Valuations of "Sustainably Produced" Labels on Beef, Tomato, and Apple Products

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This study evaluates consumer perceptions of what "sustainably produced" food labels imply and estimates corresponding demand for products carrying these labels. Results suggest that the typical U.S. consumer is not willing to pay a positive premium for beef, tomatoes, or apple products labeled as "sustainably produced." Demand is particularly sensitive to inferences consumers make regarding what a "sustainably produced" food label implies. Suggestions for future work and implications of standardizing the definition of sustainability are provided.

Key Words: consumer perceptions, credence labeling, production practices, sustainable, U.S. consumer demand, willingness to pay

Food produced using "sustainable" production practices is receiving increasing degrees of attention in both public and private arenas. More food products are being marketed using "sustainable" or "sustainably produced" labeling claims, and the public sector is increasingly investing in the adoption of sustainable production practices [i.e., USDA-SARE (Sustainable Agriculture Research and Education) program]. A search of the Mintel Global New Products Database identifies 483 new food products, introduced in North America between January 2007 and January 2009, that carry "sustainable" or "sustainably produced" phrases in their labels. As interest in sustainably produced food increases, questions arise about what consumers perceive when faced with "sustainably produced" labels. For instance, consider an example product description as identified by Mintel:

> *"World Berries Organic Inca Berries, also known as gooseberries, is vegan raw food,* ***produced by sustainable methods,*** *and sourced from all over the world."*

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A reasonable question to ask is: What do consumers infer from labeling claims of "produced by sustainable methods"? Moreover, what is the corresponding demand for products carrying such labels? Estimation of not only acceptable price premiums, but consumer-specific determinants of these premiums are vital to the success of firms interested in building and maintaining a profitable market for their product. If consumers' willingness to pay (WTP) for sustainably produced food is primarily driven by implicit inferences from incomplete labels, the profitability of products labeled as "sustainably produced" may be particularly sensitive to any efforts to standardize labeling. Additionally, answers to open questions such as these will help inform public resource allocation decisions related to sustainability. In particular, public sector officials interested in efficient markets and the welfare impacts of alternative food labeling strategies will benefit from additional insights regarding consumer demands for and perceptions of "sustainably produced"products.

Accordingly, the core objective of this article is to initiate the process of examining consumer inferences and valuations of food products carrying "sustainably produced" labels. Using stated preference data obtained in a national survey of U.S. consumers, we investigate consumer perceptions

Agricultural and Resource Economics Review 38/3 (December 2009) 371–383

regarding definitions of "sustainable production" and estimate consumer WTP for beef, tomatoes, and apples carrying corresponding labels.

The rest of the article is organized as follows. A brief summary of the literature is provided, followed by a review of the contingent valuation methods used and a description of the national survey-based data used. The last two sections outline the results and findings of the study and provide a discussion of this study's implications as well as some suggestions for future research that would leverage our initial findings.

Background

Surprisingly, relatively little economic research has focused on sustainability in the context of agricultural production practices. Some exceptions are: 1) Calker et al. (2005), who surveyed experts in a variety of technical fields to examine the extent to which production practices can be considered sustainable; 2) Callens and Tyteca (1999), who suggest a framework for evaluating (using economic, social, and environmental metrics) the productive efficiency of agricultural firms in the context of overall sustainability; and 3) Rigby and Caceres (2001) and Rigby et al. (2001), who consider the relationships between sustainability and organic farming practices. Within this limited literature on sustainability, very little of the research has focused on consumer perceptions and corresponding demand for sustainable production practices and resulting food products.

There has been, however, much research regarding credence attributes in food and corresponding consumer demand. For instance, there are extensive literatures evaluating genetically modified products (Lusk, Roosen, and Fox 2003, Tonsor et al. 2005); country or region of origin (Loureiro and Umberger 2007, Alfnes and Rickertsen 2003); use of growth hormones (Alfnes 2004); and locally produced food (Darby et al. 2008). Moreover, substantial effort has focused on the welfare impacts and consumer valuations of alternative food labeling regulations (i.e., Lusk and Fox 2002, Radas, Teisl, and Roe 2008, Zago and Pick 2004, Roosen, Lusk, and Fox 2003, Hu, Adamowicz, and Veeman 2006).

Kardes, Posavac, and Cronley (2004) note, "Because products are rarely described completely, consumers often form inferences that go beyond the information given." (p. 230.) The issue of consumer inferences is well noted throughout the marketing literature (Huber and McCann 1982, Islam, Louviere, and Burke 2007, Johnson and Levin 1985, Meyer 1981). Moreover, several other studies have noted the substantial impacts consumer perceptions may have on the demand for food products (Moon and Balasubramanian 2003, Kaiser, Scherer, and Barbano 1992, Zepeda, Douthitt, and You 2003, McCluskey et al. 2003). Again, in the context of our study this raises the question: What do consumers infer from labeling claims of "produced by sustainable methods"? For instance, does the term induce inferences from consumers regarding farm ownership or size, and/or specific production practices such as use of organic or more environmentally friendly methods? As noted by Darby et al. (2008) in their evaluation of "locally produced" foods, the ability of a marketing firm to differentiate their product hinges critically on an accurate understanding of the perceptions consumers hold regarding what a credence labeling claim implies. Understanding these perceptions is crucial to the successful product placement of target marketers.

In summary, we are unaware of existing research examining: a) what consumers may be willing to pay (WTP) for sustainably produced food products, or b) the inferences consumers make when presented with a food label containing the phrase "sustainably produced." Building upon existing work evaluating other food attribute labels (e.g., genetically-modified products, region of origin, use of growth hormones) and the impact of consumer inferences (e.g., implicit associations made from explicitly provided information), we seek to begin addressing these gaps in the literature regarding food products with "sustainably produced" labels.

Methods

We begin by succinctly summarizing the general inferences model put forth by Meyer (1981) and Huber and McCann (1982). In short, the general inferences model assumes that consumers make inferences regarding attributes that do not explicitly appear on a product's label and that these inferences are formed such that the probability of the attribute under consideration is replaced by the

consumer's personal assessment. If one defines the consumer's general preference relationship (f) to be a function of explicitly presented attributes X_1 and attributes not appearing on product labels X_2, this leads to consumer preference functions of the form: $f(X_1, E[X_2])$,where $E[\bullet]$ denotes expectations.

For the purpose of this paper, the general inferences model is useful in examining how assessments of what "sustainably produced" means to consumers can shed light on why consumers may value differently food products that carry "sustainably produced" labels. To estimate consumer demand for sustainable food products, we followed a double-bounded dichotomous choice (DBDC) approach that has frequently been used to examine demand for many other products (i.e., Kimenju and Groote 2008). We primarily chose the DBDC approach, given its prominence in the contingent valuation literature and the finding of Hanemann, Loomis, and Kanninen (1991) that DBDC methods are more efficient than single-bounded approaches.[1]

As in many other evaluations of food product attributes and consumer demand (e.g., Hu, Adamowicz, and Veeman 2006, Nilsson, Foster, and Lusk 2006, Moon and Balasubramanian 2003, McCluskey et al. 2003 and 2005, De Pelsmacker et al. 2005), our survey was hypothetical, as participation in it did not include exchange of actual money or products. Accordingly, we employed a "cheap-talk" strategy—introducing survey participants to the concept of hypothetical bias—that has been found to be effective at reducing hypothetical bias itself in subsequent responses (Lusk 2003, Cummings and Taylor 1999). In particular, our survey included the following text employed by Lusk (2003) that states:

> *"The experience from previous similar surveys is that people often state a higher willingness to pay than what one is actually willing to pay for the good. For instance, a recent study asked people whether they would purchase a new food product similar to the one you are about to be asked about. This purchase was hypothetical (as it will be for you) in that no one actually had to pay money when they indicated a willingness to purchase. In the study, 80% of people said they would buy the new product, but when a grocery store actually stocked the product, only 43% of people actually bought the new product when they had to pay for it. This difference (43% vs. 80%) is what we refer to as hypothetical bias. Accordingly, it is important that you make each of your upcoming selections like you would if you were actually facing these exact choices at a store; noting that buying a product means that you would have less money available for other purchases."*

Our DBDC approach most closely follows Loureiro, McCluskey, and Mittelhammer (2002) as we assess demand in a way that allows for both negative and positive premiums to occur. In particular, we conducted a survey requiring participants to respond to the following question: *Would you be willing to pay a premium for beef labeled as "sustainably produced"?* ***YES*** *OR* ***NO***.[2] Respondents were then presented with a subsequent question, conditional on their first response. If the participant responds "YES" ("No") the respondent was presented with the follow-up question: *Would you buy beef labeled as "sustainably produced" if it cost X%* ***more (less)*** *than beef not labeled as "sustainably produced"?* ***YES*** *OR* ***NO***.[3] In this question, *X*% varied randomly between 1% and 100%. Notice that this approach allows for consumers who initially indicated they would not pay a premium for a sustainably labeled product to reveal the discount at which they would select a sustainably labeled rather than conventional product. Accordingly, net willingness to pay (nWTP) is identified by this question sequence.

The four possible outcomes to these two questions are a) "no" to both; b) "no" followed by "yes"; c) "yes" followed by "no"; and d) "yes" to both. This in turn isolates one range containing

[1] Here we provide only a succinct overview of DBDC methods. Interested readers are referred to Hanemann, Loomis, and Kanninen (1991), who provide a more through overview.

[2] A reviewer noted the possible uncertainty that could result from the lack of a specific premium being noted in the initial question. In our model, the premium was set at 0.01 following Loureiro, McCluskey, and Mittelhammer (2002), while our conclusions were insensitive to also using 0.00 and 0.10. While consistent with prior work, this issue is worthy of further investigation in the future.

[3] Similar questions were asked regarding tomatoes and apples (see Appendix).

each individual's nWTP from the four general possibilities of: ($nWTP < -X$), ($-X \leq nWTP < 0$), ($0 \leq nWTP < X$), and ($X \leq nWTP$). We denote the probability of each outcome as

$$\pi^{NN}, \pi^{NY}, \pi^{YN}, \text{ and } \pi^{YY},$$

respectively. Given a sample of K respondents, the log-likelihood function to be maximized is:

$$\ln L = \sum_{i=1}^{K} \left\{ d_i^{NN} \ln \pi^{NN} + d_i^{NY} \ln \pi^{NY} + d_i^{YN} \ln \pi^{YN} + d_i^{YY} \ln \pi^{YY} \right\} \quad (1)$$

where d_i^{NN}, d_i^{NY}, d_i^{YN}, and d_i^{YY} are binary variables with 1 denoting the occurrence of that particular outcome, and 0 otherwise.

To empirically operationalize the model, nWTP is specified as:

$$nWTP_i = \alpha_0 + \alpha_P X_i + \boldsymbol{\beta}'\mathbf{Z}_i + \boldsymbol{\lambda}\boldsymbol{\Gamma}_i + \varepsilon_i, \quad (2)$$

where X is the randomly selected premium or discount amount faced by individual i; $\mathbf{Z}$ is a vector of individual-specific characteristics; $\boldsymbol{\Gamma}$ is a vector defining associations consumer i makes from "sustainably produced" labels regarding the presence of other attributes; and α_0, α_P, $\boldsymbol{\beta}$ and $\boldsymbol{\lambda}$ are parameters to be estimated. We also specify $\varepsilon \sim f(0, \sigma^2)$ where f denotes a cumulative distribution function assumed to be the standard logistic distribution (i.e., distribution with mean zero and standard deviation $\sigma = \pi / \sqrt{3}$). Upon estimation, mean nWTP is calculated as:

$$-\left(\alpha_0 + \boldsymbol{\beta}'\bar{\mathbf{Z}} + \boldsymbol{\lambda}'\bar{\boldsymbol{\Gamma}}_i\right) / \alpha_P \text{ where } \bar{\mathbf{Z}} \text{ and } \bar{\boldsymbol{\Gamma}}$$

denote sample average values (Kimenju and Groote 2008).

Data

We collected information about consumer perceptions and preferences for food labeled as sustainably produced via a national survey of U.S. consumers. Surveys were administered to U.S. households online with participants being recruited from a large opt-in panel (Louviere et al. 2008). Online surveys are increasingly being used by researchers, given their cost and completion time advantages relative to mail, phone, and in-person approaches (Hu, Adamowicz, and Veeman 2006). Additionally, Hudson et al. (2004) find that Internet surveys do not suffer from non-response bias. Fleming and Bowden (2009) and Marta-Pedroso, Freitas, and Domingos (2007), respectively, found that a web-based survey produced results similar to companion conventional mail and in-person interview surveys.

Participants were recruited from a panel maintained by Survey Sampling International to be representative of the U.S. population. In October 2008, 1,502 surveys were completed resulting in a national sample consistent with U.S. demographics (United States Census Bureau 2008). To examine preferences for alternative products, three different survey versions were administered that differed only based upon the product in question. Accordingly, we obtained 500, 502, and 500 completed surveys focusing on beef, tomato, and apple products, respectively.

Summary statistics of selected demographics from each of the three samples are provided in Table 1. Female respondents outnumbered male respondents as our survey sought out the primary grocery/food purchaser in the household (Loureiro, McCluskey, and Mittelhammer 2002). The mean respondent was about 44 years old; the mean income was approximately $46,000-$48,000; 22 percent-24 percent of respondents had earned a college degree; and the mean number of children ranged from 0.78 to 0.89 in the three product-specific samples. With the exception of gender, these demographics are generally consistent with those of the overall U.S. population (United States Census Bureau 2008).

The representative respondent in each sample consumed (*Consume*) the product in question at least three times per week. To assess familiarity with production practices, we asked participants when they last visited (*Visit*) a farm. Approximately three-fourths of the beef survey respondents indicated they have not visited a farm where animals/livestock (milk and/or meat) were being raised for human consumption. In contrast, over 50 percent of tomato and apple survey respondents indicating they have visited a farm with vegetables and/or fruit being raised for human consumption. While simply visiting a farm doesn't perfectly inform consumers of production practices, this

Table 1. Summary Statistics for Select Measures

Variable	Description	Beef (n=500)	Tomato (n=502)	Apple (n=500)
Female	1 if female; 0 if male	0.742 (0.438)	0.719 (0.450)	0.760 (0.428)
Age	Age of consumer (years)	44.290 (14.469)	43.900 (14.747)	44.440 (14.373)
Income	Annual household income (In thousands)	48.180 (38.064)	46.315 (33.404)	46.730 (35.346)
College	1 = Earned a college degree; 0 otherwise	0.236 (0.425)	0.223 (0.417)	0.242 (0.429)
Kids	Number of children in household	0.892 (1.246)	0.777 (1.266)	0.810 (1.200)
Consume[a]	Number of times per week product is consumed	5.574 (4.691)	4.851 (4.709)	2.944 (3.837)
Visit[b]	1 if visited a farm within last 5 years; 0 otherwise	0.260 (0.439)	0.526 (0.500)	0.522 (0.500)
WTP Question Responses[c]	1 if *Yes/Yes*; 0 otherwise	0.148 (0.355)	0.147 (0.355)	0.146 (0.353)
	1 if *Yes/No*; 0 otherwise	0.302 (0.460)	0.251 (0.434)	0.256 (0.437)
	1 if *No/Yes*; 0 otherwise	0.346 (0.476)	0.430 (0.496)	0.436 (0.496)
	1 if *No/No*; 0 otherwise	0.204 (0.403)	0.171 (0.377)	0.162 (0.369)

Note: Values presented are means; standard deviations are in parentheses.
[a] This question was asked specific to the product evaluated in the beef, tomato, and apple surveys.
[a,b,c] Actual survey questions are provided in the Appendix.

difference in visit frequency may suggest U.S. consumers believe they are more familiar with vegetable and fruit production than meat production. Moreover, this difference may influence demand for a given attribute across alternative products.

To more completely understand consumer perceptions regarding food products carrying "sustainably produced" labels, the survey included the question: "*What does your definition of a beef farm using 'sustainable production' practices entail?*" requiring participants to indicate from a list of ten attributes which, if any, attributes they associate with "sustainable production."[4] Table 2 shows the frequency that each attribute was selected by each product-specific sample. Over 60 percent of respondents in each sample indicated that their definition of sustainable production includes "hormone-free," "organic production," "natural production," and "environmentally friendly." Moreover, about 70 percent of the tomato and apple (beef) respondents indicated "pesticide-free" ("pasture-based") associations. In contrast, perceptive links between ownership, farm size, or labor source and sustainable production were present, but relatively lower.

While one would like to incorporate each of these individual association variables into the analysis [i.e., components of Γ in equation (2)], this is avoided due to multicollinearity concerns, as several of the attributes are frequently highly correlated. To more appropriately incorporate this information, we identified the subset of associations with correlations under 0.50 and included them in our estimated models.[5]

Table 1 also provides a summary of responses in each sample to the two-question sequence

[4] A similar question was asked in the tomato and apple surveys. See Appendix for the actual survey questions.

[5] Our base conclusions were similar when applying a 0.40 cutoff, with the primary difference being exclusion of the *Environmentally Friendly* variable.

Table 2. Summary Statistics for Sustainable Production Definition Perceptions

Variable	Description	Beef (n=500)	Tomato (n=502)	Apple (n=500)
Sustainable Production Perceptions	1 - if "family owned"; 0 - otherwise	0.528	0.522	0.540
	1 - if "corporate ownership"; 0 - otherwise	0.328	0.329	0.302
	1 - if"only family labor"; 0 - otherwise	0.246	0.241	0.272
	1 - if "hired labor allowed"; 0 - otherwise	0.632	0.629	0.640
	1 - if "smaller than average size"; 0 - otherwise	0.372	0.333	0.334
	1 - if "hormone-free"; 0 - otherwise	0.722	0.697	0.674
	1 - if "organic production"; 0 - otherwise	0.602	0.675	0.688
	1 - if "natural production"; 0 - otherwise	0.764	0.827	0.798
	1 - if "environmentally friendly"; 0 - otherwise	0.776	0.835	0.802
	1 - if "pasture-based"; 0 - otherwise	0.700	N/A	N/A
	1 - if "pesticide-free"; 0 - otherwise	N/A	0.733	0.690

Note: Actual survey questions are provided in the Appendix.

(*WTP Question Responses*) designed to elicit WTP estimates and discussed with equation (1). The presented values indicated the mean frequency (i.e., π^{NN}, π^{NY}, π^{YN}, and π^{YY}) of all four possible response combinations. Responses to the first question reveal 55.0 percent, 60.1 percent, and 59.8 percent indicated they were *not* willing to pay a premium for beef, tomatoes, and apples, respectively, labeled as "sustainably produced." However, 34.6 percent, 43.0 percent, and 43.6 percent indicated a willingness to buy beef, tomatoes, and apples, respectively, labeled as "sustainably produced" when discounted by the randomly presented *X%*. Moreover, roughly 15 percent in each sample indicated a willingness-to-pay premium of *X%*. To more precisely evaluate aggregate demand we estimated an array of dichotomous choice models.

Results

To evaluate demand for products labeled as "sustainably produced" we optimized equation (1), incorporating equation (2), using NLOGIT (Greene 2008). Table 3 reports model estimates for each of the three evaluated products. The estimated model includes constant and price variables; as well as socioeconomic (*Female*, *Age*, *Income*, *College*, *Kids*); consumption (*Consume*); farm visit (*Visit*); and "sustainably produced" label inference variables (*Family Owned*, *Hired Labor Allowed*, *Smaller than Average Size*, *Pasture Based*, *Organic Production*, *Environmentally Friendly*).[6]

Mean estimates of nWTP range from -8.4 percent to -5.9 percent across products and models. This suggests that, to be indifferent in their purchasing decisions, the representative consumer would require 5.9 percent, 6.0 percent, and 8.4 percent reductions in the price of beef, apples, and tomatoes, respectively, that carry labels indicating the use of sustainable production practices. Evaluating confidence intervals of the preferred models including multiple covariates, identified using Krinsky and Robb (1986) bootstrapping techniques, indicate that mean nWTP is significantly below zero for all three products. Moreover, these confidence intervals cover a range of approximately 10 percent, reflecting substantial variability in the mean nWTP estimates. Furthermore, we fail to reject the hypothesis of equality in mean nWTP (in "percent" terms) for the representative consumer between sustainably produced beef, tomato, and apples as the estimated confidence intervals are overlapping.

Table 3 also provides insights into the covariates that significantly influence nWTP. Demand for beef, tomatoes, and apples labeled as sustainably produced is found to be higher for individuals associating sustainable production with production practices that include organic and environmentally friendly. Sustainably produced beef demand is

[6] We also evaluated regional effects of residential location, but failed to reject the hypothesis that regional location effects are jointly zero.

found to be higher for younger consumers, those with higher incomes, and those perceiving pasture-based methods to underlie "sustainably produced" labels. Consumers with a college education are found to be willing to pay more for both sustainably produced tomatoes and apples. Moreover, sustainably produced tomato demand is weaker for households with more children living at home, while nWTP for sustainably produced apples is higher for those more frequently consuming apples.

Table 3. Double-Bounded Model Estimates of Consumer Demand for Food Products with "Sustainably Produced" Labels

Variable Name	Beef Model	Tomato Model	Apple Model
	Estimate	Estimate	Estimate
Constant	-1.292***	-1.554***	-0.839*
	(0.444)	(0.439)	(0.463)
Price	-0.036***	-0.036***	-0.037***
	(0.002)	(0.002)	(0.002)
Female	-0.147	-0.197	-0.339**
	(0.206)	(0.200)	
Age	-0.010*	0.001	-0.007
	(0.006)	(0.006)	
Income [a]	0.008***	0.004*	0.002
	(0.003)	(0.003)	(0.002)
College	-0.256	0.388**	0.358**
	(0.231)	(0.225)	(0.219)
Kids	-0.102	-0.182***	-0.116*
	(0.078)	(0.081)	(0.081)
Consume	0.026	0.008	0.062***
	(0.018)	(0.020)	(0.023)
Visit	-0.166	0.065	0.208
	(0.209)	(0.173)	(0.181)
Family Owned	0.067	-0.182	0.097
	(0.194)	(0.189)	(0.194)
Hired Labor Allowed	0.035	0.281*	0.327**
	(0.188)	(0.182)	(0.187)
Smaller than Average Size	-0.372*	-0.160	-0.102
	(0.188)	(0.196)	(0.200)
Pasture Based	0.585***		
	(0.225)		
Organic Production	0.664***	0.770***	0.306*
	(0.210)	(0.218)	(0.211)
Environmentally Friendly	0.701***	0.682***	0.465**
	(0.253)	(0.254)	(0.253)
Mean nWTP (%) [b]	-5.946	-8.365	-6.009
95% Confidence Interval [c]	[-10.87, -1.27]	[-13.32, -3.94]	[-10.39, -1.20]
Log-likelihood	-677.113	-697.349	-716.035

*, **, *** denote coefficient estimates statistically significant at the 0.15, 0.10, and 0.05 level, respectively. Standard errors are presented in parentheses. Each variable is defined in Tables 1 or 2.

[a] Income was divided by $1,000 to facilitate model convergence. [b] nWTP point estimates were calculated at the mean level of included covariates. [c] nWTP Confidence intervals were calculated using Krinsky-Robb bootstrapping techniques.

Entities interested in producing and marketing products using "sustainably produced" labels are arguably less interested in the demand of representative consumers than in the demand of select consumers most interested in their product. That is, as a new claim or a marketing strategy targets select individuals, demand for the entire population may not be of central interest. Accordingly, we also evaluated demand for the subset of respondents (45.0 percent, 39.8 percent, and 40.2 percent, respectively, for beef, tomatoes, and apples) indicating they were willing to pay a premium. This effectively resorts to estimating a single-bounded model (Hanemann, Loomis, and Kanninen 1991) using only responses to the follow-up question presented to participants with affirmative answers to the initial question.[7] We refer to this as an assessment of conditional demand, as the evaluation is conditional on initial indication of interest in the product. The corresponding conditional log-likelihood function can be written as:

$$\ln L^C = \sum_{i=1}^{M} \left\{ d_i^Y \ln \pi^Y + d_i^N \ln \pi^N \right\} \tag{3}$$

where d_i^Y and d_i^N are binary variables with 1 denoting the occurrence of that particular outcome and 0 otherwise, and M is the number of respondents with affirmative answers to the initial question.

Equation (3) was optimized using the functional specification shown in equation (2). Table 4 presents results for the estimated conditional demand models of each product. Mean estimates of conditional net willingness to pay (cnWTP) suggested by preferred models including multiple covariates are 11.6 percent, 19.5 percent, and 23.0 percent, respectively, for apples, tomatoes, and beef. This would suggest the typical consumer who initially indicated a willingness to pay a premium for a product labeled as being "sustainably produced" would tolerate premiums ranging from 11.6 percent to 23.0 percent depending on the product, before they would decide to purchase an alternative. However, examination of confidence intervals indicates that mean cnWTP is significantly above zero only for beef. Furthermore, all the confidence intervals are very wide, indicating notable variation in cnWTP estimates. By comparing confidence intervals of the three products, we fail to reject the hypothesis of equality in cnWTP (in "percent" terms) between sustainably produced beef, tomatoes, and apples.

Consistent with population-wide, nWTP, Table 4 indicates that conditional nWTP for apples labeled as "sustainably produced" are higher for individuals associating sustainable production with environmentally friendly production practices. Moreover, cnWTP for tomatoes is higher for those with a college education and those making smaller farm size inferences with sustainable production labels. The model also suggests that having visited a vegetable or fruit farm within the last five years increases cnWTP for apples and reduces cnWTP for tomatoes. It is also noteworthy that notably fewer model covariates are significant in our conditional demand evaluation.

Our results suggest that identifying individuals, at least based upon the factors considered here, for target marketing efforts may be challenging for those interested in effectively promoting food carrying sustainably produced labels. This challenge is primarily presented by the importance of consumer beliefs regarding what sustainability means, an unobservable trait to marketers, relative to observable demographic characteristics.

Conclusions and Implications

This study provides the first known evaluation of U.S. consumer perceptions of what "sustainably produced" implies and of the corresponding demand for food products carrying "sustainably produced" labels. Given the recent acceleration in both private and public investment and interest in "sustainability," this study provides a timely contribution that enriches the understanding of public perceptions and preferences for "sustainably produced" food products. Our results suggest that the typical U.S. consumer is not willing to pay a positive premium for beef, tomatoes, or apple products labeled as "sustainably produced." However, when evaluating only the subset of respondents initially showing interest in the product, our analysis estimates that a positive premium for sustainably produced beef may exist. This suggests that successful marketing of food (or at least beef,

7 We first estimated bivariate probit, double-hurdle models. In all three product-specific models, we fail to reject the hypothesis of no correlation. This supports our independent use of probit models on second stage responses of initial supporters.

Table 4. Estimates of Conditional Consumer Demand for Food Products with "Sustainably Produced" Labels

Variable Name	Beef Model	Tomato Model	Apple Model
	Estimate	Estimate	Estimate
Constant	1.303***	0.098	-0.040
	(0.542)	(0.556)	(0.563)
Price	-0.018***	-0.012***	-0.010***
	(0.003)	(0.003)	(0.004)
Female	-0.217	-0.011	-0.331
	(0.222)	(0.228)	(0.233)
Age	-0.011*	0.003	-0.004
	(0.007)	(0.007)	(0.008)
Income [a]	-0.003	-0.003	0.001
	(0.003)	(0.003)	(0.003)
College	0.164	0.513***	0.163
	(0.248)	(0.228)	(0.231)
Kids	-0.061	0.108	-0.041
	(0.087)	(0.102)	(0.108)
Consume	-0.016	0.019	-0.001
	(0.021)	(0.024)	(0.023)
Visit	-0.295	-0.346**	0.296*
	(0.231)	(0.193)	(0.205)
Family Owned	0.114	-0.046	0.111
	(0.207)	(0.210)	(0.218)
Hired Labor Allowed	-0.216	-0.001	-0.288
	(0.208)	(0.215)	(0.226)
Smaller than Average Size	0.185	0.372**	0.033
	(0.206)	(0.226)	(0.218)
Pasture Based	-0.001		
	(0.263)		
Organic Production	-0.196	0.274	-0.330
	(0.233)	(0.262)	(0.249)
Environmentally Friendly	0.297	-0.350	0.873***
	(0.322)	(0.326)	(0.333)
Mean cnWTP (%) [b]	22.964	19.467	11.627
95% Confidence Interval [c]	[6.21, 34.37]	[-16.15, 35.10]	[-61.07, 31.43]
Number of observations	225	200	201
Log-likelihood	-120.781	-116.293	-118.723

*, **, *** denote coefficient estimates statistically significant at the 0.15, 0.10, and 0.05 levels, respectively. Standard errors are presented in parentheses. Each variable is defined in Tables 1 or 2.

[a] Income was divided by $1,000 to facilitate model convergence.

[b] cnWTP point estimates were calculated at the mean level of included covariates.

[c] cnWTP Confidence intervals were calculated using Krinsky-Robb bootstrapping techniques. The presented models were estimated using only observations from respondents responding with an affirmative answer to the initial WTP question.

tomatoes, or apples) by use of "sustainably produced" labels may not be successful for the general public and may require target marketing to select consumer sub-samples.

Demand for beef, tomatoes, and apples labeled as "sustainably produced" is found to be substantially higher for individuals associating sustainable production with production practices including organic and environmentally friendly, as well as farm size and use of hired labor or pastoral methods. In the current absence of a globally accepted, standardized definition of "sustainable," this finding suggests that entities currently marketing food products under such claims may be particularly sensitive to future efforts to standardize or harmonize labeling information. In particular, any events that trigger consumers to weaken (strengthen) current associations between sustainability and these other production practices (namely organic and environmentally friendly) seem likely to significantly dampen (enhance) demand for sustainably produced food.

While this study does provide valuable insights into U.S. consumer issues regarding sustainably produced food products, it raises several interesting issues as well. It would be useful to further examine the types and sources of information that consumers use in processing food labels, with a particular focus on issues that may impact their internal assessment of what "sustainably produced" implies. It would also be useful to examine other food products and to use non-hypothetical methods. Furthermore, it would be valuable to conduct additional experiments designed to evaluate label valuations when alternative forms and levels of information are provided to consumers. This may provide insights into the future viability and value of target marketing or efforts to educate U.S. consumers regarding sustainable production issues. Moreover, it would be useful to assess public support for alternative legislative scenarios that may further encourage or mandate the use of sustainable production practices.

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Appendix

Here is a list of the survey questions (differentiated by product sample and presented in the order they appeared to participants) used in generating key variables of this analysis:

BEEF SURVEY QUESTIONS:

Consume variable (Table 1) was obtained from:
Most households consume an average of 21 meals in a typical week.
How many of these 21 meals consumed by your household normally include:

beef: _____

Visit variable (Table 1) was obtained from:
When was the last time you visited a farm with animals/livestock (milk and/or meat) being raised for human consumption?

a) I have never visited such a farm
b) Over 10 years ago
c) 6-10 years ago
d) 1-5 years ago
e) Within the last year

WTP Question Responses (Table 1) were obtained from:
Would you be willing to pay a premium for beef labeled as "sustainably produced"?
YES OR **NO**

a) *If Yes***,** Would you buy beef labeled as "sustainably produced" if it cost **X% *more*** than beef *not* labeled as "sustainably produced" (random variable 1-100%)
YES OR **NO**

a) *If No,* Would you buy beef labeled as "sustainably produced" if it cost **X% *less*** than beef *not* labeled as "sustainably produced" (random variable 1-100%)
YES OR **NO**

Sustainable Production Perception Responses (Table 1) were obtained from:
What does your definition of a beef farm using "sustainable production" practices entail?
(Check all that apply from the following list of attributes)

family owned	☐ Yes	☐ No
corporate ownership	☐ Yes	☐ No
only family labor	☐ Yes	☐ No
hired labor allowed	☐ Yes	☐ No
smaller than average size	☐ Yes	☐ No
pasture-based	☐ Yes	☐ No
hormone-free	☐ Yes	☐ No
organic production	☐ Yes	☐ No
natural production	☐ Yes	☐ No
environmentally friendly	☐ Yes	☐ No

Other (please specify :) _____

Presentation of the individual list items was randomized to mitigate order effects

TOMATO (APPLE) SURVEY QUESTIONS:

Consume variable (Table 1) was obtained from:
Most households consume an average of 21 meals in a typical week.
How many of these 21 meals consumed by your household normally include:

tomatoes (apples): _____

Visit variable (Table 1) was obtained from:
When was the last time you visited a farm with vegetables and/or fruit being raised for human consumption?

a) I have never visited such a farm
b) Over 10 years ago
c) 6-10 years ago
d) 1-5 years ago
e) Within the last year

WTP Question Responses (Table 1) were obtained from:
Would you be willing to pay a premium for tomatoes (apples) labeled as "sustainably produced"? YES OR NO

a) *If Yes***,** Would you buy tomatoes (apples) labeled as "sustainably produced" if it cost **X%** ***more*** than tomatoes (apples) *not* labeled as "sustainably produced" (random variable 1-100%) YES OR NO
b) *If No,* Would you buy tomatoes (apples) labeled as "sustainably produced" if it cost **X%** ***less*** than tomatoes (apples) *not* labeled as "sustainably produced" (random variable 1-100%) YES OR NO

Sustainable Production Perception Responses (Table 1) were obtained from:
What does your definition of a tomato (apple) farm using "sustainable production" practices entail? (Check all that apply from the following list of attributes)

family owned	☐ Yes	☐ No
corporate ownership	☐ Yes	☐ No
only family labor	☐ Yes	☐ No
hired labor allowed	☐ Yes	☐ No
smaller than average size	☐ Yes	☐ No
pesticide-free	☐ Yes	☐ No
hormone-free	☐ Yes	☐ No
organic production	☐ Yes	☐ No
natural production	☐ Yes	☐ No
environmentally friendly	☐ Yes	☐ No

Other (please specify :) _____

Presentation of the individual list items was randomized to mitigate order effects
The entire survey document is available from the authors upon request.