zones[3].

Respondents were asked general demographic questions such as their gender, relationship status, and region and/or country of origin. In addition, respondents were asked questions more specific to the university setting, such as which college they attended at Purdue University, their current academic year, and whether the respondent was living on or off campus. The survey also prompted respondents about their food consumption habits, including if they had a campus meal plan, their estimated weekly food expenditure, and the number of monthly restaurant visits they made.

Methodology

The methodology used in this analysis, best-worst scaling (BWS), forced participants to make tradeoffs among multiple fast food restaurants over multiple choice occasions or scenarios.

[1] The survey instrument used is presented in its entirety in Appendix 1. The survey, when distributed, was printed on both sides of a single sheet of paper.
[2] Survey data collection occurred August 24-27, 2015, each day from 9-11AM, 11AM-1PM, and 3:30-5:30PM.
[3] Locations for surveying included the Purdue Memorial Union, Beering Hall Loeb Fountain area, Cordova Co-recreational Sports Center lobby, Wiley Dining Court, and the Engineering Fountain area.

BWS is also called maximum difference scaling, as the outcome represents the maximum difference between a respondent's most preferred option and their least preferred option (Louviere 1993). The method of BWS was developed by Jordan Louviere in the late 1980s, although it was not published until the early 1990s. The BWS methodology builds on Thurstone's (1927) Method of Paired Comparison (MPC), although it is more general and allows for more attribute selections (Erdem, Rigby, and Wossink 2012).

BWS originates in random utility theory, a well-tested theory of human decision-making (McFadden 1974). Other BWS research has used different terms to elicit a tradeoff between attributes. Terms such as "most" and "least" important were used by Lusk and Briggeman (2009) to examine food values, while Wolf and Tonsor (2013) investigated the "best" and "worst" of dairy farmer policy preferences. Erdem, Rigby, and Wossink (2012) used "most responsible" and "least responsible" to elicit from consumers and farmers their subjective perceptions of their relative responsibility for ensuring food safety. This analysis uses "most socially responsible" and "least socially responsible" to elicit student perceptions of CSR in prominent fast food restaurants.

The eleven fast food restaurants studied in this analysis were (in no particular order): McDonald's, Subway, Starbucks, Panera Bread, Wendy's, Burger King, Taco Bell, Dunkin' Donuts, Chick-fil-A, KFC, and Chipotle. Each of these fast food restaurants, with the exception of Dunkin' Donuts, was located within eight miles of Purdue University at the time of data collection. In total, there were nine McDonald's, ten Subway, two Panera Bread stores, eight Starbucks, six Wendy's, five Burger King, five Taco Bell, four KFC, one Chick-fil-A and two Chipotle restaurants within eight miles of campus[4].

Students were presented with eleven different questions (choice sets), each presenting five fast food restaurants from which they could select. Participants could choose any one fast food restaurant up to five times over the survey in its entirety There are eleven fast food restaurants presented (*j*), Participant selections of the "most" and "least" socially responsible fast food restaurants were used to determine the relative social responsibility of each fast food restaurant presented in this study. Theoretically, these two choices represent the maximum difference between two attributes on the underlying continuum of importance (Lusk and Briggeman 2009). Following Lusk and Briggeman's (2009) study, λ_i is used to represent the location of importance for each attribute *j* on the continuum of importance, and the random error term is denoted by ε_{ij}. Thus, the true unobservable level of importance for each respondent is represented:

$$(1) \quad I_{ij} = \lambda_i + \varepsilon_{ij}$$

The probability that a respondent in this study *i*, a Purdue University student, chooses *j* and *k*, respectively as the best and worst, or "most" and "least" socially responsible fast food restaurants, is the probability that the difference between I_{ij} and I_{ik} is larger than all otherpossible

[4] The distances were collected using Google Maps. The starting location was Purdue University, 610 Purdue Mall, West Lafayette, IN 47907. At the time of the survey the closest Dunkin' Donut locations were beyond 30 miles from campus; a location was built closer but was not opened until after the survey had concluded.

differences from the choice combinations (Lusk and Briggeman 2009), represented by the maximum difference between a respondent's two chosen attributes. As in the experiment outlined by Lusk and Briggeman (2009) the error term is assumed to be independently and identically distributed, therefore the probability of choosing a most-least socially responsible combination took on the multinomial logit (MNL) form:

$$(2)\quad \text{Prob } (j \text{ is chosen most and } k \text{ is chosen least}) = \frac{e^{\lambda_j - \lambda_k}}{\sum_{l=1}^{J}\sum_{m=1}^{J} e^{\lambda_l - \lambda_m - J}}$$

Maximum likelihood estimation (MLE) is used to estimate the parameter λ_j which represents how responsible restaurant j is relative to the least responsible restaurant. The least responsible restaurant is not known ex ante; rather it is determined through analysis of responses, whereby its value must be normalized to zero to prevent the "dummy variable trap" (Lusk and Briggeman 2009).

A limitation of the MNL model is that it assumes homogeneity amongst respondents' preferences for presented attributes across individuals. Student perceptions of social responsibility among fast food restaurants were hypothesized to be heterogeneous. Heterogeneous preferences for various production processes and product attributes have been well documented in the literature. Previous studies such as Schwartz (1992) and Auger, Devinney, and Louviere (2007), have shown that individual people, even within the same society, can have unique preferences. Therefore, the random parameter logit (RPL) model was used, which assumes heterogeneous preferences among respondents for the presented attributes. Adjustments from (2) for the RPL model include the unobservable level of importance for respondent i and attribute j in population λ_j, in which the mean is represented as $\bar{\lambda}_j$, the standard deviation σ_j, and the random term μ_i. Adjustments for the RPL model were specified as:

$$(3)\quad \tilde{\lambda}_{ij} = \bar{\lambda}_j + \sigma_j \mu_{ij}$$

The random term, within the RPL model, was normally distributed with mean zero and unit standard deviation, thus distributing the level of responsibility of restaurant j according to a normal distribution curve (Lusk and Briggeman 2009). The probability that each fast food restaurant was picked as most responsible across all eleven restaurants was then estimated. In other words, for each of the eleven fast food restaurants, a share of preference was calculated using parameter estimates from the RPL model. The probabilities, termed "shares of preference" by Lusk and Briggeman (2009) were calculated as:

$$(4)\quad share_j = \frac{e^{\hat{\lambda}_j}}{\sum_{k=1}^{J} e^{\hat{\lambda}_l}}$$

Preference shares provide a more intuitive means of analyzing relationships between the restaurants explored than do the coefficient estimates (Wolf and Tonsor 2013). The shares must sum to one across the eleven restaurants. The calculated preference share for each attribute is the forecasted probability that each restaurant is chosen as the most responsible (Wolf and Tonsor 2013).

In addition to mean parameter estimates, individual-specific parameter estimates were estimated for each individual student respondent in the sample. Those individual-specific coefficient estimates were used to calculate individual-specific preference shares for perceived social responsibility of each fast food restaurant (relative to all other restaurants presented) for each individual student respondent. For any individual respondent, the shares of preference across all eleven fast food restaurants studied must sum to one. Estimations were performed in NLOGIT 5.0.

Results and Discussion

The participants in this survey were a convenience sample of Purdue University students, who were present in highly populated, on-campus locations during the first week of classes in the Fall semester of 2015. In total, 550 Purdue students completed the survey. Summary statistics for demographic variables are shown in Table 1. Eighty-five percent of respondents were from the Midwest region, where Purdue University is located (West Lafayette, Indiana), and 91% reported the US as their country of origin. Thus, a majority of the sample is likely familiar with the Midwest region of the United States and the restaurants that are the focus of this study, even outside their Purdue University experience. For analysis purposes, undergraduate students were divided into two groups: lower classmen (freshmen and sophomores) and upperclassmen (juniors and seniors).

At the time of the survey, 60% of respondents reported that they lived on campus and 53% indicated that they had a campus meal plan. Of those 294 respondents who indicated that they had a campus meal plan, 283 responded to questioning surrounding how much additional money outside their meal plan they spent on food each week. The mean spending among those 283 respondents was $23.02/week. Students were not specifically asked which meal plan they had, which could range from eight meals per week in the dining courts for the most basic plan, thirteen meals per week for an intermediate plan, and up to unlimited trips through the dining court covering all breakfast, lunch, dinner, and snacks each day of the week. All meal plans except the eight meals per week also included "dining dollars," which could be spent at all dining or retail locations on campus, including a Starbucks (Purdue University 2016). In total, 256 respondents indicated that they did not have a campus meal plan and 232 of them provided average weekly spending on food, with the mean of those responses being $71.89/week. Questions about restaurant patronage were asked to elicit where students were spending their food dollars. From the entire sample, 529 respondents reported weekly fast food consumption at sit-down restaurants, the mean of which was 3.4 visits per week. A total of 523 respondents provided information on take-out or drive-through fast food restaurant visits, the average of which was 4.2 visits per week.

Table 1. Sample Demographics (n=550, % of respondents)

Variable Description	Survey
Female	56
Region	
Northeast	4
South	5
Midwest	85
West	6
Classification	
Freshman	43
Sophomore	18
Junior	19
Senior	16
MS/MA	2
PhD	2
Other	1
Major of study	
Agriculture	9
Engineering	34
Health and Human Studies	13
Science	17
Liberal Arts	9
Other	18
Marital status	
Single	98
Married	2
Divorced	0
Nationality	
United States Resident	91
Other	9
I live:	
On-campus	60
Off-campus	40
Campus meal plan	53

Results for the BWS questions for the eleven fast food restaurants are shown in Table 2. In addition to the mean shares of preference for all fast food restaurants presented, individual-specific preference shares for each respondent and for each restaurant were also calculated using the individual-specific parameter estimates from the RPL model. Individual-specific preference shares, while not displayed for every individual (n=550), were used in the correlation analysis between individual-specific preference shares and key student demographics collected in the survey instrument. Estimated mean preference shares revealed three distinct restaurants which obtained the cumulative majority of preference shares, where mean preference shares were largest for Panera Bread and Chipotle, followed by Starbucks. In contrast, a national sample in a previous study revealed Subway and Chick-fil-A, in addition to Panera Bread, as the top three most socially responsible fast food restaurants, although each with much smaller mean preference shares than found in this analysis (Morgan et al. 2016).

Table 2. Output and Derived Preference Shares

Value	RPL Parameter Estimates		Mean Shares of Preferences
	Coefficient	Standard Deviation	
McDonald's	-1.0709***	2.2521***	0.0115
	(0.0871)	(0.0864)	
Subway	.8238***	0.9905***	0.0767
	(0.0675)	(0.0740)	
Panera Bread	2.1925***	1.6404***	0.3016
	(0.0797)	(0.0873)	
Starbucks	1.4764***	1.2909***	0.1474
	(0.0726)	(0.0705)	
Wendy's	-0.2749***	0.1509**	0.0262
	(0.0591)	(0.0675)	
Burger King	-1.1025***	04954*	0.0111
	(0.0605)	(0.0625)	
Taco Bell	-1.517***	0.9478**	0.0073
	(0.0638)	(0.0744)	
KFC	-1.2727***	0.6812**	0.0094
	(0.0612)	(0.0707)	
Chick-fil-A	0.6753***	1.9901***	0.0661
	(0.0838)	(0.0847)	
Chipotle	2.2146***	1.8358***	0.3084
	(0.0869)	(0.0716)	
Dunkin Donuts	0.00		0.0336

Statistical significance at the 1%***, 5%**, and 10%* levels.

Observable significant relationships, in the form of correlations, existed among respondents' demographic factors and the sizes of preference shares (perceived social responsibility) of fast food restaurants (Table A1, see Appendix A). With respect to gender, being female was negatively correlated with the sizes of individual-specific preference shares for Wendy's and Chipotle, whereas being female was positively correlated with the size of individual-specific preference share for McDonald's. In contrast to a study which used a national sample (n=302), being female was found to be negatively correlated with the size of preference share for the social responsibility of McDonald's, Wendy's, Burger King, Taco Bell, Dunkin Donuts, and KFC, while positively correlated with Chipotle (Morgan et al. 2016). Thus, the relationship of relative ranking of social responsibility of fast food restaurants is not consistent across the national sample and student sample used in this analysis. The region of origin yielded little significance with respect to respondents' perceived social responsibility in fast food restaurants. Even so, the respondents from the US Northeast were positively correlated with the sizes of individual-specific preference shares for Burger King and Chipotle and negatively correlated with the size of individual-specific preference share for Chick-fil-A. The negative correlation between the sizes of preference shares for Chick-fil-A and being a resident of the Northeast was also present in the national analysis by Morgan et al. (2016). Respondents indicating US residency yielded interesting results; this response/demographic was negatively correlated with the sizes of individual-specific preference shares for Subway, Starbucks, Wendy's, Taco Bell,

and Dunkin' Donuts, and positively correlated with the size of individual-specific preference share for Chick-fil-A.

With respect to more student-specific demographics, lower class year was positively correlated with the sizes of individual-specific preference shares for Subway, Wendy's, Burger King, Taco Bell, Dunkin' Donuts, and KFC, and negatively correlated with the size of individual-specific preference share for Chipotle. Upper class year status was negatively correlated with the sizes of individual-specific preference shares for Subway, Wendy's, Burger King, Taco Bell, Dunkin' Donuts, and KFC. Graduate-level enrollment was negatively correlated with the size of individual-specific preference share for Chick-fil-A. Living on campus was positively correlated with the size of individual-specific preference share for Subway.

Having a campus meal plan was positively correlated with the sizes of individual-specific preference shares for Subway, Wendy's, Burger King, Dunkin' Donuts, and KFC. Indicating a major in agriculture was positively correlated with the sizes of individual-specific preference shares for McDonald's, Wendy's, Burger King, Taco Bell, Dunkin' Donuts, and Chick-fil-A; whereas, it was negatively correlated with the size of individual-specific preference share for Chipotle. While the precise reason that a major in agriculture might be correlated to the ranking of CSR for Chipotle is outside the realm of this analysis, it is hypothesized that aspects of Chipotle's marketing (especially potentially negative depictions of large-scale and/or conventional production systems, and insinuations that such systems are inherently irresponsible) may offend those with agricultural knowledge or backgrounds, as Chipotle is often criticized by these groups. Majoring in engineering was positively correlated with the individual-specific size of preference share for Subway, and negatively correlated with the size of individual-specific preference share for Chick-fil-A. A major in health and human studies, interestingly, yielded primarily negatively correlated relationships with perceived CSR of fast food restaurants in this study. This response by students was negatively correlated with the sizes of individual-specific preference shares for Wendy's, Dunkin' Donuts, and KFC. While beyond the scope of this analysis, it is likely that those selecting health and human studies as an area of focus might be more focused on healthy dietary choices than the general student population. Furthermore, the curriculum itself, focused on human healthfulness (and thus dietary choices, at least to some degree) may be impacting perceptions of fast food restaurants by students in this area of study. Finally, students whose major area was science was negatively correlated with the sizes of individual-specific preference shares for McDonald's and Starbucks.

Conclusions and Implications

University students are notoriously frequent consumers of fast food, with many reportedly visiting such eateries multiple times a week, for a variety of meals. University campuses have been shown to be high competition markets, each offering many options, and even multiple locations of each option, often regardless of campus size. This study finds that students appear to base perceptions of these restaurants at least, in part, on concepts that can be interpreted as components of CSR programs.

The sample of Purdue University students in this study perceived Chipotle and Panera Bread to be the most socially responsible fast food restaurants of the options presented. Observable

relationships also existed in perceptions of fast food CSR and student demographic factors. This finding suggests that CSR could be an attribute that students use to make dining decisions. Note that, in terms of restaurants that offer tacos and burritos as staple menu items; Chipotle was rated most socially responsible (31% of mean preference shares), while Taco Bell was viewed as decidedly less so (8% of mean preference shares).

While it cannot be stated that consumers purchase solely on the basis of CSR, other product attribute combinations should be considered. Consider the example of price-competitive hamburger restaurants, McDonald's and Burger King, where both received 1% of preference shares for CSR and were statistically indistinguishable from each other in that regard. As discussed, product differentiation, via social responsibility, could shift consumption patterns in areas where price alone is not sufficient. Likewise, it is also important for companies to consider the potential to boost brand image by exceeding consumer expectations for CSR in their practices. Future studies could build on this research by investigating student perceptions of CSR of specific fast food, in conjunction with actual student consumption/patronage at those restaurants. In addition, a more complete understanding of student values could add further insight into the underlying factors shaping student perceptions of and their resulting purchasing behavior at prominent fast food restaurants.

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Appendix A.

Table A1. Correlations among Perceived Fast Food Social Responsibility Preference Shares and Sample Demographics (n=550)

	McDonald's	**Subway**	**Panera Bread**	**Starbucks**	**Wendy's**	**Burger King**	**Taco Bell**	**Dunkin' Donuts**	**KFC**	**Chick-fil-A**	**Chipotle**
Female	0.0755*	-0.0202	0.0651	0.0186	-0.0759*	-0.0108	-0.0179	-0.0604	-0.0641	0.0043	-0.0765*
Region											
Northeast	-0.0123	-0.0308	-0.0307	0.0732	0.0731	0.0871**	0.0733	0.0608	0.0269	-0.1279***	0.0841*
South	-0.0592	0.0085	-0.0186	-0.0219	-0.0581	-0.0755*	-0.0614	-0.0651	-0.0636	0.0390	0.0289
Midwest	0.0446	0.0480	0.0179	-0.0116	0.0228	0.0374	0.0187	0.0281	0.0380	0.0179	-0.0569
West	-0.0136	-0.0413	0.0022	0.0002	-0.0251	-0.0449	-0.0289	-0.0187	-0.0085	-0.0017	0.0206
US resident	-0.0249	-0.1469***	0.0562	-0.1522***	-0.0752*	-0.0159	-0.1024**	-0.0739*	-0.0493	0.0982**	0.0261
Classification	0.0372	-0.0204	0.0166	-0.0712*	0.0069	-0.0128	-0.0149	0.0126	0.0157	0.0833**	-0.0444
Lower classmen	-0.0335	0.1284***	0.0467	0.0108	0.1372***	0.1063**	0.1003**	0.1334***	0.1271***	-0.0205	-0.0875**
Upper classmen	0.0536	-0.1432***	-0.0399	-0.0473	-0.1385***	-0.1165***	-0.1114***	-0.1316***	-0.1235***	0.0635	0.0679
Graduate-level	-0.0143	0.0483	0.0297	0.0358	0.0107	0.0382	0.0395	0.0068	0.0134	-0.0977**	0.0143
I live on-campus	0.0384	0.0808*	-0.0510	-0.0201	0.0750	0.0624	0.0305	0.0711	0.0314	-0.0150	0.0207
Campus meal plan	-0.0077	0.1294***	-0.0069	0.0182	0.1102***	0.0836**	0.0412	0.1038**	0.0705*	-0.0426	-0.0269
Major											
Agriculture	0.1089***	0.0193	-0.0631	-0.0086	0.0779*	0.1033**	0.1893***	0.1028**	0.0630	0.1020**	-0.0814*
Engineering	-0.0352	0.0913**	0.0274	0.0352	0.0595	-0.0130	-0.0268	0.0384	0.0528	-0.0877**	0.0028
Health and Human Studies	-0.0572	-0.0003	0.0140	-0.0291	-0.0807*	-0.0438	-0.0630	-0.0775*	-0.0888**	-0.0217	0.0561
Liberal Arts	-0.0315	-0.0555	0.0830	0.0018	-0.0275	0.0022	-0.0175	-0.0234	0.0202	-0.0470	-0.0112
Science	-0.0924**	-0.0531	0.0328	-0.0760*	-0.0219	-0.0361	-0.0234	-0.0204	-0.0197	0.0182	0.0488

Statistical significance is indicated at 1%***, 5%**, and 10%* level.

Appendix B.

Survey Instrument (Distributed as single sheet printed front and back)

Purdue University Student Fast Food Perceptions Survey

Fall Semester 2015

Your participation in this survey is entirely voluntary and your responses will be kept in strict confidence.

□ Male □ Female _____ years of age

Where are you from? Country: _____
(If from the United States) State: _____

What college do you study/work in?				
□ AG	□ ENGR	□ HHS	□ SCI	□ PHARM
□ ED	□ MGMT	□ NUR	□ LA	□ VET MED

□ Freshman □ Sophomore □ Junior □ Senior
Graduate-level □ MS/MA □ PhD □ Other Prof.

Do you have a summer job? □ Yes □ No
If **YES**, what are you approximate weekly earnings?
$ _____ per week

Do you have a job during the academic year?
□ Yes □ No
If **YES**, what are you approximate weekly earnings?
$ _____ per week

I am: □ Married □ Single □ Divorced
I live: □ On campus □ Off campus

Do you have a campus meal plan?

□ **YES –** How much additional money do you spend on groceries, in restaurants, for take-outs, etc.? *Please provide your best estimate.*
$ _____ per week

□ **NO – How much** do you spend on food each week including at home, in groceries, in restaurants, take-outs, etc.? *Please provide your best estimate.*
$ _____ per week

Indicate the number of times per month you visit each restaurant category:

Category		**# visits per month**
Fast Food –	Sit down	
	Take out/Drive Through	
All other restaurants (excluding fast food)		

Have you traveled abroad (outside the United States) in the past 5 years? □ Yes □ No

Rank the importance of each of the following areas of social responsibility *(1 indicating extremely unimportant and 7 extremely important)*:

Environment: 1 2 3 4 5 6 7
Biotechnology: 1 2 3 4 5 6 7
Fair Trade: 1 2 3 4 5 6 7
Health and Safety: 1 2 3 4 5 6 7
Animal Welfare: 1 2 3 4 5 6 7
Community: 1 2 3 4 5 6 7
Procurement/ Input Supply or Acquisition: 1 2 3 4 5 6 7
Labor and Fair Compensation: 1 2 3 4 5 6 7

For the following practices, rate your knowledge *(1 indicating extremely unknowledgeable and 7 indicating extremely knowledgeable)*:

Business practices in *food production*:
1 2 3 4 5 6 7
Business practices in the fast food industry:
1 2 3 4 5 6 7

Indicate the box that best fits you for each of the statements listed below:

I try to buy products that can be recycled. □ *Always* □ *Most of the time* □ *Sometimes* □ *Never*

I try to purchase from companies that make donations to charity. □ *Always* □ *Most of the time* □ *Sometimes* □ *Never*

I do not buy meat products from farms that do not allow their cattle access to pasture. □ *Always* □ *Most of the time* □ *Sometimes* □ *Never*

Other people try to buy products that can be recycled. □ *Always* □ *Most of the time* □ *Sometimes* □ *Never*

Other people try to purchase from companies that make donations to charity. □ *Always* □ *Most of the time* □ *Sometimes* □ *Never*

Other people do not buy meat products from farms that do not allow their cattle access to pasture. □ *Always* □ *Most of the time* □ *Sometimes* □ *Never*

Purdue University Student Fast Food Perceptions Survey

Fall Semester 2015

Your participation in this survey is entirely voluntary and your responses will be kept in strict confidence.

From the following list of fast food options, select the restaurant that you believe is the most socially responsible and the store you believe is the least socially responsible.

Question 1		
Most		Least
□	Subway	□
□	KFC	□
□	Burger King	□
□	Chipotle	□
□	Chik-fil-A	□

Question 2		
Most		Least
□	Burger King	□
□	Panera Bread	□
□	Subway	□
□	Wendy's	□
□	McDonalds	□

Question 3		
Most		Least
□	Taco Bell	□
□	Starbucks	□
□	Wendy's	□
□	KFC	□
□	Subway	□

Question 4		
Most		Least
□	Panera Bread	□
□	Dunkin' Donuts	□
□	KFC	□
□	Starbucks	□
□	Burger King	□

Question 5		
Most		Least
□	Chipotle	□
□	McDonalds	□
□	Dunkin' Donuts	□
□	Subway	□
□	Starbucks	□

Question 6		
Most		Least
□	Dunkin' Donuts	□
□	Taco Bell	□
□	Chipotle	□
□	Burger King	□
□	Wendy's	□

Question 7		
Most		Least
□	McDonalds	□
□	Burger King	□
□	Starbucks	□
□	Chik-fil-A	□
□	Taco Bell	□

Question 8		
Most		Least
□	KFC	□
□	Chipotle	□
□	Taco Bell	□
□	McDonalds	□
□	Panera Bread	□

Question 9		
Most		Least
□	Starbucks	□
□	Wendy's	□
□	Chik-fil-A	□
□	Panera Bread	□
□	Chipotle	□

Question 10		
Most		Least
□	Chik-fil-A	□
□	Subway	□
□	Panera Bread	□
□	Taco Bell	□
□	Dunkin' Donuts	□

Question 11		
Most		Least
□	Wendy's	□
□	Chik-fil-A	□
□	McDonalds	□
□	Dunkin' Donuts	□
□	KFC	□

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Students' Willingness to Pay for More Local, Organic, Non-GMO and General Food Options

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Abstract

As universities look to source "sustainable" products, it is critical to understand student demand and the economic feasibility of adding new sustainable products. Using an online survey in conjunction with a Tobit model we find that half of students in our sample are willing to pay more for increased local and organic food options with only a third willing to pay more for increased non-GMO options. The economic feasibility of adding new local, organic, and non-GMO options is questionable as charging students for their willingness to pay results in only a 1–2% gain in revenue which may not cover the cost of more options in on-campus dining halls.

Keywords: food to institution; genetically modified organism; Tobit model; university food sourcing

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Introduction

Local, organic and non-genetically modified organism (GMO) food products have significantly grown in popularity in recent years. To put the growth into perspective, non-GMO sales topped $550 billion worldwide with 36% of those sales occurring in the United States (Package Facts 2015). With respect to organic food, US food sales were around $35 billion in 2014, which is up about 350% over the last decade (Organic Trade Association 2015). As noted by Schweizer (2015), organic and non-GMO food sales have outpaced overall store sales at Whole Foods by 54%. Even with the growth of non-GMO and organic, local food sales have continually trended upward as well. A recent estimate for local food sales was $12 billion which is considerably higher than the $6.1 billion reported in 2012 (Low et al. 2015; USDA 2015).

Driving increased demand for local, organic, and non-GMO is the positive perceptions of local and organic by many consumers and the negative perception of GMO. Local production is defined by a majority of consumers as decreased miles to transport, while organic production is defined as produced with non-synthetic pesticides (Campbell, Mhlanga, and Lesschaeve 2013; Campbell et al. 2014). Furthermore, local is perceived as helping the local community, better quality, and being sustainable (Darby et al. 2008; Yue and Tong 2009; Onozaka, Nurse, and McFadden 2010; Campbell et al. 2015) with organic being perceived as better for the environment, safer and sustainable (Ritson and Oughton 2007; Essoussi and Zahaf 2008; Campbell et al. 2015). However, consumers often infer incorrect characteristics onto these labels, such as local is produced chemical free or organic is local (Ipsos Reid 2006; Campbell, Mhlanga, and Lesschaeve 2013; Campbell et al. 2014). With respect to GMOs, health concerns are a major reason why many consumers have a negative view of GMOs leading some consumers to seek non-GMO alternatives (Anderson, Wachenheim, and Lesch 2006).

From the initial beginnings of local and organic as meeting niche market demand, there have been efforts to expand foods *perceived* as sustainably produced into institutional settings. Numerous farm-to-institution (FTI) initiatives have emerged with the overarching goal of moving local food into hospitals, universities, and other large institutions (Buckley et al. 2013). For example, the governor of New York (Cuomo) is trying to increase the amount of New York grown products entering state institutions through the *Grown in New York* plan implemented in 2015. This plan includes a $2.5 million in financial incentives for schools to purchase locally grown products (Ritchie 2015). Other initiatives have been introduced such as the University of California-Berkeley's move to organic dining options and Kennesaw State working toward bringing more non-GMO and organic options to their dining halls (Greensfelder 2006; Young 2013).

With respect to universities, there is growing demand for perceived sustainable food options as can be seen by the influx of new purchasing initiatives for local, organic, and non-GMO foods, such as initiatives at Yale, Duke, Emory, and the University of Connecticut, just to name a few. Of particular note, the University of Toronto requires local and sustainable farm products to be used by its corporate caterers (Friedmann 2007). Benefits of these initiatives to universities are a connection to the local community, helping the local economy, and student education (Strohbehn and Gregoire 2005; Ng, Bednar, and Longley 2010). However, numerous barriers have been identified with FTI initiatives. A 2008 meta-analysis of the literature found that infrastructure, financial support for processing, and central distribution are key barriers to FTI retailing (Vogt and Kaiser 2008). Further, as noted by Heiss et al. (2014), infrastructure, relationships, and

pricing are important factors that can constrain FTI programs.With respect to university purchasing, availability, procurement, price, and adequacy are some of the main barriers (Ng, Bednar, and Longley 2010). Furthermore, understanding whether university students want more sustainable foods and are willing to pay for them is not well understood. Considering students are the major group that influences what sustainable practices a university food service implements (Chen, Arendt, and Gregoire 2010), it is essential to understand students views of potentially sustainable foods.

The objective of this study was to determine whether or not students at a large land grant university in the Northeast want more local, organic, and non-GMO food products and how much would they be willing to pay extra for more options. Furthermore, we utilized the willingness to pay (WTP) estimates to construct the amount of "extra" revenue that a university might obtain if charging students at varying WTP rates. Since production costs and extra costs were cited as some of the most important challenges by university foodservice administrators (Ng, Bednar, and Longley 2010), examining how universities might offset extra costs is essential. Based on our results, approximately half of the students surveyed are willing to pay extra for meal plans with more local and organic options. One-third are willing to pay more for non-GMO options. Further, we find that it is not clear whether charging the estimated WTP would be enough to cover the additional costs of providing more local, organic, and non-GMO options. Costs are, of course, not the only reason a university might opt to expand their food selections, but with constricting budgets (Reitz 2015) it is essential to understand how budgets may be impacted. Finally, we examine how student characteristics and on-campus purchasing behaviors impact student WTP.

Materials and Methods

The University of Connecticut was chosen for this study based on their promotion of sustainable food initiatives such as *Local Routes*. The dining services program *Local Routes* works to help educate the University of Connecticut community about the importance of choosing foods that will benefit the local economy, the environment, and New England farmers (University of Connecticut 2015b). Furthermore, the University of Connecticut was ranked in the top 10 of 360 universities worldwide for their "efforts towards sustainability and environmentally friendly university management." (UI GreenMetric 2014). Based on a number of factors (i.e. the University of Connecticut's interest in increasing sustainable food, the state of Connecticut's goal of increasing local food expenditures to 5% of total food expenditures by 2020, and Connecticut being the first state to pass a GMO labeling law (Reilly 2013; University of Connecticut Dining Services 2015a; Connecticut Department of Agriculture 2016)), the University of Connecticut appears to be a prime institution where students may be willing to pay extra on their meal plan for more local, organic, and non-GMO options.

During the fall 2014, an online survey was distributed to every University of Connecticut undergraduate student via the University of Connecticut's daily student email system, *UConn Daily Digest.* Before distributing the survey, it was approved by the university's Institutional Review Board.[1] A total of 288 students completed the online survey. Students participating in the survey were entered into a drawing for a gift card. This represents 1.6% of the total undergraduate population (18,395) at the University of Connecticut's main campus in Storrs,

[1] Informed consent was obtained from all individual participants included in the study.

Connecticut. The survey sample consisted of 20% freshman, 26% sophomores, 26% juniors and 28% seniors (Table 1). Of the 78% of students living on campus, 72% reported having purchased on-campus meal plans. The survey focused on students with meal plans during the fall of 2014 given that students are the primary consumers of on-campus meals. As can be seen in Table 1, the demographics and purchasing behaviors of students without a meal plan are different than sampled students with a meal plan. Notably, students not utilizing a meal plan were more likely to be seniors, living off campus, and consuming less meals on-campus. By examining only meal plan users, recommendations can be enacted for students that would most benefit from a policy change, such as purchasing more local or organic products if desired.

Table 1. Characteristics of the sample by meal plan use.

	All Sample	**Students without a Meal Plan**	**Students with a Meal Plan**
	Mean	Mean	Mean
Class (%)			
Freshman	0.20	0.02	0.27
Sophomore	0.26	0.12	0.32
Junior	0.26	0.16	0.30
Senior	0.28	0.71	0.11
Live on campus (%)	0.78	0.37	0.95
Have a job (full/part-time) (%)	0.63	0.71	0.60
Meals on-campus (%)			
Breakfast	0.46	0.18	0.57
Lunch	0.77	0.67	0.81
Dinner	0.66	0.39	0.78
Morning snack	0.11	0.14	0.09
Afternoon snack	0.27	0.27	0.27
Evening snack	0.16	0.12	0.17
Meal plan (%)			
Ultimate (highest priced)	0.19	0.00	0.29
Value (medium-high priced)	0.29	0.00	0.44
Custom (low-medium priced)	0.12	0.00	0.18
Other (lowest priced – not a traditional plan)	0.06	0.00	0.09
Types of food purchased on-campus per week			
Fruit/vegetable	5.85	3.38	6.84
Red meat	4.24	1.43	5.36
Dairy products	5.49	3.09	6.45
Fish/seafood	3.36	1.33	4.17
Chicken	5.46	2.84	6.50
Grain products	5.60	3.92	6.28
Other products	2.24	1.75	2.44

The survey consisted of questions about student demographics, knowledge of, and WTP for more local, non-GMO, and organic food. WTP was estimated by asking students how much more would they be willing to pay on their current meal plan for more of a particular type of food option (i.e., local, organic, non-GMO, more options in general). Even in cases where parents bear the cost of paying for meal plans, students play a critical role in deciding whether eating on campus is worthwhile and are central to the decision-making process. If some students are not paying for their own meals, then we suspect that the WTP results are most likely overstated due to hypothetical bias. Furthermore, given the nature of the survey was hypothetical; the WTP values are most likely an overestimation of the true premium (Lusk and Schroeder 2004). However, the WTP estimates allow us to put an upper bound on the amount of money the university could expect to extract if they increased meal plan prices at a rate consistent with that desired by students. We also asked in-depth questions about which foods (e.g., fruit, vegetables, meat, etc.) the student would like to see in each category (i.e., local, non-GMO, and organic) and their general food purchasing habits on-campus.

With respect to the WTP question, responding students were asked to indicate on a scale from \$0-\$100 how much they would be willing to pay on top of their current meal plan price for more local, organic, non-GMO, and more options in general. Zero dollars was a natural lower bound as some students may not want to pay any extra for one or more of the options being evaluated. The \$100 upper bound was set to limit the values to a reasonable dollar amount that the university might be willing to consider raising the meal plan price. Approximately 2% of the sample indicated they would be willing to pay \$100 or more. In order to account for censoring within the data the two-limit Tobit model developed by Rossett and Nelson (1975) was utilized. The model can be represented as:

$$(1)\ y^{*}_{i} = \beta' x_i + \varepsilon_i \quad (i = 1, \ldots, n)$$

$$y_i = \begin{cases} 0 & if\ y_i^* \le 0 \\ y_i^* & if\ 0 < y_i^* < 100 \\ 100 & if\ y_i^* \ge 100 \end{cases} \quad (i = 1, \ldots, n)$$

where y_i* is a latent variable that is not observed for values below \$0 and above \$100, x is a matrix of explanatory variables, β is a vector of coefficients, and ε is an independently and normally distributed error term with zero mean and variance σ^2. As noted by Davidson and McKinnon 1993, 541), we can maximize the likelihood function in equation two to obtain coefficient estimates.

$$(2)\ \sum_{y_t^L \le y_t^* \le y_t^U} log\left(\frac{1}{\sigma}\phi\left(\frac{1}{\sigma}\left(y_t - x_t\beta\right)\right)\right) + \sum_{y_t^* < y_t^L} log\left(\phi\left(\frac{1}{\sigma}\left(y_t^L - x_t\beta\right)\right)\right) + \sum_{y_t^* > y_t^U} log\left(\phi\left(-\frac{1}{\sigma}\left(y_t^U - x_t\beta\right)\right)\right)$$

However, the estimated β coefficients are not interpretable as the marginal effect of a unit change in an independent variable (Gould, Saupe, and Klemme 1989). Using an extension of the McDonald and Moffitt decomposition to a two-limit situation we obtain the unconditional and conditional marginal effects as well as the corresponding probabilities of having a positive WTP (McDonald and Moffitt 1980). The unconditional effect of WTP accounts for both students that would not pay \$0 for extra options as well as those willing to pay some positive value, including the few students willing to pay more than \$100. The conditional marginal effects only account

for those students willing to pay some positive value between the bounds (i.e., $0 and $100). The probabilities indicate how likely a student would be to have WTP between the bounds.

Results and Discussion

Viewing WTP on a broad spectrum, we found that approximately half of meal plan participants in the survey were willing to pay more on their meal plan fees for more organic and local options with only 35% willing to pay more for non-GMO options (Table 2). A majority of students (64%) were willing to pay extra for more food options in general. With respect to the average WTP for more organic products, we find that on average a meal plan participant would add $20.69 to their meal plan, while students would pay $17.14 extra for more local options. However, the average WTP for students who noted they would pay extra for more organic and local options (i.e., excluding those with a WTP equal to zero) was $41.74 and $34.57, respectively. Amongst the WTP estimates for organic, local, and non-GMO, more organic options produced the largest premium which could be due to reacting to the perceived higher price of organic products within the marketplace. Of note, the meal plans for a semester range in price from around $2600–$2900 so students would only be willing to add between 1–2% onto their meal plan for organic, local, non-GMO, and more food options.

Table 2. Willingness to pay estimates for more organic, local, non-GMO, and general food options.

	All Students with Meal Plan		**Only Students with Meal Plans Willing to Pay More**		**Percent of Students with a Meal Plan that are WTP More**
Options	Mean	Std. Dev.	Mean	Std. Dev.	Percent
Organic	$20.69	$28.14	$41.74	$26.78	50%
Local	$17.14	$24.28	$34.57	$24.22	50%
Non-GMO	$11.58	$20.80	$33.05	$22.96	35%
More Options	$31.00	$32.80	$47.95	$29.13	64%

The WTP findings evoke interesting questions as to whether there is enough demand for and availability of local, organic, and non-GMO, as well as who should be paying for the increases? From a university perspective charging extra for only those students willing to pay more would be ideal, but this represents only half of meal plan users and would be hard to implement. So the half not charged extra could easily free ride on the payments of those choosing to pay the extra fee. Thereby, if the university is going to increase meal plan prices, charging all meal plan users at the average WTP across all meal plan users is the most viable option. However, this would only generate around $275,000 in additional revenue for the university to purchase more organic food and only $227,000 for more local food options (Table 3). This equates to 1–2% increase in the overall food budget, $17,771,697, in 2014 (University of Connecticut 2015c). Given the potential cost increases associated with sourcing new organic and local options it is not clear whether these projected revenues would cover the additional costs, especially given these additional revenues are most likely at the upper bound of what could be expected due to potentially hypothetical biases from the survey or sample. Compounding the issue would be the ability of the university to add local, organic, non-GMO foods at an economically feasible level. Warner et al. (2012) noted that the state of Connecticut has limited local food production.

Increased demand from the University of Connecticut could potentially drive up prices in the short-term further making the supply of local products more difficult.

Table 3. Potential money that could be raised by charging higher meal plan prices.

	All students pay extra [a]	Only meal plan participants [b]	Only those wanting to pay more [c]
Organic	$380,635	$274,057	$552,840
Local	$315,231	$226,966	$457,845
Non-GMO	$213,036	$153,386	$437,711
More Options	$570,245	$410,576	$635,025

Note. [a] Assuming 18,000 students each paying the average willingness to pay of all meal plan participants. This number is just for comparison as to earn this amount a non-meal plan fee would have to be added to each student.
[b] Assuming 18,000 students with 72% participating in a meal plan.
[c] Assuming 18,000 students with 72% participating in a meal plan and the percentage willing to pay more coming from Table 1.

Assuming the university pursued more options, fruits and vegetables are consistently the most popular food option students would want (Table 4). Using a 5-point likert scale we see that fruits and vegetables score between 4.4–4.6 which corresponds to students wanting to see a lot more of these products. However, other products such as meats, dairy, and grain are 3.5–4 range which corresponds to students wanting no change to a few more options. Based on these findings the university should focus on fruits and vegetables if new food options are added.

Table 4. Types of products preferred by students on a meal plan that would pay more for organic, local, non-GMO, or more food options in general.

Product	Organic	Local	Non-GMO	More Options
Fruit and Vegetables	4.6	4.6	4.4	4.4
Red Meat	3.6	3.7	3.7	3.7
Dairy Products	3.7	3.9	4.1	3.7
Grain Products	3.8	3.7	4.1	3.9
Fish/Seafood	3.5	3.6	3.6	3.5
Chicken	3.8	4.0	4.1	4.0
Other	3.5	3.4	3.3	3.5

Note. [a] Scale is between 1 = a lot less and 5 = a lot more.

Tobit Model Results

The Tobit model results are provided in Table A1 (see Appendix). Given these coefficients are not easily interpretable we do not discuss them in the paper. Further, for brevity we provide, but do not discuss the unconditional marginal effects (Table A2, see Appendix) or probabilities (Table A3, see Appendix). The focus for this paper is on the conditional marginal effects (Table 5).

Table 5. Mean conditional marginal effects of each explanatory variable for organic, local, non-GMO, and more options.

	Organic		Local		Non-GMO		More Options	
Variables [a]	Coef.	P-value	Coef.	P-value	Coef.	P-value	Coef.	P-value
Class								
Sophomore	-$6.52	0.097	$0.88	0.814	$5.68	0.131	-$1.68	0.689
Junior	**-$8.07**	0.069	$1.61	0.694	$2.03	0.614	-$3.00	0.507
Senior	**-$19.06**	0.038	-$7.36	0.294	-$2.06	0.731	-$4.19	0.496
Live on campus	$2.52	0.818	**-$22.45**	0.066	$6.96	0.409	-$0.69	0.951
Have a job (full/part-time)	$2.74	0.406	-$0.30	0.923	-$0.86	0.768	-$2.60	0.432
Meals on-campus								
Breakfast	$1.01	0.776	$3.87	0.252	$4.38	0.168	$2.70	0.443
Lunch	$2.30	0.578	$1.88	0.624	-$2.17	0.549	-$1.75	0.657
Dinner	**$9.12**	0.064	$2.74	0.510	$3.53	0.367	**$8.17**	0.075
Morning snack	-$1.13	0.827	-$9.24	0.121	-$4.33	0.401	$7.15	0.173
Afternoon snack	$1.85	0.597	$2.69	0.435	$3.85	0.214	$1.67	0.657
Evening snack	**$9.47**	0.023	**$9.65**	0.016	$5.41	0.146	$2.19	0.612
Meal plan								
Value	-$2.54	0.471	$2.64	0.438	-$0.89	0.775	**$6.53**	0.079
Custom	-$3.15	0.484	**$9.72**	0.023	-$2.58	0.530	-$2.24	0.635
Other	$14.49	0.136	$4.32	0.701	**$24.08**	0.002	$6.28	0.533
Types of food purchased on-campus per week								
Fruit/vegetable	-$0.75	0.200	**-$1.21**	0.020	-$0.52	0.277	-$0.03	0.952
Red meat	-$0.23	0.473	-$0.25	0.405	-$0.06	0.823	$0.10	0.775
Dairy products	**$0.83**	0.023	**$0.65**	0.057	**$0.69**	0.040	$0.27	0.480
Fish	$0.04	0.903	-$0.43	0.169	-$0.36	0.230	-$0.19	0.553
Chicken	$0.00	0.995	**$0.56**	0.089	$0.02	0.951	$0.44	0.213
Grain products	-$0.42	0.438	-$0.03	0.954	-$0.38	0.411	$0.08	0.880
Other products	$1.08	0.136	-$0.19	0.770	$0.32	0.581	$1.03	0.131
Constant	-$8.68	0.499	$9.53	0.474	**-$17.66**	0.090	-$9.50	0.480

Note. [a] Base categories are: class = freshman, meal plan = Ultimate.
Bolding indicates significance at the 0.1 level or less.

Conditional Marginal Effects

Organic. With respect to the conditional marginal effects, we see that juniors and seniors are willing to pay less than freshman and sophomores for more organic products within on-campus dining halls (Table 5). However, students indicating they eat dinner and evening snacks on-campus are willing to pay around $9 extra on their meal plan for more organic options. Of interest, even though organic fruits and vegetables were at the top of the list of products students wanted more of, compared to other types of food products, students that ate more fruits and vegetables from an on-campus dining hall were not willing to pay more on their meal plans. In

comparison, students that consumed more dairy products were willing to pay $0.83 more per transaction above the mean.

Local. Students living on-campus with a meal plan would pay on average $22.45 less on their meal plan for more local options (Table 5). This may indicate that students on-campus feel there are enough or too many local options currently available and would like a lower meal plan price. With respect to type of meal plan, students participating in the custom plan had a $9.72 higher WTP for more local food products in dining halls compared to students with other meal plans. This may be due to the fact that custom meal plans are generally cheaper than the other traditional meal plans; thereby, giving students room in their budget to pay for more local options. Further, students that eat an evening snack would pay $9.65 more on their meal plan for more options. In contrast to the organic model, students eating major meals, such as dinner, at an on-campus dining hall did not want to pay more for more local options.

Examining the types of foods purchased, students would pay more for dairy and chicken produced locally (Table 5). For instance, students would pay $0.65 and $0.56 more on their meal plan for each time they purchased dairy and chicken per week above the mean at an on-campus dining hall. Given dairy is an important agricultural industry in Connecticut (Lopez, Plesha, and Campbell 2015), creating a linkage to Connecticut based dairies could provide a local source of demand for dairy products. However, students eating more on-campus were willing to pay less (-$1.21) for local fruits and vegetables. This finding may indicate that students feel that local sourcing of fruits and vegetables would be less costly, so there should be a reduction in their meal plan price.

GMO. Considering the media attention that has been devoted to GMO labeling over the past couple of years, the low number of students willing to pay for more non-GMO foods is interesting (Table 2). With respect to the Tobit model conditional marginal effects, we find that students on an "other" type of meal plan (e.g., community plan) would pay $24.08 more for more non-GMO products. The plans making-up the other category are the cheapest plans in initial cost so students may feel they can afford extra to get food they want given the low initial cost or may perceive the current offerings not in-line with their needs. Further, we see that students would be willing to pay $0.69 for each additional dairy product purchased per week from an on-campus dining hall. Noticeably, we again find that even though fruits and vegetables are the types of foods wanted, students eating more fruits and vegetables from on-campus dining per week were not willing to pay more for them.

More Food Options. Overwhelmingly, students want more food options in general as can be seen by the 64% of students that would be willing to pay more (Table 2). Students that would pay extra for more options are students eating dinner and students on a value plan. Value plan participants would pay an extra $6.53 or 0.24% on their plan price. Students eating dinner on-campus would pay an extra $8.17 on their meal plan for more food options.

Implications

This study examined student WTP for various sustainably perceived production/marketing practices at a university that is considered progressive in its sustainability initiatives. Based on

this study's findings there is not a clear consensus that adding more local, organic, or non-GMO options is economically viable. From a sustainability perspective, there seems to be a demand for organic and local options as half of survey respondents with meal plans indicated they wanted more local and organic options. However, realistically the university could expect around $250,000 in additional revenue (as an upper bound) if it charged a higher price that was in-line with our WTP estimates. Considering the size and scope of adding more local and organic options, such as sourcing, transporting, certifying, etc., the economic viability is questionable. As with any enterprise, non-economic motives (e.g., community relationships and perception) must be taken into account; however, from strictly a cost perspective, adding more local, organic, and/or non-GMO options may not be feasible given constrained budgets at the state and university level.

This paper does provide some interesting insights that can be used by other institutions looking at adding more "sustainable" food options. Notably, Connecticut has progressive sustainability initiatives which for institutions that have focused less on these initiatives the economic viability of adding more organic and local options may be more of an issue. Further, how to pay for more food options will be an issue as not all students want to pay more. Should a university raise meal plan prices to placate half their student body? This paper does not attempt to answer the latter question, but rather offers insights into how students at a sustainably minded university value more perceived sustainable food options.

Conclusion

Local, organic and non-GMO food products have grown significantly in popularity during the past decade. As the popularity and positive perceptions of these options have increased, local governments have expanded their efforts to increase the amount and types of these food products for purchase and consumption. Regarding local food, FTI initiatives have emerged, putting local food in the spotlight for many large state institutions. This type of movement is clear in states like Connecticut, where the Governor's Council for Agricultural Development is pushing for increased expenditures on local food products. Given that the University of Connecticut's dining services is the state's largest local produce consumer (University of Connecticut 2016a), initiatives that increase consumption on campus could be important for the state. However, with the potential higher costs of local foods, it's essential to understand if those impacted by these types of policies actually value the products.

Key findings from the population of students sampled at the University of Connecticut include:

- WTP for more organic food options decreased as class standing (freshman to senior) went up
- Students who ate dairy products have a higher WTP for organic, local and non-GMO options
- Students who eat on-campus more often had a higher WTP for more food options
- Approximately half of the meal plan participants would pay more for organic and local foods, while only about one-third would pay more for more non-GMO foods

Furthermore, the economic viability of adding more organic, local, and non-GMO options needs to be further examined to determine if making these investments are viable from a cost perspective. Future research should examine how students at other institutions with varying levels of sustainability initiatives would respond to increasing organic, local, and non-GMO food options.

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Appendix

Table A1. Tobit regression results for organic, local, non-GMO, and more options.

	Organic		Local		Non-GMO		More Options	
Variables [a]	Coef.	P-value	Coef.	P-value	Coef.	P-value	Coef.	P-value
Class								
Sophomore	**-$25.55**	0.090	$2.84	0.815	$21.76	0.151	-$6.10	0.689
Junior	**-$32.12**	0.059	$5.12	0.698	$7.97	0.621	-$10.93	0.505
Senior	**-$101.50**	0.005	-$27.27	0.231	-$8.57	0.721	-$15.55	0.486
Live on campus	$9.88	0.812	-$56.74	0.154	$33.06	0.329	-$2.47	0.951
Have a job (full/part-time)	$10.47	0.404	-$0.98	0.923	-$3.44	0.770	-$9.36	0.435
Meals on-campus								
Breakfast	$3.83	0.776	$12.64	0.249	$17.77	0.165	$9.80	0.443
Lunch	$8.91	0.572	$6.20	0.617	-$8.42	0.562	-$6.27	0.66
Dinner	**$37.84**	0.046	$9.15	0.497	$14.85	0.345	**$30.78**	0.067
Morning snack	-$4.36	0.825	**-$35.93**	0.065	-$18.97	0.360	$25.06	0.189
Afternoon snack	$6.94	0.602	$8.47	0.448	$14.80	0.235	$5.99	0.659
Evening snack	**$33.38**	0.038	**$27.92**	0.033	$20.04	0.181	$7.85	0.616
Meal plan								
Value	-$9.67	0.471	$8.47	0.443	-$3.58	0.775	**$23.51**	0.083
Custom	-$12.32	0.472	**$28.18**	0.044	-$10.73	0.514	-$8.16	0.633
Other	$48.72	0.189	$13.03	0.720	**$72.26**	0.024	$22.06	0.546
Types of food purchased on-campus per week								
Fruit/vegetable	-$2.83	0.203	**-$3.91**	0.023	-$2.09	0.280	-$0.12	0.952
Red meat	-$0.89	0.474	-$0.82	0.407	-$0.26	0.824	$0.35	0.776
Dairy products	**$3.15**	0.025	**$2.11**	0.060	**$2.74**	0.043	$0.97	0.482
Fish/seafood	$0.15	0.903	-$1.40	0.172	-$1.42	0.233	-$0.69	0.555
Chicken	-$0.01	0.995	**$1.79**	0.092	$0.07	0.952	$1.60	0.216
Grain products	-$1.59	0.439	-$0.09	0.954	-$1.51	0.413	$0.30	0.880
Other products	$4.09	0.140	-$0.63	0.770	$1.29	0.583	$3.71	0.134
Constant	-$32.89	0.501	$30.72	0.475	**-$70.58**	0.093	-$34.31	0.482
Log likelihood	-305.87		-298.88		-239.33		-376.43	
Pseudo R2	6%		6%		5%		3%	
Lower Censored	52%		54%		66%		38%	
Upper Censored	4%		2%		0%		7%	

Note. [a] Base categories are: class = freshman, meal plan = Ultimate.
Bolding indicates significance at the 0.1 level or less.

Table A2. Mean unconditional marginal effects of each explanatory variable for organic, local, non-GMO, and more options.

	Organic		**Local**		**Non-GMO**		**More Options**	
Variables [a]	Coef.	P-value	Coef.	P-value	Coef.	P-value	Coef.	P-value
Class								
Sophomore	-$10.49	0.112	$1.30	0.813	$7.65	0.111	-$3.59	0.691
Junior	**-$12.73**	0.088	$2.37	0.691	$2.65	0.606	-$6.35	0.512
Senior	-$20.60	0.183	-$9.46	0.355	-$2.49	0.744	-$8.66	0.511
Live on campus	$4.04	0.826	**-$37.70**	0.035	$7.00	0.515	-$1.48	0.951
Have a job (full/part time)	$4.54	0.412	-$0.44	0.923	-$1.11	0.767	-$5.61	0.429
Meals on-campus								
Breakfast	$1.69	0.777	$5.59	0.257	$5.48	0.176	$5.77	0.445
Lunch	$3.76	0.589	$2.69	0.631	-$2.88	0.534	-$3.78	0.654
Dinner	$13.58	0.101	$3.89	0.522	$4.21	0.399	**$16.52**	0.093
Morning snack	-$1.87	0.830	-$11.31	0.193	-$4.89	0.457	$15.97	0.155
Afternoon snack	$3.16	0.591	$4.00	0.427	$5.16	0.192	$3.60	0.655
Evening snack	**$17.51**	0.013	**$15.17**	0.009	$7.57	0.110	$4.76	0.607
Meal plan								
Value	-$4.24	0.474	$3.88	0.436	-$1.13	0.776	**$14.05**	0.077
Custom	-$5.08	0.502	**$15.26**	0.015	-$3.12	0.551	-$4.72	0.640
Other	**$28.31**	0.083	$6.61	0.687	**$40.91**	0.000	$13.99	0.517
Types of food purchased on-campus per week								
Fruit/vegetable	-$1.26	0.200	**-$1.77**	0.020	-$0.67	0.277		0.952
Red meat	-$0.39	0.473	-$0.37	0.405	-$0.08	0.823		0.775
Dairy products	**$1.39**	0.023	**$0.95**	0.057	**$0.88**	0.040		0.480
Fish	$0.07	0.903	-$0.63	0.169	-$0.45	0.230		0.553
Chicken	$0.00	0.995	**$0.81**	0.089	$0.02	0.951		0.213
Grain products	-$0.70	0.438	-$0.04	0.954	-$0.48	0.411		0.880
Other products	$1.82	0.136	-$0.28	0.770	$0.41	0.581		0.131
Constant	-$14.59	0.499	$13.89	0.474	**-$22.52**	0.090		0.480

Note. [a] Base categories are: class = freshman, meal plan = Ultimate.
Bolding indicates significance at the 0.1 level or less.

Table A3. Mean probability change associated with not being censored for each explanatory variable by organic, local, non-GMO, and more options.

	Organic		Local		Non-GMO		More Options	
Variables [a]	Coef.	P-value	Coef.	P-value	Coef.	P-value	Coef.	P-value
Class								
Sophomore	**-0.198**	0.092	0.029	0.815	0.191	0.139	-0.034	0.682
Junior	**-0.246**	0.064	0.052	0.697	0.069	0.616	-0.062	0.485
Senior	**-0.505**	0.066	-0.257	0.266	-0.071	0.731	-0.095	0.434
Live on campus	0.078	0.812	-0.396	0.327	0.226	0.435	-0.013	0.952
Have a job (full/part-time)	0.082	0.402	-0.010	0.923	-0.030	0.768	-0.050	0.446
Meals on-campus								
Breakfast	0.030	0.776	0.129	0.250	0.149	0.171	0.054	0.435
Lunch	0.070	0.570	0.063	0.618	-0.074	0.552	-0.033	0.674
Dinner	**0.282**	0.055	0.093	0.500	0.121	0.369	**0.191**	0.034
Morning snack	-0.034	0.824	-0.322	0.102	-0.147	0.407	0.098	0.342
Afternoon snack	0.054	0.603	0.087	0.447	0.130	0.221	0.032	0.669
Evening snack	**0.240**	0.054	**0.272**	0.040	0.180	0.159	0.040	0.637
Meal plan	-0.076	0.470	0.087	0.442	-0.031	0.775	**0.122**	0.095
Value								
Custom	-0.097	0.472	**0.274**	0.053	-0.088	0.530	-0.047	0.613
Other	0.295	0.309	0.132	0.722	**0.508**	0.059	0.090	0.649
Types of food purchased on-campus per week								
Fruit/vegetable	0.022	0.200	**0.040**	0.020	0.018	0.277	0.001	0.952
Red meat	0.007	0.473	0.008	0.405	0.002	0.823	-0.002	0.775
Dairy products	**-0.025**	0.023	**-0.022**	0.057	**-0.024**	0.040	-0.005	0.480
Fish	-0.001	0.903	0.014	0.169	0.012	0.230	0.004	0.553
Chicken	0.000	0.995	**-0.018**	0.089	-0.001	0.951	-0.009	0.213
Grain products	0.013	0.438	0.001	0.954	0.013	0.411	-0.002	0.880
Other products	-0.032	0.136	0.006	0.770	-0.011	0.581	-0.020	0.131
Constant	0.259	0.499	-0.315	0.474	**0.606**	0.090	0.187	0.480

Note. [a] Base categories are: class = freshman, meal plan = Ultimate.
Bolding indicates significance at the 0.1 level or less.

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Market Barriers Faced by Formal and Informal Vendors of African Leafy Vegetables in Western Kenya

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Abstract

This research investigated market barriers faced by formal and informal vendors of traditional vegetables in Kenya, with the goal of closing market gaps and improving consumer access. The most common problem was access to capital, but informal vendors were more likely than formal vendors to perceive this as a major problem. Overall, 97% of vendors said that they had seen the vegetable market grow, which suggests that this market is still expanding. To improve urban nutritional security, the most important changes policymakers could enact are to increase access to capital and improve infrastructure to connect rural growers with urban consumers.

Keywords: market barriers, African leafy vegetables, formal markets, Western Kenya, nutritional security

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Introduction

Sub-Saharan Africa is home to the greatest concentration of food insecure people, where one quarter of the population is chronically hungry (FAO 2014). Malnutrition is even more common, as many people lack the essential vitamins and minerals needed to grow and lead healthy lives. This 'hidden hunger' can lead to stunting and blindness, impacting an estimated two billion people worldwide (WHO and FAO 2006). However, the fruits and vegetables that contain these critical micronutrients are often expensive and unattainable for the poor (Smith and Longvah 2008). Western Kenya is a prime example of the interconnected and complex issues of poverty, malnutrition, and low agricultural productivity (Conelly and Chaiken 2000) which has created many food insecure communities.

African Leafy Vegetables (ALVs) offer an innovative and locally appropriate way to address many of the food security challenges that face western Kenya. ALVs are a diverse set of vegetables that are consumed across Kenya as a mainstay of traditional diets (Muhanji et al. 2011). In many cases, however, introduced vegetables such as cabbage have received greater research investment into understanding barriers to production and marketing, compared to traditional vegetables (Adeka, Maundu and Imbumi 2009). ALVs are a nutritious and affordable source of micronutrients, providing vitamins A, B, and C, as well as minerals like calcium, iron, and zinc (Uusiku et al. 2010). They are adapted to the climate of western Kenya and are especially important to female smallholder farmers as they provide an important income-generating opportunity (Weinberger et al. 2011). In recent years the demand for ALVs, especially in urban centers, has outstripped the supply (Mwangi and Kimathi 2006) which creates new challenges and opportunities for urban vegetable vendors.

The formal market sector for fresh vegetables has been rapidly growing in recent years. Although well over 90% of consumers still purchase fresh vegetables from informal open air markets, the supermarket sector has been growing at 18% annually since 1995 (Neven et al. 2009). Participation in supermarket channels has significant financial implications for smallholder farmers. Growers participating in formal markets such as supermarkets increased their household income by 48% (Rao and Qaim 2011), as these growers receive 57% of the retail price as opposed to receiving 17% in informal market channels (Neven et al. 2009). Growers for supermarkets tend to own more land, have better access to transportation, and have off-farm income available as well (Rao and Qaim 2013). In addition, they were likely to hire more labor, and generally more female labor, although female workers were paid slightly less on average (Rao and Qaim 2013). There is still a much greater demand for ALVs in the informal urban market, but changing supply chains will impact both formal and informal vendors. Whether growers are producing for formal or informal markets, the growing demand in urban centers means that retailers and growers must seek new ways of ensuring that their products reach consumers.

Previous research has indicated that access to capital, inputs, and transportation have been major barriers to Kenyan smallholder farmers participating in formal markets (Neven et al. 2009). Less research has focused on the role of the vendor, but the informal relationship between the vendor and grower is critical to maintaining this supply chain (Bett, Ismail and Kavoi 2013). The barriers that prevent vendors from accessing ALVs or expanding their businesses are also

reducing ALV availability and accessibility for consumers. In areas where nutritional security is a widespread challenge, improving market supply chains has the potential to benefit growers, retailers and urban residents. Closing market gaps and modifying local policy has the potential to generate income for smallholder ALV growers and address unmet demand in cities across western Kenya.

The goal of this research was to understand the market barriers that both formal and informal ALV vendors face in the city of Eldoret, Kenya, which is Kenya's fifth largest city and a trading hub in western Kenya (with a population of 289,380) (Kenya National Bureau of Statistics 2009). Ultimately, improved nutritional security through ALVs can only be achieved when consumers and growers are better connected. Vendors provide this critical link, and the obstacles they encounter as intermediaries between growers and consumers should be reduced. This research will examine the prevalence of market barriers for formal and informal ALV vendors, as well as the differences between these two groups, with the goal of proposing solutions through policy recommendations.

Methods

Survey Design and Sample

The data presented here are based on surveys collected in the city of Eldoret, in Uasin Gishu County, Kenya. Surveys were collected between June and November 2015 from vendors who sold at least one variety of ALV. Eldoret was chosen based on its intermediate size and stage of supermarket expansion as the documented by Neven and Reardon (2004). Eldoret currently has a large array of national and independent supermarkets offering fresh produce, while still maintaining a variety of open air markets.

Vendors who indicated they were willing to be surveyed were included in the sample and were stratified between formal and informal vendors. Informal vendors were randomly sampled using a random number generator and were interviewed in person at the markets where they sell vegetables. Supermarket vendors were interviewed at their workplace and were oversampled to obtain adequate data, since the number of supermarkets is still small. Vendors were surveyed on their ALV purchasing and sales behavior, postharvest handling, seasonal variation, and perceptions of market barriers using a structured questionnaire. Market barriers included infrastructure (specifically roads), municipal regulations, seasonal availability, price fluctuation, quality of produce, access to capital, consumer demand, and consumer perceptions of ALVs. Demographic information on vendor age, gender, income, and primary occupation was also collected. The surveys were validated through pre-testing.

In total, 158 informal vendors were surveyed and twelve formal vendors were surveyed, for a total of 170 vendors. Most vendors sold more than just ALVs, but were included if they sold at least one variety of ALV. Only supermarkets that had produce sections were included, and surveys were conducted at all of these locations. At larger supermarkets the produce manager was surveyed, and in smaller supermarkets the store owner was surveyed. Among informal vendors, there were multiple family members present at some informal market stalls, but usually only one adult was present. Thus, whoever self-identified as the proprietor was surveyed.

Informal market vendors were more likely to source directly from a variety of local farmers, while some of the major supermarkets sourced all of their produce from a single company in Nairobi, Kenya, approximately eight hours away by road. The biggest supermarket chains, Nakumatt and Tusky's, are both Kenyan-owned and each had two retail outlets in Eldoret with slightly different selections of fruits and vegetables. The majority of supermarkets sourced vegetables from closer farms, especially independently-owned grocery stores which had a single retail location and were generally family-owned.

Data Analysis

Data were analyzed for differences between informal and formal vendors for both market characteristics and perceptions of market barriers. Where appropriate, differences in the responses from formal and informal vendors were analyzed for significance at each level of barrier perception (not a problem, a small problem, or a big problem). Additionally, distance travelled in minutes to reach the market was modeled for both informal and formal vendors.

To evaluate differences between formal and informal markets, variables were divided into categorical and continuous variables. Continuous variables (age, income, species richness, distance travelled, bundle prices, and volumes sold) were subject to the non-parametric Mann-Whitney-Wilcoxon Sign Rank test, while categorical variables (all others) were analyzed by the Chi-Square Test of Independence. Differences in the perception of market barriers by formal and informal vendors were analyzed with a Fisher's Exact Test due to small sample size of formal vendors. This test calculates an exact p value and does not assume equal sample sizes between the two groups (formal and informal vendors), making it possible to make comparisons between them. Where perceived market barriers had significantly different distributions by market type, post-hoc tests were carried out by Chi-Square Test of Independence with 2,000 Monte Carlo simulated p values.

Distance travelled by produce impacts both product quality and cost to vendors, so the distance produce traveled in minutes was analyzed using OLS regression to determine which vendor characteristics explain distance travelled. In this case, our model was specified as:

$$(1)\quad y_i = \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_K x_{iK} + \varepsilon_i, i = 1, \ldots, n$$

where *y* is the dependent variable, distance (in minutes) travelled by produce, $x_1, \ldots, x_K$ are the explanatory variables, and *i* represents the *n* sample observations. The error term, ε_i, is assumed to follow a normal distribution and the coefficients, $\beta_1, .., \beta_K$, are parameters to be estimated (Greene 1991).

Variables included in the empirical specification of the model were: market type, gender, transporting agent (either farmer or vendor), postharvest handling method, transportation method, volume sold, presence of other primary income source(s), degree of problems encountered with infrastructure, and capital. It was hypothesized that formal markets might source their vegetables from farther away, given the larger volumes they require. When vendors transport produce themselves, rather than the farmers, they may be willing to travel farther. Among the informal vendors surveyed, no brokers or middlemen were used to transport produce.

Some supermarkets did have a third-party company that was responsible for providing and delivering fresh produce, but this was not common. It was hypothesized that when postharvest measures were taken, the distance traveled could be increased without reducing quality. The vendors who sell greater volumes, or who rely on selling vegetables as their primary source of income, may travel greater distances. Vendors who have greater problems with infrastructure and access to capital may be less likely to travel longer distances, and vendors with access to a private vehicle were hypothesized to travel farther than those on foot, using public transportation, motorcycles, or other means of transportation. Since the most common form of transportation was public transport (thirteen-passenger vans or *matatus* in Kenya), this was used as the reference variable for all other forms of transport. All analyses were carried out in R 3.1.2 (R Core Team 2015; Nakazawa 2015).

Results

Table 1 shows descriptive statistics for the sample, while Table 2 shows differences between formal and informal markets. Informal market vendors represent the majority of vendors, as well as the majority of the sample. Informal vendors were significantly more likely to be women than formal market vendors. Distance traveled was not significantly different between groups, although the average time taken for produce to reach the market through formal vendors was almost twice that of vendors in informal markets. Although only 32.5% of vendors sell to more than one market, these vendors were more likely to sell through formal markets. The most common form of transportation was public transportation (*matatus*), and this was more widespread among informal vendors. Private vehicles, on the other hand, were almost exclusively used by supermarkets. In general, the vendor was responsible for transporting the vegetables, although supermarkets often had third-party companies that provided produce and absorbed the cost of transportation.

Vendors purchase vegetables by the sack (used for measuring 50 kg of maize) and then re-bundle produce into 200–500 gram bunches that vary in size according to the season and price. Even though informal vendors were selling more produce than their formal counterparts, their gross incomes in both rainy and dry seasons were on average less than half of the formal retailers (shown in Kenyan Shillings, or KSH). This discrepancy may be attributed to the lower prices informal vendors charged for their bundles, as well as their treatment of unsold produce at the end of the day. Although most informal vendors (71.4%) resold the same produce the next day, 17.5% gave away their leftover produce, fed it to animals, or ate it themselves. Formal vendors were more likely to have arrangements with vendors to come and purchase back any unsold produce at the end of the day, which would help formal vendors mitigate any losses. No informal vendors had such arrangements.

The vast majority of vendors (97.0%) considered the market for ALVs to be growing. Surprisingly, formal vendors were not as optimistic, and 25% thought the market was either declining or showing no change. Formal vendors were significantly younger than informal vendors, but only half of each group considered vegetable sales to be their primary source of income. Formal markets offered more exotic vegetable species such as cabbage and collard greens, but there were no differences in the number of traditional species or total species.

Table 1. Descriptive Statistics of Variables for ALV Vendors.

Variable	Definition	Mean	SD
Vendor Characteristics			
Market type	=0 if a supermarket vendor, 1 otherwise	0.93	0.26
Gender	=0 if male, 1 if female	0.77	0.43
Age	Age of the vendor (years)	36.92	7.56
Income rainy	Average income per week from ALVs in the rainy season (KSH)	2775.63	3058.83
Income dry	Average income per week from ALVs in the dry season (KSH)	5625.96	6086.03
Primary income	=1 if selling produce is the primary source of income for the vendor, 0 otherwise	0.52	0.50
Traditional species	Number of traditional species sold	3.92	0.95
Exotic species	Number of exotic species sold	1.93	0.92
Total species	Total number of vegetable species sold	5.85	1.36
Transportation			
Distance	Distance traveled for vegetables to reach the market, in minutes	91.46	77.94
Other markets	=1 if a vendor sells ALVs at other markets as well, 0 otherwise	0.33	0.57
Matatu	=1 if produce is transported by public transportation, 0 otherwise	0.57	0.50
Motorcycle	=1 if produce is transported by motorcycle, 0 otherwise	0.24	0.43
Walk	=1 if produce is transported by foot, 0 other	0.04	0.19
Private vehicle	=1 if produce is transported by private vehicle, 0 otherwise	0.11	0.31
Other transport	=1 if produce is transported by other methods, 0 otherwise	0.04	0.20
Who transports	=0 if the vendor transports, 1 if the farmer	0.20	0.43
Who pays transport	=0 if the vendor pays, 1 if the farmer	0.05	0.25
Market Practices			
Volume sold	Number of sacks of produce sold per week	6.32	4.17
Price rainy	Price per bundle in the rainy season (KSH)	11.88	3.87
Pay rainy	Price paid to supplier per sack in the rainy season (KSH)	860.46	466.42
Postharvest	=1 if any postharvest measures are taken to maintain vegetable freshness, 0 otherwise	0.90	0.22
Resold	=1 if the produce left over at the end of the day is resold the next day, 0 otherwise	0.67	0.47
Market trend	=0 if the vendor has seen the market for ALVs grow in recent years, 1 if it has stayed the same or shrunk	0.03	0.17
Market Barriers			
Infrastructure	=0 if poor infrastructure is not a barrier to the vendor's market, 1 if a small problem, and 2 if a large problem	0.74	0.82
Municipal	=0 if municipal regulations are not a barrier to the vendor's market, 1ifa small problem, and 2 if a large problem	0.39	0.64
Season	=0 if seasonal fluctuations are not a barrier to the vendor's market, 1 if a small problem, and 2 if a large problem	0.94	0.67
Price	=0 if price fluctuations are not a barrier to the vendor's market, 1 if a small problem, and 2 if a large problem	0.79	0.75
Quality	=0 if poor quality is not a barrier to the vendor's market, 1 if a small problem, and 2 if a large problem	0.59	0.72
Capital	=0 if access to capital is not a barrier to the vendor's market, 1 if a small problem, and 2 if a large problem	1.48	0.73
Demand	=0 if consumer demand is a barrier to the vendor's market, 1 if a small problem, and 2 if a large problem	0.63	0.70
Perception	=0 if consumer perceptions are not a barrier to the vendor's market, if a small problem, and 2 if a large problem	0.42	0.67

Note. All monetary values shown in Kenyan Shillings 100 KSH = 0.99 USD.

Table 2. Characteristics of Formal and Informal ALV Vendors.

	Formal Market		Informal Market		
	Mean	*SD*	*Mean*	*SD*	*P value*
Vendor Characteristics					
Gender	0.17	0.39	0.81	0.39	0.00***
Age	26.75	5.80	37.87	7.00	0.000***
Income rainy (KSH)	7104.17	8522.63	2419.86	1715.36	0.08*
Income dry (KSH)	14977.27	16807.52	4916.55	3614.54	0.08*
Primary income	0.56	0.53	0.52	0.50	1.00
Traditional species	3.42	1.24	3.96	0.91	0.16
Exotic species	2.75	0.45	1.87	0.91	0.00***
Total species	6.17	1.47	5.83	1.35	0.59
Transportation					
Distance (min)	161.67	197.80	85.95	57.48	0.22
Other markets	0.75	1.06	0.29	0.51	0.17
Matatu	0.17	0.39	0.60	0.49	0.005***
Motorcycle	0.17	0.39	0.25	0.43	0.74
Walk	0.00	0.00	0.04	0.19	1.00
Private vehicle	0.58	0.52	0.07	0.26	0.001****
Other transport	0.08	0.29	0.04	0.19	1.00
Who transports	0.50	0.67	0.17	0.40	0.02**
Who pays transport	0.42	0.67	0.03	0.16	0.001***
Market Practices					
Volume sold	2.25	0.83	6.47	4.17	0.007***
Price rainy (KSH)	18.92	4.42	11.34	3.27	0.00***
Pay rainy (KSH)	400.00	282.84	866.51	465.89	0.25
Postharvest	1.00	0.00	0.94	0.24	1.00
Resold	0.08	0.29	0.71	0.45	0.001****
Market trend	0.25	0.45	0.01	0.11	0.003***
Market Barriers					
Infrastructure	0.83	0.84	0.73	0.83	0.74
Municipal	0.08	0.29	0.42	0.65	0.31
Season	1.17	0.94	0.93	0.64	0.004***
Price	0.67	0.78	0.80	0.75	0.93
Quality	1.00	1.00	0.56	0.69	0.01***
Capital	0.46	0.82	1.55	0.67	0.001***
Demand	0.33	0.65	0.65	0.70	0.19
Perception	0.83	0.94	0.38	0.64	0.03**

Note. Significant differences denoted by asterisks * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$. All monetary values shown in Kenyan Shillings 100 KSH = 0.99 USD.

Perceptions about market barriers differed between formal and informal market vendors, although infrastructure and price variability were cited by both (Tables 2 and 3). Consumer perception was more often cited as a problem by formal market vendors, with some noting public unease about genetically modified vegetables (even though these are not available for ALVs). Seasonal variability was a problem for both informal and formal vendors, but more likely to be a small problem for informal vendors and a large problem for formal vendors. Poor quality produce was a much greater problem for formal vendors, while access to capital was a much smaller problem. For informal vendors, capital was cited as a large problem 64.7% of the time (Table 3). Overall, municipal regulations and consumer demand were not cited as problems by the majority of vendors, either formal or informal.

Table 3. Vendor Rating of Barriers to ALV Markets.

Market Barrier	Market Type	Not a problem	Small problem	Big problem
Infrastructure	Formal	0.42	0.33	0.25
	Informal	0.51	0.25	0.24
Municipal	Formal	0.92	0.08	0.00
	Informal	0.68	0.23	0.09
Season	Formal	0.33	0.17	0.50*
	Informal	0.25	0.59*	0.17
Price	Formal	0.50	0.33	0.17
	Informal	0.40	0.40	0.20
Quality	Formal	0.46	0.09	0.46*
	Informal	0.55	0.34	0.11
Capital	Formal	0.73*	0.09	0.18
	Informal	0.10	0.26	0.65*
Demand	Formal	0.75	0.17	0.08
	Informal	0.48	0.39	0.13
Perception	Formal	0.50	0.17	0.33
	Informal	0.70	0.21	0.08

Note. Asterisks indicate that the proportion was significantly higher than the other market type, at $p < 0.05$.

Distance travelled to reach the market may impact the quality of vegetables and cost to consumers, so time in minutes required to reach the market was modeled in Table 4. Market type significantly impacted distance, with formal vendors travelling 196 minutes more than informal market vendors. When produce was transported by the grower, it traveled thirty-seven minutes less than when the vendor was responsible for transportation. When vendors used private vehicles, transportation time increased by sixty minutes compared to using public transportation. Greater time spent in transportation was associated with increased perception of infrastructure as a limiting factor. The distance was not significantly impacted by the volume of vegetables sold or whether selling vegetable was the vendor's primary occupation, as these coefficients were not significant in the model (Table 4).

Table 4. Model of distance travelled in minutes for produce to reach market. Transportation method as compared to public transportation (Matatu).

	Estimate	Standard Error	t Value	p Value
Intercept	229.09	42.98	5.33	0.00***
Market type	-197.63	47.61	-4.15	0.00***
Gender	14.37	20.26	0.71	0.48
Primary income	7.01	13.07	0.54	0.59
Motorcycle	26.19	16.03	1.63	0.11
Walk	-2.37	29.13	-0.08	0.94
Private vehicle	59.95	28.32	2.12	0.04**
Other transport	46.26	31.87	1.45	0.15
Who transports	-36.93	20.48	-1.80	0.07*
Volume sold	1.43	1.46	0.98	0.33
Postharvest	6.49	22.51	0.29	0.77
Infrastructure	13.80	7.88	1.75	0.08*
Capital	10.05	9.65	1.04	0.30

Note. N = 131, AIC = 1476.9. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Discussion

The expansion of the formal market in Kenya, which is similar to other developing countries, may pose a risk to the informal market and the people who depend on it for their livelihoods. Although informal markets continue to hold the majority of ALV sales, the proportion of sales in the formal market has been increasing (Neven and Reardon 2004). This shift in balance is likely to open up opportunities in some sectors while closing others (Rao, Brummer and Qaim 2012; Rao and Qaim 2011; Rao and Qaim 2013) but each actor may not be able to adapt equally to the market environment. Rao and Qaim (2013) have suggested that farmers participating in supermarket channels are more likely to hire more female labor, although women are usually paid less than men for agricultural labor. Farmers participating in supermarket supply chains were also shown to be overwhelmingly male (Rao and Qaim 2011), and our data have confirmed that formal market vendors are much more likely to be male as well (Table 2). It is still not clear how formal market expansion into a traditionally female-controlled crop (Weinberger et al. 2011) will affect male and female stakeholders. In a similar case in which power over horticultural crops transitioned from primarily female to male hands, this change led to sometimes violent struggles over household resources, as well as increased accusations of witchcraft in a Kenyan agricultural community (Dolan 2001). The social costs paid by communities undergoing this transition are likely to accrue unequally to actors across the value chain.

Our data reveal a vibrant informal community that still persists in Eldoret, Kenya. Despite rapidly expanding supermarkets, the vast majority of ALVs are still traded informally. Informal markets may have advantages over formal markets in areas where vendors perceive market barriers differently. The shorter distance produce travels to reach informal markets may lead to improved quality, which is a characteristic that local consumers value and for which they are willing to pay premia (Chelang'a, Obare and Kimenju 2013; Croft, Marshall and Weller 2014). Informal market vendors may be at a disadvantage when accessing credit is necessary, as formal markets have much greater resources. Informal markets have fewer problems with seasonality so they can attract customers looking for a stable year-round supply and lower prices (Tables 2 and 3). This trend may be due to the fact that supermarkets depend on larger farmers to meet their greater volumes or quality standards (Rao and Qaim 2011), which may in turn limit the number of farmers who can supply supermarkets. This smaller base of farmers may make supermarkets more sensitive to seasonal fluctuations. On the other hand, informal vendors may have a much great number of farmers from whom they can source, which can help them adapt to seasonal fluctuations in supply and keep their prices low. However, supermarkets may be able to target customers who value the convenience of completing all their shopping in one location and are willing to pay a premium for that convenience. These customers are still the minority in Eldoret, Kenya, and may be influencing the responses of formal vendors (25%) who did not see the ALV market as expanding.

Although the informal market still holds more than 90% of the fresh fruit and vegetable market (Neven et al. 2009), its future is not certain. Informal markets provide income for hundreds of informal vendors and easy access to nutritious vegetables for consumers in urban centers across Kenya. In order to support informal vegetable vendors, policymakers should improve access to credit for these small-scale businesses through private banks, government-subsidized loans, or

microcredit. Providing training on business skills may also help informal vendors, who sell more produce than formal markets but still make less in gross income. Improving infrastructure that connects urban and rural areas would benefit both formal and informal vendors, who may be able to maintain higher vegetable quality by cutting transport time and connecting more areas to urban markets. This may also address the seasonal unavailability of ALVs experienced primarily by formal vendors. Improved infrastructure could connect formal supply chains to a diversity of growers and increase the stability of the ALV supply in urban areas. More research needs to be conducted to better understand how women may be impacted by the changing balance between the formal and informal markets.

Conclusion

Despite the expanding formal market, informal vendors in open air markets still dominate the ALV market in Eldoret, Kenya, selling at both greater volume and lower price. In spite of their current position, there are threats to the sustainability of these businesses since their gross incomes from vegetable sales are less than half of the formal markets in both rainy and dry seasons (Table 2). Supermarkets face challenges establishing their vegetable market due to seasonal supply issues and low quality of vegetables, likely due to the increased length of time the vegetables spend en route to market. If they were able to source vegetables from a diverse set of local growers as do the informal market vendors, this could improve both the quality and stability of the vegetable supply in formal markets. Unlike the formal markets, however, informal markets are dominated by women and they face consistent problems accessing credit. Improving the ability for these small businesses to borrow money would help them grow their businesses and potentially invest more in postharvest handling to reduce produce losses from day to day. Since these businesses represent the vast majority of the market, reducing the market barriers they face could strengthen the supply chain and have a positive impact on both ALV growers and consumers. Investing in infrastructure could also help reduce transport times and link growers to markets, both formal and informal. Although many challenges still face the ALV supply chain, addressing market gaps and reducing barriers can improve access and availability of nutritious ALVs in western Kenya.

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Farm Impacts of Farm-to-Grocer Sales: The Case of Hawai'i

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Abstract

There are scant studies that examine farm-retailer dynamics, despite growing interest in local food markets and the fact that most local food is sold to intermediaries (like retailers). To address this gap we conducted a case study in Hawai'i, the state with the highest percentage of farms selling direct to retail in the United States. Results show a statistically significant relationship between the number of farms from which a grocery store purchases product and the grocery store's average markup for food products, rather than with the store's gross sales as one might expect.

Keywords: food retail, local food, Good Agricultural Practices (GAP), market channel, profitability, Hawai'i, direct-to-retail

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Introduction

Federal support for local and regional food systems has grown tremendously under the Obama Administration. Though these initiatives are purported to support a variety of positive economic, environmental, social, and health outcomes, much of the language from the White House Rural Council and the USDA justifying these expenditures focuses on their potential for economic development and enhanced farm viability (McKalip 2014; USDA 2013). Strong local food systems, for example, are one of USDA Secretary Vilsack's four pillars to revitalize rural economies (USDA 2014).

Despite the increased interest in supporting these initiatives, there have been few empirically-driven analyses of the effectiveness of local food systems as a strategy to support local economic development or economic growth (Brown et al. 2013; Gunter and Thilmany 2012; Henneberry et al. 2009; Hughes et al. 2008; Jablonski et al. 2016; Mansury and Hara 2007; Sadler et al. 2013; Schmit et al. 2016), and even fewer that assess farm-level impacts by market channel (Ahern and Sterns 2013; Brown et al. 2006; Detre et al. 2011; Feenstra et al. 2003; Hardesty and Leff 2010; LeRoux et al. 2010; Park et al. 2014; Shilling et al. 2014). Of the studies that assess the farm-level impacts by local food market channels, all but two (Park et al. 2014; Silva et al. 2014) focus on the impact of direct-to-consumer sales. Yet, there is clear evidence that most local food is sold to an intermediary business (e.g., aggregator, distributor, wholesaler, retailer) rather than direct-to-consumer (Low et al. 2015; Low and Vogel 2011).

Given that customers purchase the vast majority of their food-at-home from grocery stores (retail food and nonfood sales were $571 billion in 2011) (USDA–ERS 2014), and that recent research demonstrates growing interest in locally-grown food through this market channel (Oberholtzer 2014; Rushing 2013; Rushing and Goldblatt 2014), this study examines farm-level impacts that result from grocery stores' purchasing of locally-grown farm products in two counties in Hawai‘i.

Farm Impacts of Local Food System Participation

Few studies have examined the farm impacts resulting from sales in local food markets (e.g., farm-to-school, farm-to-restaurant, Community Supported Agriculture, farmers' markets). Part of the reason why there is limited research in this area is due to the lack of requisite data for a complete analysis. The USDA, for example, has historically focused its data collection by commodity rather than market channel (Jablonski 2014).

There are a handful of studies that examine farm impacts resulting from direct sales (Brown et al. 2006; Detre et al. 2011; Shilling et al. 2014; Ahern and Sterns 2013), however Park et al. (2014) and Silva et al. (2014) provide the only two studies that fully incorporated intermediated channels. Park et al. (2014) find that farmers selling only through direct-to-consumer outlets report earnings that are significantly lower than earnings from intermediated market channels. Similarly, Silva et al. (2014) report farmers selling into farmers' markets and through Community Supported Agriculture marketing arrangements are significantly less satisfied with profitability than those selling through wholesale markets, whereas farmers selling through wholesale markets and restaurants/institutions are significantly more likely to be dissatisfied with their quality of life compared to those using direct channels.

Several additional studies provide evidence of the differential cost structure associated with sales through different types of local food market outlets. Importantly they note these sales channels often require producers assume additional supply chain functions (e.g. processing, distribution) that can require additional labor (Jablonski and Schmit 2016; Hardesty and Leff 2010; King et al. 2010; LeRoux et al. 2010).

Grocery Stores and Local Food

US retailing has undergone rapid changes over the last twenty years, including but not limited to an increase in nontraditional stores, consolidation and concentration among the largest retailers and their supply chains, and expanded availability of organic and locally-grown foods (Martinez et al. 2010; Oberholtzer et al. 2014; Sexton 2010). Martinez et al. (2010) documented that in 2009, seven of the top ten food retailers had some reference to local food on their website. Rushing (2013) reports that Supervalu, owner of many grocery store chains throughout the US, estimates that it buys between 25–40% of its produce locally. In 2010, Wal-Mart Stores, Inc. (Walmart) pledged to increase its share of local produce to 9% by 2015, and by 2013 had exceeded its goal, reaching 11% (Clifford 2010; Swanson 2013). These shifts to local purchasing reflect the well documented consumer demand and willingness to pay a premium for these products (Carpio and Isengildina-Massa 2009; Costanigro et al. 2011; Darby et al. 2008; Loureiro and Hine 2002; Moser et al. 2011; Onken et al. 2011; Onozaka et al. 2010; Schneider and Francis 2005; Zepeda 2009).

Since grocery stores are where most consumers buy food consumed at home, the grocer-farmer relationship merits particular examination. Oberholtzer et al. (2014) write that that "although traditional food retailers can have a potentially significant impact on the sales of organic and local food, as most consumers purchase their food at these stores, there is a dearth of literature exploring retailers' procurement of local foods direct from farmers…in fact, most discussions relegate local food to direct-to-consumer markets" (Oberholtzer et al. 2014, 347). Part of the challenge is that 'local' is not defined by the USDA, making grocers' purchases of these products more difficult to track (Martinez et al. 2010).

Many researchers have also pointed to the challenges working through existing supply chains to scale up the availability of local food in grocery stores; conventional supply chains require products with consistent quantity and quality – often difficult for small and mid-scale producers that dominate local food markets (Bloom and Hinrichs 2011; Dunne et al. 2010; Ekelund and Tjarnemo 2009; Guptill and Wilkins 2002; McCallum et al. 2014). Bloom and Hinrichs (2011) identified challenges coordinating supply and demand in their case studies focused on moving local food through conventional supply chain infrastructure. Barrentine et al. (2010) found that packaging and labeling can cause conflict between producers and retailers. McCallum et al. (2014) note the challenges coordinating transport and aggregation, as well as extending product shelf-life.

In spite of the challenges, there is evidence that in situations where there are strong trust relationships, farm-retail partnerships can exist. Case studies by Diamond et al. (2014), Dreier and Taheri (2008), and Guptill and Wilkins (2002), for example, provide evidence of opportunities for farm-to-retail collaboration. However, none of these studies examine the farm profitability impacts of these channels. To address this gap, this study explores the dynamics of the farm-to-retail relationship and the potential to support farm viability.

Methodology

This study uses a case study of farm-grocer relations in two counties in the state of Hawai‘i. Hawai‘i provides an interesting example as it is the top state in direct sales to retailers, when measured in terms of the percent of farms selling through this market channel (see Table 1) (USDA Ag Census 2014).

Table 1. Top States in Direct Sales to Retailers

State	Percent of total farms
Hawai‘i	18
Vermont	16
Alaska	15
Rhode Island	14
New Hampshire	14
Massachusetts	13
Maine	13
Connecticut	10
New York	7
New Jersey	7

Source: USDA Ag Census 2014

In some respects Hawai‘i’s small average farm size (161 acres, compared to 434 acres in the United States.) (Arita et al. 2012), its sloped and dramatic topography (making it difficult to scale up farms), high costs of agricultural real estate (50% of agricultural land in Hawai’i is rented), as well as higher average costs for labor, electricity, fertilizer and transportation relative to their US mainland and Japanese market competitors make it an anomaly (Arita et al. 2012; Parcon et al. 2011). However, it arguably reflects—perhaps a heightened version of—the general barriers to financial success that farmers face in many parts of the United States.

Hawai‘i is also an interesting example due to the State’s concern about its high levels of food imports, and thus its statewide food self-sufficiency goals. Given the State’s geographic isolation and increasingly prevalent natural disasters, the Government is concerned about disruptions to its supply chains. Recent research shows that Hawai‘i imports almost 90% of its food (Loke and Leung 2013b). Though Hawai‘i does have a vibrant agricultural industry, with about 1.1 million acres under agricultural production, $661,347,000 market value in 2012 (US rank 45), most of Hawai‘i’s agricultural products are export crops – including tropical fruits, macadamia nuts and coffee (2012 market value of $179,699,000, 27% of the value of total agricultural production) (USDA Ag Census 2012).

The State’s food self-sufficiency goals have translated into several concrete plans with ample public and private support. The Hawai‘i State Constitution, the Hawai‘i 2050 Sustainability Plan, the New Day Plan, the Hawai‘i Comprehensive Economic Development Strategy (CEDS) and other state documents all explicitly support strengthening Hawai‘i’s local food system in order to promote food self-sufficiency (Abercrombie 2010; Hawai‘i Office of Planning 2010, 2012; Higa 2008). The State also incentivizes local food purchases by retail stores through its two branding

programs (Island Fresh and Hawai‘i Seals of Quality) and a Buy Local, It Matters campaign (Loke and Leung 2013a; Ulupono 2011).

Grocery Store Interviews

We used ReferenceUSA's business database to develop a list of grocery and health food stores in Hawai‘i. ReferenceUSA (2014), an infogroup company, has a database of over 24 million US businesses and claims to be the most accurate and comprehensive in the industry. It is increasingly used by researchers to obtain business information by: sales volume; number of employees; date established; and, North American Industry Classification System (NAICS) (Jilcott et al. 2011; McGuirt et al. 2011; O'Connell et al. 2011). Retailers were defined as those businesses that classify primarily as grocery stores (NAICS code 445110) or health food stores (NAICS code 446191). Accordingly, 702 businesses were identified, representing 412 unique companies (i.e., several grocery stores have multiple locations in Hawai‘i and thus appeared multiple times in the database).

Once we identified the grocery and health food stores, we split them into two groups: those that explicitly made an effort to purchase local products; and those that did not. Of the 412 unique companies, 150 of them had websites, thirty-nine of which included a statement about local foods. We made the assumption that if the website did not mention an effort to purchase local products that the store did not. For the 262 without websites (412 minus 150), we called the stores and asked the person who answered the phone if the store purchased local food. Of the ninety-one stores that we were able to reach, fifty-one replied affirmatively that they purchased local food.

Of the ninety stores that we identified that purchase local products (thirty-nine via the stores' website, and fifty-one from the phone survey), twenty-eight are located in Hawai‘i county, thirty-five in Honolulu county, thirteen in Kaua‘i county, and fourteen in Maui county. Given that the majority of the state's population and agricultural land are in the counties of Honolulu and Hawai‘i respectively, and that we had limited resources to conduct the interviews, we determined it more effective to focus our attention on farm-grocer dynamics in the two counties.

We conducted interviews with twenty-eight of the fifty-three grocery stores in the two counties (52.8%) between March and May of 2014 (we were unable to reach the remaining twenty-five stores). Figure 1 provides information on the location of the stores and farms interviewed. Each interview was conducted with a store manager over the phone and lasted approximately twenty minutes.[1] Questions pertained to how the store defines local, how they price and advertise local items, percent of total expenditure (or Cost of Goods Sold, COGS) on local items, perceived consumer demand for these items, farm regulatory requirements (i.e., does the store require farms to have specific food safety protocol in place), and supply chain logistics (i.e. how do products get from farm-to-grocer). At the end of each interview, the manager was asked to provide contact information for its store's farm-vendors.

[1] Interview protocol is available upon request from the corresponding author.

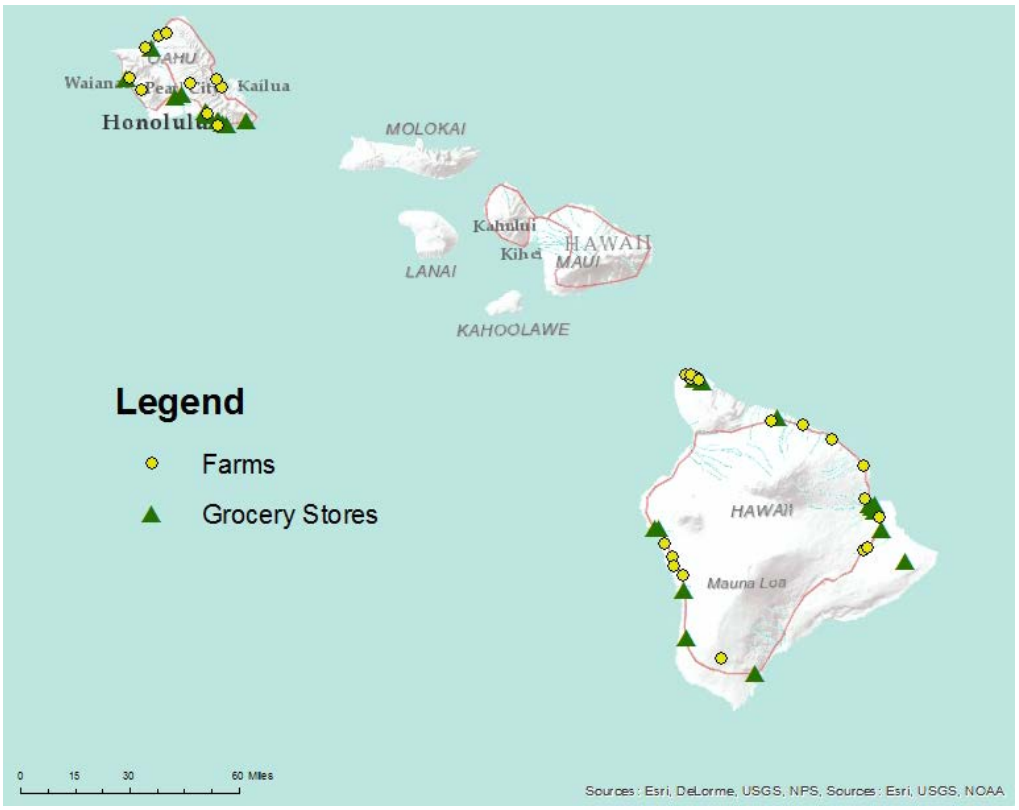

Figure 1. Map of the locations of the interviewed farms and grocery stores

Full descriptive statistics of the twenty-eight grocery stores interviewed are available in Table 2. The twenty-eight grocery stores had average annual sales volume per location of $6,844,034 (median of $1,278,000),[2] and an average of forty-two (median of seven) employees per location. The year of store establishment ranged from 1915 to 2012. On average, the stores sourced directly from twenty-three local farm vendors, however, these local vendor numbers do not account for the local vendors whose products were distributed by an intermediary, rather than direct from the farm-to-grocer. According to the data in ReferenceUSA, eight of the stores identified "health food store" as their primary NAICS (ReferenceUSA 2014). On average, stores reported average expenditure of 62% of total expenditure on the COGS, and an average markup on all food items of 31%. An average markup of 31% translates to a 24% gross profit margin, calculated as the difference between sales and the costs of goods sold divided by revenue, and representing the percentage of each dollar of a company's revenue available after accounting for COGS, in this case 0.31/(1+0.31). Stores also reported that the markup on local food products was lower than on comparable nonlocal items. Only 17% of stores included a formal definition for 'local', and 55% reported increased consumer demand for these local products. Thirty-four percent of the stores reported specific requirements for how product(s) must arrive to the store (e.g., packaging), and 55% of stores had regulatory requirements that farms had to meet in order to sell product(s) (e.g., GAP certification). Very few grocers (17%) met with farms in advance of the season to help with planning.

[2] Though ReferenceUSA does provide location sales volume for each of the stores (ReferenceUSA 2014), during the interviews we asked whether or not the information was accurate. Though in most cases the information was accurate, in others it was not and the manager would not provide updated figures.

Table 2. Summary Statistics for Key Grocery Store Variables (n=28)

Variable Name	Description	Mean	Standard Deviation
Grocery store location sales volume	In US 2013 dollars	6,844,034.00	0.00
Category grocery store location sales volume	0 = less than $1,000,000 1 = $1,000,000 to $4,999,999 2 = $5,000,000 to $14,999,999 3 = $15,000,000+	1.24	0.94
Number of employees	In terms of full-time equivalents	42.02	101.21
# of local farm vendors selling direct to store	Actual number	22.72	39.70
# of local nonfarm vendors selling direct to store	Actual number	18.17	28.43
Grocer markup on food products	Percent	0.31	0.19
Grocery markup on local food products compared to nonlocal average	0 = lower; 1 = same; 2 = higher	0.72	0.45
Cost of local items compared to nonlocal equivalent	0 = less; 1 = same; 2 = local costs more	1.00	0.77
Store advertises 'local'	1 if yes, 0 if no	0.34	0.48
Store has point of purchase labeling for 'local'	1 if yes, 0 if no	0.70	0.47
Store expenditure on COGS	In US 2013 dollars	630,125.00	2,296,449.00
Store expenditure on COGS as % of total expenditure	Percent	0.62	0.33
% of COGS expenditure from 'local' sources	Percent	0.21	0.24
Store has formal definition of local	1 if yes, 0 if no	0.17	0.38
++Store has increased demand for 'local' products?	1 if yes, 0 if no	0.55	0.51
Store has specific requirement for how product(s) must arrive to store (e.g., packaging requirements)	1 if yes, 0 if no	0.34	0.48
Store has regulatory requirements that farms must meet in order to sell product(s) (e.g., GAPs certification)	1 if yes, 0 if no	0.57	0.50
Store has planning meetings with farmers in advance of season	1 if yes, 0 if no	0.17	0.38

Farm Surveys

As this research aims to understand the farm impacts of sales to grocery stores, our farm surveys were limited to farms that have existing buyer-seller relationships with grocery stores. Farm information was obtained from a variety of sources, including: farm-vendor lists from interviewed grocery stores; publically available lists of farms in Hawai‘i that are GAPs certified; buy local campaign farm directories; the Kohala Center, a community-based nonprofit; and a local food hub website. In total we collected valid contact information for eighty-eight farms that included sales to grocery stores in their market portfolio. Every farm on the list was initially emailed with details about the survey, and subsequently called and invited to participate. From March to May 2014, we surveyed forty-seven of the eighty-eight farms. Survey questions focused on information about the farm (ownership structure, primary commodity, total sales), and sales from and satisfaction with market channels divided into three categories: direct-to-consumer markets; grocery stores; and, wholesale non-grocers. Building off a survey protocol designed and tested by the Cornell Small Farm Program, we asked producers about their level of satisfaction (very dissatisfied, dissatisfied, neutral, satisfied, or very satisfied) in eight categories for each of the three market channels:

- Profit earned through the channel;
- Labor (i.e., harvest, processing and packing, travel and delivery, and sales time) required to sell through the channel; volume of product sold through the channel;
- Lifestyle preferences (i.e., personal reward, enjoyment, fulfillment and convenience) that selling through the channel provides;
- Risk (i.e., customer turn-out, price, variability, competition) specific to selling through the channel;
- Associated costs (i.e., packaging supplies, special certifications) required to sell through the channel;
- Physical infrastructure (i.e., buildings, facilities, internet) specific to this channel; and,
- Social infrastructure (i.e., relationships or organizations that support this channel).

Full descriptive statistics from the farm interviews are available in Table 3. Of the forty-seven farmer respondents, 70% were small scale (under $350,000 gross cash farm income), 10% medium scale ($350,000–$999,999), and 20% large (greater than $1,000,000).[3] Two-thirds of farmer respondents produced fruit or vegetables, 9% meat or livestock, 13% other crops, 6% dairy, 11% value added or processed products (meaning that they added value to the raw product produced on the farm), and, 11% other (e.g., tea, eggs, and coffee) – note that many farmers produce multiple commodities. On average, the farm had been in operation for twelve years, with 15% of the farms in operation less than five years, 25% between five and fifteen years, and 60% for over fifteen years. Additionally, 77% of respondents reported that they own the farm (though not necessarily the land, which may be leased). On average, farm respondents reported selling to 2.63 grocery stores (23% sold to one store, 34% sold to two or three, and 43% sold to four or more).[4] Fifteen percent of farms reported being GAPs certified.

[3] The scale classification follows the USDA ERS revised farm typology (Hoppe and MacDonald 2013)
[4] Note that the number of stores does not include stores that have multiple locations, thus each chain would be considered one location.

Table 3. Summary Statistics for Key Farm Variables (n=47)

Variable Name	Description	Mean	Standard Deviation
Farm years in operation	In years	12.23	4.49
Gross farm sales	0 = under $350,000 1 = $350,000-$999,999 2 = $1,000,000-$4,999,999 3=$5,000,000+	0.49	0.81
% of gross sales to grocery stores	Percent	24.21	30.58
Own farm	1 if yes, 0 if no	0.77	0.43
Primary commodity produced - fruit or vegetable	1 if yes, 0 if no	0.66	0.48
Commodity produced - meat or livestock	1 if yes, 0 if no	0.09	0.28
Commodity produced - dairy	1 if yes, 0 if no	0.06	0.25
Commodity produced - crops	1 if yes, 0 if no	0.13	0.34
Commodity produced - value added	1 if yes, 0 if no	0.11	0.31
Farm is Good Agricultural Practice (GAPs) Certified	1 if yes, 0 if no	0.15	0.36
# grocery stores to which farm sells product	Actual number	2.63	1.26
Farm satisfaction with profit earned through sales to grocery stores	1 = very dissatisfied; 5 = very satisfied	3.5	1.16
Farm satisfaction with labor (i.e., harvest, processing, and packing, travel and delivery, and sales time) required to sell to grocery stores	1 = very dissatisfied; 5 = very satisfied	3.84	1.11
Farm satisfaction with the volume of product that can be moved through sales to grocery stores	1 = very dissatisfied; 5 = very satisfied	3.4	1.13
Farm satisfied with lifestyle preferences (personal reward, enjoyment, fulfillment and convenience) that selling to grocery stores provide	1 = very dissatisfied; 5 = very satisfied	3.88	1.04
Farm satisfaction with risk (customer turn-out, price variability, competition) selling to grocery stores	1 = very dissatisfied; 5 = very satisfied	4	0.98
Farm satisfied with associated costs (packaging supplies, special certifications) required to sell to grocery stores	1 = very dissatisfied; 5 = very satisfied	3.75	1.11
Farm satisfied with physical infrastructure (buildings, facilities, internet) required to sell to grocery stores	1 = very dissatisfied; 5 = very satisfied	3.75	1.08
Farm satisfied with social infrastructure (relationships or organizations that support this channel)	1 = very dissatisfied; 5 = very satisfied	3.88	1.08

Statistical Analysis

In the statistical analysis, we first examined farm responses about satisfaction with various items by market channel (profit, labor, volume of product, lifestyle preference, risk, associated costs, physical infrastructure, and social infrastructure). Each of these questions was asked in the context of a five-choice Likert scale. Each farmer respondent *i* had five options (very dissatisfied, dissatisfied, neutral, satisfied, and very satisfied) to indicate their farm's satisfaction with eight variables. As each farmer could only mark one of the ordered responses for each answer, and the continuum of options signal relative ratings, an ordered choice model is appropriate to utilize for the analysis. Each of the eight questions was modeled individually using an ordered probit model and following Silva et al. (2014).

An ordered probit model includes each farmer's reported choice y_{ij}, and incorporates the unobserved yet continually varying strength of preferences $U^*_{i,j}$. The ordered probit model for the eight equations about satisfaction by market channel can be expressed as follows:

$$
\begin{aligned}
U^*_{i,1} &= \beta_1^{'} X_{i,1} + \varepsilon_{i,1} \\
U^*_{i,2} &= \beta_2^{'} X_{i,2} + \varepsilon_{i,2} \\
U^*_{i,3} &= \beta_3^{'} X_{i,3} + \varepsilon_{i,3} \\
U^*_{i,4} &= \beta_4^{'} X_{i,4} + \varepsilon_{i,4} \\
U^*_{i,5} &= \beta_5^{'} X_{i,5} + \varepsilon_{i,5} \\
U^*_{i,6} &= \beta_6^{'} X_{i,6} + \varepsilon_{i,6} \\
U^*_{i,7} &= \beta_7^{'} X_{i,7} + \varepsilon_{i,7} \\
U^*_{i,8} &= \beta_8^{'} X_{i,8} + \varepsilon_{i,8}
\end{aligned}
$$

Here $X_{i,j}$ is the vector of explanatory variables for farmer *i*'s satisfaction with profit ($X_{i,1}$), labor ($X_{i,2}$), volume of product ($X_{i,3}$), lifestyle preference ($X_{i,4}$), risk ($X_{i,5}$), associated costs ($X_{i,6}$), physical infrastructure ($X_{i,7}$), and social infrastructure ($X_{i,8}$). y_{ij}, each farmer's observed choice, is determined by $U^*_{i,j}$:

$$
\begin{aligned}
y_{ij} = \quad & 1 \text{ if } \infty < U^*_{i,j} \leq u_{i2} \\
& 2 \text{ if } u_{i2} < U^*_{i,j} \leq u_{i3} \\
& 3 \text{ if } u_{i3} < U^*_{i,j} \leq u_{i4} \\
& 4 \text{ if } u_{i4} < U^*_{i,j} \leq u_{i5} \\
& 5 \text{ if } u_{i5} < U^*_{i,j} \leq \infty
\end{aligned}
$$

u_{kj} provides thresholds dividing the range of the unobserved utility $U^*_{i,j}$ into five ordered choices that map y_{ij}. The error terms ε_{ij} follow a normal distribution N[0,1].

The vector $X_{i,1}$ includes variables on farm years in operation (continuous variable defined in terms of years), farm ownership (1 if yes, 0 if no), gross farm sales (categorical variable where 0= <$350,000; 1= $350,000-$999,999; 2= $1,000,000-$4,999,999; 3=≥$5,000,000), percent of gross sales to grocery stores (continuous variable from 0 to 1), commodity produced – fruit and vegetable (1 if yes, 0 if no), farm is GAPs certified (1 if yes, 0 if no), and number of grocery stores to which farm sells product (maximum value = 4). The ordered probit model was estimated by using *oprobit* in StataIC 12.0.[5]

Next we used ordered probit models to examine three ordered questions asked of grocers:

1. Is your store mark-up of local food items lower, the same, or higher compared to other food products?;
2. On average, are items marked 'local' more expensive than non-locally grown or labeled items?; and,
3. In 2013, in which category did your grocery store's sales volume fall?

The theoretical framework is identical to what is described above, except here, in questions one and two, grocer *i* has three possible responses from which to choose: y_{ij}=0, the grocer indicated that the store's mark-up of local items is lower than other food items or items marked local are less expensive than non-locally grown or labeled items; y_{ij}=1, the grocery responded that the store's mark-up of local items is the same as other food items or items market local are the same cost as non-locally grown or label items; or y_{ij}=2, the grocer indicated that the store's mark-up of local items is higher than other food items or items marked local are more expensive than non-locally grown or labeled items.

For these questions, the vector $X_{i,1}$ varies from the farm-based models and includes variables on the number of producers from which the store purchases product (whole number greater than zero), whether the store advertises local offerings (1 if yes, 0 if no), whether the store has point of purchase labeling for local items (1 if yes, 0 if no), percent of COGS expenditure on local sources (continuous variable from 0 to 1), whether the store has a formal definition of local (1 if yes, 0 if no), whether the store has experienced increased demand for local products (1 if yes, 0 if no), whether the store has regulatory requirements that farms must meet in order to sell products (1 if yes, 0 if no), and the grocery store's sales volume by location (continuous variable). Again, the ordered probit model was estimated by using *oprobit* in StataIC 12.0.

Finally, we used a tobit model to analyze grocers average retail markup on food products. Tobit models assume that the dependent variable has a notable share of its values clustered at a limiting value, usually zero, given the nature of the question. The model supposes that there is an unobservable variable y_i^* that linearly depends on X_i via parameter β (vector of unknown coefficients), which determines the relationship between the independent variable X_i and y_i^*. Additionally, there is an independently distributed error term u_i to capture random influences in the relationship (McDonald and Moffitt 1980).

[5] For a more in-depth explanation of ordered choice models, please see Greene and Hensher (2010): Greene, W. and Hensher, S. 2010. *Modeling Ordered Choices: A primer*. 1st ed. Cambridge University Press, Cambridge. UK.

$$y_i^* = \beta X_i + u_i$$

In the tobit model, the vector X_i includes variables on the number of producers from which the grocer purchases product (whole number greater than zero), whether the store advertises local (1 if yes, 0 if no), whether the store has point of purchase labeling for local items (1 if yes, 0 if no), percent of COGS expenditures paid to local sources (continuous variable from 0 to 1), whether the store has a formal definition of local (1 if yes, 0 if no), whether the store perceives increased demand for local products (1 if yes, 0 if no), whether the store has regulatory requirements that farms must meet in order to sell products (1 if yes, 0 if no), whether the store has specific requirements for how products must arrive to the store (1 if yes, 0 if no), whether the store has production planning meetings with farmers in advance of the season (1 if yes, 0 if no), and the grocery store sales volume (continuous variable). The tobit model was estimated by using *tobit* in StataIC 12.0, and a maximum value (ul) of 1 was applied.

Results

Statistical Analysis

Full results from our ordered probit model analyzing farmer satisfaction with sales through grocery stores are available in Table A1 (see Appendix). Results show that for the volume of product, lifestyle preferences, risk, associated costs, physical infrastructure, and social infrastructure equations, the coefficient gross farm sales is positive and statistically significant. This means that the larger the farm, the more likely they are to be satisfied with all aspects of sales to grocery stores except profit and labor (which are not significant). The other two statistically significant coefficients are farm is GAPs certified and commodity produced-fruit or vegetable. For the equations volume of product, lifestyle preferences, risk, associated costs, physical infrastructure, and social infrastructure, farm is GAPs certified is negative and significant. Therefore, farms that are GAPs certified are less likely to be satisfied with the volume of product, lifestyle preferences, risk, associated costs, physical infrastructure, and social infrastructure associated with sales to grocery stores. Similarly, for the equations associated costs, physical infrastructure, and social infrastructure, the coefficient commodity produced-fruit or vegetable is negative and significant. Fruit and vegetable growers are therefore significantly less likely to be satisfied with the associated costs, physical infrastructure, and social infrastructure associated with sales to grocery stores. None of the other equations (profit or labor) yielded statistically significant results.

We did not find any significant results in our equation grocers' average cost of local items compared to nonlocal items, and we found only one significant coefficient in our grocer's markup for local food products compared to other food products equation. Stores with point of purchase labeling for local products were likely to have lower markups for local food products compared to other food products. Full results from these models are available in Table 4.

Table 4. Coefficient estimates, grocers' responses to measure perceptions on local food procurement

Variable	Grocer's markup for local food products compared to other food products	Grocer's average cost of local items compared to nonlocal items
# farm producers	0.0095 (0.0177)	-0.0178 (0.0154)
Store advertises 'local'	-0.8800 (0.6545)	-0.6560 (0.6820)
Store has point of purchase labeling for 'local'	-2.3943* (1.380)	1.4778 (0.9152)
% of COGS expenditure from 'local' sources	-0.9955 (1.8649)	0.2695 (1.8755)
Store has formal definition of local	-1.5489 (2.3262)	1.5795 (1.3858)
Store has increased demand for 'local' products?	1.1682 (0.8951)	1.0152 (0.8148)
Store has regulatory requirements that farms must meet in order to sell product(s) (e.g., GAPs certification)	1.1919 (0.8527)	-0.2538 (0.7144)

Note. Standard errors in parentheses.

Finally, the tobit model results show grocers' average markup of food products and the coefficient number of farm producers is positive and significant. As a store retains a larger share of the retail dollar, they are significantly more likely to work with a larger number of local farms. Three other coefficients were also significant in this equation. Store has point of purchase labeling for local was negative and significant. Store has planning meetings with farmers in advance of the season was negative and significant. And store has regulatory requirements that farms must meet in order to sell products was positive and significant. Full results for the tobit model are presented in Table 5.

Table 5. Coefficient estimates for tobit model, grocers' average markup of food products

Variable	Grocers' average markup of food products
# farm producers	0.0034** (0.0014)
Store advertises 'local'	0.0197 (0.0765)
Store has point of purchase labeling for 'local'	-0.1567* (0.0803)
% of COGS expenditure from 'local' sources	-0.1142 (0.1433)
Store has formal definition of local	-0.0586 (0.1593)
Store has increased demand for 'local' products?	0.0794 (0.0746)
Store has specific requirement for how product(s) must arrive to store (e.g., packaging requirements)	0.0146 (0.0696)
Store has regulatory requirements that farms must meet in order to sell product(s) (e.g., GAPs certification)	0.0669*** (0.0661)
Store has planning meetings with farmers in advance of season	-0.3961*** (0.1267)

Note. Asterisks indicate significance at: *α = 0.1; **α = 0.05; ***α = 0.01. Standard errors in parentheses.

Discussion

Farm Scale, Commodity, and GAPs

Our results demonstrate that as producers get larger, they are significantly more likely to be satisfied with the volume of product, lifestyle preferences, risk, associated costs, physical infrastructure, and social infrastructure associated with sales to grocery stores. This finding is in line with previous literature, which finds it is often difficult for small and mid-scale producers to work with grocery stores (Bloom and Hinrichs 2011; Dunne et al. 2010; Ekelund and Tjarnemo 2009; Guptill and Wilkins 2002; McCallum et al. 2014).

GAPs certified farms, as well as producers of fruits or vegetables, however, are significantly less likely to be satisfied with the associated costs, physical infrastructure, and social infrastructure associated with sales to grocery stores. Given the additional costs and regulatory hoops associated with GAPs certification, and the fact that it is mainly farms that produce fruits or vegetables that would be GAPs certified, it is possible to see why these farms might be less likely to be satisfied with sales to grocery stores. Further, the US lacks a unified food safety standard (the Food Safety Modernization Act, FSMA, was signed into law on February 4, 2011, but when we were conducting this survey the details for most aspects of the act were still to be determined) (Holcomb et al. 2013). In the absence of a unified standard, many grocery stores developed their own independent requirements, for which the burden of compliance is borne by producers wishing to sell through these markets. "Producers [are] required to comply with whatever food safety-based standards their buyers require if they wish to be active market participants." (Paggi et al. 2013, 462). Though the majority of grocery stores in our study did not require farms to be GAPs certified, it is easy to see why producers that do have GAPs certification are less satisfied.

As Congress debated the FSMA throughout the 2010 session, one of the points of contention focused on whether the costs of complying with the additional regulatory requirements of the new food safety law would place a disproportionately large burden on small producers (Hassanein 2011). Our results show that as the scale of the farm operation increases, farmers are significantly more satisfied with the volume of product, lifestyle preferences, risk, associate costs, physical infrastructure and social infrastructure associated with sales to grocery stores. This finding supports the contention that it is more difficult for smaller producers to comply with these requirements.

Indicators of Successful Grocer-Farmer Relationships

Our results show only one statistically significant relationship between the size of the store (in terms of annual revenue by location) and the buying-selling relationship between grocers and farmers: store advertises local. Given that the larger the grocery store the more money they likely have for advertising (as well as a market research team advising them on current retail trends), this is not surprising. However, the lack of other significant relationships stands in contrast to previous research that generally uses a categorical scheme based on total revenue to analyze grocery stores (Guptill and Wilkins 2002).

We find that a significant predictor for grocer's average markup on total COGS is their working with a greater number of producers. To illustrate why this might be important in farmer-grocer relations, we can take a closer look at Whole Foods Market, Inc. (Whole foods) and Walmart. Whole foods has an average gross profit margin around 35%, whereas Walmart has an average gross profit margin around 25% (YCharts n.d). This means that Whole Foods has more money available to spend on non-COGS expenditures than does Walmart. It therefore stands to reason that Whole Foods is able to have a lower revenue per employee rate. As of June 2015, Whole Food's revenue per employee was $171,456, compared to $220,690 for Walmart (CSI Market n.d.). Though the revenue per employee rates indicate that Whole foods is less efficient than Walmart, they also imply that Whole Foods' employees may have more time available to work directly with individual local food producers than might a Walmart employee.

Conclusion and Future Research

One key area for additional research is in understanding the farm profitability impacts not just from sales to grocery stores, but to other non-commodity market channels generally. Employing a more data-intensive method of data collection – i.e., market channel assessments (Hardesty and Leff 2010; LeRoux et al. 2010) – to more fully capture expenditures (including unpaid labor) and returns by market channel would be informative for policymakers, researchers, and practitioners alike. The fact that our farm questions asked about farm perception of satisfaction poses some limitations that a more in-depth market channel assessment in conjunction with these more subjective responses could address.

While we acknowledge that generalizing from our Hawai‘i -focused study to the broader US poses challenges given Hawai‘i's unique agricultural profile and distance from trading partners, there are still some interesting findings from our research that warrant additional examination in other contexts. First, our study provides evidence of the importance of classifying grocers' current or potential relations with farms in terms of gross average markup on food or gross profit margin rather than scale. We recommend that future research moves beyond the scale classification when considering the impact of farm-to-grocery sales, and more fully considers the impact of the store's gross profit margin. This is also an important point for practitioners interested in facilitating additional farm-to-grocery initiatives; the easiest to access stores may be those with higher gross profit margins and not a priori independent or health food retailers. Second, the impact of food safety regulations, namely GAPs, and farm scale on grocer-farm relations was significant in our study. As the FSMA is implemented throughout the country, studies that assess the farm-level impacts – and particularly the market opportunities that these requirements hinder or facilitate –are welcome. Will grocers, for example, adopt a more unified food safety protocol, or will they continue to have similar, but divergent, requirements? Will food safety exemptions at certain gross revenue levels or by market channel impact the markets to which producers decide to sell?

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Appendix

Table A1. Coefficient estimates for ordered probit model, farmer satisfaction with sales through grocery stores

Variable	Profit	Labor	Vol. of product	Lifestyle preferences	Risk	Associated costs	Physical infrastructure	Social infrastructure
Farm years in operation	-0.0329 (0.0535)	-0.0065 (0.0510)	-0.0715 (0.0518)	-0.0285 (0.0565)	-0.0348 (0.0531)	-0.0110 (0.0532)	-0.0544 (0.0535)	0.0299 (0.0535)
Own farm	0.9437 (0.7943)	0.9468 (0.7952)	0.0781 (0.7526)	1.2574 (0.8362)	0.3888 (0.8348)	0.6573 (0.8004)	0.2605 (0.7780)	0.7421 (0.7906)
Gross farm sales	0.2302 (0.4773)	0.6942 (0.5116)	0.8563* (0.4958)	1.5330** (0.6304)	1.5994** (0.6667)	1.4588** (0.6199)	1.3697** (0.5815)	1.5432*** (0.6142)
% gross sales to grocery stores	0.0402 (0.0288)	0.0280 (0.285)	0.0226 (0.0277)	0.0334 (0.0308)	0.0241 (0.0286)	0.0004 (0.0278)	-0.0016 (0.0279)	0.0131 (0.02829)
Commodity produced - fruit or vegetable	-0.8285 (0.5672)	-0.0072 (0.5550)	-0.3259 (0.5457)	-1.0268 (0.6433)	-0.7978 (0.6422)	-1.5955** (0.6532)	-1.6949*** (0.6411)	-1.3786** (0.6316)
Farm is GAPs certified	-0.2372 (0.7540)	-1.2446 (0.8000)	-1.4090* (0.7978)	-1.7429** (0.9028)	-2.3214** (0.9987)	-2.5327*** (0.9423)	-2.4361*** (0.8953)	-2.1954** (0.9032)
# grocery stores to which farm sells product	-0.2905 (0.4074)	-0.2875 (0.4103)	-0.1200 (0.3973)	-0.1293 (0.4305)	-0.7400* (0.4537)	0.0226 (0.4102)	0.2166 (0.4123)	-0.1008 (0.4126)

Asterisks indicate significance at: *$\alpha = 0.1$; **$\alpha = 0.05$; ***$\alpha = 0.01$.
Standard errors in parentheses.

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Consumer Preferences for Delacata Catfish: A Choice Experiment with Tasting

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Abstract

This article investigates consumer preferences for *Delacata* catfish, a relatively new fillet of grade-A catfish, by conducting in-person choice experiments with tasting sessions. Panels were held at three white-tablecloth restaurants across the United States, featuring sample entrées of *Delacata* catfish along with sample entrées of other species of mild-tasting, white-fleshed fish. Results suggest that *Delacata* catfish may fare well in terms of search and experience attributes such as taste and texture, across all locations, but may face labeling challenges in certain locations. This study provides willingness-to-pay estimates and discusses possible marketing strategies to further increase market potential for the US fish industry.
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Keywords: catfish, choice experiment, conditional logit, taste panel, willingness to pay

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Introduction

Americans consume an average of fifteen pounds of seafood annually, including 0.56 pounds of US farm-raised catfish, making it the eighth-most consumed seafood in the United States (Hanson and Sites 2015). Catfish comprises 46% of the total value of US aquaculture production (Mississippi State University 2016). Since 2006, however, imports have seized a large portion of the catfish market share. Over the first seven months of 2006, catfish imports (mostly from Vietnam) totaled 14.8 million pounds, representing a 71% increase from 2005, and a 780% increase from 2004 (Harvey 2006). By 2014, imports of frozen catfish fillets totaled 239 million pounds, accounting for 80% of the total US sales (Hanson and Sites 2015).[1] Additionally, the influx of imports—coupled with an increase in feed costs—has led to a decrease in US catfish production, from a high of 196,760 water-surface acres in 2002 to 69,910 acres in 2015—a 64% decline (Hanson and Sites 2015).

In an effort to combat these market conditions, and find new and higher-value market opportunities for domestic catfish producers, the Catfish Institute developed and released a product known as *Delacata* (The Catfish Institute 2016a).[2] *Delacata* is a fillet of grade-A catfish that is larger, deep-skinned, and hand-trimmed. The goal of *Delacata* is to appeal to consumers looking for a high-quality, domestically- and sustainably-produced fish. Thus, the target customers for this product are higher-end restaurants and higher-income consumers who demand a consistent, high-quality cut of fish that can compete with other prime cuts of fish.[3]

Along these lines, several lines of research were initiated to better understand consumer preferences for catfish. Quagrainie and Engle (2006) conducted an in-person choice experiment on restaurant managers who serve catfish to determine preferences over alternative catfish products, focusing on the attributes of price, color, dryness, flavor, and texture. Kumar, Quagrainie, and Engle (2008) conducted a telephone survey of US households to obtain estimates of actual catfish purchase and consumption habits, and estimate a model of the factors influencing consumption frequency. Hill et al. (2013) conducted a series of taste-sensory panels, as well as in-store choice experiments on catfish nuggets, focusing on the attributes of price, color of breading, cooking method, and country of origin. Other research has been conducted to understand the factors that explain why consumers do or do not currently consume catfish (Hanson and Rose 2011; Drammeh et al. 2002; Engle 1998; Dellenbarger et al. 1992).

We are not aware, however, of any research conducted to understand the conditions under which current non-consumers of catfish *would* consume it, or if there are alternative catfish products that would be more appealing to such consumers. The focus of the present work is to ascertain the status of current perceptions and consumption of US catfish by consumers—specifically in a

[1] The USDA-FSIS Catfish Inspection Program, authorized by the 2014 Farm Bill, is expected to introduce a more frequent and rigorous inspection program for both domestic and imported catfish, compared with the inspection program currently in place (USDA 2015). The final rule, released in 2015, requires on-site inspections of catfish farms and processing plants for both domestic and foreign producers, to ensure they meet the same standards required in the United States (Salter 2015).

[2] The Catfish Institute also provides information to the public such as recipes, food safety education, and production practices by the US catfish industry (The Catfish Institute 2016b).

[3] Farmed US catfish, including blue and channel, are listed as "Best Choice" options on the Monterey Bay Aquarium *Seafood Watch* list, whereas catfish varieties imported from Vietnam are listed as options to "Avoid".

restaurant setting—both within and outside of the Gulf region, and to ascertain the market potential for *Delacata* catfish. This approach is consistent with a now twenty-one-year-old report that suggests that the catfish industry should make changes that would improve the image of catfish to higher-income consumers (Dellenbarger et al. 1992).

To investigate consumer preferences, we conducted in-person choice experiments that included tasting sessions at three white-tablecloth US restaurants, featuring sample entrées of Delacata catfish along with sample entrées of two other species of lean, flaky, mild-tasting, white-fleshed fish. This type of value elicitation mechanism gives us more control relative to using non-experimental data (e.g. scanner data) and a richer context relative to data collected in a laboratory setting (Lusk and Shogren 2007). The panels assembled at each restaurant consisted of four tasting rounds / choice tasks that featured three fish species. The first two rounds were "blind" (panelists were not provided with information regarding any specifics of the sample entrées they were tasting), whereas the last two rounds were "labeled" (panelists were provided with the description of each fish, including its species (*Delacata* catfish, grouper, black drum, or walleye), production method (wild-caught or farm-raised), and place of origin). Catfish and walleye are freshwater species, whereas the rest of the fish used were saltwater species. Although the fish were prepared in a different way across rounds, the three fish species were prepared identically within each round, such that the only difference during each choice task was the fish species itself. Results from this study show that when served blind, consumers were either indifferent to the fish species or preferred *Delacata* catfish but, when served labeled, consumers preferred other fish species or had weakened preferences for *Delacata* catfish. These findings suggest that *Delacata* catfish may fare well in terms of search and experience attributes, such as taste and texture, across all locations, but may face labeling challenges in certain locations. Similar challenges have been faced by other fish species, such as Mahi Mahi and Chilean Seabass, which the industry ultimately renamed in order to improve consumer acceptance. In this paper, we provide willingness-to-pay estimates and discuss possible marketing strategies to further increase the market potential for the US fish industry.

Experimental Design

Three taste panels were conducted to collect data on consumer preferences for fish entrées at high-end seafood restaurants. The first was held on September 15, 2014, at Calcasieu in New Orleans, Louisiana, and consisted of 103 panelists. The second occurred on February 9, 2015, at Shaw's Crab House in Chicago, Illinois, and had sixty-seven panelists. The third was on March 22, 2015, at Fortify Kitchen & Bar in Clayton, Georgia, and had eighty-five panelists. Panel summaries are provided in Table 1. These locations were chosen based on the willingness of restaurants from different regions of the United States to participate; thus, they can be interpreted as a convenience panel.

The experimental design consisted of six choice sets that included three alternatives (fish A, fish B, and fish C) at a given price. Not all choice sets were seen by all individuals. Instead, the choice sets were divided into three blocks of two choice sets each, with a particular panelist facing one of these blocks per treatment. There were two treatments (discussed next), and the same design was used for both. Therefore, each panelist faced four choice sets (or rounds) in total. During the first treatment (rounds one and two), the fish were served blind (participants

were not told which fish species they were evaluating), and the alternatives were simply labeled "A," "B," and "C." During the labeled treatment (rounds three and four), participants were provided information on the specific fish species of each alternative, as well as a brief description of each that mimicked the information one would normally find on a menu, including production method (wild-caught or farm-raised) and place of origin. This information depended, in part, on the fish products that the restaurants were able to procure (see Table 1).

Table 1. Taste Panel and Preparation Details

Panel Location ***Restaurant*** **Date (# Panelists)**	**Fish Species Tested (Descriptions provided to respondents during labeled rounds)**	**Preparation (All fish prepared same way each round)**
New Orleans, LA	*Delacata Catfish*	1) Smoked fish salad
Calcasieu	(Farm-raised from Yazoo City, Mississippi)	2) Blackened
Sept 15, 2014	*Grouper*	3) Baked with lemon beurre blanc
(103)	(Wild-caught from the Gulf of Mexico)	4) Courtboullion
	Black Drum	
	(Wild-caught from the Gulf of Mexico)	
Chicago, IL	*Delacata Catfish*	1) Mustard char glaze
Shaw's Crab House	(Farm-raised from Yazoo City, Mississippi)	2) Beer-battered fish tacos
Feb 9, 2015	*Grouper*	
(67)	(Wild-Caught from the coast of Virginia)	3) Sautéed with kale and dijon sauce
	Walleye	
	(Wild-Caught from Lake Erie)	4) Horseradish crust
Clayton, GA	*Delacata Catfish*	1) Fried
Fortify Kitchen & Bar	(Farm-raised from Yazoo City, Mississippi)	2) Crab-stuffed
March 22, 2015	*Grouper*	3) Asiago-crusted
(85)	(Wild-Caught from the Florida Gulf Coast)	4) Cajun-grilled
	Black Drum	
	(Wild-Caught from Lake Pontchartrain, Louisiana)	

The design utility function was linear, with a single price variable and two binary indicators for fish species (catfish served as the omitted base). The experimental design was generated using NGene software, and optimized according to s-efficiency (Choice Metrics 2012). S-efficiency requires the specification of estimates of coefficient parameters: we used 0.10 for price and 0.25 for each binary fish indicator.[4] The same design was used in all three panel locations, with the exception of the assigned prices, which were shifted monotonically. In other words, we scaled prices up or down to be at parity with fish prices in each location. Thus, relative price differences did not change.

At the request of the participating restaurant staff, and in order to minimize mistakes during preparation, the order of fish served was not varied throughout the panels. Thus, Fish A was fixed as the *Delacata* catfish, and fish B was fixed as grouper. Fish C was fixed as black drum

[4] Although specification of coefficient values is somewhat arbitrary because they are unknown, we assumed a $2.50 price premium for grouper, black drum, and walleye relative to *Delacata.* Thus, we specified the coefficient on each fish species as 0.25, and the price coefficient as 0.10, given that WTP is defined as the ratio of the non-price coefficient to the price coefficient: 0.25 / 0.10 = $2.50.

for the New Orleans and Clayton panels and, due to availability constraints, was fixed as walleye for the Chicago panel. Randomly-assigned prices were chosen to reflect prevailing fish entrée prices in each panel's market and were set as $15, $17, $19, $21, $23, and $25 per entrée during the New Orleans panel; $18, $21, $24, $27, $30, and $33 during the Chicago panel; and $15, $18, $21, $24, $27, and $30 during the Clayton panel.

For the New Orleans panel, panelists were recruited using printed advertisements in local newspapers, and digital advertisements in social media and food blogs. For the Chicago and Clayton panels, the host venue was allowed to recruit participants from each restaurant's own customer base as a promotional event. Participants were asked to review and sign an IRB-approved consent form upon arrival at the event site. They were then allowed to sit anywhere they liked as long as they remained in the same seat throughout the panel. Participants were asked to treat the event as they would a regular trip to a restaurant. Thus, they were allowed to drink and converse as they normally would, with the exception of discussing the fish being evaluated (and their opinions of them) once the tasting began. Session monitors helped ensure that participants adhered to these rules. Participants were not allowed to amend the dishes, with the exception of salt and pepper.

As a means to garner interest to participate and gain experience with the fish being tested, restaurant chefs were given the freedom to prepare the fish using recipes they would typically offer to a consumer in their region; the only restriction being that the fish be prominent in each dish (i.e., with minimal amounts of other ingredients or without ingredients that would overwhelm the taste of the fish itself). See Table 1 for a summary of how the fish were prepared during each round of each panel. As noted earlier, each fish alternative was prepared identically within the same round, such that the only difference across the alternatives presented during each round was the species of fish being served.

After participants were seated, an introduction was given by the session moderator to provide general information about the reason for the taste panel, expectations from participants during the panel, and an explanation of the vote cards. For the latter, the vote cards for the first round were handed out to facilitate explanation. Participants were then given the opportunity to ask any clarifying questions. After all participants' questions and concerns were addressed, the first round of fish was served.

Each panel consisted of four rounds, and each round consisted of three fish alternatives. After tasting 1.5 oz. entrée samples of each fish, participants filled out a vote card for that round (see example in Figure 1). The vote card indicated a posted (hypothetical) price per entrée for each alternative.[5] Panelists were also invited to write down any additional comments on the vote card. At the conclusion of the four rounds, participants were asked to complete a short questionnaire that collected additional behavioral and demographic information.

On each vote card, participants indicated which of the three alternatives they were "most likely to buy" at the posted prices, and which of the three alternatives there were "least likely to buy" at the posted prices. This response elicitation format is a form of best-worst scaling (BWS) (Louviere, Flynn, and Marley 2015). BWS has recently emerged as an alternative to the format of having respondents indicate only their first-best choice (Flynn and Marley 2014; Flynn et al. 2007; Marley and Louviere 2005; Potoglou et al. 2011; Rigby, Burton, and Lusk 2015; Scarpa et

[5] Vote cards specified that an entrée would consist of a 6 oz. fillet of fish and two sides.

al. 2011). The BWS format asks respondents to indicate the "best" alternative (in the present case, "Most Likely to Buy") and then to indicate the "worst" alternative ("Least Likely to Buy"), and then, of the remaining alternatives, to indicate the "best" of those remaining, then the "worst", etc., until a full ranking is achieved. The argument is made that choosing "bests" and "worsts" is a relatively easy task for respondents, and yields more information per choice set than the standard question format. Thus, it represents an extension of the discrete-choice experiment format with the potential to increase cost efficiency of survey administration.

Blind Round

INSTRUCTIONS: After sampling all 3 fish, *first* indicate the fish entrée you are MOST LIKELY to buy given the posted prices, *and then* indicate the fish entrée you are LEAST LIKELY to buy given the posted prices.

ID# _____	*Price per entrée**	I am MOST LIKELY to buy: (check only ONE)	I am LEAST LIKELY to buy: (check only ONE)
A	**$15**	☐	☐
B	**$27**	☐	☐
C	**$27**	☐	☐

Labeled Round

INSTRUCTIONS: After sampling all 3 fish, *first* indicate the fish entrée you are MOST LIKELY to buy given the posted prices, *and then* indicate the fish entrée you are LEAST LIKELY to buy given the posted prices.

ID# _____	*Price per entrée**	I am MOST LIKELY to buy: (check only ONE)	I am LEAST LIKELY to buy: (check only ONE)
Delacata Catfish *Farm-raised from Yazoo City, Mississippi*	**$21**	☐	☐
Grouper *Wild-caught from the Florida Gulf Coast*	**$24**	☐	☐
Black Drum *Wild-caught from Lake Pontchartrain, Louisiana*	**$18**	☐	☐

*** An entrée includes a 6 oz. fillet of fish and 2 sides.**

Figure 1. Example vote cards, blind, and labeled rounds

The present format is an application of "Case III" BWS (the multi-profile case; see Flynn and Marley 2014), and included a single question with three alternatives, eliciting the "best" and "worst" choice of the three alternatives, thus yielding a full ranking. This ranking was then decomposed following the method of rank-order explosion proposed by Chapman and Staelin (1982), which, in our case, yields two choice observations for each choice set evaluated: a three-alternative observation (first-best case) and a two-alternative observation (second-best case).[6]

Conceptual and Econometric Models

It is assumed that respondent *i* chooses alternative *j* if, and only if, the level of utility associated with alternative *j* is greater than the level of utility associated with the remaining alternatives ~*j*. We adopt a random-utility framework wherein utility comprises two components: 1) observables, which in this case are the attribute levels of the given alternatives; and 2) unobservables, which are those factors known to the respondent that affect utility but are unknown to the researcher. We specify the observable part of utility to be a linear function of attributes for the alternatives. To control for any further differences across fish species, between blind and labeled rounds, and across taste panel locations, we specify binary indicators for each and then interact them. Thus, observable utility for alternative *j* was specified as:

$$
\begin{aligned}
(1) \quad U_j = {} & [\beta_G + \beta_{GN} I_N + \beta_{GC} I_C + (\beta_{GNL} I_N + \beta_{GChL} I_{Ch} + \beta_{GCL} I_C) I_L] I_G \\
& + [\beta_D + \beta_{DC} I_C + (\beta_{DNL} I_N + \beta_{DCL} I_C) I_L] I_D \\
& + (\beta_W + \beta_{WL} I_L) I_W + \beta_P P
\end{aligned}
$$

where I_k, $k = G, D, W$ are binary indicators for fish species Grouper, Drum, and Walleye, respectively, $k = N, Ch, C$ are binary indicators for New Orleans, Chicago, and Clayton taste panel locations, respectively, and where $k = L$ is a binary indicator for Labeled treatment. The omitted base categories were Catfish (for fish species), Chicago (for taste panel locations for Grouper), New Orleans (for taste panel locations for Black Drum), and Blind (for choice set treatment). Price is specified as a continuous variable, P. Therefore, the coefficients β_m, $m = G, GN, GC, GNL, GChL, GCL, D, DC, DNL, DCL, W, WL, P$ capture the estimated contribution of each variable to utility, according to the same subscript notation above. For example, β_G captures the contribution of grouper and β_{GNL} captures the contribution of the interaction effect of grouper x New Orleans x Labeled. Thus, the model allows for the full range of coefficient differences according to all possible combinations of fish species, taste panel location, and labeling treatment.

The regression model, a conditional logit, was estimated using NLOGIT's "clogit" routine with a cluster correction to account for the panel (i.e., repeated-choice) nature of the data. This correction leaves the coefficient estimates unchanged but makes an adjustment to the estimated asymptotic covariance matrix (Greene 2012).

[6] Let A and B represent a pair of alternatives in a choice set. The second-best case operates under the assumption that the probability of A being chosen as "worst" is equal to the probability of B being chosen as "best".

Results

Table 2 reports responses from panelists describing their eating habits pertaining to fish. Frequency of eating fish was fairly consistent across panels, with those responding "once a week" comprising 42–47% of the sample. Panels in more populated cities, such as New Orleans and Chicago, had larger proportions of panelists responding "more than once a week" than did the Clayton panel. Relative to the other locations, the Chicago panel had a higher proportion of panelists who usually purchase fish at restaurants, whereas more New Orleans panelists usually purchased fish at a seafood market. Perhaps because of its proximity to the Gulf Coast, about 21% of New Orleans panelists indicated that they harvest their own fish. The New Orleans panel also had, by far, the largest proportion of panelists that currently eat catfish, whereas the Chicago panel had the lowest.

Table 2. Panelist Responses to Post-Choice-Experiment Questions

	New Orleans		**Chicago**		**Clayton**	
	Freq.	*%*	*Freq.*	*%*	*Freq.*	*%*
How often do you eat fish?						
More than once a week	30	0.29	22	0.33	10	0.12
Once a week	44	0.43	28	0.42	39	0.47
Once a month	24	0.23	15	0.22	24	0.29
Rarely / Special occasions only	5	0.05	2	0.03	10	0.12
Where do you usually get your fish?*						
Restaurant	61	0.59	51	0.76	46	0.54
Seafood Market	32	0.31	12	0.18	19	0.22
Grocery	41	0.40	37	0.55	50	0.59
Self-harvest	22	0.21	0	0.00	7	0.08
Other	0	0.00	5	0.07	5	0.06
What species of fish do you eat?*						
Catfish	*72*	0.70	*17*	0.25	*42*	0.49
Bass	24	0.23	12	0.18	21	0.25
Drum	65	0.63	0	0.00	5	0.06
Flounder	46	0.45	15	0.22	33	0.39
Grouper	50	0.49	40	0.60	57	0.67
Mahi-Mahi	53	0.51	46	0.69	35	0.41
Salmon	69	0.67	61	0.91	70	0.82
Sea Bass	24	0.23	29	0.43	23	0.27
Tilapia	52	0.50	40	0.60	41	0.48
Trout	72	0.70	17	0.25	45	0.53
Tuna	73	0.71	55	0.82	48	0.56

Note. * Because panelists could select more than one response, proportions do not sum to one

Tables 3 and 4 report the panelists' responses to questions about their perceptions and preferences for various fish attributes, as well as some demographic indicators (gender and age).

Table 3. Panelist Responses to Post-Choice-Experiment Questions–*continued*

	New Orleans		Chicago		Clayton	
	Freq.	*%*	*Freq.*	*%*	*Freq.*	*%*
Knowing whether the fish I eat is locally-caught or produced is very important to me when buying fish.						
Strongly Disagree	0	0.00	4	0.06	1	0.01
Disagree	5	0.05	8	0.12	5	0.06
Neutral	21	0.20	17	0.25	21	0.25
Agree	38	0.37	25	0.37	30	0.36
Strongly Agree	39	0.38	13	0.19	27	0.32
Knowing whether the fish I eat is domestic (U.S.) or imported is very important to me.						
Strongly Disagree	1	0.01	4	0.06	0	0.00
Disagree	5	0.05	11	0.16	2	0.02
Neutral	18	0.17	19	0.28	11	0.13
Agree	24	0.23	19	0.28	21	0.25
Strongly Agree	55	0.53	14	0.21	51	0.60
Knowing whether the fish I eat are wild-caught or farm-raised is very important to me.						
Strongly Disagree	4	0.04	3	0.05	0	0.00
Disagree	5	0.05	5	0.08	1	0.01
Neutral	33	0.33	13	0.20	18	0.21
Agree	34	0.34	27	0.41	29	0.34
Strongly Agree	24	0.24	18	0.27	37	0.44
In general, do you prefer to buy wild-caught or farm-raised fish?						
Wild-caught	74	0.81	55	0.83	67	0.85
Farm-raised	17	0.19	7	0.11	12	0.15
No preference / other	0	0.00	4	0.06	0	0.00
Knowing whether the fish are organically grown is very important to me when buying farm-raised fish.						
Strongly Disagree	3	0.03	3	0.05	1	0.01
Disagree	15	0.15	6	0.09	2	0.02
Neutral	40	0.40	20	0.30	19	0.23
Agree	23	0.23	22	0.33	39	0.46
Strongly Agree	19	0.19	15	0.23	23	0.27

Knowing whether fish was locally-caught or produced was relatively more important for panelists in southern locations, like New Orleans and Clayton, compared to Chicago panelists, and the same pattern held for knowing whether fish was domestic or imported. Knowing whether fish was wild-caught or farm-raised was relatively more important among Clayton panelists compared to New Orleans and Chicago panelists. Responses in favor of wild-caught fish over farm-raised fish were consistent across panels, with over 80% preferring wild-caught fish. At the same time, however, knowing whether fish were organically grown and whether fish were caught or farmed in ways that cause little or no harm to habitats and other wildlife was relatively

more important among Chicago and Clayton panelists, with relatively more New Orleans panelists remaining neutral or disagreeing with these statements. The importance of knowing the species of fish being consumed was fairly consistent across panels, as was the importance of price for buying fish. In terms of demographic indicators, panels were slightly biased toward females, which are typically a household's primary grocery shoppers. The Chicago panel had the youngest mean panelist age (36-years-old), whereas the Clayton panel had the oldest (57-years-old), with 92% in Chicago and 78% in Clayton indicating a willingness to take risks when trying new foods.

Table 4. Panelist Responses to Post-Choice-Experiment Questions–*continued*

	New Orleans		**Chicago**		**Clayton**	
	Freq.	*%*	*Freq.*	*%*	*Freq.*	*%*
Knowing whether the fish I eat were caught or farmed in ways that cause little or no harm to habitats and other wildlife is very important to me.						
Strongly Disagree	2	0.02	1	0.02	0	0.00
Disagree	7	0.07	1	0.02	0	0.00
Neutral	21	0.21	9	0.14	9	0.11
Agree	39	0.39	35	0.53	34	0.41
Strongly Agree	31	0.31	20	0.30	40	0.48
Knowing which species of fish I eat is very important to me.						
Strongly Disagree	0	0.00	1	0.02	0	0.00
Disagree	5	0.05	2	0.03	1	0.01
Neutral	20	0.20	11	0.17	10	0.12
Agree	36	0.36	27	0.41	44	0.52
Strongly Agree	39	0.39	25	0.38	30	0.35
Price is the most important factor for me when buying fish.						
Strongly Disagree	5	0.05	9	0.14	7	0.08
Disagree	49	0.49	26	0.39	23	0.27
Neutral	20	0.20	16	0.24	28	0.33
Agree	18	0.18	12	0.18	21	0.25
Strongly Agree	8	0.08	3	0.05	5	0.06
In general, rate your willingness to take risks when trying new foods:						
Unwilling	9	0.09	1	0.02	5	0.06
Middle of the Road	8	0.08	4	0.06	14	0.16
Willing	82	0.83	61	0.92	66	0.78
Male	41	0.40	30	0.45	37	0.44
Age (Mean)	46.8		36.2		57.0	

Table A1 (see Appendix) reports the proportions of responses for each panel, separated by label treatment (blinded or labeled). Although these results do not account for price effects (which are statistically significant in the regression model in Table 5), they provide some preliminary indication of preferences. During the New Orleans panel, there were no indications of strong

preferences during the blind rounds, whereas we see a substantial proportion of "Least likely to buy" votes for *Delacata* catfish (0.50) and "Most likely to buy" votes for black drum (0.49) during labeled rounds. During the Chicago panel, we saw a substantial proportion of "Least likely to buy" votes for grouper and "Most likely to buy" votes for walleye during blind rounds. These preferences appear to change during labeled rounds, however, where we observe a substantial proportion of "Least likely to buy" votes for *Delacata* catfish (0.58) and "Most likely to buy" votes for grouper (0.56). During the Clayton panel we see a substantial proportion of "Most likely to buy" votes for *Delacata* catfish (0.52) and "Least likely to buy" votes for grouper (0.57), whereas during labeled rounds we observe a substantial proportion of "Most likely to buy" votes for grouper (0.41) and "Least likely to buy" votes for black drum (0.50). Again, these results do not account for price effects and are reported only to provide the reader with a general sense of the distribution of consumer choices.

Econometric Regression Model

Table 5 contains the results of the conditional logit regression model. The main coefficients on each fish species should be interpreted relative to the omitted base, *Delacata* catfish. None of the main fish species coefficients is significant, indicating that any significant differences regarding choice of these fish relative to *Delacata* are not attributable to the fish species themselves; rather to location and/or labeling effects. Grouper appeared in all three taste panels. The Grouper x Clayton interaction term is significant and negative, indicating that Grouper was significantly less likely to be chosen over *Delacata* during the Clayton panel relative to Chicago, which was the omitted base location. The Grouper x New Orleans interaction term is not significant, indicating no preference for one species over the other in New Orleans, relative to Chicago. Black Drum appeared in the Clayton and New Orleans taste panels only. The Black Drum x Clayton interaction term is significant and negative, indicating that Black Drum was significantly less preferred to *Delacata* during the Clayton panel relative to the omitted base location, New Orleans.

Table 5. Conditional Logit Regression Results.

	Coefficient		**Std. Error**
Grouper	0.112		0.164
x Clayton	-0.489	**	0.219
x Clayton x Labeled	0.297		0.223
x New Orleans	-0.253		0.224
x New Orleans x Labeled	0.403	**	0.200
x Chicago x Labeled	1.007	***	0.232
Black Drum	0.228		0.158
x Clayton	-1.250	***	0.232
x Clayton x Labeled	0.416	*	0.234
x New Orleans x Labeled	0.575	***	0.210
Walleye	-0.216		0.149
x Labeled	0.890	***	0.226
Price	0.019	***	0.006
Log Likelihood= -1712.184			
N=2006			

***, **, * indicate significance at the 99%, 95%, and 90% confidence levels, respectively.

Regarding labeling effects, the Grouper x Clayton x Labeled interaction term is not significant, indicating that labeling had no effect on consumer choice of Grouper relative to *Delacata* during the Clayton panel. However, the same interaction terms for New Orleans and Chicago are significant and positive indicating that, when the fish species were labeled, Grouper was significantly more likely to be chosen over *Delacata* at these locations. Similarly, the corresponding interaction terms for Black Drum are significant and positive, indicating that during the Clayton and New Orleans panels, Black Drum was significantly more likely to be chosen over *Delacata* when labeled. Note, however, that the magnitude of the Black Drum x Clayton coefficient is greater than that of the Black Drum x Clayton x Labeled coefficient meaning that, although Clayton panelists had a strong preference for *Delacata* relative to Black Drum overall, this preference was somewhat weakened by labeling. Finally, Walleye appeared only in the Chicago panel. The interaction term Walleye x Labeled is significant and positive, indicating that, when labeled, Walleye was significantly more likely to be chosen over *Delacata* at this location.

In sum, when served blind, panelists tended to be indifferent to fish species (as in the cases of New Orleans and Chicago) or to prefer *Delacata* catfish (as in the case of Clayton) but, when served labeled, panelists tended to prefer Grouper, Black Drum, and Walleye over *Delacata* catfish (as in the case of New Orleans and Chicago) or to have weaker preferences for *Delacata* catfish (as in the case of Clayton).

Welfare Estimates

Estimates of willingness-to-pay (WTP) for each fish alternative relative to *Delacata* catfish were calculated based on the results of the conditional logit regression. We report sample-weighted mean WTP for each fish, under the blind and labeled treatments, respectively.[7] That is, the welfare estimates are reported as weighted-average WTP across taste panel locations. Confidence intervals are calculated using the Delta method following Bliemer and Rose (2013).

Table 6 reports the willingness-to-pay estimates. Because *Delacata* catfish served as the base, each should be interpreted as a willingness to pay a premium (if the sign is positive) or as a required price discount (if the sign is negative), relative to *Delacata* catfish. Under the blind treatment, we estimate a price discount of -$8.24 for a fish entrée containing grouper relative to *Delacata* catfish. We calculate similar prices discounts for Black Drum (-$26.08) and Walleye (-$11.26).

[7] Following the notation of Equation 1, WTP for grouper under the blind treatment is defined as $WTP_G = \left[\beta_G + \beta_{GN} \left(\frac{p_{GN}}{p_G} \right) + \beta_{GC} \left(\frac{p_{GC}}{p_G} \right) \right] / \beta_P$, where p_{GN} and p_{GC} are defined as the proportions of grouper observations served at the New Orleans and Clayton panels, respectively; and p_G is defined as the proportion of grouper observations. WTP for grouper under the labeled treatment is defined as $WTP_{GL} = \left[\beta_G + \beta_{GN} \left(\frac{p_{GN}}{p_G} \right) + \beta_{GC} \left(\frac{p_{GC}}{p_G} \right) + \beta_{GNL} \left(\frac{p_{GNL}}{p_{GL}} \right) + \beta_{GCL} \left(\frac{p_{GCL}}{p_{GL}} \right) + \beta_{GChL} \left(\frac{p_{GChL}}{p_{GL}} \right) \right] / \beta_P$, where p_{GNL} , p_{GCL}, and p_{GChL} are defined as the proportions of labeled grouper observations that were served at the New Orleans, Clayton, and Chicago panels, respectively; and p_{GL} is defined as the proportion of labeled grouper observations. WTP for the other fish species are defined similarly.

Table 6. Blinded and labeled treatments: WTP and 95% confidence intervals for fish species relative to catfish entrée.

	Blind treatment		**Labeled treatment**	
	Mean WTP relative to Catfish	95% Confidence Interval	Mean WTP relative to Catfish	95% Confidence Interval
Grouper	-$8.24	(-$18.36, $1.87)	$18.31	($3.43, $33.19)
Black Drum	-$26.08	(-$43.04, -$9.13)	-$0.20	(-$11.69, $11.28)
Walleye	-$11.26	(-$28.56, $6.04)	$35.03	($6.55, $63.51)

For labeled treatments, we estimate a price premium of $18.31 associated with Grouper relative to *Delacata* catfish when labeled. We calculate a similar price premium for Walleye ($35.03). For Black Drum, however, we calculate a very slight price discount, i.e., a mean WTP of -$0.20. In summary, we find price discounts needed for Grouper, Black Drum, and Walleye relative to *Delacata* catfish when the tasting was blind, but find price premia for Grouper and Walleye relative to *Delacata* catfish when the alternatives were labeled.

Conclusions

This paper reports the results of what we believe to be the only consumer study that compares preferences for catfish directly to other fish species in a choice experiment with tasting sessions. The use of tasting sessions in seafood restaurants at several locations in the United States served to increase the experimental context of the study. Furthermore, this is the first study, to our knowledge, that tests consumer preferences for *Delacata* catfish, a relatively new cut of catfish developed with the specific goal of competing with other premium cuts of fish.

Our results indicate that *Delacata* catfish may fare well in terms of search and experience attributes such as entrée appearance, taste, texture, and similar characteristics. Under blinded choice tasks (i.e., when panelists were not provided information on the sample entrées they were tasting), it fared equally well or better than the other fish species tested against it. The results indicate, however, that *Delacata* catfish faces some perception challenges when consumers are aware of the fish they are evaluating. During the labeled rounds (i.e., when panelists were provided with information on fish species, production method, and place of origin), all of the alternative fish species were preferred to *Delacata* catfish in two of the three taste panels, and the presence of labeling weakened preferences for *Delacata* catfish in the third panel.

The labeling effect could be a function of several things, which the current study was unable to identify specifically. First, consumer choices could have been driven by the species of fish or by the production method (wild-caught vs. farm-raised), or by both, with potentially conflicting effects. For example, *Delacata* catfish was the only farm-raised fish used in the study; all others were wild-caught. Based on panelists' responses to questions about general fish-buying habits, wild-caught fish are very strongly preferred. The same applies to origin. Although all fish used during the panels were domestically-caught, panelists indicated a preference for locally-caught fish in their responses about their purchasing habits. During the New Orleans panel, both wild-caught species (grouper and black drum) were originally from the Gulf of Mexico, whereas the *Delacata* catfish was farm-raised in Yazoo City, Mississippi. It is unknown how panelists perceived these origins, but it is possible that the *Delacata* may have been perceived as "less-

local" than the other two. In the Chicago panel, the grouper was originally from coastal Virginia, while the walleye was from Lake Erie. In this case, the walleye was likely the "local" alternative, with the others perceived as equally non-local. In the Clayton panel, *Delacata* catfish came from Mississippi, whereas the grouper and black drum were from Florida and Louisiana, respectively. In this case, these may have been perceived as equally non-local. These attributes depended on the specific fish fillets that the restaurants were able to procure and, thus, constitutes a limitation of the study. Additionally, our study focused on preferences in a high-end restaurant setting only; therefore our results may not reflect the preferences for these same products in other settings. Future research could focus on an experimental design that disentangles the species effects from that of production method, origin, and other key attributes, as well as expands into additional purchase points, such as groceries and seafood markets.

Overall, the findings here signal both challenges and opportunities in terms of expanded market potential for *Delacata* catfish. Possible avenues to increase its market potential could include marketing strategies that highlight the fact that catfish is considered a "Best choice" (see Footnote 1), in terms of sustainability and is domestically-produced. On the other hand, the findings also highlight some potential challenges, such as overcoming the apparent consumer preference for wild-caught fish. Another challenge seems to be implied by our finding that preferences for catfish were relatively strong when panelists were not aware of the species they were tasting, but declined when panelists were informed about the species of fish. It is unclear whether this is because panelists simply have strong preferences for the other fish species, or because they have strong preferences against catfish. Our results do provide some evidence, however, that the name of the fish may play an important role in consumer perceptions. Marketing strategies such as renaming a product, which was done with Mahi Mahi and Chilean Seabass, have shown to be successful in repositioning products that have consumer perception challenges.

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Appendix

Table A1. Proportions of Responses by Fish Species at Each Panel.

	New Orleans				**Chicago**				**Clayton**			
	Blind		*Labeled*		*Blind*		*Labeled*		*Blind*		*Labeled*	
	MLTB	**LLTB**	**MLTB**	**LLTB**	**MLTB**	**LLTB**	**MLTB**	**LLTB**	**MLTB**	**LLTB**	**MLTB**	**LLTB**
Delacata Catfish	.39	.38	.29	.50	.34	.31	.18	.58	.52	.19	.37	.22
Grouper	.38	.24	.22	.33	.25	.40	.56	.19	.14	.57	.41	.29
Black Drum	.23	.39	.49	.17					.28	.24	.22	.50
Walleye					.42	.29	.26	.23				
N =	194		205		134		134		169		167	

Note. MLTB=Most Likely to Buy; **LLTB**=Least likely to Buy

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The Marketing of Meat Goats in the US: What, Where, and When?[1]

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Abstract

Using nationwide survey data, this study investigates US meat goat producers' selection of marketing channels, factors affecting selections, and targeting of ethnic holiday markets. Results show the two most commonly cited marketing channels are *direct sales to consumers* and *live auctions.* Only a relatively small portion of the population uses other marketing channels. Ethnic holiday markets are targeted by 22% of the producers—Easter being the most popular choice. Multivariate probit results show that farm and farmer characteristics, types of animals sold, and regional variables impact marketing channel selection.

Keywords: marketing channels, meat goat

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[1] The views expressed here are not necessarily those of Economic Research Service or the U.S. Department of Agriculture.

Introduction

The United States meat goat industry has rapidly increased in size over the past couple of decades, from 415,196 head of meat and other goats on over 29,354 farms in 1987[2] (excluding wool and milk goats) to 2,053,228 head of goats on more than 101,910 farms in 2012.[3] Although the industry has expanded, it continues to lack a well-structured marketing system (Glimp 1995; Onyango et al. 2015). As such, meat goat producers need information on how to most effectively market their products. Jones and Raper (2012) discuss the need for producers to have answers to the what, where, and when questions for effective product marketing. A number of previous studies have addressed meat goat marketing dynamics and price seasonality in the US and around the world (Aduku et al.; 1991; Pinkerton, Scarfe, and Pinkerton 1991; Degner and Lin 1993; Glimp 1995; Frasor 2004; Larson and Thompson 2005; Pandit and Dhaka 2005; Jones, McCarter, and Cheney 2012; Jones and Raper 2012) and some other aspects of meat goat production (Gillespie, Nyaupane, and McMillin 2013; Onyango et al. 2015; Gillespie et al. 2016; Osti et al. 2016; Qushim, Gillespie, and McMillin 2016). However, we find no previous attempts to extensively analyze the "what, where, and when" questions of meat goat marketing. This study addresses these questions and will be useful in further enhancing the economic sustainability and competitiveness of the US meat goat industry.

The meat goat industry is unique in at least three dimensions of marketing as compared to the major US livestock industries, beef, pork, and poultry. First, a significant portion of US meat goat and goat meat demand is for live goats that consumers slaughter and process themselves. In these cases, consumers generally go directly to the farmers to purchase goats (Stanton 2006). Second, meat goat demand is seasonal, as it is more heavily consumed during certain ethnic holidays (Coffey 2006). Table 1 summarizes the type and quality of goat meat demanded by consumers during various ethnic holidays. Third, most US meat goat production occurs in Texas and in the Southeast whereas the major US meat goat slaughter and processing facilities and goat meat consuming population are located on the west and east coasts (Pinkerton, Scarfe, and Pinkerton 1991).

Being a relatively new industry with unique marketing characteristics, the US meat goat industry needs information on current marketing practices so that it can determine strategies for enhanced industry competitiveness. A number of previous studies have addressed producer selection of marketing channels for various agricultural enterprises (e.g., Schmitz, Moss, and Schmitz 2003; Gillespie, Basarir, and Schupp 2004; Park 2009; Nyaupane and Gillespie 2010; Kim, Curtis, and Yeager 2014), but we are aware of none that have addressed marketing channels in the US meat goat industry. The objectives of this study are to determine: (1) the major meat goat marketing channels in the US and the factors affecting producer selection among marketing channels and (2) the interrelationship between the attributes of meat goats produced and the targeting of ethnic holidays for sales.

[2] USDA-APHIS 2005.
[3] USDA-NASS Census of Agriculture 2012.

Table 1. Type and Quality of Goat Meat Demanded during Ethnic Holidays

Ethnic holidays	Date	Preference	Optimum Weight (lbs)
Western Roman Easter	March-April	Mild fed kids, 3 months or younger	30
Eastern Orthodox Easter	April-May	Mild fed kids, 3 months or younger	35
Mother's Day	May	Suckling kids or larger	60
Cinco de Mayo	May 5	Suckling kids	15-30
Ramadan	June-July	Male or female with all milk teeth, ≤12 months, whole or castrated	60
Id al Fitr	July-August	Male or female with all milk teeth, ≤12 months, whole or castrated	60
Navadurga, Dashain	October	Castrated male	60-120
Eid al-Adha	September-October	Yearlings	60-100
Muharramn	October-November	Male or female with all milk teeth, ≤12 months, whole or castrated	60
Diwali	October-November	Castrated male	60-120
Christmas and New Year	Dec.25 & Jan. 1	Milk fed kids	18-30
Caribbean holidays and Chinese market for goat		Young, smelly bucks, older animals of all sexes	60-80

Source. http://sheepgoatmarketing.info/calendar.php

The US Meat Goat Industry and Ethnic Demand

The US population increased significantly from 152.3 million in 1950, to 308.7 million in 2010, to 322.7 million in January, 2016; and immigration has been a primary contributor (Shrestha and Heisler 2011; US Census Bureau 2016). The foreign-born population residing in the US in 2015 was 14% and is projected to increase to 18% by 2065 (Cohn 2015). Hispanics and Asians comprised 18% and 6% respectively of the total in 2015, and are expected to rise to 24% and 14%, respectively, by 2065 (Cohn 2015). A significant increase in immigrants from goat meat consuming nations has increased the demand for meat goats in the US and demand will likely continue as the growth in the immigrant population continues (Solaiman 2007). The US foreign-born population increased from 9.7 million in 1960 to 31.1 million in 2000, and to 41.3 million in 2013 (Pew Research Center 2015). In 1966, 84% of the US immigrants were from Europe and Canada, with the percentage dropping to 14% by 2013. During that same period, immigrants from goat meat consuming areas such as Mexico, South and East Asia, and other Latin America countries increased from 6%, 4%, and 4% of total immigrants to 28%, 26%, and 24% of total immigrants, respectively (Pew Research Center 2015).

Although domestic meat goat production has increased considerably over the last few decades, the US continues to partially supply its demand by importing frozen goat meat from Australia and New Zealand (Stanton 2012). Goat meat imports increased from 1,749 metric tons in 1991 to 8462 metric tons in 2003; to 15,752 metric tons in 2011—equivalent to approximately 1,052,340 live goats (Stanton 2012). Since most consumers prefer fresh meat over frozen, there is significant potential for growth and development of domestic meat goat production (Knudson 2006). With the varying nature of consumer preferences and their willingness to pay (Knight et al. 2006; Ibrahim 2011), supplying the most preferred product to the market will not only guarantee consumer satisfaction but also provide meat goat producers an opportunity for greater economic return.

Meat Goat Marketing Channels

According to Stanton (2006), in a typical US meat goat supply chain, meat goats are first marketed to nearby live auction markets. Dealers purchase goats for sale to meat packers, wholesale businesses, or further sale via regional auctions. Meat packers then sell meat cuts or carcasses to retailers and wholesale businesses arrange for further processing of animals. This typical scenario is by no means universal for all farms and locations, as some producers market live goats directly to consumers and market goat meat, etc.

Considering the various marketing alternatives discussed by Stanton (2006), a thorough evaluation of the industry and direct communication with selected producers[4], seven major meat goat marketing channels were identified for examination in this study: (a) dealers, brokers, or meat packers; (b) wholesale and retail businesses; (c) selling of goat meat (there are several options investigated in this study); (d) live auctions; (e) market pooling; (f) direct sale to consumers; and (g) cooperatives.

A typical meat goat marketing system involves producers selling goats via local auctions, from where livestock dealers purchase goats and deliver them to regional auctions and/or sell them directly to other distributing agents such as meat packers or wholesale businesses. These distributing agents sell the meat to retailers, which is eventually sold to consumers (Stanton 2006). Selling via live auction reduces marketing effort and thus transaction costs, with the additional benefit of timely and reliable payment, but producers have no control over price. As this option introduces substantial price risk, producers using this market outlet can reduce potential risk associated with auction markets via larger regional auctions and/or contacting several local auctions to better navigate the marketing scenarios (Jones, McCarter, and Cheney 2012).

Livestock dealers and brokers are similar as both may go directly to the farm to purchase goats, with the latter generally working on commission. Meat packers operate slaughterhouses and supply meat to wholesale and retail customers. If producers choose to bypass dealers, brokers, or meat packers, they can act as wholesalers or retail businesses themselves (Ziehl et al. 2006) and sell inspected meat directly to restaurants, retail meat shops, and individuals. Using this channel,

[4]Several meat goat producers around Baton Rouge, Louisiana, were contacted to review the draft questionnaire, and three of them agreed. We arranged one-to-one personal interviews with them and discussed the overall representativeness of questionnaire, including marketing outlets.

producers make all arrangements for slaughter, processing, and transport of meat to buyers. Challenges with this route are finding dependable inspected slaughter facilities and establishing legal, reliable methods of delivering meat to buyers. Furthermore, it requires one to solicit clients, to maintain good business relationships with them, arrange shipments, and periodically negotiate with new customers such as chefs. In addition to slaughtering and processing at a USDA or state-inspected facility, strict procedures have to be maintained in transporting ($<40^0$F) and storing the meat (Stanton 2006). Although more effort is generally required in selling to wholesalers and retail businesses, higher prices generally result (Stanton 2006).

A viable option for relatively smaller sized farms is to pool animals where one or two producers act as market coordinators and animals are pooled together from multiple small-sized farms. This not only increases the negotiating power of producers but also facilitates the sales to volume buyers. Another option is to sell animals directly to consumers, either via 'on-farm' sales (local customers come to the farm and choose animals) or the 'freezer trade,' where goats are transported to slaughterhouses for slaughter and processing. Formal cooperatives can be another option for producers for marketing their animals to volume buyers. Establishment costs, maintenance of member loyalty, quality assurance, and associated commissions are major considerations when establishing a cooperative (Stanton 2006). In a broad perspective, producers may choose to either sell live goats off the farm via various outlets or be involved in processing, wholesaling, and retailing of goat meat to individual consumers, stores, and/or restaurants.

First, we examine to what extent producers use each of these marketing channels and the factors impacting producer use in each method. This is followed by an analysis of the types of goats sold throughout the year in accordance with the targeting of ethnic holidays.

Data and Methods

A mail survey was sent to 1,600 US meat goat producers during July–August of 2012, utilizing Dillman, Smyth, and Christian's (2009) Tailored Design Method. Producer names were collected online. Search phrases such as *"meat goat producers in Louisiana"*, *"meat goat association, LA"*, or *"meat goat farms, Louisiana"* were entered for each state resulting in 4-5 Google pages that were thoroughly assessed for web-links and listing of meat goat farms. Most producers listed were members of statewide meat goat associations, however, some did not belong to associations and had their own websites; and others were listed as meat goat producers on www.eatwild.com. The first round of mailing included a cover letter, a ten-page questionnaire, a complementary pen, and a postage-paid return envelope. After one week, a postcard reminder was sent to non-respondents. This was followed by a second cover letter, survey, and return envelope to non-respondents two weeks later. One week later, a final reminder (second postcard) was sent. After removing 190 producers who did not produce meat goats in 2011 and fifty-two non-deliverables, an adjusted response rate of 43% was received for a total of 584 completed responses. Several other studies have also used this data to analyze various aspects of meat goat production, for example Gillespie, Nyaupane, and McMillin (2013), Gillespie et al. (2016), Osti et al. (2016) etc.

To determine the marketing channels producers used, the following question was asked: "Which of the following marketing channels do you use to sell goats? (Check all that apply)." Possible choices included: (a) Dealers, brokers, or meat packers, (b) Wholesale and retail businesses, (c) I

sell goat meat, (d) Live auctions, (e) Market pooling, (f) Direct sale to consumers; and (g) Cooperatives. One question designed to identify farmers selling live goats, was followed with the following responses: "If you answered that you sell goat meat [(c)], through what outlets do you market the meat?," with the following possible choices: (a) Farmers markets, (b) Direct to consumers, (c) Grocery stores, (d) Restaurants, and (e) Other. Some readers may initially find it difficult to distinguish between "Direct sales to consumers," and "I sell goat meat". It is noteworthy to mention that in the first question with marketing outlet "Direct sale to consumers," producers sell the animals "on-farm". In some cases, they may then deliver the sold animal to a slaughterhouse for the buyer. In the outlet "I sell goat meat," producers act as processor, wholesaler, and retailer to slaughter animals in inspected slaughterhouses and to sell meat (following strict protocols) in various outlets such as farmers markets, direct to consumers, grocery stores, restaurants etc. (Stanton 2006; Ziehl 2006).

To meet the second objective, a follow-up question was asked: "Do you target your goat production for specific ethnic holiday markets?" with possible choices of "Yes" and "No." Producers responding "Yes" to the question were directed to another follow-up question: "For which of the following holiday seasons do you generally focus sales? (Circle all that apply)." Possible choices included: (a) Easter, (b) Ramadan, (c) Eid al-Adha, (d) Hispanic holidays, (e) Christmas and/or New Years, (f) Dashain, (g) Caribbean holidays, and (h) Other. Easter is a Christian holiday that celebrates the resurrection of Jesus Christ. Easter generally falls during March or April. Ramadan (May/June) is observed by Muslims as a month of fasting (food is served before dawn and after sunset). Eid al-Adha (August/September) is also an Islamic festival and is widely regarded as 'Festival of the Sacrifice' or 'Sacrifice Feast.' Dashain (October) is arguably the largest festival for Hindus. It is celebrated as the symbol of victory of good over evil. Most of these ethnic holidays have their own characteristic demands for specific types of meat goats. Information on different types of meat goat sales was collected by the following question: "Please list the total numbers of goats you sold in each of the following categories during 2011." Possible choices included: "(a) Suckling kids, (b) Weaned kids (≤30 lbs), (c) Wethers (>30 lbs), (d) Bucks (31- 120 lbs), (e) Bucks (>120 lbs), (f) Does (31-100 lbs), (g) Does (>100 lbs), and (h) Other." Suckling kids are unweaned goat kids ranging from four to twelve weeks old. Weaned kids, also called market kids, are separated from their mothers but have no adult teeth (all milk teeth). Wethers are castrated male goats; bucks are adult male goats, and does are adult female goats (Stanton 2006). The remainder of the survey included questions related to production practices, breeding practices, producer perceptions of market prices of different quality goats, important challenges facing the industry, producer goal structure, selection of breeding stock, and socio-demographic information of the producer.

Representativeness of the Sample Population

Estimates from the USDA-NASS Census of Agriculture (2012) show that there were 100,910 meat goat farms (not including angora or milk goats) in the US with 2,053,228 meat goats in inventory, so the average meat goat farm inventory was about twenty goats. Our sample farms included an average of sixty-one goats (See Table A1, Appendix) of which sixteen were breeds that could have been used for hair (i.e., mohair, cashmere), dairy, or other purposes. Therefore, our farms are larger-scale than the average agricultural census farm.

However, before concluding that our sample of commercial meat goat farms is not representative, several things should be considered. First, USDA-APHIS (2005) states that meat goat experts believe the 2002 agricultural census captured only 55% to 65% of the meat goat producer population. USDA-APHIS (2011), analyzing 2007 Census of Agriculture data, showed that 52.4% of US meat goat farms had <10 goats in inventory, accounting for 9.1% of total goat inventory. USDA-APHIS (2011) shows that the focus of 72.4% of those with <10 goats was "other," listed for livestock shows, pack animals, pets, and brush control. They found that the larger the farm, the less likely the farm was focused on "other" functions, with only 4.9% of farms holding 100-499 goats focusing on "other" functions.

If farms with <10 goats cannot be truly considered to represent commercial meat goat operations, then the USDA-NASS Census of Agriculture (2012) average of 20 goats per farm cannot be considered representative of commercial meat goat production. We argue that our sample meat goat producers were behaving as commercial producers since they were members of meat goat associations and/or were advertising their products via the Internet. Furthermore, our sample was represented by farms in all states in the US except for AK, CT, HI, MT, NV, RI, and WY, which together represented <2% of US meat goat farms in 2007 (USDA-NASS Census of Agriculture 2007).

Producer Selection of Marketing Channels

Coase (1937) discussed transaction costs, which are the costs associated with the economic exchange, as the major determinants in the decision-making process of a firm. Williamson (1979) further argued that transaction costs are so central to the economic activities of a firm that the relative advantages of one mode of organizational activity to the others are decided by their associated cost structure. Categories of transaction costs include those associated with bargaining, collecting information, searching for inputs to purchase or markets through which to sell a product, and policing (or enforcing) to ensure that both parties to a transaction are complying with the agreed-upon terms of the contract, whether formal or informal. Hobbs (1997) and De Bruyn et al. (2001) found that transaction costs significantly affected producer selection of livestock marketing channels. In this study, we assume that meat goat marketing channels differ in their relative transaction cost structures and producers consider these costs in their marketing decisions.

We describe the producer's utility associated with marketing channel selection as:

$$(1) \quad U_{ij} = V_{ij} + \varepsilon_{ij},$$

where meat goat farm *i* chooses the marketing channel *j* that provides the highest utility among *J* alternatives. The deterministic component of the utility is V_{ij} and ε_{ij} is the random component. Assuming farm profit as a latent consideration of a producer in selecting a marketing channel, his/her marketing channel selection decision is modeled in this study as being a function of farm and farmer characteristics, which may be associated with specific transaction costs.

Since the selection of marketing channel(s) can be described as a system of equations for multiple discrete outcomes (1 if selected; 0 if not selected), the probability distribution of

selection can be estimated using the multivariate probit model. In accordance with Cappellari and Jenkins (2003), the probability of a producer selecting given marketing channels can be described as:

$$(2)\quad y_{im}^{*} = \beta_m' x_{im} + \varepsilon_{im},\ m = 1, \ldots\ldots, M$$
$$y_{im} = 1\ if\ y_{im}^{*} > 0, 0\ \text{otherwise}$$

where y_{im} represents the outcomes for *M* different choices of marketing channels that a producer is likely to select, β_m' represents the coefficients for marketing channels, and x_{im} is a set of explanatory variables used in the analysis. Furthermore, ε_{im}, *m* = 1,…, *M*, are error terms with multivariate normal distribution, each with zero mean and variance-covariance matrix of *V* Cappellari and Jenkins (2003). There are *M*=7 marketing channels.

Independent Variables Used in the Marketing Channel Selection Models

Factors hypothesized to impact a producer's choice of market for selling goats include farm characteristics, producer demographics, production systems, and production region. *Number Goats* is the total number of meat goats raised on the farm, serving as a proxy for farm size. Schmitz, Moss, and Schmitz (2003) and Gillespie, Basarir, and Schupp (2004) found that larger-scale beef producers were more likely than smaller-scale producers to select alternative markets over the conventional auction. Schmitz, Moss, and Schmitz (2003) argued that larger-scale producers could take advantage of an increased number of marketing alternatives and lower per-unit transaction costs (such as those associated with bargaining, information collection, and market search) as compared to smaller-scale producers. In this study, it was expected that larger-scale producers would more likely market to volume buyers such as dealers, wholesalers, and meat packers with transportation and marketing costs spread over volume sales.

Percent Sale Slaughter is the percentage of goat sales for slaughter or as meat. Lower percentages of sales to slaughter suggest that higher percentages of goats are sold for breeding, show, and other purposes. Breeding and show goats tend to generally be sold directly to consumers either via private treaty or consignment sales (invited sales at auctions) (Jones, McCarter, and Cheney 2012). Prices received for breeding stock and show goats are generally higher than those for slaughter goats (Jones, McCarter, and Cheney 2012). These higher prices likely serve to offset the higher transaction costs (such as those associated with bargaining, searching for markets, and collecting market information) associated with selling individual animals with specific characteristics desirable for breeding or for show. Furthermore, producers are likely to consider minimizing "shrinkage" that is caused by extensive handling and transporting of animals so that the quality of breeding animals is maintained using on-farm direct sales.

Producer demographics for operator *Age* and *Bachelor* are included. Nyaupane and Gillespie (2010) found crawfish producer age to be positively associated with sales direct to processors and negatively associated with sales to wholesalers in crawfish marketing. Gillespie, Basarir, and Schupp (2004) found that cattle producers holding college degrees were more likely to market via private treaty and strategic alliances. In this study, *Age* is a continuous variable representing

the producer's age in 15-year intervals, and *Bachelor* is a dummy variable indicating whether a producer held at least a college bachelor's degree.

Income diversification variables *Off Farm Job* and *Farm Income Goat* are included. *Off Farm Job* is a dummy variable indicating the producer held an off-farm job. Producers with off-farm jobs are generally expected to have less time available to devote to farm activities. Thus, they are expected to be less likely to sell meat goats direct to consumers or to sell goat meat due to the higher transaction costs associated with the time required for each sale with these outlets. On the other hand, they are expected to be more likely to use marketing outlets that entail lower producer transaction costs, such as cooperatives and market pooling. In these cases, major marketing responsibilities which may include searching for markets and/or low-priced bulk inputs for producers, collecting information on markets, and negotiating terms of agreement are taken by the market coordinator(s). Gillespie, Basarir, and Schupp (2004) found that producers receiving greater shares of their income from off-farm jobs were more likely to use conventional auctions in cattle marketing. *Farm Income Goat* is a continuous variable indicating the percentage of annual net farm income derived from the meat goat operation, a measure of farm diversification. Farm diversification may serve as a risk management tool (Robison and Barry 1987) and has been shown to impact marketing channel selection (Davis and Gillespie 2007; Nyaupane and Gillespie 2010).

Three major production systems used on US meat goat farms were included in this analysis. With the extensive system (*Extensive*) as described by Coffey (2006), goats are not handled much and are kept on large tracts of pasture or rangeland, mostly "fending for themselves." They forage for food and care for young with minimal assistance. In a pastured but not rotated system, goats are pastured without using a management intensive rotational grazing system. In a pastured and rotated system, pastures are cross-fenced into paddocks so that animals can be rotated to fresh pasture on a regular basis to maximize forage productivity. We represent these two systems as *Pastured* system. In a dry lot system (*Dry Lot*), goats are kept in an area where there is no growing forage. Goats are fed with purchased feed and/or hay (Coffey 2006). The percentage of animals in the extensive system serves as the base.

Regional dummy variables *Southeast* (including AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, and WV), *Northeast* (including CT, DE, IA, IL, IN, MA, MD, ME, MI, MN, MO, NH, NJ, NY, OH, PA, RI, VT, and WI), and *West* (including AK, AZ, CA, CO, HI, ID, KS, MT, ND, NE, NM, NV, OR, SD, UT, WA, and WY) were used to explore geographical differences in meat goat marketing. *Texas/Oklahoma* (TX and OK) was used as the base. According to Census of Agriculture (2012), Texas ranks first in terms of both total meat goat producing farms and number of meat goats produced, whereas Oklahoma ranks fourth and fifth in both categories, respectively, thereby representing 37% of total US meat goat production in 2012. The total number of responses we received from Texas and Oklahoma do not exactly resemble the national statistics (Appendix B), which is likely because the online availability of statewide producer addresses are not necessarily proportional to the total number of producers in those states. Land quality, market availability, prices, and other factors differ by region; therefore producer selection of marketing channels may also differ by region. Previous studies including regional variables in marketing channel research include Park and Lohr (2006) and Park (2009).

Results

Table 2 shows the use of different marketing channels by US meat goat producers. The two most commonly used marketing channels were *Direct Sale to Consumer* (79%) and *Live Auctions* (65%), whereas others were used by relatively smaller portions of the population. Fifteen percent of the producers used *Dealers, Brokers, or Meat Packers*, 11% sold goat meat, 5% used *Market Pooling*, 3% sold to *Wholesale and Retail Businesses*, and 3% used *Cooperatives*. Of those selling goat meat, 94% sold directly to the consumer[5], 21% sold at farmers markets, 14% sold to restaurants, 4% sold to grocery stores, and 7% sold to others. It is important to understand that percentage use of marketing channels does not necessarily represent the number of animals sold via that marketing outlet. For instance, it is likely that many producers sold only a few goats via *Direct Sale to Consumers* but indicate its use as a marketing outlet in the questionnaire.

Table 2. Percentage Use of Marketing Channels

Marketing Channels	Percent
Direct sale to consumer	79
Live auction	65
Dealer, brokers, or meat packers	15
I sell goat meat	11
Market pooling	5
Wholesale and retail businesses	3
Cooperatives	3

Table 3 shows the percentages of producers targeting their meat goat sales for different ethnic holiday markets. Only 22% of producers targeted their meat goat sales to any specific ethnic holiday market. Most producers (18%) targeted Easter, followed by Ramadan and Christmas/ New Year's (11% each). The result showing Easter as a dominant ethnic holiday market is consistent with Gipson (1996) who argued that the total number of goats slaughtered (primarily 'Easter kid') doubled two weeks before Easter, a primary result of demand generated by the Greek and Italian ethnic populations. Hispanic holidays were targeted by 9% of the producers. The holiday markets Eid al-Adha, Caribbean holidays, Dashain, and others were targeted by considerably smaller percentages of the population, 3%, 1%, <1%, and <1%, respectively. Overall, relatively few farmers targeted their sales to specific holiday markets.

[5] We asked the question in such a way that farmers were given separate response categories for farmers markets and direct to consumer sales. It is conceivable, however, that some respondents who sold only at farmer's markets could have also checked "sold direct to consumers" since farmer's markets are set up for farmers to sell direct to the consumer.

Table 3. Percentage of Producers Targeting Sales to the Specific Ethnic Holidays

Ethnic Holidays	Percent Targeting
Easter	18
Ramadan	11
Christmas and/or New Year	11
Hispanic holidays	9
Eid al-Adha	3
Caribbean holidays	1
Dashain	<1
Other	<1

Note. A total of 22% producers targeted ethnic holidays

Table 4 provides the means and standard deviations of the total numbers of goats sold by producers under different categories. Does weighing 31–100 pounds were the most commonly sold animal category with an average of more than 10 animals per farm, followed by wethers weighing >30 pounds with an average of more than 9 animals per year. An average of 7.5 bucks, weighing 31–120 pounds were sold by farms. Smith, Carpenter, and Shelton (1978) and Madruga, Arruda, and Nascimento (1999) discussed animal age to be one of the major determinant factors of goat meat quality and found that meat produced from six months to one-year-old animals is superior in juiciness, palatability, and tenderness. Colomer-Rocher et al. (1992) found a reduction in percentage bone content with an increase in animal weight. These findings suggest that the age and weight of an animal impact the quality and quantity of meat produced, and potentially influence consumer demand. Our observation of higher sales of animals in the 31–120 lbs. category is consistent with the meat qualities preferred by most consumers as well the larger volume of meat production as suggested by previous studies. Higher sales of wethers is probably because of their improved meat juiciness, flavor, and tenderness (El-Hag et al. 2007) as well as their preference by some ethnic consumers, such as Hindus.

Table 4. Summary of Total Goats Sold in 2011

Categories	Mean	S.D.
Suckling kids	1.0	5.5
Weaned kids (≤30 lbs)	4.2	15.9
Wethers (>30 lbs)	9.4	22.0
Bucks (31-120 lbs)	7.5	18.1
Bucks (>120 lbs)	1.3	4.3
Does (31-100 lbs)	10.4	20.0
Does (>100 lbs)	4.9	10.6
Others	0.9	10.0

Farms sold an average of 4.9 does weighing >100 pounds and 4.2 weaned kids weighing ≤30 pounds. A few bucks weighing >120 pounds were sold (1.3 animals). The reduction in juiciness and tenderness of meat in older animals (Smith, Carpenter, and Shelton 1978; Schönfeldt et al. 1993; Pratiwi, Murray, and Taylor 2007) could have played a significant role in the lower sales of heavier animals. Although it is surprising to see relatively small numbers of suckling kids sold despite the fact that Easter (for which suckling kids are highly demanded) is a leading ethnic holiday selected, the small portion of the producers targeting ethnic markets (22%) and no records available for total animals sold during each season may have led to this disparity.

Factors Affecting Producer Selection of Meat Goat Marketing Channels

Table A1 (see Appendix) presents summary statistics of each of the independent variables included in the multivariate probit model. Multivariate probit results in Table A2 (See Appendix) suggest that larger-scale producers were generally greater users of dealers, brokers, and meat packers. It is not surprising to see larger-scale producers selling via volume buyers as they can reduce per-animal transaction costs associated with individual animal or small-volume sales and reduce per animal transportation costs. Producers selling higher percentages of animals for slaughter were greater users of dealers, brokers, and meat packers; live auctions; and cooperatives; sold more goat meat, and were less likely to sell directly to consumers. In cases where animals are differentiated from others due to their superior breeding or show ability, use of direct marketing to consumers is expected.

Older producers were less likely to use live auctions. Producers holding bachelor's degrees were greater marketers via dealers, brokers, or meat packers and wholesale and retail businesses and lesser users of live auction markets. This suggests that more highly educated producers were more likely to sell via marketing outlets where they could receive market premiums. Producers holding off-farm jobs were less likely to sell goat meat and more likely to market via cooperatives. As discussed earlier, producers holding off-farm jobs would generally have less time for involvement in value-added activities. Selling goat meat requires considerable effort in building professional/business relationships with buyers as well as arranging for transportation, slaughter, packing, storing, etc. (Knudson 2006), all of which are associated with higher transaction costs. On the other hand, producers holding off-farm jobs may benefit from marketing via cooperatives where they can share marketing responsibility and sell with other producers in volume.

Producers receiving higher percentages of net farm income from the goat enterprise (*Farm Income Goat*) were more likely to sell goats via wholesale and retail businesses. Relative to using extensive-range production systems, the probability of selling goats via a live auction market increased if producers were using pastured systems (*Pastured*). Selling via dealers, brokers, and meat packers increased if the producer used a dry lot system relative to an extensive system.

Results for the regional variables show that, compared with producers in *TX* and *OK*, producers in the *Northeast* and *West* were more likely to sell goat meat to producers in the *West* and were more likely to use cooperatives to sell their goats. Having higher concentrations of the foreign-born population residing in Northeast and West (particularly on the coasts) (Grieco et al. 2012), it is not surprising to see producers utilizing the opportunity to maximize returns by selling goat meat direct to consumers in those regions. *Northeast* was automatically dropped from the

regression for the market pooling and cooperatives regressions due to perfect collinearity. On the other hand, none of the variables showed significant impacts on producer use of market pooling; therefore those results are not reported.

Discussion and Conclusions

Using nationwide survey data, this study examines the various aspects of meat goat marketing in the United States. Results showed that *Direct Sale to Consumer* and *Live Auction* were the most heavily used marketing channels by US meat goat producers, at 79% and 65%, respectively. These results do not necessarily suggest that these channels moved the greatest volumes, but indicate that most producers used them for marketing at least some of their goats. Higher price premiums, reduced transportation cost, and an opportunity to develop long-term business relationships with local consumers likely played roles in producers selling direct to consumers, whereas an opportunity for volume sales, lower transaction costs associated with identifying buyers, and reliable markets could be some of the primary reasons for using live auction markets. Fewer producers, 15%, and 11%, were found to market via dealers, brokers, or meat packers, and to sell goat meat, whereas the remaining marketing channels were used by less than 5% each.

Multivariate probit results show farm size, type of animal sold, producer demographics, production systems, and regional variables to be significant determinants in producer selection of marketing channels. Larger-scale producers tended to use marketing channels such as dealers, brokers, and meat packers likely because they have the volume required by these buyers. Producers selling greater percentages of slaughter goats were more likely to sell via dealers, brokers and meat packers and were less likely to sell directly to consumers. This is consistent with the general tendency of producers to sell breeding stock via consignment sales and private treaty (Jones, McCarter, and Cheney 2012).

Only 22% of producers targeted their production for specific ethnic holiday markets. Of those, more than 80% targeted Easter. The lower use of ethnic holiday markets could possibly suggest two scenarios – either most of these producers are unaware of the opportunity associated with these ethnic markets or they ignore it because the cost associated with targeting breeding does not make it economically favorable. On the other hand, targeting production could largely depend on the density of local ethnic consumers as well as the availability and efficiency of other marketing outlets, many of which are still developing.

As immigration into the US from meat goat-consuming countries continues, it is expected that demand for goat meat will continue to expand. The US meat goat industry can benefit from further developing an efficient marketing / distribution system for meat goats, paying close attention to reducing transaction costs, benefitting from the economies of scale associated with marketing in volume, and providing incentives for quality. Further examining the marketing systems of the more established livestock industries (i.e., beef and pork) would be helpful in designing a more efficient marketing system for the US meat goat industry. Continued development of the meat goat marketing system will require significant effort by industry leaders. Livestock economists and animal scientists involved in research and extension efforts at land grant universities can provide assistance in evaluating ways in which the current system can become more efficient.

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Appendix A

Table A1. Summary Statistics of Independent Variables Used in the Analyses

Variables	Description	Mean	S.D.
Number Goats	Total number of meat goats on the farm	60.84	71.77
Percent Sale Slaughter	Percentage of goat sold for slaughter or as meat	44.61	36.56
Age	Producer age (years)	51.91	0.91
Bachelor	*Dummy* = Whether producer holds at least a college bachelor's degree	0.45	0.50
Off Farm Job	*Dummy* = Whether the producer holds an off-farm job	0.61	0.49
Farm Income Goat	Percentage of annual net farm income derived from goat operation	39.86	1.71
Extensive	Percentage of meat goats raised under this system	10.54	28.28
Pastured	Percentage of meat goats raised under this system	76.43	35.59
Dry Lot	Percentage of meat goats raised under this system	13.03	41.43
Southeast	*Dummy* = Whether the producer resides in the states: AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, or WV	0.36	0.48
Northeast	*Dummy* = Whether the producer resides in the states: CT, DE, IA, IL, IN, MA, MD, ME, MI, MN, MO, NH, NJ, NY, OH, PA, RI, VT, or WI	0.39	0.49
West	*Dummy* = Whether the producer resides in the states: AK, AZ, CA, CO, HI, ID, KS, MT, ND, NE, NM, NV, OR, SD, UT, WA, or WY	0.14	0.34
Texas/Oklahoma	*Dummy* = Whether the producer resides in the states: TX, or OK	0.11	0.31

Table A2. Multivariate Probit Runs on Producer Selection of Marketing Channels

Variables	Dealers, Brokers, or Meat Packers	I Sell Goat Meat	Direct Sale to Consumer	Live ions	Wholesale and Retail Businesses	Cooperatives
Number Goats	0.0031***	0.0001	-0.0006	0.0012	0.0012	0.0001
	(0.0011)	(0.0013)	(0.0011)	(0.0010)	(0.0016)	(0.0020)
Percent Sale Slaughter	0.0086***	0.0048**	-0.0099***	0.0048***	-0.0009	0.0074**
	(0.0020)	(0.0023)	(0.0018)	(0.0016)	(0.0037)	(0.0035)
Age	0.0063	-0.0453	0.0091	-0.1614**	0.0028	0.2400
	(0.0886)	(0.0974)	(0.0788)	(0.0710)	(0.1546)	(0.1603)
Bachelor	0.2581*	0.2402	0.1456	-0.3352***	0.4616**	0.1331
	(0.1464)	(0.1635)	(0.1357)	(0.1190)	(0.2614)	(0.2525)
Off Farm Job	0.1898	-0.5332***	0.0327	-0.0369	-0.1835	0.6719**
	(0.1646)	(0.1741)	(0.1463)	(0.1292)	(0.2722)	(0.3186)
Farm Income Goat	0.0166	0.0166	0.0094	0.0054	0.1800**	-0.0057
	(0.0426)	(0.0481)	(0.0397)	(0.0349)	(0.0741)	(0.0742)
Pastured	0.0013	0.0032	0.0006	0.0049**	-0.0061	-0.0054
	(0.0027)	(0.0032)	(0.0023)	(0.0021)	(0.0041)	(0.0036)
Dry Lot	0.0060*	-0.0013	0.0025	0.0032	-0.0084	-0.0021
	(0.0037)	(0.0049)	(0.0035)	(0.0029)	(0.0071)	(0.0055)
Southeast	4.5077	0.6245	0.0761	-0.2457	4.4570	-0.0692
	(77.9386)	(0.4885)	(0.2418)	(0.2112)	(1755.8050)	(0.2859)
Northeast	4.6164	1.1933***	-0.2251	-0.2132	5.0424	
	(77.9385)	(0.4797)	(0.2350)	(0.2112)	(1755.8050)	
West	4.1464	1.1055**	0.3558	-0.3669	4.9867	0.5362**
	(77.9387)	(0.5029)	(0.2989)	(0.2460)	(1755.8050)	(0.3188)
Constant	-6.5660	-2.3916***	1.1870***	0.5806	-6.8688	-3.2067***
	(77.9402)	(0.6657)	(0.4373)	(0.3838)	(1755.8060)	(0.8275)
Observations	511					

Log Likelihood = - 991.52, Wald $Chi^2(65) = 172.87$, Log Likelihood Ratio Test ($Chi^2(15)$) = 52.22

Note. ***, **, and * indicate variables significant at $P < 0.01$, $P < 0.05$, and $P < 0.10$ levels respectively

Appendix B

Number of Survey Respondents by States

States	Respondents	States	Respondents
AL	7	MO	45
AR	39	MS	7
CA	7	NC	64
CO	14	NE	4
FL	5	NY	6
GA	18	OH	22
IA	45	OK	15
ID	9	OR	9
IL	30	PA	9
IN	18	SC	7
KS	20	TN	16
KY	7	TX	48
LA	27	VA	9
MD	11	WA	8
ME	7	WI	3
MI	24	WV	5
MN	3	Other*	16

***Note.** "Other" category includes states with <3 respondents (AZ, DE, MA, MT, NH, NJ, NM, SD, UT, and VT).

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Consumer Valuation of Organic and Conventional Milk: Does Shelf Life Matter?

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Abstract

The objective of this study is to assess whether shelf life, as indicated by the processor "sell by" date, influences product attractiveness, willingness to purchase and willingness to pay for organic and conventional milk—controlling for the effect of the milk production system. A completely randomized factorial between-subject design is combined with GLM-based ANOVA to assess mean differences for production systems and shelf life values. Experimental results indicate that consumers value the production system. However, consumers also indicated that they value the length of shelf life only after being prompted. Assessment of this attribute provides information relevant to product development and in-store marketing practices, although additional study of this issue appears merited.

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Keywords: organic milk, shelf life, UHT processing, willingness to pay, experimental analysis.

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Introduction

Organic milk sales have steadily increased for the past decade. In contrast, total US per capita consumption of fluid milk produced in "conventional" (i.e., non-organic) production systems reached a record low level in 2013 of 164.6 pounds or 19.22 gallons per capita (International Dairy Foods Association 2015). In September 2016, the U.S. Department of Agriculture's Agricultural Marketing Service (USDA-AMS) reported total conventional fluid milk at 4.1 billion pounds, which was unchanged from September 2015. In comparison, organic milk products sales were reported at 218 million pounds, which is up 5.3% from the previous year (USDA–AMS 2016). In fact, sales of organic fluid retail milk in May 2016 have been the highest recorded in the history of the USDA's Agricultural Marketing Service recordkeeping system (Northeast Organic Dairy Producers Alliance (NODPA) 2016). This increased demand for organic milk reflects rising consumer concerns about health and nutrition. Many consumers perceive organic products (including milk) to be healthier and more environmentally friendly (Harper and Makatouni 2002; Dreezens et al. 2005; Winter and Davis 2006), despite sometimes limited scientific evidence to support these perceptions (e.g. Williams, Audsley, and Sandars 2006; Loder et al. 2008). Rapid growth in sales of organic products has been attributed to changes in consumer preferences for specific intrinsic attributes such as quality, freshness, and health benefits as well as extrinsic indicators such as price, packaging and labeling (Pearson, Henryks, and Moffitt 2007; Faber 2016). For the consumer, information regarding intrinsic attributes may be based on research, personal experience with the product or credence (Hammarlund 2002; Grolleau and Caswell 2005).

Previous studies have examined the patterns of organic milk consumption, the factors influencing them, and the characteristics of organic milk consumers (e.g. Glaser and Thompson 2000; Wang and Sun 2003; Dimitri and Venezia 2007; Alviola and Capps 2010; Liu et al. 2011; Li, Hanawa Peterson, and Xia 2012). In particular, these studies have focused on demographic characteristics, along with consumer perceptions of environmental, health and safety attributes. For instance, Wang and Sun (2003) found that production method and price were the most important attributes in organic milk purchasing decisions. Taken as a whole, these studies reach somewhat inconsistent conclusions about which factors are most strongly associated with organic milk consumption. However, the majority of studies indicate that consumers are willing to pay a price premium for milk produced by an organic production system.

One attribute that previous work has not assessed is whether shelf life is an important factor in the purchasing decision between organic versus conventional milk. Accordingly, the main objective of our study is to assess whether shelf life, as indicated by the processor "sell by" date, influences product attractiveness, willingness to purchase, and willingness to pay for organic and conventional milk—while controlling for the effect of the milk production system. Assessment of this attribute will be of interest to both conventional and organic milk processors and food retailers, who will value additional information relevant for product development and in-store marketing practices.

Background

Shelf life is defined as "the period of time that a product can be kept under practical storage conditions and still retain acceptable quality." The "practical storage conditions" for fluid milk mean refrigeration at temperatures of less than 7.2 degrees Celsius (45 degrees Fahrenheit). "Acceptable quality" means that the product is safe[1] to drink and that the product's flavor, odor and appearance are satisfactory to the consumer (Cornell University 2009). Thus, shelf life combines elements of safety with product quality, including the perceived freshness of milk. Most organic milk is pasteurized at ultra-high temperature (UHT). During this process, the milk is heated for two to four seconds at 280 degrees Fahrenheit and then cooled to room temperature (Johnson 1984). Heating the milk to this temperature kills more bacteria than does conventional pasteurization. This allows processors to label milk with a "sell by" date of up to six weeks after processing compared to the "sell by" dates of 14 to 21 days after processing used for conventional milk[2].

For three related reasons, most organic milk undergoes the UHT process. First, the volume of organic milk distributed to individual retail outlets is smaller than for conventional milk. Thus, milk has to last longer because it spends more time in the commercial distribution system (Baumrucker 2008; Ray 2016). Second, UHT may result in fewer product returns due to milk not being sold before its "sell by" date, particularly with less frequent deliveries. Finally, given their smaller herd sizes, the somatic cell count in milk (an indication of the presence of pathogenic bacteria) from organic farms tends to be higher than from conventional dairy farms. A low somatic cell count is desirable, as a higher somatic cell count might indicate infections (Tikofsky et al. 2003; Zwald et al. 2004; Nauta, Baars, and Bovenhuis 2006; Cheung 2010). As such, organic milk may be more likely to have unacceptable quality attributes by the time it reaches its "sell by" date, unless it is UHT pasteurized. Thus, UHT processing and longer shelf life are beneficial (less costly) to organic milk processing companies.[3]

However, UHT pasteurization also modifies the taste of milk (Baumrucker 2008) because this process caramelizes milk sugars. This results in the milk tasting sweeter and somewhat cooked. These may not be desired product attributes. Sensory research comparing UHT-processed and conventional milks indicates that tasting panels identified more off-flavors in UHT milk and indicated that the product had lower levels of "fresh dairy flavor characteristics" (Oupadissakoon 2007). Some organic milk processors sell both conventional and UHT milk, indicating this difference on their packaging for these products. However, most packaging for organic milk processed with UHT pasteurization does not highlight its longer shelf life.

[1] Microbiologically, fluid milk shelf life is assessed by the Standard Plate Count (SPC), which is an estimate of the total number of aerobic bacteria present in a sample that are capable of growth on SPC media when incubated at 32 degrees Celsius (89.6 degrees Fahrenheit) for 48 hours. The SCP of freshly pasteurized milk is less than 500/ml, with a standard limit of 20,000/ml. Bacteria will grow as milk is held under refrigeration (Cornell University 2009).
[2] Milk processors assign "sell by" dates in the absence of federal or state regulation and, therefore, can assign dates they deem consistent with the initial quality (bacterial load) of the milk, and the spatial extent of their distribution networks.
[3] Some organic milk processors (e.g. Aurora Organic Dairy) may use UHT because they distribute milk over long distances from a single processing facility.

Studies regarding consumer awareness of the shelf life attribute for milk and its valuation are still limited. Consumer preferences for food attributes often are analyzed in a random utility discrete choice model framework (McFadden 1978; Revelt and Train 1998). In this model, longer shelf life would be considered a positive attribute. Previous studies indicate that expiration dates influence both acceptability and taste perceptions of consumers and that shelf life is considered the most important safety-related factor in milk purchase decisions (e.g. Wang, Mao, and Gale 2008; Wansink et al. 2013). Furthermore, consumers appear to relate shelf life to food safety and may value it for this reason (Wang, Mao, and Gale 2008). However, a limited number of studies have focused on consumers' valuation of the shelf life of milk (e.g. Ortega et al. 2011). Ortega et al. (2011) found that consumers in China, where the milk market is segmented into shorter shelf-life and longer shelf-life UHT products, prefer shorter shelf life milk compared to the longer-shelf life product, because they perceive it to be fresher.

Extended shelf life can provide functional utility to consumers, such as reduced waste and the need to make fewer trips to the grocery store if milk is consumed infrequently. Thus, shelf life can also be considered an attribute of convenience. Consumers valuing this factor might be willing to pay for enhanced shelf life. Lusk et al. (2001) found that consumers would be willing to pay more for corn chips with extended shelf life. Similarly, Onyango and Govindasamy (2005) found that consumers valued the attribute "stays riper longer" for a banana produced with genetic modification more than five other attributes, second only to "less chemicals and pesticides." In contrast, Grebitus et al. (2009) found that shelf life was not a statistically significant determinant of willingness to pay for ground beef with Modified Atmosphere Packaging using a non-hypothetical choice experiment.

Methods

To test whether shelf life, as indicated by the processor "sell by" date, influences product attractiveness, willingness to purchase and willingness to pay for organic and conventional milk, we designed and implemented an experiment using a 2 x 3 completely randomized factorial between-subjects design, with milk production system (conventional versus organic) and expiration date (unspecified, 2-week, and 6-week) as the factors. Between-subjects experimental designs are commonly used in behavioral marketing and applied psychology. They have the advantage that each subject's response is independent of other individuals' responses. Moreover, results are not influenced by practice or experience in other treatments, fatigue or boredom from exposure to a number of treatments, or contrast and order effects from comparing one treatment to another (Perreault 1975; Kutner et al. 2004). This design also allows for eliciting perceptions without prompting subject responses on the basis of background information typically provided in many consumer surveys. In that sense, the experimental design of this study better simulates a consumer decision in a shopping setting. Given that this study is an initial exploratory analysis of milk shelf life valuation, we opted for a simpler experimental approach rather than alternatives such as conjoint analysis or contingent valuation.

Subjects were randomly assigned to view an image of a half-gallon milk carton in one of the six aforementioned treatments (Figure S1 in Supplemental Materials) Respondents were shown an image of a half-gallon carton of either conventional or organic milk with one of three expiration dates: 1) no date indicated (as a control condition); 2) two weeks from the date of subject

participation in the experiment; and 3) six weeks from the date of participation in the experiment. The two expiration dates provided were based on current dairy processor practices for "sell by" labeling, and thus represent a realistic choice set for consumers. The scenario accompanying the image asked subjects to imagine themselves at a grocery store, facing the dairy case and preparing to make a purchase of a half-gallon of milk. This use of scenarios is consistent with the approaches used in other consumer choice experiments (e.g. Managi et al. 2008; James, Rickard; and Rossman 2009; Katare, Yue, and Hurley 2013).

Although the image contained implicit information about the container size and material, as well as more explicit information about the production system and the expiration date, the experimental design avoided explicitly directing consumers to focus on specific attributes to avoid bias effects. For the displayed carton, subjects rated product attractiveness (1-9 Likert scale, with 1 = 'Not at all attractive' and 9 = 'Extremely attractive'), their willingness to purchase the product (1-9 Likert scale, with 1 = 'Not at all willing' and 9 = 'Extremely willing"), and how much they would be willing to pay for the displayed carton ($ per half gallon), as if they were buying the product during this trip to the grocery store. The subjects also provided information about the relative importance of seven milk attributes to their willingness to pay for milk in general, including expiration date, container size, organically produced, locally produced (with the term 'locally' defined by the subjects), container material, fat content, and fresh taste. The subjects assigned importance weights to these seven attributes so that they summed to 100. Subjects indicated the price premium they would be willing to pay for a half gallon of organic milk, compared to a base price of $2.00 per half gallon for conventional milk. They also indicated the premium they would be willing to pay for extended-shelf life conventional milk compared to conventional milk with a two-week shelf life. To provide a way to identify subjects who were not paying attention to the experimental stimuli, we embedded questions within the experiment to identify subjects responding randomly[4]. Finally, we collected information on demographic characteristics, discretionary income, and milk consumption.

Subjects were recruited from a national panel of adults using Amazon's Mechanical Turk (MTurk; http://aws.amazon.com/mturk/). Panel members peruse the MTurk website until they locate a study they are interested in participating in. After expressing interest in the study, they click on an electronic link that forwards them to a specific data collection site. Each participant was paid $0.80 for participating in this twelve-minute study.

A total of 304 subjects participated in the experiment during a single day in April 2013. All participants indicated that they both purchased and consumed milk at least once per month. Twenty-six individuals were eliminated because they failed the attention check, which suggested that they were not paying sufficient attention to the experimental stimuli. This resulted in 278 usable responses. This level of subject elimination is not atypical for MTurk studies (Downs et al. 2010; Mason and Suri 2012). In order to test for differences in mean values of attractiveness, willingness to purchase, and willingness to pay for the two production systems and the three shelf lives in each of the six cells, we used ANOVA—implemented as a General Linear Model (GLM) procedure.

The experimental design model equation (following Kirk 2013) in this case is:

[4] For example, embedded within a long string of questions we asked subjects to provide the response "2." Anyone who failed to respond with the answer "2" on the nine-point scale failed the attention check.

(1) $Y_{ijk} = \mu + \alpha_j + \beta_k + \alpha_j \cdot \beta_k + \varepsilon_{ijk}$

where Y_{ijk} is the reported value of product attractiveness, willingness to purchase or amount the subject is willing to pay, μ is an overall population mean, α_j is the treatment effect for production system (j=1,2 for conventional and organic) equal to the difference between the population mean for treatment level j and the overall mean μ, β_k is the treatment effect for the expiration date (k=1,2,3 for short shelf life, extended shelf life and no shelf life indicated, respectively), equal to the difference between the mean for treatment level k and the overall mean μ, $\alpha_j \cdot \beta_k$ is the interaction effect for the populations receiving treatment j and treatment k, and ε_{ijk} is a random error attributable to both the individual subject's responses and any other effects that had not been controlled for. This design allows us to test three null hypotheses:

H_1: $\alpha_1 = \alpha_2 = 0$ (mean values are equal for different production systems)
H_2: $\beta_1 = \beta_2 = \beta_3 = 0$ (mean values are equal for different expiration dates)
H_3: $\alpha_1\beta_1 = \alpha_1\beta_2 = \alpha_1\beta_3 = \alpha_2\beta_1 = \alpha_2\beta_2 = \alpha_2\beta_3 = 0$ (all interaction effects equal 0)

This analysis is complemented by additional descriptive analyses of the subjects and other related factors.

Results

Subject Description

The descriptive characteristics of the subjects are shown in Table 1. The subjects participating in our study were on average thirty-seven years old (with a range of eighteen to sixty-nine years), and predominantly female (59%; see Table 1). Most were the primary shopper for their household (85%). A somewhat larger proportion of our subjects were of Asian descent compared the overall population of the U.S., and a smaller proportion were White/Caucasian, African-American or Latino. The household size of the subjects was somewhat larger than the 2014 US average of 2.63 persons (U.S. Census 2015). Nearly two-thirds of households spent between $50 and $150 per week on groceries.

Forty percent of subjects reported that their households consumed between a half-gallon and a gallon of milk per week, and only 15% reported milk consumption greater than a gallon per week. As is consistent with previous studies (e.g. Dimitri and Venezia 2007), consumers of organic milk also report frequent purchases of conventional milk. Two-thirds of the study's subjects indicated that less than 10% of the milk they consume is organic. Furthermore, only 7.5% reported that organic milk comprises more than 90% of their milk purchases. The subjects grew up in diverse locations, but only 2% indicated they grew up on a farm (Table 1). On the basis of these summary statistics, we conclude that, although there are some differences between our subjects and the characteristics of the broader US population, our pool is sufficiently representative to allow cautious generalizations.

Table 1. Descriptive Characteristics of Subjects

Characteristic	Mean or Percentage
Age, years	36.9
Female, %	58.6
Race/Ethnicity, %	
White/Caucasian	66.5
Black/African-American	4.0
Hispanic/Latino	3.2
Asian/Asian-American	23.7
Other	2.5
Primary shopper for household, %	85.3
Household size, including subject, %	
1	14.0
2	25.5
3	25.5
4	23.0
5	7.6
6 or more	4.3
Average spending on groceries, $/week, %	
0 to 49.99	24.8
50 to 99.99	34.5
100 to 149.99	30.2
150 or more	10.4
Milk consumed by household per week, %	
Less than 1 quart	22.3
1 quart to ½ gallon	23.0
½ gallon to 1 gallon	39.6
1 gallon or more	15.1
Percentage of milk consumed that is organic, %	
0 (No organic milk)	50.4
10% or less	66.7
90% or more	7.5
Type of area subject grew up in, %	
Farm	2.2
Rural area	15.1
Small town	26.6
Suburb	29.5
City	26.6

Valuation of Milk Production System and Expiration Date Attributes

Mean values for all treatments in the 2 x 3 design were less than 5 (that is, less than the midpoint of the 1 to 9 rating scale) for attractiveness of the product and willingness to purchase (Table 2).

Table 2. Summary of Attractiveness of Product, Willingness to Purchase and Willingness to Pay by Treatment

Variable	Production System and Outcome	Shelf Life Label		
		None	Short expiration date	Long Expiration date
Attractiveness of Product	Conventional milk			
(1-9 Likert Scale)	Mean (s.d.)	3.77 (2.35)	3.24 (2.00)	3.24 (2.24)
	N=	44	45	46
	Organic milk			
	Mean (s.d.)	4.32 (2.23)	4.39 (2.24)	4.27 (2.28)
	N=	47	44	52
Willingness to Purchase	Conventional milk			
(1-9 Likert Scale)	Mean (s.d.)	4.39 (2.55)	3.69 (2.03)	3.89 (2.45)
	N=	44	45	46
	Organic milk			
	Mean (s.d.)	4.64 (2.26)	4.73 (2.33)	4.92 (2.37)
	N=	47	44	52
Amount Willing to Pay for Product ($/half gallon)	Conventional milk			
	Mean (s.d.)	1.87 (1.02)	1.86 (0.92)	1.87 (1.15)
	N=	44	45	45
	Organic milk			
	Mean (s.d.)	2.32 (0.98)	2.26 (1.20)	2.33 (1.17)
	N=	46	44	52

Nearly three-quarters of the subjects reported values of 5 or less for attractiveness, and nearly two-thirds reported values of 5 or less for willingness to purchase. This suggests that the subjects were not strongly attracted to milk products or highly inclined to purchase them, despite universal consumption. Moreover, the distribution of values for each valuation variable was non-normal. The modal response for attractiveness was 1, and the proportion decreased as the attractiveness rating increased. A similar pattern existed in the willingness to purchase data, although the modal value was 3 and the proportion of subjects decreased less rapidly as the willingness to purchase rating increased.

The mean amount subjects were willing to pay for a half gallon of the product displayed ranges from $1.86 to $2.33. Table 2 shows the mean value for conventional milk was $1.87, while it was $2.32 for organic milk. These values are roughly consistent with the average US retail fluid milk price in April 2013 of $3.43 *per gallon* reported by the Bureau of Labor Statistics (2013).[5]

[5] BLS does not report national average retail prices for half gallons of milk. Retail prices in New York during this period ranged from $1.74 to 2.74 per half gallon in paper containers (New York Department of Agriculture and Markets 2012), while retail prices in Pennsylvania ranged from $1.77 to 1.98 per half gallon (Commonwealth of Pennsylvania 2013).

The overall distribution of willingness to pay values was also non-normal, skewed to the left of the mean and with significant kurtosis.

GLM Analysis of Milk Production System and Expiration Date Attributes

Profile plots (Appendix Figures A1, A2 and A3 in Supplemental Materials) indicated it was appropriate to assess interaction terms, in addition to the main effects of production system and expiration date. The GLM model in (1) was run with the full factorial design (including intercept and interaction terms). All interaction terms were not statistically significant. Thus, the GLM was re-run omitting the interaction and intercept terms, consistent with common practice (Kirk 2013). The model results were robust with respect to these changes, and regarding the inclusion of the "no date" treatment (which would not be a choice faced by milk consumers but which served as a control condition).

The results for each of our three valuation variables are similar. Statistically significant differences ($p<0.05$) exist in the mean values for the production system treatment but they do not exist for the expiration date (Appendix B, Table B1).

Thus, consumers find organic milk more attractive than conventional milk. The results show they are more willing to purchase organic milk, and their willingness to pay is higher. These findings are broadly consistent with the findings of previous studies (Dhar and Foltz 2005; Bernard and Bernard 2009). These results also suggest that mean attractiveness, willingness to purchase, and the amount consumers are willing to pay do not differ based on shelf life. This is in conflict with our initial hypothesis that shelf life is a determinant of valuation. The mean difference in attractiveness for organic milk, relative to conventional milk, was nearly 1 point on the 1 to 9 rating scale. The mean difference for willingness to purchase was less than 0.8 (Table 3).

Table 3. Summary of Mean Differences for Conventional and Organic Conditions. Three Value Indicators

Value Indicator	Mean Difference (Organic less Conventional)	SE	Prob.	Lower Bound	Upper Bound
Attractiveness (1-9 scale)	0.91	0.27	0.001	0.38	1.43
Willingness to Purchase (1-9 scale)	0.77	0.28	0.006	0.22	1.32
Amount Willing to Pay ($/half gallon)	0.44	0.13	0.001	0.18	0.69

The mean difference in the amount that subjects were willing to pay for organic compared to conventional milk was $0.44 per half gallon. This amount is substantially lower than values reported in previous studies (e.g. Kanter, Messer, and Kaiser 2009; Brooks and Lusk 2010). It is also less than the existing price differential between organic and conventional milk at most food retailers.

We asked subjects directly about the importance they place on various milk attributes that might affect their willingness to pay, including expiration date. In allocating 100 points to assess each attribute's relative importance, the product's expiration date was the most highly rated attribute, and was statistically significantly larger than the mean ratings for the six other attributes (Table 4).

Table 4. Importance of Characteristics Affecting Willingness to Pay for Milk

Characteristic	Minimum	Maximum	Mean	SD	Mean Difference with Expiration Date	t value
Expiration date, %	0	100	27.45	19.13	–	–
Fresh taste, %	0	100	23.33	18.09	4.12	2.61
Fat content, %	0	80	14.80	14.11	12.65	8.87
Container size, %	0	75	11.90	11.59	15.55	11.59
Organic, %	0	80	9.74	14.49	17.71	12.31
Produced locally, %	0	50	7.74	8.92	19.71	15.57
Container material, %	0	45	5.12	6.52	22.33	18.42

Note. N=278 except for Fresh Taste, for which N=277.

When subjects were evaluating the importance of overall milk attributes (as opposed to the specific carton image they viewed for the treatment), the expiration date was a critical component of the decision. Fresh taste, an attribute more likely to be associated with conventional milk, was the second most highly-ranked attribute. This apparent inconsistency regarding the contribution of the expiration date to the valuation of the product between the treatments and the response to direct questions is all the more curious given that more than 80% of subjects agreed or strongly agreed with the statement "I always pay attention to the expiration dates on dairy products." This is consistent with Tsiros and Heilman (2005), who found that 99% of milk consumers are aware of expiration dates and 93% claim they "always/usually check the expiration dates."

Finally, subjects indicated the price premium they would be willing to pay for organic milk and long-shelf life conventional milk, compared to conventional milk with a standard shelf life and a price of $2.00 per half gallon. Consistent with the hypothesis that consumers value longer shelf lives, the mean premium for longer shelf life conventional milk was $1.30 per half gallon. This is statistically significantly greater than zero ($p < 0.01$) but is not statistically significantly different from the mean premium for organic over conventional milk (Table 5).

Table 5. Premium Willing to Pay Milk Organic or Long Shelf Life Milk Compared to Conventional Milk at a Price of $2 per Half Gallon, $/half gallon

Characteristic	Minimum	Maximum	Mean	SD	Mean Difference with Organic	t value
Organic	0.00	4.00	1.41	1.13	–	–
Long shelf life	0.00	4.00	1.30	1.16	0.11	1.08

Note. N=278 for both.

Conclusions

Previous work on consumer valuation of organic milk has not controlled for the potential impact of longer shelf life due to UHT processing, in addition to the perceived attributes of the milk production system. Our results are consistent with previous studies, indicating that consumers value attributes of the organic production system, although our estimates of the difference in willingness to pay for organic compared to conventionally-produced milk are smaller. In contrast, our results are inconsistent with regard to consumer valuation of milk shelf life. We found no statistically significant differences in product attractiveness, consumer willingness to purchase or willingness to pay among the three shelf-life categories (none, short, long) using the 2x3 between-subjects experimental design. However, when prompted, subjects placed a significant value on the length of shelf life, ranking it as the most important of seven product attributes. This confirms the findings by previous research. Shepherd, Mangusson, and Sjödén (2005) found that consumers rated taste and shelf life of great importance, but respondents did not think that organic products tasted better or had a longer shelf life than their conventional counterparts. In our study, subjects indicated a willingness to pay a price premium for milk with a longer shelf life that is not statistically different from the price premium for organic rather than conventionally-produced milk. The importance of shelf life also suggested that more than 80% of subjects indicated that they check shelf life for dairy products when making purchases.

Our findings suggest that promotion of production system attributes (primarily through product labeling) is appropriate for organic milk processors, but the benefits of highlighting longer shelf life are uncertain. Our results that shelf life is not valued without prompting could arise from study design factors (e.g. the simplicity of the carton designs or the specific shelf-life values used in this study) or it could be an indication that the current expiration date label on milk may not serve as an effective visual signal to consumers. Future research could usefully assess this by modifying the amount and type of information provided on the carton images used in an experimental design. For example, the researchers' specific choice of expiration dates may have affected the outcomes. Consumers did not place a different value on the two-week and six-week expiration dates. This may have occurred because both are longer than the time required for many households to consume milk. Thus, it might be of advantage to use a broader range of expiration dates than those employed in this study. A future study could also modify the amount of information provided on the milk carton to assess consumers' ability to perceive and use information provided. In addition, alternative analytical approaches such as conjoint analysis and contingent valuation could be used to assess whether the consumer valuation of milk shelf life is sensitive to the method used. A broader set of additional studies will help to clarify the role that processing technology and shelf life play in the consumption of both organic and conventional milk, and may also provide additional insights about the influence of label information on consumer purchasing decisions. This information would be relevant for product development by fluid milk processors and marketing efforts by food retailers. Given the rising imports of organic milk and organic milk powder, and the increasing consolidation in organic dairy production, there are multiple challenges ahead for agribusiness companies operating in the dairy value chain (NODPA 2016). Greater general awareness of diet-health issues and various trends have increased consumer demand for more products with identifiable product attributes. This trend towards "nutritionism" (Scrinis 2013) will demand significant adjustments on the side of stakeholders along many agri-food value chains. Thus, estimates of existing consumer behavior, and their impacts on purchasing behavior, will become even more relevant to industry.

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Consumer Valuation of Organic and Conventional Milk: Does Shelf Life Matter?

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SUPPLEMENTAL MATERIALS

Figure S1. Milk Carton Images Displayed Under the 2x3 CRF Treatment Design

Appendix A.

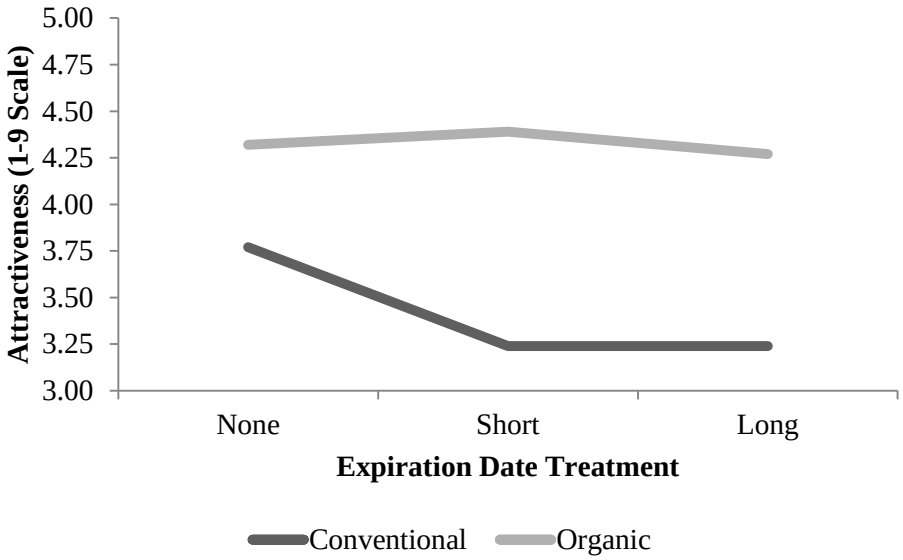

Figure A1. Profile Plot of Mean Attractiveness Values, By Treatment

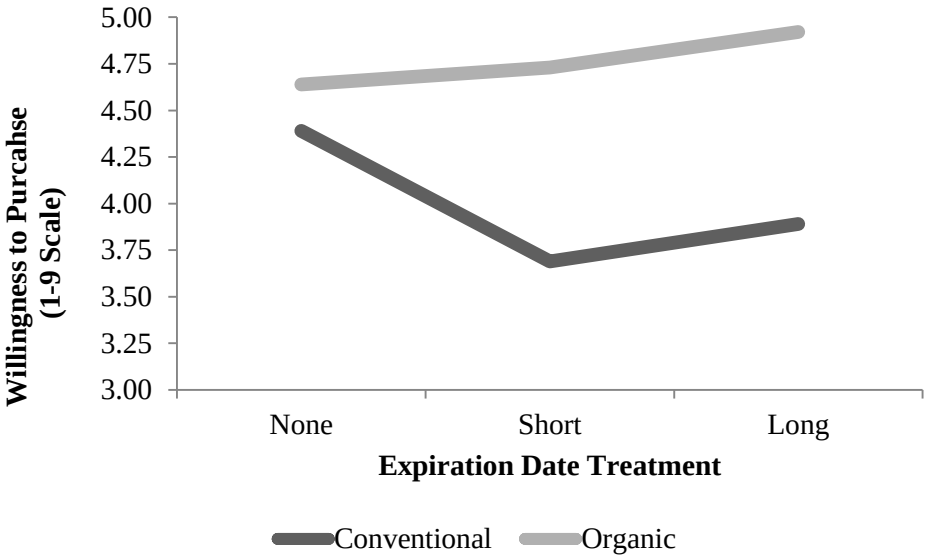

Figure A2. Profile Plot Mean Willingness to Purchase Values, By Treatment

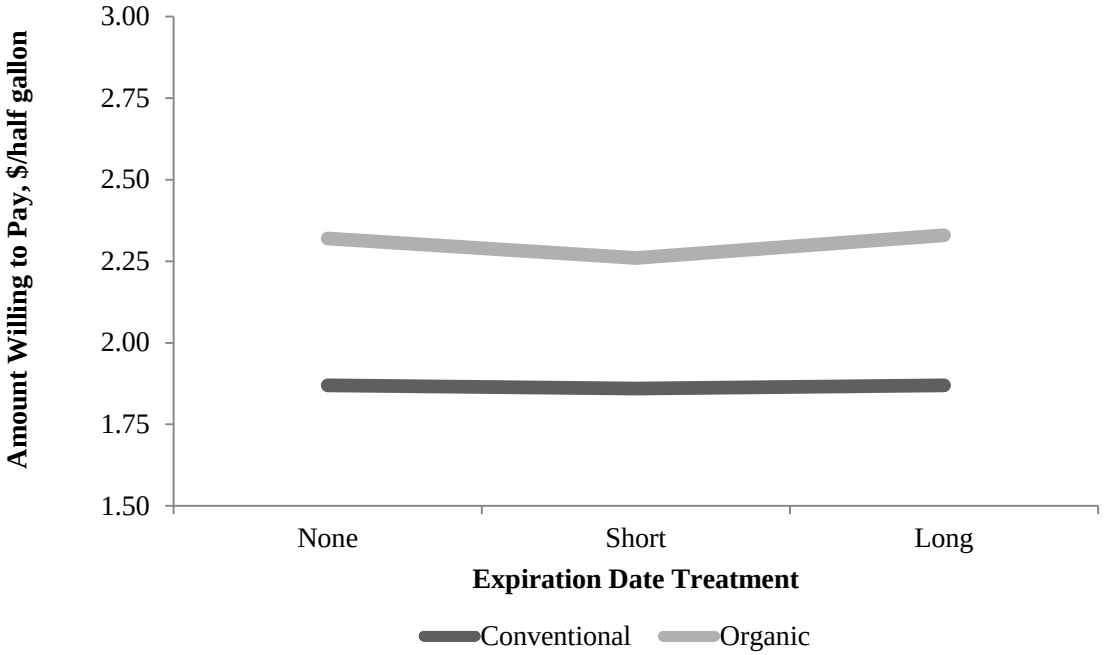

Figure A3. Profile Plot of Mean Amount Willing to Pay Values, By Treatment

Appendix B.

Table B1. GLM/ANOVA Analysis of Product Attractiveness, Willingness to Purchase, and Amount Willing to Pay

Variable	Source	Type III Sum of Squares	df	Mean Square	F-statistic	Prob.	Observed Power (α=0.05)
Attractiveness of Product (1-9 Likert Scale) R Squared = .758 Adj. R Squared = .755	Model	4249.1	4	1062.3	214.7	.00	1.00
	Production System	57.1	1	57.1	11.5	.00	.92
	Expiration Date	4.1	2	2.1	0.4	.66	.12
	Error	1355.8	274	4.9			
	Total	5605.0	278				
Willingness to Purchase (1-9 Likert Scale) R Squared = .783 Adj. R Squared = .780	Model	5400.8	4	1350.2	247.8	.00	1.00
	Production System	42.0	1	42.0	7.7	.01	.79
	Expiration Date	4.2	2	2.1	0.4	.68	.11
	Error	1493.2	274	5.450			
	Total	6894.0	278				
Amount Willing to Pay for Product ($/half gallon) R Squared = .795 Adj. R Squared = .792)	Model	1225.0	4	306.2	263.8	.00	1.00
	Production System	13.1	1	13.1	11.3	.00	.92
	Expiration Date	0.1	2	.1	0.0	.96	.06
	Error	315.8	272	1.2			
	Total	1540.8	276				