Willingness to Pay for Sustainable Agriculture Products

Report to the Federal State Marketing Improvement Program

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Table of Contents

Executive Summary

In this study, we assessed consumer preferences for sustainable agricultural, organic, and conventional apples. We identify socio-demographic characteristics that affect the choice of the three alternatives. When consumers choose from among organic, sustainable agriculture, and conventional apples, we find that the sustainable agriculture choice is an intermediate choice when food safety, the environment, and children's needs are considered. Moreover, factors that one would expect to positively affect the decision to buy sustainable agriculture apples in the context of a dichotomous choice relative to conventional apples actually have the opposite effect in the presence of the organic alternative. However, due to high quality perceptions, in the context of this trichotomous choice, we also find that consumers will pay a premium for sustainable agriculture apples.

Estimates based on stated preferences are compared with actual purchase behavior obtained from a market experiment. We conclude that in spite of differences in hypothetical and actual behavior, consumers acted consistently in the market experiment with the stated preferences obtained from our survey.

Finally, we evaluated scanned data from Thirftway Stores in Portland, where The Food Alliance (TFA) products and other generic products without labels are regularly sold. However, since all the large apples sold at Thirftway are labeled with the TFA Seal of Approval, it was not possible to identify the effects of the TFA Seal of Approval separately from the large size effects on price.

Willingness-to-Pay for Sustainable Agriculture Products

I. Introduction

Consumer demand for healthier, safer, and more environmentally friendly food products has become very important in recent years. In response, producers are marketing organic and other quality-differentiated foods, sometimes explicitly claiming to have followed sound environmental and animal welfare practices during the production process. These products frequently have unobservable quality attributes, which make them fundamentally different from products where quality is observable or where quality can be determined after consumption. If a product has unobservable quality attributes, then its reputation becomes very important. Consumers will only be willing to pay a premium for the products with good reputations (or equivalently, products with high expected levels of quality) because producers have an incentive to profit from false quality claims.

A. Labels as Information Providing Instruments

Asymmetric information problems exist in food markets because producers know whether they have used the appropriate methods to achieve the desired quality attributes, but consumers only know what the producers' claims are or what the label says. Nelson (1970), and Darby and Karni (1974) described three major categories of products based on the degree of asymmetric information about quality: search goods, experience goods, and credence goods. In the case of a search good, consumers can determine its characteristics at the moment of purchase. For example, while trying on a dress, a consumer can determine how the dress fits. If it does not, the consumer searches for another dress. For experience goods, a consumer is not able to determine the product's characteristics prior to its purchase. For example, the only way to decide which brand of milk tastes best is to have consumed it and compare its taste to that of other brands. In the case of credence goods, consumers are not able to determine the quality even after consumption. A consumer is not usually able to decide if one brand of cereal contains more fiber than another brand. In the case of the products labeled as "organic" or "traditional," a consumer may recognize after consumption that the flavor was really special, but they may not be able to identify the specific quality attributes. Other examples of credence goods are professional services from doctors, lawyers, and auto mechanics. If an individual with an illness visits the doctor and experiences a prompt recovery, he or she cannot determine whether the quick recovery was or was not caused by the doctor's intervention.

This study explores whether labels are a signal of quality for credence goods. If the producer issues the organic label himself with no outside monitoring, then it is just cheap talk in the sense of Farrell (1993). On the other hand, if the label stands for credible third-party monitoring, then the label is like a guarantee. Caswell and Padberg (1992) discuss the possibility of food labels as the answer to the imperfect information dilemma in food safety. Caswell and Mojduszka (1996) argue that quality signaling through product labeling promotes market incentives with relatively limited government involvement. They point out that the monitoring and enforcement activities of the government are an attempt to ensure that the disclosures made are truthful and credible. McCluskey (2000) concludes that repeat-purchase relationships and third party monitoring are required for high quality credence goods to be available.

B. The Growing Importance of Credence Goods

The food industry has implemented numerous labeling programs with many kinds of "environmentally friendly" claims (such as organic, pesticide-free, recyclable, and eco-labels) in order to market these value-added food products. Overall, they have been a success. For example, the U.S. market for organic foods has increased by more than 20 percent each year for almost a decade. According to the Organic Trade Association, sales of organic products in the United States are currently about $6 billion a year (*Boston Globe*, 2000). The eco-label movement is also growing rapidly. Sustainable agriculture and eco-labels, which suggest the limited use of synthetic inputs, are less expensive in practice than organic farming.

Despite the potential importance of labeling claims in these and other markets, there has been very little formal analysis of consumer response to environmentally friendly products, and still less analysis of regional specialty products. This study provides an in-depth analysis of the consumer response to these products.

1. Sustainable Agricultural Products and Eco-labels

Eco-labels are a broader category than organic, and products which are labeled as "sustainable agricultural products" can be categorized as eco-labeled products. An eco-label identifies environmentally preferable products based on an environmental impact assessment of the product compared to other products in the same category. The environmental impact assessment includes the production process, use, and disposal of the product (van Ravenswaay and Blend, 1997). While eco-labels require compliance to standards, they are still considered market-oriented because they do not involve direct government regulation.

Europe has been very successful in developing and promoting large eco-label programs for non-agricultural products. For instance, the German eco-label, Blue Angel (*Blauer Engel*), which was introduced in 1978, has become a successful instrument in environmental protection with nearly 4,000 certified products. Launched in 1998, the Euro-eco-label regulates and sets common standards for all eco-labels in the European Union countries.[1] In the United States, eco-labels are proliferating rapidly with programs such as Green Seal, Scientific Certification Systems, and the U.S. Environmental Protection Agency's Energy Star Program. In addition, there are regional programs in agriculture that aim for specific niche markets. U.S. examples of regional eco-label programs for produce include Stemilt Growers Inc., which is located in the State of Washington, California Clean Growers, and The Food Alliance (TFA), which is located in Portland, Oregon.

[1] The emblem of the European Community environmental labeling system is a stylized flower incorporating the EU's star symbol

Since both sustainable agriculture products and organic products are marketed as "environmentally friendly," they will sometimes compete for the same consumers. While eco-label standards often include reducing or eliminating pesticide use, organic standards will likely be stricter in terms of restricted pesticide usage. The term "organic" has been applied to measurable product standards, such as no observed pesticides, as well as process standards. Under the latter definition, organic foods are distinguished from conventional foods by production and processing principles rather than attributes that are noticeable in the product itself. This philosophy stresses production and processing without the use of synthetic chemicals and soil fertility management that use techniques that enhance biological activity in the soil such as composting, green manuring, and rotating crops (Vandeman and Hayden, 1997).

C. Research Objectives

The major objective of this study is to ascertain how markets for sustainable agricultural products (a specific type of credence good) operate. Consumers' responses to a sustainable agriculture product are assessed and potential opportunities for producers are evaluated. Specifically, the economic value of The Food Alliance sustainable agriculture label was estimated. In addition, consumers' willingness to pay (WTP) for the TFA sustainable agriculture labelwas estimated based on survey responses, and an economic experiment was conducted in order to test the consistency between consumers' revealed and stated preferences. This study is the first to quantify the difference between stated and revealed preferences with respect to sustainable agriculture labels valuation.

This study will help producers and retailers to better understand and evaluate the opportunities in niche markets in the United States and abroad. With respect to the sustainable agriculture labelin the study, TFA commissioned The Hartman Group to conduct an analysis of consumer's attitudes toward sustainable agricultural products. The general conclusions support the hypothesis that there is a large demand for food grown by producers with a strong commitment to environmentally friendly practices. This hypothesis has been verified anecdotally by local customer interviews and focus groups conducted in the Pacific Northwest, without much formal analysis and ignoring the contrast between revealed and stated preferences.

There is a contrast between stated and revealed preferences in economic and social science in general. That is, people say they would do something in a particular situation and frequently end up doing something else. For example, Marler and Hadaway (1999) reported that in a survey of 300 church members, only 38 percent of respondents accurately reported attending Sunday school, rather than the 60 percent who claimed attendance. In this study, the issue of consistency is explored between stated preferences for sustainable agriculture products and actual purchase of these products in a market experiment conducted in two grocery stores in Portland, Oregon.

In summary, the main objective of this study is to evaluate consumer response to labels that claim to have credence attributes. Specifically, we examine The Food Alliance sustainable agriculture label. We will address the following questions: How do this labels affect consumer demand? Does the labels have intrinsic economic value? How much are the consumers willing to pay for products that are certified as sustainable agricultural products? The economic value of this label is studied using a direct approach (contingent valuation methods) and an indirect approach (hedonic models), respectively.

II. Previous Studies

A. Environmental and Sustainable Agriculture Labeling

Many researchers have studied behavioral changes that take place in response to labeling. Examples include Chang and Kinnucan (1991), Kim *et al*. (1999), Mathios (1998), and Wessells *et al*. (1999). These studies consistently found that a change in labeling or information can change consumers' perceptions and behavior.

A smaller number of studies have specifically examined the effect of eco-labels. There remains disagreement over whether eco-labels increase consumers' WTP for a particular product. The study by van Ravenswaay and Blend (1999) examined willingness to pay for sustainable agriculture apples. They concluded that at a $0.40 per pound premium, over a third of surveyed households would be willing to buy eco-labeled apples. Ethier *et al.* (2000) found that 30.6% of phone respondents and 35.5% of mail survey respondents said that they would choose to join the Green Choice™ program for "green" electricity at a $6/month price premium. Although Nimon and Beghin (1999) identified a premium for organic cotton fibers, they could not find evidence of a premium associated with environmental friendly dyes.[2] Teisl, Roe, and Levy (1999) studied how eco-marketing and seals of approval affect consumer choice and preference rankings of electricity suppliers and how reactions differ across consumers. They concluded that eco-labels were more likely to affect the preference rankings of products rather than the choice of products.

Complicating eco-label valuation is the fact that eco-labels may work better for some products than for others, implying that a general "recipe" to stimulate "green markets" may not work. In a study related to this point, Wessells *et al*. (1999) found that consumers do not value all certified fish and seafood species in the same way, stating higher subjective willingness to pay values for certified salmon than cod.

In addition to these eco-label studies, many researchers have studied consumer demand for organic or other products with low or no pesticide usage.[3] Thompson and Kidwell (1998) analyzed the choice between organic and conventional produce using a two-equation probit model. Their finding that households with children under eighteen were more likely to purchase organic produce is consistent with our results.

B. Consistency of Stated Preferences with Actual Purchases

In order to evaluate the validity of CV estimates, in 1993 a National Oceanic and Atmospheric Administration (NOAA) panel encouraged studies to be conducted that

[2] Note that these choices do not need to be mutually exclusive.
[3] See Thompson (1998) for a comprehensive review of studies on organic food demand.

compare stated and revealed preferences. Carson et al. (1996) examined 83 studies in which 616 comparisons between contingent valuation estimates to revealed preferences are made. Surprisingly, the sample mean of CV/RP ratio is 0.89, implying that contingent valuation estimates are smaller than their revealed preferences counterparts.

Many recent studies provide insights on the benefits of combining revealed and stated preferences in order to obtain more reliable estimates of willingness to pay and, therefore, to make better policy decisions. Adamowicz et al. (1994) observe that combining revealed and stated preferences mitigates multicollinearity problems and provides evidence that the underlying preferences are similar. Cooper (1997) uses farmers' responses to CV questions in combination with actual data to estimate the minimum incentive payments required for farmers to adopt environmentally friendly practices. Following the same underlying idea, Hubbell et al. (2000) combine RP data obtained from a survey on adoption of Bt cotton with SP data on WTP from the adopters of the new product. Loomis (1997) also combines RP and SP using a panel data approach in order to identify characteristics of visitors to the Rio Mameyes. The same approach has been used by Vaughn Nestor (1998), who combines SP from a survey with RP from observed behavior in order to study the effects of new pricing in trash services in Georgia. CV estimates have also been combined with RP estimates in the context of travel costs models. Cameron (1992) argues that instead of treating CV and travel cost as competing methods, both types of data can be combined to successfully estimate welfare measures. Kling (1997) combines travel costs and CV estimates obtaining more precise estimates for single and double bounded probit models.

However, studies that test consistency of RP versus SP are very limited. Herriges et al (1997) develop the idea of consistency and how to test for full and partial consistency between revealed and stated preferences under different error term assumptions. They conclude that the hypothesis of full consistency between RP and SP cannot be rejected in their study. Rimal et al. (1999) use a bivariate probit model with equations for intended purchase and actual purchase in a supermarket simulation. They test whether the parameters are the same across the two equations. They reject this hypothesis and conclude that the people in their sample did not do what they said that they intended to do.

III. Data Collection

Our data was collected with in person interviews and purchases in actual grocery stores. We collected data from consumers at grocery stores for two reasons: (1) we hoped to obtain data directly from the actual decision makers and to better elicit consumers' true preferences, and (2) we could collect stated preferences (SP) and revealed preferences (RP) from the same individual at roughly the same point in time. Shoppers were solicited in the vicinity of the produce section of the grocery store. The turndown rate was approximately fifty percent. After the shoppers completed the SP survey, they received three discount coupons that were valid only for that day, one for organic apples, a second for sustainable agriculture apples, and a third for regular apples. Using these coupons we randomly varied the ratio of relative prices of sustainable agriculture apples with respect to organic and regular apples. The coupons were numbered to correspond to the numbered questionnaire for each survey participant. Consequently, we observed stated preference behavior from questions asked in the SP survey and then observed RP behavior from the exercise of the discount coupons (the economic experiment) from the same person at roughly the same point in time.

The survey was conducted during January 2000 in the produce section of two grocery stores in Portland, Oregon, in cooperation with The Food Alliance (TFA), a Portland, Oregon-based, non-profit third-party certifying organization. TFA uses market-based incentives to promote sustainable agricultural practices in the Pacific Northwest. Farmers who reduce or eliminate pesticides, conserve the soil and water, and provide safe and fair working conditions, become eligible to market their products with the TFA-Approved seal. TFA has the only labeling program in the Northwest that is based on farm practices.

The survey respondents were asked about their consumption of apples, their attitudes about the environment and food safety, their familiarity and perceptions about the TFA sustainable agriculture label, and socio-demographic information. Those consumers who indicated that they were not knowledgeable about TFA were read a short paragraph (see the appendix for the actual text) about what TFA stands for. Contingent valuation questions regarding willingness to pay for TFA-approved apples were asked using two approaches: dichotomous choice and multinomial contingent ranking.

In total, 289 consumers were surveyed. The majority of respondents were the primary food shopper of the household (87%), white (92%) and female (89%). The respondents' average age was 46 years, and 36% of all respondents had children under the age of 18 years old living in their household. The average household income of the sample was between $50,000 and $70,000[4] for the 1999 fiscal year, and their average education was some years of college. Summary statistics and variable descriptions are presented in Table 1. This sample includes fewer minorities and has a higher average income compared to national averages.

Information about environmental and food safety attitudes was obtained by presenting trade-off situations between environmental quality and job creation and between food safety and product appearance. (The questions used to elicit consumers' environmental attitudes and food safety concerns are presented in the appendix.) Eliciting these attitudes from trade-off scenarios was an effective way of ensuring that survey information was informative as well as useful in an empirical modeling context. For example, without the tradeoff, most respondents will say that they highly value the environment (this outcome occurred in Parker and Jolly, 2000). The lack of variation in response can lead to statistical insignificance of the effect of the environmental variable, and in the extreme if all responses are uniform, the effect is statistically unidentifiable.

Regarding environmental and food safety attitudes, 52% of the customers assign more importance to preserving the environment than creation of employment opportunities, and 33% place more importance on food safety issues rather than appearance of the fruit. Note that information about environmental and food safety preferences has been obtained by presenting a trade-off situation between environmental quality and job creation. On

[4] In order to obtain a high response rate, respondents were asked to place themselves in income intervals, rather than give their exact income amount. Survey respondents are typically reluctant to divulge incomes

average, surveyed consumers do not perceive a significant difference in quality between TFA-approved apples and all the rest of apples in the store. Examples of the questions that were used to elicit the environmental and food safety concerns and perceived quality are presented in the appendix. Variable definitions and summary statistics from some of the questions related to consumers' environmental and food safety attitudes and consumers' knowledge about TFA are presented in Table 2.

We also obtained scanner data from Thirftway stores in Portland, Oregon, where TFA products and other generic products without label are regularly sold. Weekly retail apple prices have been collected in these Thirftway stores for each variety and size of apple between 10/27/98 and 12/29/98.

IV. Model of Apple Choice

The discrete choice from among organic, sustainable agriculture, and conventional apples was modeled within a multinomial logit framework. The theoretical foundations of the (unordered) multinomial logit model lie in the random utility model approach (Mittelhammer *et al*. 2000). Suppose the i^{th} consumer's utility derived from the selection of apples of type *j* (sustainable agriculture, organic or conventional) can be represented as

(1) $$U_{ij} = X_i \beta_j + e_{ij}$$

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information.

where U_{ij} represents the utility that the i^{th} consumer obtains from choosing the j^{th} type of apple; X_i represents the i^{th} consumer's sociodemographic characteristics (such as presence of children in the household, income and family size) and beliefs and perceptions (such as food safety concerns, environmental attitudes, and perceptions of apple quality); and ε_{ij} is the residual error term which captures errors in perception and in the overall representation of the level of utility. Notice that the utility from choosing the j^{th} alternative is not observable, but the consumer's choice is observable.

Assuming that the consumer is a rational agent, we expect him/her to select the type of apple (from among organic, sustainable agriculture, and conventional) that results in the highest utility possible from his or her choice. Thus, if the i^{th} consumer selects type j, then U_{ij} is the highest utility obtainable from among the J possible choices. Hence, the statistical model of the probability that alternative j is chosen by individual i is given by

(2) $$Prob_{ij} = \text{Prob}(U_{ij} > U_{ia}; a = 1,\ 2, \ldots, J, a \neq j) =$$

$$Prob(\varepsilon_{ia} - \varepsilon_{ij} > \hat{U}_{ij} - \hat{U}_{ia}; a = 1,\ 2, \ldots, J, a \neq j),$$

where $\hat{U}_{ij} = X_i \beta_j$ Maddala (1996) shows that if the residuals are independently and identically distributed following a Type I Extreme Value distribution, such as:

(3) $$F(\varepsilon_{ij}) = e^{(e^{-\varepsilon_{ij}})},$$

then it follows that the difference in error terms, displayed in equation (2), has a logistic distribution. Therefore, a multinomial logit model can represent the i^{th} consumer's probability of selecting the j^{th} choice:

(4) $$\text{Prob}(y_i = j) = \frac{e^{\boldsymbol{\beta}'_j x_i}}{\sum_{k=1}^{J} e^{\boldsymbol{\beta}'_k x_i}} \text{ for } j = 1, \ldots, J,$$

where β_j refers to estimated parameters that weight exogenous variables in determining the utility of choice j; and x_i is the exogenous variable vector corresponding to socio-demographic characteristics, perceptions, and attitudes of the i^{th} consumer. The parameters in equation (4) are unidentified since more than one set of parameters can generate identical probability values. To identify the parameters of the model, constraints on the *β's* must be imposed. The most common constraint in multinomial logit models, and the one we adopt without loss of generality, is that $\beta_1 = 0$. The log likelihood of the multinomial logit is given by:

(5) $$L = \prod_{i=1}^{n} \prod_{j=1}^{J} \Pr ob(y_i = j)^{y_{ij}},$$

where $y_{ij} = 1$ if alternative j is chosen by the i^{th} individual, and zero otherwise.

V. Empirical Model Specification for Survey Data

Note that the choice from among organic, sustainable agriculture, and conventional apples was presented to the consumers in a way that removes any price effect (see the Appendix for the actual questions). Therefore, the empirical specifications of the utility levels underlying the multinomial logit model make no reference to prices, and were formulated as follows:

$$(6)\qquad \begin{aligned} U_{ij} = \beta_{0j} &+ \beta_{1j} Children + \beta_{2j} Food\ Safety + \beta_{3j} Environment + \beta_{4j} TFAQuality + \\ &\beta_{5j} Family\ Size + \beta_{6j} Income + \beta_{7j} Gender + \varepsilon_{ij} \end{aligned}.$$

Note that since U_{ij} is the latent unobservable utility level that the i^{th} consumer obtains from choosing the j^{th} apple type, the observed apple choice is a reflection of this latent unobservable utility. Also note that additional socio-demographic variables such as race, age, and education have been excluded from this empirical specification because they were not statistically significant in any of the utility equations relating to this application .

VI. Multinomial Logit Model Estimation Results

The multinomial logit model based on (5)-(6) was used in a maximum likelihood framework to estimate product choice behavior when the three alternatives are equally priced. The marginal effects of the explanatory variables on the likelihood of choosing each type of apple evaluated at the mean values of the explanatory variables are presented in Table 3.

The results indicate that consumers with children under the age of eighteen and strong environmental and food safety attitudes are more likely to buy organic apples, *ceteris paribus*. These results are consistent with Thompson and Kidwell (1998), who analyzed the factors affecting the actual choice of organic versus conventional produce. At the same time, family size has a significant negative effect on the likelihood of choosing organic.[5] Although the three products were offered at the same price, shoppers with large families may have been conditioned by their customary shopping behavior (purchasing low-cost items to economize food budgets) towards being less likely to purchase organic products. An alternative explanation is that shoppers with large families may be more conservative, and as a result, less interested in or cognizant of organic products.

Perceived quality of sustainable agriculture apples has a positive and significant effect on the likelihood of choosing sustainable agriculture apples. This implies that environmentally friendly marketing will not compensate for poor quality.

Consistent with the notion that the sustainable agriculture label alternative is an intermediate choice, some of the factors that have a positive and significant effect on the likelihood of organic choice have a negative impact (although not significant at conventional levels) on the likelihood of the sustainable agriculture choice. One reason

[5] Note that although family size is correlated with the presence of children under eighteen, it is a different variable that provides new information.

why sustainable agriculture apples may be an intermediate choice for consumers with children is that they may perceive organic products to be safer for children compared with sustainable agriculture products due to no pesticide usage associated with organic products. Similarly, although not statistically significant at conventional levels, attitudes about food safety and the environment are estimated to negatively affect the probability that a consumer will choose sustainable agriculture apples. One might reasonably expect a consumer who cares strongly about food safety and the environment to be more likely to buy sustainable agriculture products. Getting the opposite result, we conclude that many food safety and environmentally conscious consumers who would be favorably disposed towards purchasing sustainable agriculture apples consider organic apples to be even more safe and environmentally friendly, and thus will prefer to buy organic if they are offered at equal prices.

In general, the idea of a sustainable agriculture label is more vague, and the personal benefits (other than perceived fruit quality) are more difficult to measure compared with organic products. There may be more altruism required with a sustainable agriculture label purchase because environmental quality is generally a public good. On the other hand, it may be the case that organic products are perceived as better for the environment than sustainable agriculture products. Our finding that strong environmental attitudes significantly increase the probability of choosing the organic apples while insignificantly decreasing the probability of choosing the sustainable agriculture apples is consistent with this argument.

Finally, as expected, the factors that affect the decision to purchase organic have the opposite effect on the decision to purchase conventional apples. Male shoppers who have larger households and are less environmentally and food safety-conscious tend to choose conventional apples when they are offered at equal prices. The presence of children in the household has a significant negative effect on the decision to purchase conventional apples.

A. Hypotheses Testing of Label Intermediacy with Survey Data

Since the choice of apples was presented to the consumer without a price differential, we expect to find an underlying ranking of preferences, where the most environmentally and food-safety-concerned consumers choose organic apples, and at the other extreme, consumers who are not concerned about the environment or food safety choose conventional apples. Therefore, our principal hypothesis is that the sustainable agriculture label alternative is an intermediate choice between organic and conventional apples, and suits the preference of those consumers who are looking for a good quality apple, but who do not emphasize environmental or food safety concerns. In order to test this hypothesis, we focus our attention on coefficients relating to the environmental and food safety variables, and the presence of children under eighteen years old in the household. According to conventional wisdom, these variables should have very different effects on preferences for environmentally friendly products compared with conventional products.

Regarding the statistical hypothesis, we expect to obtain coefficients in the latent utility equations that lie, in terms of magnitude, between those obtained from the organic and conventional choices. In addition, we expect that some factors that positively affect preferences for organic apples may negatively affect the preference for conventional apples. In order to generate evidence for or against these conjectures, we first seek to reject the following two joint null hypotheses of no difference between the organic versus sustainable agriculture label preference, and the sustainable agriculture label versus conventional preference with respect to the effects of all three of the aforementioned explanatory variables:

(7) $H_0 : b_{i,organic} - b_{i,ecolabel} = 0$, $i = 1, 2, 3$.

(8) $H_0 : b_{i,ecolabel} - b_{i,conventional} = 0$, $i = 1, 2, 3$.

The combination of hypotheses (7) and (8) is used to determine whether the coefficients for the presence of children, food safety attitudes, and environmental attitudes, respectively, for the sustainable agriculture label choice exhibit differential effects compared with the corresponding coefficients for the organic and conventional apple choices. If the joint hypotheses represented by (7)-(8) are not rejected, then our conjecture of intermediacy of preferences for the sustainable agriculture label alternative is rendered moot.

Wald tests were conducted to evaluate the two joint null hypotheses, resulting in rejections of both hypotheses at the .01 level of type I error (see Table 4 for the chi-square statistics and p-values). We conclude that equality of the coefficients associated with the organic versus sustainable agriculture label preference and the sustainable agriculture label versus conventional preference coefficients are both rejected, and the environmental and food safety variables, and the presence of children under eighteen years old exhibit differential effects on preferences for apple alternatives.

In order to investigate the rank-ordering of the effects of the three explanatory variables on preferences for the three apple alternatives, T-tests were conducted to evaluate the following six inequality hypotheses:

(9) $$H_{0i}: b_{i,organic} - b_{i,ecolabel} \leq 0,\ i = 1, 2, 3.$$

(10) $$H_{0i}: b_{i,ecolabel} - b_{i,conventional} \leq 0,\ i = 1, 2, 3.$$

A *rejection* of the hypotheses provides evidence in favor of the intermediacy of preferences for the sustainable agriculture label alternative. The chi-square statistics and p-values are presented in Table 4 for each hypothesis. Four of the six inequality hypotheses were rejected at the ten percent level of type I error or smaller.

Consider in more detail the hypotheses that compare the organic coefficients with the sustainable agriculture coefficients (Equation 9). If sustainable agriculture products are intermediate in preference, we would expect each coefficient (presence of children, food safety attitudes, environmental attitudes) to be larger in the organic case. All of the inequality hypotheses were rejected at the ten percent level or better, consistent with the notion that the sustainable agriculture label choice is intermediate to the organic choice in terms of preference intensity.

Now consider the hypotheses that compare the sustainable agriculture coefficients with those for the regular apple choice (Equation 10). In this case the inequality hypothesis could be rejected with respect to food safety attitudes, which in conjunction with the previous results suggest that preferences for the sustainable agriculture label product lies between preferences for the organic and conventional alternatives in this regard. The inequality hypotheses relating to the presence of children and environmental attitudes could not be rejected, and thus it cannot be stated that the preference rankings of the alternative is higher relative to the conventional product with respect to these factors.

VII. Methodology for Estimation of Willingness to Pay

The second principal objective of our study is to estimate the mean willingness to pay for sustainable agriculture apples. In pursuit of this objective, we estimated a double-bounded logit model. Hanemann *et al.* (1991) showed that the double-bounded dichotomous choice model is asymptotically more efficient than the single-bounded model. In the classical double-bounded model, each participant is presented with two bids. The level of the second bid is contingent upon the response to the first bid. If the individual responds “yes,” meaning that he or she is willing-to-pay the amount of the first bid, then the level of the second bid is some amount greater than the first bid. On the other hand, if the individual responds “no,” meaning that he or she is not willing-to-pay the amount of the to the first bid, then the second bid is some amount less than the first bid.

In our model, the bids were based on price differentials. The first bid stipulated a common price (equal price) for organic, sustainable agriculture and conventional apples, implying no price difference. Thus, consumers chose their preferred type of apple at equal prices. If they indicated a preference for sustainable agriculture apples, then they received a second bid that increased the price differential to a positive number.[6] On the other hand, if consumers chose organic or conventional apples as their first choice, they were presented with a second bid that discounted the price of TFA sustainable agriculture apples in comparison with organic and regular apples and were asked again which type of apple they would buy, given the relatively less expensive sustainable agriculture apples. Therefore, a log-likelihood formulation of the classical double bounded model is applicable. In this particular case, the double-bounded model generates an estimate of the "net" willingness to pay, accounting for those consumers who in spite of not choosing sustainable agriculture apples as their first choice, they would be willing to buy them if they were cheaper than organic or regular apples. The four possible outcomes were: (a) "no" to both bids, (b) a "no" followed by a "yes", (c) a "yes" followed by a "no" and, (d) "yes" to both bids.

[6] The different bids or premiums given to the consumers were 10 extra cents/lb., 15 extra cents/lb., 20 extra cents/lb., 30 extra cents/lb. and 50 extra cents/lb. if they chose sustainable agriculture apples as their first choice. Otherwise discounted bids, with the discounts set at amounts identical to the premiums (10 cents discounted/lb. and so on), were given if consumers did not choose TFA apples as their first choice.

The sequence of questions isolates the range in which the respondents' true WTP lies, placing it into one of the following four intervals: $(-\infty, B_L)$, $[B_L, B_I)$, $[B_I, B_H)$, or $[B_H, +\infty)$. The second bid, in conjunction with the response to the initial preference decision, allows both an upper and a lower bound to be placed on the respondent's unobservable true WTP. In particular, when the second decision is in the same direction as the first one (yes, yes; no, no), it raises the lower bound or lowers the upper bound, respectively. Therefore, the following discrete outcomes of the bidding process were observable:

(11)
$$D = \begin{cases} 1 & WTP < B_L \\ 2 & B_L \leq WTP < B_I \\ 3 & B_I \leq WTP < B_H \\ 4 & B_H \leq WTP, \end{cases}$$

where WTP denotes the individual's WTP (or bid function) for sustainable agriculture apples. The WTP function is represented as:

(12)
$$WTP = \alpha - \rho B + \lambda' z + \varepsilon$$

where, B is the bid amount each consumer faces, z is a vector of observable characteristics of the individual, ε is a random variable accounting for unobservable characteristics, and γ is a vector of unknown parameters to be estimated. Assuming linearity in z and ε and letting $\varepsilon \sim G(0, \sigma^2)$, where $\varepsilon \sim G(0, \sigma^2)$ denotes a cumulative distribution function with mean zero and variance σ^2, the choice probabilities become:

$$(13)\quad prob(D=j)=\begin{Bmatrix} G(\tilde{\alpha}-\tilde{\rho}B_L+\tilde{\lambda}'z) \\ G(\tilde{\alpha}-\tilde{\rho}B_I+\tilde{\lambda}'z)-G(\tilde{\alpha}-\tilde{\rho}B_L+\tilde{\lambda}'z) \\ G(\tilde{\alpha}-\tilde{\rho}B_H+\tilde{\lambda}'z)-G(\tilde{\alpha}-\tilde{\rho}B_I+\tilde{\lambda}'z) \\ 1-G(\tilde{\alpha}-\tilde{\rho}B_H+\tilde{\lambda}'z) \end{Bmatrix} \text{ for } j=\begin{Bmatrix}1\\2\\3\\4\end{Bmatrix}.$$

Thus, the log likelihood function becomes:

(14)

$$L=\sum_i \begin{Bmatrix} I_{D_i=1}\ln G(\tilde{\alpha}-\tilde{\rho}B_{Li}+\tilde{\lambda}'z_i)+I_{D_i=2}\ln[G(\tilde{\alpha}-\tilde{\rho}B_{Ii}+\tilde{\lambda}'z_i)-G(\tilde{\alpha}-\tilde{\rho}B_{Li}+\tilde{\lambda}'z_i)] \\ +I_{D_i=3}\ln[G(\tilde{\alpha}-\tilde{\rho}B_{Hi}+\tilde{\lambda}'z_i)-G(\tilde{\alpha}-\tilde{\rho}B_{Ii}+\lambda'z_i)]+I_{D_i=4}\ln[1-G(\tilde{\alpha}-\tilde{\rho}\mathrm{B}_{Hi}+\tilde{\lambda}'z_i)] \end{Bmatrix}$$

where I_K is an indicator function for the event *K*, and *i* denotes individual *i*. In the empirical implementation of the model, we define $G(.)$ to be the standard logistic distribution with mean zero and standard deviation $\sigma=\pi/\sqrt{3}$.

VIII. Willingness to Pay Estimation Results from the Survey

The results from the double-bounded logit model estimation are presented in Table 5. Besides a constant factor and the bid, only perceived quality of the sustainable agriculture apples significantly affected mean willing to pay for the sustainable agriculture apples at the at the five percent level of type I error. Food safety attitudes were significant at the ten percent level of type I error. These results are consistent with the hypothesis that sustainable agriculture apples are an intermediate choice in terms of the environment and food safety, and that consumers' willingness to pay a premium for them is based on quality. The probabilities that a consumer will be willing to pay specific price premiums for TFA sustainable agriculture apples are presented in Figure 1. As expected, the probability of accepting a bid decreases as the premium (or bid) is augmented.

We calculated the mean willingness to pay without restricting it to be positive. The likelihood function (14) is restricted by setting all the λ's equal to zero, leaving just the constant term and the bid parameter in the model. Then the parameters of the restricted model are estimated via maximum likelihood, and the mean WTP is calculated using the formula proposed by Hanemann (1989), $\tilde{\alpha} / \tilde{\rho}$. This formula allows for the mean WTP to be negative. This will be the case if consumers are not willing to pay any premium in order to buy sustainable agriculture label apples, but rather they have to be compensated with a discounted price. Our mean WTP estimate and confidence intervals are presented in Table 6. Using the above formula, the mean WTP from the double bounded model is 9.28 cents/lb. This represents a premium of almost ten cents per pound for sustainable agriculture apples over the initial bid.

IX. Incorporating the Economic Experiment and Consistency Assessment

A two-equation model suits our research goal of testing for consistency between stated preferences and actual purchases. The hypothetical willingness to pay is modeled in the first equation, and the actual purchase behavior is modeled as a function of the hypothetical willingness to pay and other variables in the second equation. Statistical results obtained from both equations are compared and discussed.

We use a model with a double-bounded probit structure, which employs a sequence of two discrete choice questions in order to elicit the WTP estimate. An initial question about the preferences for sustainable agriculture apples was asked with the intent of removing the effects of price and size from the response. Specifically, consumers were asked to choose a type of apple from among organic, sustainable agriculture and regular, all offered at the same price and size. If consumers chose the sustainable agriculture apples, then they were asked a dichotomous choice willingness-to-pay question. Otherwise, they were asked a willingness-to-compensate question (see the appendix). The equations for stated and revealed preference for sustainable agriculture apples are respectively as follows:

(15) $$Y_i^* = \gamma X + \varepsilon_{Si}$$

(16) $$Z_i^* = \beta X + \sum_{i=1}^{3} \delta_i I_i + \varepsilon_{Ri},$$

where X is a vector of attitudes, socio-demographic characteristics, perceived product quality, and relative price measures; the I_i's are indicator variables that represent the intensity category of hypothetical WTP for sustainable agriculture apples (1, 2, 3, 4) obtained from survey responses. ε_{R_i} and ε_{S_i} are the error terms, which for parameter identification are assumed to follow a standard normal distribution. Z^* and Y^* are unobservable latent variables. They represent the *ex ante* willingness to pay and purchase-time desirability of buying TFA-sustainable agriculture apples, respectively.

A. SP Specification

The latent variable Y_i^* may lie in one of four different observed intervals: $(-\infty, \alpha_1),[\alpha_1, \alpha_2),[\alpha_2, \alpha_3),[\alpha_{3,}\infty)$. The researcher observes the discrete variable,

$$(17) \qquad Y_i = \begin{cases} 1 & -\infty < Y_i^* \leq B_{Li} \\ 2 & B_{Li} < Y_i^* \leq B_{Ii} \\ 3 & B_{Ii} < Y_i^* \leq B_{Hi} \\ 4 & B_{Hi} < Y_i^* < \infty, \end{cases}$$

where the B_i's denote various levels of bid prices for TFA apples in effect due to hypothetical discounts or premiums, with $B_L < B_I < B_H$. The hypothetical response scenario $Y_i = 1$ refers to consumers who stated they would not choose TFA apples as their first choice if they were offered at equal prices and also would not choose TFA apples if they were offered at a discount. If $Y_i = 2$ the consumer would not choose TFA apples as his/her first choice at equal prices and sizes but would choose them if they were offered at a discount. If $Y_i = 3$, the consumer would choose TFA apples as a first choice at equal prices but would not pay an extra premium for them. Finally, if $Y_i = 4$, the consumer would choose TFA apples at equal prices and, in addition, would be willing to pay a premium for these apples.

The probabilities associated with each of the aforementioned intervals for Y_i^* are:

$$\text{(18)} \qquad \Pr(Y_i^* = j) = \begin{cases} \Phi(\tilde{\gamma}_0 + \tilde{\gamma} B_{Li} + \tilde{\lambda}' z) & j = 1 \\ \Phi(\tilde{\gamma}_0 + \tilde{\gamma} B_{Ii} + \tilde{\lambda}' z) - \Phi(\tilde{\gamma}_0 + \tilde{\gamma} B_{Li} + \tilde{\lambda}' z) & j = 2 \\ \Phi(\tilde{\gamma}_0 + \gamma B_{Hi} + \tilde{\lambda}' z) - \Phi(\tilde{\gamma}_0 + \tilde{\gamma} B_{Ii} + \tilde{\lambda}' z) & j = 3 \\ 1 - \Phi(\tilde{\gamma}_0 + \tilde{\gamma} B_{Hi} + \tilde{\lambda}' z) & j = 4 \end{cases}$$

where Φ denotes the cumulative distribution function (CDF) for the standard normal distribution, the B_j's denote the aforementioned hypothetical discounts or premiums, and the z-vector denotes the remaining explanatory variable with all other symbols denoting parameters. Note, as is evident from Equations (1) and (3), that the parameters in (4) are scaled by σ^{-1}, the standard deviation of error term ε_{Si} and $\tilde{\gamma} = \sigma^{-1}$.

Following Herriges (1999), the log likelihood associated with (4) consists of a product of terms, such that:

(19)

$$L = \sum_i \left\{ \begin{array}{l} I_{Y_i=1} \ln \Phi(\tilde{\gamma}_0 + \tilde{\gamma} B_{Li} + \tilde{\lambda}' z_i) + I_{Y_i=2} \ln[\Phi(\tilde{\gamma}_0 + \tilde{\gamma} B_{Ii} + \tilde{\lambda}' z_i) - \Phi(\tilde{\gamma}_0 + \tilde{\gamma} B_{Li} + \tilde{\lambda}' z_i)] \\ + I_{Y_i=3} \ln[\Phi(\tilde{\gamma}_0 + \tilde{\gamma} B_{Hi} + \tilde{\lambda}' z_i) - \Phi(\tilde{\gamma}_0 + \tilde{\gamma} B_{Ii} + \lambda' z_i)] + I_{Y_i=4} \ln[1 - \Phi(\tilde{\gamma}_0 + \tilde{\gamma} B_H + \tilde{\lambda}' z_i)] \end{array} \right\}$$

where I_K is an indicator function for the event K, and the subscript i denotes individual i. The specific arguments of the CDFs in (5) are as follows:

$$\text{(20)} \qquad Y_i^* = \gamma_o + \gamma Bid_i + \lambda_1 Children_i + \lambda_2 FoodSafety_i + \lambda_3 TFAQuality_i + \varepsilon_{Si},$$

where the variable Bid_i represents the bid given to the i^{th} consumer in the survey, $Children_i$ represents the presence of children under 18 years old in the i^{th} consumer's household, $TFAQuality_i$ represents the i^{th} consumer's perception of the quality of TFA apples compared with the rest of the apples in the store and $Safety_i$ represents the i^{th} consumer's food safety attitudes. We did not include environmental attitudes in the set of explanatory variables because they were not significant for either the stated or revealed preference choices.

B. RP Specification

The specification of the model for the latent variable underlying the RP decision is as follows:

(21)
$$Z_i^* = \beta_0 + \beta_1 Discount_i + \beta_2 Children_i + \beta_3 FoodSafety_i + \beta_4 TFAQuality_i + \\ + \delta_1 I_{Y_i=1} + \delta_3 I_{Y_i=3} + \delta_4 I_{Y_i=4} + \varepsilon_{2Ri},$$

where

$$Z = 1 \quad if \quad Z^* > 0, \\ Z = 0 \quad if \quad Z^* \leq 0.$$

Since Z_i^* is unobservable, instead we model Z_i, the observed choice in the market experiment. We use the same explanatory variables in the SP and RP equations except the *Discount* variable replaces the *Bid* variable to account for the different market scenario, and we add the $I_{Y_i=j}$'s from (2), the indicator variables that represent intensity of hypothetical WTP obtained from survey responses.

The two-equation SP-RP model is estimated by maximizing the joint likelihood function based on a bivariate normal distribution for the disturbance terms, where the variances are scaled to unity for parameter identification purposes. A nonzero correlation between two disturbance terms is allowed via the introduction of a correlation parameter into the model. In order to provide an explicit compact representation of the joint likelihood function for the maximum likelihood problem let $\alpha_{1i} = \tilde{\gamma}_0 + \tilde{\gamma} B_{Li} + \tilde{\lambda}' z_i$, $\alpha_{2i} = \tilde{\gamma}_0 + \tilde{\gamma} B_{Ii} + \tilde{\lambda}' z_i$, $\alpha_{3i} = \tilde{\gamma}_0 + \tilde{\gamma} B_{Hi} + \tilde{\lambda}' z_i$, and let η_i denote the right hand side of (7) without the disturbance term. Also define $\alpha_{0i} \equiv -\infty$ and $\alpha_{4i} \equiv \infty$. Then the joint log-likelihood for the estimation problem can be defined as

(22)

$$L\left(\tilde{\gamma}, \tilde{\lambda}, \beta, \delta\right) = \sum_{i=1}^{n} \sum_{j=1}^{4} \left[I_{\gamma_i = j, z_i = o} \ln \Pr\left(\varepsilon_{si} \in \left(\alpha_{j-1,i}, \alpha_{j,i}\right), \varepsilon_{Ri} \leq -\eta_i\right) + I_{\gamma_i = j, z_i = 1} \ln \Pr\left(\varepsilon_{si} \in \left(\alpha_{j-1,i}, \alpha_{j,i}\right), \varepsilon_{Ri} \geq -\eta_i\right)\right]$$

where Pr(·) denotes the probability of an event. The probabilities are defined in terms of the appropriate integrals of the bivariate normal distribution of the disturbance terms.

The likelihood function (22) was maximized using the GAUSS maximum likelihood application software (Aptech Systems, 1999). Estimation results are discussed in the following section.

IX. Consistency Assessment Results

Using the estimated δ_j parameter associated with the indicator variables representing intensity of hypothetical WTP obtained from survey responses from (16), we test whether the stated intensity of preference to purchase TFA apples had a positive effect on RP. The double-bounded structure allows us to use an implicit ranking of preferences, which can be used to test the consistency of SP with actual behavior. In particular, to test whether the indicator variables associated with higher stated willingness-to-pay is consistent with actual purchase behavior, we use the above model specification to test the following null hypothesis:

(23) $$H_0 : \delta_1 = \delta_3 = \delta_4 = 0$$

Given consistency, the following alternative hypothesis should hold:

(24) $$H_1 : \delta_1 \leq 0 \leq \delta_3 \leq \delta_4 .$$

The rejection of the above null hypothesis, coupled with estimated δ_i's whose magnitudes satisfy the relationships depicted in (24), imply that the SP obtained from the survey have expected effects on the observed behavior, or in other words, that consumers were consistent between stated preferences and actual purchase behavior.

Statistical results from the observed behavior equation are presented in Table 7. Regarding the factors that affect consumer choice of sustainable agriculture apples, we find that significant factors include the perceived quality of TFA-approved apples (with a positive effect), the presence of children under 18 years old in the household (with a negative effect), and the indicator variable associated with the highest ranking of SP (with a positive effect). The latter finding, as expected, implies that the higher the stated willingness to pay, the higher the probability a consumer will ultimately buy sustainable agriculture apples.

The result that the presence of children in the household negatively affects the probability that a consumer will choose sustainable agriculture apples is somewhat surprising at first. One might expect that consumers with children would buy the sustainable agriculture product because they may care about giving their children foods with fewer pesticides and care about the environmental quality that their children will experience in the future. Getting the opposite result suggests that many of the consumers that one would expect to buy sustainable agriculture products will buy organic if they are offered as a substitute. This may be caused by the perception that organic products are safer for children owing to the association of the term organic with no pesticide usage, as opposed to reduced pesticide usage that is associated with TFA. In general, the idea of a sustainable agriculture label is more vague, and the personal benefits are more difficult to measure compared with the term organic.

Regarding the consistency of stated versus revealed preferences, although only the coefficient for δ_4, the indicator variable associated with the highest range of the latent WTP variable, has a statistically significant effect on the choice of TFA sustainable agriculture apples, all of the δ_i coefficients have the expected sign and satisfy the expected relative magnitudes identified in the alternative hypothesis stated in (24). The statistical results from a Wald test indicate that the null hypothesis can be rejected with a 90% level of confidence, implying that there is statistical evidence supporting the alternative hypothesis, and therefore, the consistent behavior of the consumers who took part in the market experiment. Together these results imply that higher rankings on stated preferences positively affect the choice of sustainable agriculture apples.

X. Hedonic Price Analysis

Scanner data has been collected from Thirftway stores in Portland, where TFA products and other generic products without label are regularly sold. Weekly retail apple prices have been collected in these Thirftway stores for each variety and size of apple between 10/27/98 and 12/29/98. However, since all the large apples sold at Thirftway are labeled with the TFA Seal of Approval, it is not possible to identify the effects of the Seal of Approval separately from the large size effects on price. In order to get a more complete data set, which includes prices of large apples that do not carry a TFA Seal of Approval label, prices corresponding to competitors' stores such as Safeway, Albertson's and Fred Meyer have been also collected for the same period of time and apple varieties. With the competitors' prices, we calculated the mean weekly price of each variety of apples per week and size. This calculated mean is taken as a good estimate of apple prices without the Food Alliance Seal of Approval.

The cross product of apple variety and size is positively statistically significant for each variety and size. However, the marginal effect on price of small sizes is smaller than larger sizes, implying the obvious result that smaller sizes bring a small price premium. It is interesting that new varieties such as Fuji and Granny apples carry a larger marginal effect on price or premium. Regarding the label variable, The Food Alliance Seal of Approval, is not statistically significant and negative. This finding is not surprising, given that there is no mark up price for sustainable agriculture apples versus regular or conventional apples. We concluded that the hedonic approach was not appropriate for our purposes.

XI. Conclusions

In this study, we considered factors that induce certain consumers to buy sustainable agriculture apples as opposed to organic or conventional apples. We conclude that sustainable agriculture and organic food products are competing for consumers with similar attitudes towards food safety and environmental quality and that this type of consumer would prefer to buy organic at equal prices. It might behoove producers and retailers to consider that organic food products may be an established and often preferred substitute when attempting to enter environmentally friendly niche markets.

We first restricted prices to be equal across apple types and estimated a multinomial logit model to analyze consumers' preferences for apples to analyze the factors affecting the decision to buy sustainable agriculture apples. We found that the presence of children under eighteen in the household**,** food safety concerns, and attitudes about the environment positively affect the likelihood that a consumer will prefer an organic product, while family size negatively affects this likelihood**.** Based on these findings, we conclude that many consumers who would be favorably disposed towards purchasing sustainable agriculture apples consider organic apples to be an even safer and more environmentally friendly alternative, and thus will buy organic if they are offered at equal prices.

The quality of sustainable agriculture apples perceived by consumers is the only variable that has a positive effect on the likelihood of purchasing sustainable agriculture apples. The fact that quality perceptions are extremely important for sustainable agriculture products is appreciated by the industry, according to a former Executive Director of an environmental certification program.

As expected, the presence of children in the household, food safety concerns, environmental attitudes, being a female, and perceived TFA quality have a negative effect on the likelihood of choosing conventional apples, while household size has a positive effect.

We hypothesized that sustainable agriculture apples are intermediate in preference among the three alternatives, lying between organic and conventional apples. Consumers who have children and strong environmental and food safety concerns will be more likely to choose organic products, while people without children and with weak environmental and food safety concerns will be more to choose conventional apples. Based on the results of hypothesis tests, we found that the sustainable agriculture label alternative falls between these two extremes with regard to food safety considerations. In the case presence of children and environmental attitudes we found that organic is preferred to the sustainable agriculture label alternative, but we could not conclude that the sustainable agriculture product was preferred to conventional apples.

Allowing relative prices to vary, we used a double-bounded logit model to estimate the mean WTP for sustainable agriculture apples to be around a nine cents per pound, which implies a positive premium above the current market price. Besides a constant factor and the bid, only perceived quality of the sustainable agriculture apples significantly affected mean willing to pay for the sustainable agriculture apples at the at the five percent level of type I error. Although sustainable agriculture apples may be an intermediate choice in terms of the environment and food safety, consumers will pay a premium for quality.

As final comments about the consistency between stated and revealed preferences, we find that the coefficient associated with the highest ranking of stated WTP has a positive and significant effect on the choice of TFA apples, while coefficients associated with lower rankings of stated WTP estimates have the expected ordering and magnitudes but were not statistically significant in their effect on choosing sustainable agriculture apples. We also can reject the null hypothesis of equality of coefficients associated with high and low stated WTP rankings. Therefore, there is evidence that actual purchase behavior by consumers in this market experiment did not violate the consistency of their stated preferences.

To the extent that these findings apply more generally, producers who are considering entering environmentally friendly niche markets would be wise to carefully examine the costs of production of both sustainable agriculture and organic crops. If production costs are not significantly lower for sustainable agriculture crops, then organic may be the better alternative for attracting the "green" consumer. This study underscores the importance and complexity of the interactions between consumer attitudes, socio-demographic realities, relative prices, and the ultimate actual value of sustainable agriculture labels to consumers, which leads to the realized value of labeling to agricultural producers.

Table 1: Summary Statistics for the Demographic Variables

Variable Name	Description	Mean	Standard Deviation.
Age	Age of the consumer	46.75	13.995
Gender	1 if female, 0 if male	0.792	0.406
Shopper	1 if interviewee is the main shopper, 0 otherwise	0.878	0.321
Education	1 = some school, 2 = high school, 3 = some college, 4 = Bachelor's degree, 5 = Advanced degree	3.723	0.892
Children	1 if children <18 live in the household, 0 otherwise	0.363	0.481
Total Children	Number of children in the household	0.6050	0.966
Family Size	Number of family members in the household	2.636	1.136
Income	1 = <$15,000, 2 = $15,000-$30,000, 3 = $30,000-$50,000, 4 = $50,000-$70,000, 5 = $70,000-100,000, 6 = >$100,000	4.065	1.222
Race	1 if white, 0 otherwise	0.920	0.271

Table 2: Summary Statistics for Consumer Information and Perception Variables

Variable Name	Description	Scaled Values	Mean	Std. Dev.
Environment	Importance of environmental sensitivity vs. jobs	(1,10)	6.3649	1.9118
Food Safety	Importance of food safety versus appearance	(1,10)	6.975	2.7008
Quality	General quality of apples in the store	(–1, 0, 1)	0.491	0.554
TFA-Approved Quality	Quality of TFA-Approved apples in comparison to other apples	(–1, 0, 1)	0.461	0.533

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Table 3: Multinomial Logit Model Results (t-statistics are in parentheses)

Variable	Marginal Effects[7] Organic Choice	 Sustainable agriculture Choice	 Conventional Choice
Constant	-0.6143 (0.18331)	0.4982** (2.834)	0.1161* (1.814)
Children	0.1833** (2.241)	-0.1128 (-1.342)	-0.0704* (-1.917)
Environment	0.0429** (2.856)	-0.0250 (-1.010)	-0.0195*** (-3.157)
Food Safety	0.0180* (1.666)	-0.0081 (-0.743)	-0.0098*** (-2.430)
Income	0.0362 (1.482)	-0.0250 (-1.010)	-0.0111 (-1.128)
Family Size	-0.0634** (-1.686)	0.0221 (0.581)	0.0412*** (2.896)
TFA Quality	-0.0428 (-0.808)	0.0901* (1.658)	-0.0473** (-2.178)
Gender	0.0735 (0.986)	-0.0062 (-0.083)	-0.06731*** (-2.617)

n = 285

(***), (**), and (*) represent significant coefficients at $\alpha = 0.001$, $\alpha = 0.05$, and $\alpha = 0.1$, respectively.

[7] Marginal effects of the attributes on the probabilities are calculated as:

$$\partial_j = \frac{\partial P_{ij}}{\partial \bar{x}_i} = P_j[\beta_j - \sum_{k=0}^{J} P_k \beta_k].$$

Table 4: Hypotheses Testing Results

Hypothesis	Test Statistic	p-value	Reject at $\alpha = 0.10$?
Presence of Children	t-statistic		
$H_0 = b_{1,organic} - b_{1,ecolabel} \leq 0$	1.98	0.025	Yes
$H_0 : b_{1,ecolabel} - b_{1,conventional} \leq 0$	-1.51	0.925	No
Food Safety Attitudes			
$H_0 = \beta_{2,organic} - \beta_{2,ecolabel} \leq 0$	1.39	0.092	Yes
$H_0 : b_{2,ecolabel} - b_{2,conventional} \leq 0$	2.09	0.036	Yes
Environmental Attitudes			
$H_o = \beta_{3,organic} - \beta_{3,ecolabel} \leq 0$	2.46	0.007	Yes
$H_0 : b_{3,ecolabel} - b_{3,conventional} \leq 0$	-2.57	0.995	No
Joint Test of the Equality of Children, Food Safety, and Environmental Effects	$\chi_{(1)}^2$		
organic vs. sustainable agriculture label	12.14	0.007	Yes
sustainable agriculture label vs. conventional	11.28	0.010	Yes

Table 5: Coefficients estimates of Double-Bounded Probit Regression

Variable Name	Coefficient	t-statistics
Constant	-3.1709**	-6.660
Bids	2.2252**	12.922
Number of Children	0.0068	0.064
Income	0.0358	0.358
Female	0.0143	0.266
Environment	-0.0042	-0.100
Food Safety	0.0283*	1.781
Quality-TFA	0.3056**	2.862
N= 285		

(**) The coefficient is significant at $\alpha = 0.05$. (*) The coefficient is significant at $\alpha = 0.1$

Table 6: WTP Estimates for Sustainable agriculture Apples (in cents/pound)

WTP estimate	Point Value	95% Confident Interval
WTP estimate from restricted double bounded logit	$\tilde{\alpha} / \tilde{\rho} = 9.28$	(8.94, 9.61)[8]

[8] This confident interval was calculated using the delta-method, which approximates the asymptotic variance of the ratio of two random variables as (see Kanninen, 1993):

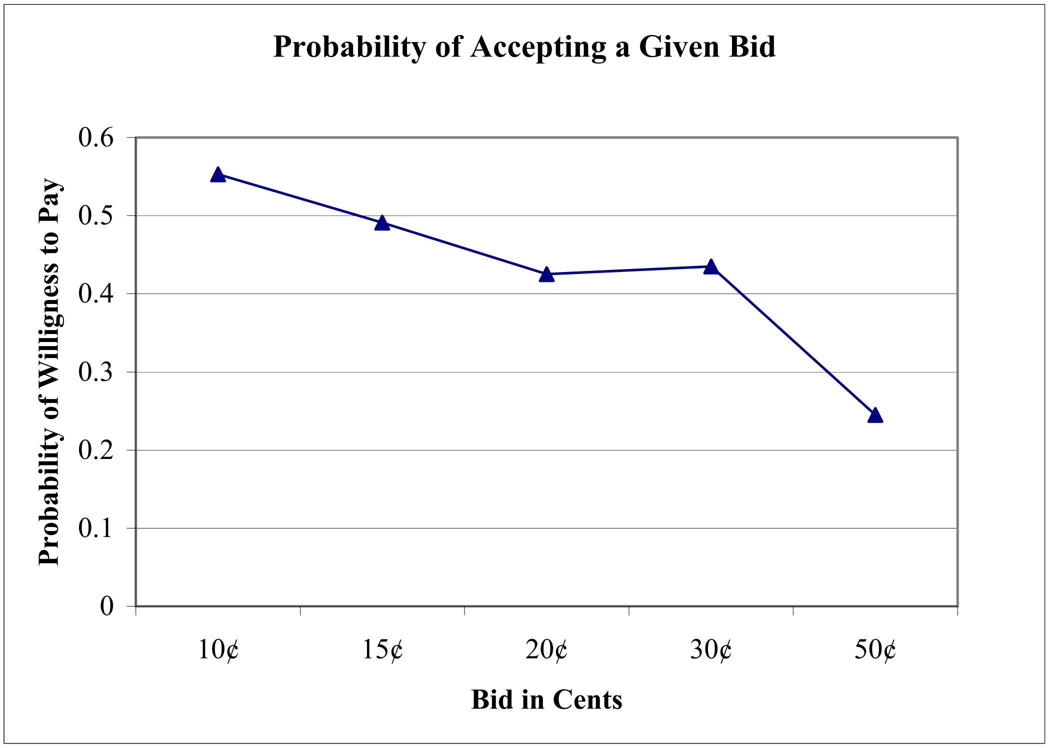
$$\text{a}\sigma^2(\frac{-\alpha}{\rho}) \cong \frac{1}{\rho^2}\left[\left(\frac{a}{\rho}\right)^2 \sigma^2(\alpha) - 2\left(\frac{\alpha}{\rho}\right)\text{cov}(\alpha\rho) + \sigma^2(\rho)\right].$$

Table 7: Revealed Preference Equation Estimation.
Dependent variable, Z = Choice of sustainable agriculture apple

Parameters	Coefficients	t-statistic	Prob. Value
Constant	-2.742**	-4.828	0.000
Discount	0.0083	0.804	0.4213
Children	-0.7788**	-2.185	0.0289
Food Safety	0.0700	1.175	0.2398
TFA Quality	2.8762*	1.706	0.0881
δ_1	-0.3082	-0.512	0.6090
δ_3	0.3389	0.748	0.4543
δ_4	0.6112*	1.645	0.0999
Correct Predictions	77%		

(*) Indicates coefficient is significant at $\alpha = 0.10$, and (**) indicates coefficient is significant at $\alpha = 0.05$.

Figure 1: Probability of Accepting the Given Willingness to Pay Bid



APPENDIX

PARAGRAPH READ TO RESPONDENTS ABOUT WHAT TFA STANDS FOR.

"The Food Alliance seal of approval identify products that are grown in ways that are environmentally and socially responsible, including: a) protecting and enhancing natural resources, b) emphasizing alternatives to pesticides, and c) caring for the health and well-being of farm workers and rural communities."

QUESTIONS USED TO ELICIT FOOD SAFETY AND ENVIROMENTAL ATTITUDES

Where would you place yourself on a scale from 1 to 10, **if saving jobs at all costs is a 1** and **saving the environment at all costs is a 10**? (CIRCLE JUST ONE)

1 2 3 4 5 6 7 8 9 10

When you are purchasing apples and other fruits, what is the importance of **food safety** versus **appearance and taste** on a scale of 1 to 10, where **1 means food safety is all important** and **10 means appearance and taste is all important**? (CIRCLE JUST ONE)

1 2 3 4 5 6 7 8 9 10

QUESTIONS RELATED TO PERCEIVED QUALITY OF APPLES

What do you think about the general quality of the apples in this store today? (CIRCLE JUST ONE)

1. Above average
2. Average
3. Below average
4. I don't know

How do you think the TFA apples look today with respect to the rest of apples in this store?

1. Above average
2. Average
3. Below average
4. I don't know

QUESTIONS RELATED TO PRODUCE CHOICE AND WILLINGNESS TO PAY

If you were to buy your favorite apple variety, and you could choose at equal prices and size between organic, TFA-approved and regular apples, which one would you choose?

1. Organic
2. TFA-Approved
3. Regular

[If TFA apples were the respondent's first choice then ask] Now, if the price of TFA-apples were raised [**$ cents/pound]**, and other apple prices stayed the same, which one would you choose?

1. Organic
2. TFA-Approved
3. Regular

[If TFA apples were *not* the respondent's first choice then ask] Now, if the price of TFA-apples were lowered [**$ cents/pound]**, and other apple prices stayed the same, which one would you choose?

1. Organic
2. TFA-Approved
3. Regular

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