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Willingness to Pay for Organic Food Products and Organic Purity: Experimental Evidence

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The market for organic products has grown rapidly over the past decade, and such products are now available not only in specialty stores but also in large grocery stores, supermarkets, and big-box super stores. The objective of this study is to estimate consumer willingness-to-pay for organic foods with varying purity levels relative to conventional foods and test the power of socio-economic attributes of consumers to explain the willingness-to-pay premiums for organic food items. The study uses unique information collected from experimental lab auctions conducted on 129 adults 18-65 years of age. The commodities are coffee, maple syrup, and olive oil, which were available in different organic purity levels. The empirical results show that consumers are, in general, willing to pay significantly more for organic than conventional products but not for purity levels beyond the 95% organic standard set by the USDA. Consumers who had more education, were a college student, were a member of an environmental group, or were from a household with higher per-capita income were willing to pay significantly higher premiums for organic relative to conventional products. Given that it costs significantly more to produce, handle, monitor for truthful labeling, and display foods with 99% or 100% organic purity, especially for fruits, vegetables, grains, oilseeds, fresh meat, and eggs foods, relative to 95% organic products, the retail market for 100% organic purity is expected to remain small. Moreover, it seems that social welfare might increase if 100% organic produce were to be eliminated from US retail food stores.

Key words: organic food, organic purity, willing to pay, random n^{th} price auction, food labels, information effects, coffee, olive oil, maple syrup.

The European Union, Japan, and Canada require organic food to contain at least 95% organic ingredients. Australia does not have a national organic standard. A large share of organic produce sold in the United States contains "at least 95% organic" ingredients, carries the word "organic" on the food label, and displays the US Department of Agriculture's (USDA) "organic" seal. US food-store sales of foods carrying the "100% organic" label are small, relative to those carrying the "organic" label, but data are difficult to obtain. A casual assessment of organic food products carried by Whole Foods, a major marketer of organic products, reveals a low frequency of products carrying the 100% organic label. One plausible explanation is that consumers are not willing to pay a significant amount for purity beyond the 95% organic level.[1] However, we do not know much about consumers' willingness to pay (WTP) for higher organic purity levels.

The objective of this study is to measure consumers' WTP for organic relative to conventional food and for organic food with different degrees of organic purity; to test for significant differences; and to test the power of socio-economic attributes of consumers to explain the average WTP premium for organic relative to conventional products. The particular food products tested in this study are coffee, olive oil, and maple syrup. These products were chosen because they were available locally in both the conventional and 100% organic versions and are products of some importance to grocery store and supermarket shoppers. Moreover, these are food products where subjects are unlikely to be able to discern a difference between organic and conventional versions, or organic versions of different purity levels. Therefore, these products are good examples of credence goods (Darby & Karni, 1973).[2]

1. *Willingness-to-pay (WTP) by a consumer for a good is best viewed as the maximum amount that he or she would be willing to pay for the first unit.*

Although stated preference surveys and field experiments have been sometimes used to assess consumer WTP, we chose to use an experimental auction in a lab setting. See Lusk and Shogren (2007) for a review of these methods. Laboratory auction markets have the advantage of a controlled experiment where a market setting is created such that a subject's bids reveal their valuation for real products, and winners must execute purchases at the winning price. Hence, experimental auctions are a non-hypothetical valuation method. This is possible through the use of an exchange mechanism or type of auction, which creates incentives for subjects to think about the valuation of the experimental good.

Description of the Experiments

To obtain subjects for the experiments, we advertised in the area of a major Midwestern university, both in local food stores and farmers' markets, and by an e-mail sent to a list of the university's employees. The advertisement mentioned the opportunity to participate in a short experiment on economic decision making with food in July 2012. Interested parties were informed that subjects were required to be between 18 and 65 years of age, and participants would be paid $20. The dates and times of proposed experiment sessions were also included. Interested parties contacted us either by email or phone to sign up for a session time. A total of 129 subjects participated in the main set of experiments. Each participant was in a session containing 12 to 20 individuals.[3]

All participants came to a central location where they were first asked to sign a consent form. Upon completing this form, they were given an ID number to ensure anonymity, instructions, and an experiment packet (hereafter packet), and then told to enter the lab. The participants were then paid $20 and signed a receipt. By paying subjects for participating in the experiments, we enhance participation rates and minimize credit concerns and the so-called endowment effect (Kahneman, Knetsch, & Thaler, 1990; Plott & Zeiler, 2005).

Sessions were conducted one at a time by one monitor and one assistant. The packet of materials that each participant received upon entering the lab included information about experimental products that were to be auctioned, an explanation of a random n^{th}-price auction, a quiz on the auction format, and the bid instructions for each round. In addition to the packet, the session monitor also reviewed all of the information with the participants.

Participants were then informed by the session monitor that they would be bidding on one unit of each of three target commodities, only one of several rounds of biding would be binding, and all bids were to be for non-negative values. They were also informed that there would be a practice round using candy bars, but this would not be binding. Participants were also asked to refrain from communicating with other participants. However, subjects were encouraged to direct relevant questions to the session monitor.

Participants were told that in a random n^{th}-price auction, each participant places a bid on all auctioned products. Then, bids are collected, ranked from highest to lowest and assigned a number representing their rank (i.e., the highest bid is 1 and the 4^{th} highest bid is 4). A number is then randomly generated from a uniform distribution between 2 and k, where k is the number of participants in the auction. This number n is then the rank of the price of the winning bid (the n^{th}-price, or the market price), and any participant who bids higher wins the auction. Hence, this auction is different from many auctions in that all participants place bids, and there may be multiple winners. Participants were also told that their best strategy was to bid sincerely (a common practice in such auctions). In all of the rounds of bidding, including the practice round, participants were told that they could examine the products before placing bids.

Next, participants were given a hypothetical example, which was followed by a short quiz, to test their understanding of the random n^{th}-price auction. The monitor reviewed the correct answers and provided

2. *Coffee, olive, and sugar maple trees are frequently grown on soils that are deficient in nitrogen, phosphorus, and potassium. In these situations, commercial fertilizer is frequently applied to increase production and/or quality, e.g., see Wilmot and Perkins (2004). However, the use of commercial fertilizer is a prohibited substance under the US National Organic Program (USDA, Agricultural Marketing Service, 2000). In addition, products of different organic purity levels arise when uncertified organic and certified organic products are co-mingled together during harvesting, processing, or handling.*
3. *Differences in the number of subjects in lab sessions could affect the size of bids placed. For example, in a fourth-price auction with known limited supply of the experimental product, Umberger and Feuz (2004) found that the "market price" was affected positively by the sample size. However, this seems to be largely due to the auction design. For example, a random n^{th}-price auction is designed to circumvent these problems, especially when there is no apparent limit on the supply of experimental product, and price differentials for similar products rather than price levels are the target of the econometric analysis.*

explanations when questions were raised. The practice round and an auction of candy bars followed. Participants came to a table in the front of the lab to examine the candy bar, and returned to their seat to register their bid on a piece of paper—a bid sheet. After the monitor collected all bid sheets, bids were rank-ordered, the random n^{th}-price was chosen and winning bids and bidders were identified. Any remaining questions were addressed.

Next, the auction turned to the target commodities—coffee, maple syrup, and olive oil. One unit of coffee consisted of ¼ pound of whole bean Arabica French roast, one unit of maple syrup consisted of 250 milliliters US Grade A dark amber, and one unit of olive oil consisted of 250 milliliters cold-pressed extra virgin.[4,5] These commodities were chosen because they are available locally and carried the USDA's "100% organic" label, while many others commodities were not. Moreover, having access to organic products with 100% organic ingredients is required to circumvent possible claims of deceiving subjects about the organic content of auctioned food items. A label of "at least 95% organic" or "organic" was chosen because this is the most common organic label marketed in the United States, and it is the lowest organic purity level that can display the USDA's organic seal. In addition, the 95% threshold is the organic food standard of the European Union, Japan, and Canada. We chose "at least 99% organic ingredients" rather than 100% organic ingredients as our highest purity level because uninformed subjects might be suspicious of a "100% organic" label, believing that it is unlikely to be factually correct in the United States due to inadequate segregation of organic from non-organic ingredients in production, processing, and handling. In addition, an individual informed about the USDA's organic labeling policy might also be concerned.[6] A midrange value of "at least 97% organic" label was also chosen. Additional variants in the organic ingredient content were not considered to guard against overburdening or confusing subjects.

Experimental products were properly grouped and placed under colored plastic tubs on a table at the front of the lab.[7] Across sessions, the ordering of the groups of products was randomized to minimize sequencing effects. Participants were then asked to come to the front of the room sequentially to view and examine the target products. Then, they were to return to their seat and write down their bids on the bid sheets provided in their packet. When this was completed, the participants laid the bid sheet face down on the table and the assistant collected them. After all bids were collected in a session (three rounds of bidding), they were rank-ordered by commodity with participants' ID numbers displayed. The random n was generated and winners of each commodity were notified.

For our experimental auctions, the subjects were faced with a situation similar to what a consumer might experience in a major grocery store or supermarket, where conventional and organic versions of the same commodity are located side by side. Subjects were asked to place bids on one unit of a target commodity carrying the "organic" and "conventional" food labels. The organic labels were randomly assigned one of the statements: at least 95%, 97%, or 99% organic ingredients. There were three rounds of bidding, one for each of the target commodities, and the order in which they occurred across lab sessions was randomized.

In the experiments, the ordering of the groups of products in a session was randomized to minimize sequencing effects. One example of how the rounds of bidding occurred is as follows:

- Round 1—Olive Oil: Two products shown, one labeled "conventional" and one "organic," with additional information in the packet stating that "olive oil labeled as organic is at least 97% organic."
- Round 2—Maple Syrup: Two products shown, one labeled "conventional" and one "organic," with additional information in the packet stating the "maple syrup labeled as organic is at least 95% organic."
- Round 3—Coffee: Two products shown, one labeled "conventional" and one "organic," with additional

4. *All products were repackaged to eliminate commercial labels, and the new generic packaging contained only the labels that were consistent with our project.*
5. *In situations where a subject asked about maple syrup, the monitor indicated that maple syrup is a natural sweetening product made from maple tree sap, and it is similar to honey, but with a much lower relative viscosity and stronger taste.*
6. *For example, if a certified organic producer follows his organic plan, his product can be marketed as "organic" even if there is contamination with non-organic ingredients exceeding 5% (USDA AMS, 2000). Hence, the 100% organic product is not as "pure" as its label would suggest.*
7. *All display products had been stripped of commercial labels. We then attached our own labels containing only information that was the focus of our study.*

Table 1. Stacked seemingly unrelated regression of within-subject willingness-to-pay differences [organic relative to conventional products, pooled across experimental products (N = 370)].

Regressor	Mean	Std. dev	Coefficient	Std. error	Coefficient	Std. error
Intercept			-1.1490	0.7710	-0.0790	0.5030
Age	38.23	15.30	-0.0110	0.0350	--	--
Age squared			-0.0001	0.0004	--	--
Education (years completed)	16.98	2.80	0.0670**	0.0280	0.0660**	0.0270
Undergraduate (=1)	0.14	0.40	0.4100*	0.2190	0.4100**	0.2190
Income per capita ($1,000)	30.53	23.60	0.0150*	0.0100	0.0120*	0.0080
Income per capital squared			-0.0001	0.0001	-0.0001	0.0001
Read food labels (=1)	0.66	0.50	-0.0320	0.1190	--	--
Relatively informed about organics (=1)	0.22	0.42	0.2230*	0.1190	0.1790*	0.1100
Employed in agriculture or farming (=1)	0.07	0.26	-0.2220	0.2160	--	--
Member of environmental group (=1)	0.11	0.31	0.4140*	0.1650	0.3920**	0.1630
Physically healthy (=1)	0.94	0.26	-0.1710	0.2180	--	--
Maple syrup (=1)	0.33		0.1650	0.1240	--	--
Olive oil (=1)	0.33		-0.0470	0.1230	--	--
At least 97% organic (=1)	0.33		-0.0790	0.1220	-0.0980	0.1220
At least 99% organic (=1)	0.33		0.0600	0.1230	0.0430	0.1230
R^2			0.102		0.088	

**(**) Denotes coefficient that is significantly different from zero at the 10% (5%) level.*

information in the packet stating the "coffee labeled as organic is at least 99% organic."

At this point, subjects were informed that the winning experimental products might come in a different container than those shown in the lab experiments. After the binding round was chosen, another random draw was made to determine the version of the winning commodity. If the commodity with "at least 95% organic ingredients" was binding, the individual paid the winning price for a commodity with "at least 95% organic ingredients," but received a 100% organic product in original commercial packaging.

Description of the Sample and Summary Statistics

One-hundred-twenty-nine subjects participated in the experiments. In Table 1, the left-most column of data reports the sample mean of the regressors. Mean age of subjects was 38 years, mean education was 17 years, and mean annual per-capita household income was $30,530. Sixty-five percent of participants reported reading food labels more often than not, but only 22% reported that they were relatively informed about organics. Eight percent were employed in agriculture, but only 11% reported being a member of an environmental group. However, an unusually high frequency of adults reported being in good to excellent health. In addition, 59% of the sample were women, 72% were white, 42% were married, and average household size was 2.3 individuals.

In this experiment, subjects bid on a given commodity with both a conventional and organic label. Which version came first was randomly determined; likewise, the purity level for the organic versions was randomly determined. A total of 387 bids were placed; 23 bids are less for one unit of an organic than a conventional product (approximately 6%), and 86 bids are the same for one unit of the organic and conventional product (approximately 22%).[8] The remaining 278 bids (72%) are greater for one unit of organic than the conventional version of a commodity. Hence, a large majority of the bids were higher for organic than conventional commodities, but not all of them. Upon disaggregating bids by commodity, 4% of the bids for coffee, and 7% of the bids for maple syrup and olive oil are less for one unit of the organic than the conventional product. Approximately 23% of coffee bids, 20% of maple syrup bids,

8. *Across all there commodities there were only 17 zero bids; 2.3% for olive oil and maple syrup but 12% for coffee. Coffee is a product with a unique taste and for those who don't like it, one can easily imagine a zero bid as truthful.*

Table 2. Mean willingness-to-pay and test of equality of mean willingness-to-pay for organic and conventional coffee, maple syrup, and olives.

Panel A. Coffee (1/4 lb whole bean Arabica French roast			
Mean WTP by product or comparison:[a]	**Conventional**	**Organic**	**Difference**
1) ≥ 95% organic to conventional	\$1.609	\$2.134	\$0.525
2) ≥ 97% organic to conventional	\$1.859	\$2.481	\$0.622
3) ≥ 99% organic to conventional	\$1.458	\$1.916	\$0.458
4) All bids on conventional	\$1.626		
Results from *t*-test for H_o of equal means:[b]	**Decision**	**Significance level**	
WTP(≥ 95% organic) = WTP(conv)	Reject H_o	0.022	
WTP(≥ 97% organic) = WTP(conv)	Reject H_o	0.007	
WTP(≥ 99% organic) = WTP(conv)	Reject H_o	0.013	
Panel B. Maple syrup (250 ml US grade A dark amber)			
Mean WTP by from comparisons of:	**Conventional**	**Organic**	**Difference**
1) ≥ 95% organic to conventional	\$2.347	\$2.738	\$0.391
2) ≥ 97% organic to conventional	\$2.949	\$2.937	\$-0.012
3) ≥ 99% organic to conventional	\$2.234	\$4.068	\$1.834
4) All bids on conventional	\$2.485		
Results from *t*-test for H_o of equal means:	**Decision**	**Significance level**	
WTP(≥ 95% organic) = WTP(conv)	Fail to reject H_o	0.100	
WTP(≥ 97% organic) = WTP(conv)	Fail to reject H_o	0.100	
WTP(≥ 99% organic) = WTP(conv)	Reject H_o	0.000	
Panel C. Olive oil (250 ml cold-pressed extra virgin)			
Mean WTP from comparisons of:	**Conventional**	**Organic**	**Difference**
1) ≥ 95% organic to conventional	\$2.125	\$3.303	\$1.178
2) ≥ 97% organic to conventional	\$2.525	\$2.531	\$0.006
3) ≥ 99% organic to convention	\$2.159	\$2.560	\$0.401
4) All bids on conventional	\$2.259		
Results from *t*-test for H_o of equal means:	**Decision**	**Significance level**	
WTP(≥ 95% organic) = WTP(conv)	Reject H_o	0.001	
WTP(≥ 97% organic) = WTP(conv)	Fail to reject H_o	0.100	
WTP(≥ 99% organic) = WTP(conv)	Fail to reject H_o	0.100	

[a] *The first two columns of numbers give the sample mean for consumers' WTP for one unit of a good. The third column gives WTP differences.*

[b] *Here we perform a test of null hypothesis that mean WTP for an organic product with given purity level is equal to the mean WTP for a conventional/nonorganic product. We reject this hypothesis when differences in mean WTP are relatively large. The significance level indicates the probability of rejecting the null hypothesis when it is true.*

and 23% of olive oil bids are the same for conventional and organic food products.

For coffee, mean WTP for organic having "at least 95% organic" is \$0.525 higher than for conventional, organic having "at least 97% organic" ingredients is \$0.622 higher than conventional, and organic having "at least 99% organic" ingredients is \$0.458 higher than conventional. These three differences are all significantly different from zero at the 2.5% level. (See Table 2 for all results.)

For maple syrup, mean WTP for organic having "at least 95% organic" ingredients is \$0.301 higher than for conventional, organic having "at least 97% organic" ingredients is slightly higher for conventional than organic, and for having "at least 99% organic" ingredients is \$1.834 higher for organic than conventional. The first two differences are not significantly different from zero at the 5% significance level, but the last one is significantly different from zero at 2.5% level.

For olive oil, mean WTP for organic having "at least 95% organic" ingredients is \$1.178 higher than for conventional oil, organic "at least 97% organic" ingredients is the same as for conventional, and organic having "at least 99% organic" ingredients is \$0.401 higher than for conventional oil. The first difference is significantly different from zero at the 2.5% level and the other two differences are not significantly different from zero at the 5% significance level.

Regression Analysis of the Organic Premium

Our next step is to conduct a regression analysis to explain within subject WTP differences using socio-economic attributes of the subjects and controls for the product and organic purity level. To set the stage, consider a model to explain the average WTP (Y) is for the g^{th} commodity, i^{th} food label, and j^{th} individual:

$$Y_{ij}^{g} = \delta_{i0}^{g} + \boldsymbol{\delta_i^g X_j} + \sigma_{is}^{g} D_s + \sigma_{io}^{g} D_o + \varphi_{i0}^{g} P_0 + \varphi_{i1}^{g} P_1 + \mu_{ij}^{g}, \quad (1)$$

where g (commodities) = c, s, and o (where c = coffee, s = maple syrup and o = olive oil), i = 1,2 (where 1 = plain label and 2 = organic of some % purity), and j = individual.

In Equation 1, $\boldsymbol{X_j}$ is the vector of socio-economic attributes of subjects; D_s is a 1-0 dummy variable for maple syrup; D_o is a 1-0 dummy variable for olive oil; P_0 is a 1-0 dummy variable for a product having ≥ 97% organic ingredients; and P_1 is a 1-0 dummy variable for a commodity having ≥ 99% organic ingredients. The coefficients of the variables have superscripts to indicate that they may vary across commodities (g). The zero-mean random disturbance term μ_j^g represents the effect of other (excluded) variables on WTP. In Equation 1, the reference good is coffee and the reference organic content is "at least 95% organic" ingredients.

Major advantages exist from converting the model into one of WTP differences for a given commodity, i.e., WTP for an organic version of a commodity less WTP for a conventional version of the same commodity. This method goes back to the work of Hoffman, Menkhaus, Chakravarti, Field, and Whipple (1992). This difference is best interpreted as the average WTP premium for an organic relative to conventional commodity. The advantages include that the sample values of the 'WTP premium' can be positive, negative, or zero, and hence, the distribution of the WTP premium can better approximate a normal distribution than sample WTP outcomes for each component.[9] It also differences out any common individual fixed or random effects, including individual idiosyncrasies. The equation for the average WTP premium is

$$Y_{2j}^{g} - Y_{1j}^{g} = \beta_0 + \boldsymbol{\beta X_j} + \gamma_s D_s + \gamma_o D_o + \rho_0 P_0 + \rho_1 P_1 + \epsilon_j, \quad (2)$$

where $Y_{2j}^{g} - Y_{1j}^{g}$ is the WTP difference for the g^{th} commodity and j^{th} individual; β_0 ($=\delta_{20}^{g} - \delta_{10}^{g}$) is the intercept term; $\boldsymbol{\beta}$ ($=\boldsymbol{\delta_2^g - \delta_1^g}$) is the vector of coefficients associated with $\boldsymbol{X_j}$, the vector of exogenous variables; γ_s ($=\sigma_{2s}^{g} - \sigma_{1s}^{g}$) is the coefficient for the dummy variable D_s ; γ_o ($=\sigma_{2o}^{g} - \sigma_{1o}^{g}$) is the coefficient for the dummy variable D_o ; ρ_0 ($=\varphi_{20}^{g} - \varphi_{10}^{g}$) is the coefficient for the dummy variable P_0 ; ρ_1 ($=\varphi_{21}^{g} - \varphi_{11}^{g}$) is the coefficient for the dummy variable P_1; and ϵ_j ($=\mu_{2j}^{g} - \mu_{1j}^{g}$) is a new zero-mean random disturbance term.

The corresponding equation for the WTP premium for each commodity, $g = c$, s, and o, is

$$Y_{2j}^{c} - Y_{1j}^{c} = \beta_0 + \boldsymbol{\beta X_j} + \rho_0 P_0 + \rho_1 P_1 + \epsilon_j , \quad (3a)$$

$$Y_{2j}^{s} - Y_{1j}^{s} = \beta_0' + \boldsymbol{\beta X_j} + \gamma_s D_s + \rho_0 P_0 + \rho_1 P_1 + \epsilon_j' , \quad (3b)$$

$$Y_{2j}^{o} - Y_{1j}^{o} = \beta_0'' + \boldsymbol{\beta X_j} + \gamma_o D_o + \rho_0 P_0 + \rho_1 P_1 + \epsilon_j''. \quad (3c)$$

[10]

Equations 3a, 3b, and 3c can be stacked over commodities (g) to create one seemingly-unrelated-regression model (Zellner, 1962) of WTP premiums. This leads to a model with a total of 370 observations (only 17—or 4%—of 387 observations due to zero bids or missing values were omitted).[11]

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9. *In contrast, if WTP values were the dependent variable, one could apply a tobit model or sample selection model to deal with zero bids, e.g., see Bernard and Bernard (2010) and Gracia, Loureiro, and Nayga (2011). These estimators have some advantages but are susceptible to biases caused by unobserved individual idiosyncratic effects, whereas our model can minimize these effects by differencing they away (Wooldridge, 2010). In addition, our model had the major advantage of making the average WTP premium for organic (relative to a conventional product) a key parameter in the estimation process.*

10. *Dummy variables for goods are omitted in the previous equations to simplify notation when a variable would have a value of zero.*

The regressors included in X are common socio-economic variables of the participants: age, age squared, education, per-capita household income, income squared, and health status. Less common, but seemingly important attributes for this study include status as an undergraduate student, use of food labels, being informed about organics, being employed in agriculture, and being a member of an environmental group.[12] See Table 1 for more information on these definitions.[13] Individuals who have more education are expected to be willing to pay a larger premium for organic than conventional commodities. This would occur if they see broader benefits to themselves and/or to the environment. Undergraduate students are expected to be more idealistic, to be affected more by state and local organizations (such as "Live Green" and the "Student Organic Farm"), and to have preferences that are stronger for organic than conventional food, ceteris paribus. Subjects in households having larger per-capita income are expected to have a higher WTP premium for organic relative to conventional food items (Lin, Smith, & Huang, 2008). Additionally, subjects who regularly read grocery store food labels are hypothesized to have a higher WTP premium for organic than conventional food items. Similarly, health conscious consumers are expected to have a higher WTP premium for organic foods. Individuals who are employed in agriculture could be favorably predisposed to conventional or organics, but the share of local farmers that grows organics is quite low (USDA, Economic Research Service, 2010). Hence, subjects employed in agriculture are expected to have a lower WTP premium for organic products, and it could be negative. The coefficients of P_0 and P_1—which are dummy variables for "at least 97% organic" and "at least 99% organic" ingredients, respectively—are expected to be positive.

Equations 3a, 3b, and 3c are fitted jointly to the data, and the estimated coefficients and standard errors are reported for the full model in the middle two columns of Table 1. A number of the socio-economic attributes and the two commodity-type dummy variables have coefficients that are not significantly different from zero and are excluded from the second regression reported in the right-most columns of Table 1.[14] In moving from Regression 1 to 2, the R^2 declines slightly, from 0.102 to 0.088. In Regression 2, one additional year of schooling of a subject increases his or her average WTP premium for one unit of "at least 95% organic" content relative to the conventional version of the same commodity by only \$0.066 or \$0.264 for an additional 4 years of completed schooling, seemingly very small. A subject's status as an undergraduate increases the average WTP premium by \$0.357, all other things equal. Additional per-capita income of participants increases the average WTP premium, but the size of this effect declines as per-capita income increases, giving a non-linear marginal effect. No participant was observed to have per-capita household income larger than \$85,400, which is the value where the marginal effect of income on the WTP premium is zero. At the sample mean of household income, an increase in household income of \$1,000 increases the WTP premium by only \$0.006 (or \$0.059 for a \$10,000 increase), which seems quite small. Finally, the size of the WTP premium does not increase significantly for a commodity having "at least 97% organic" or "at least 99% organic" purity relative to a commodity having at least 95% organic purity. However, since the estimate of the constant or intercept term is not significantly different from zero, it seems that subjects are not willing to pay more for organics relative to conventional food products, controlling for a subject's education, being an undergraduate student, household income, and a subject being informed about organics and being a member of an environmental group.

11. *We have assumed that the variances of the differenced disturbances in these equations are the same and that no cross-equation correlation of disturbances exists. Even if these assumptions are violated, there is no gain to a feasible generalized least squares estimator because all equations contain the same set of regressors (Greene, 2003).*

12. *We did not ask about recent purchases of products or home inventories. Holding inventories of the target products could affect bid levels but seems less likely to affect average WTP premiums.*

13. *Gender was never a significant explanatory variable.*

14. *Variables that are excluded are the subject's age and age squared, whether the subject reads food labels when purchasing a new food type, whether employed in agriculture, and commodity dummy variables. A test of the null hypothesis that all seven of these coefficients are jointly zero yields a sample value of the F statistic of 0.787. In contrast, the tabled value of the F for 7 and 354 degrees of freedom at the 5% significance level is 2.05. Hence, we cannot reject the null hypothesis. However, estimated coefficients for organic purity level were retained even though they had low explanatory power in both regressions reported in Table 1.*

Conclusion

Of the bids placed concurrently on organic and conventional products, 72% were higher for organic than conventional (28% were the same or lower). However, the average premium for organic coffee was 28% and for organic olive oil was 44%, but the premium was much lower for organic maple syrup. These numbers provide an upper-bound estimate of mean WTP for "at least 95% organic" relative to conventional commodities, but it does not exceed 50%, which is a rough estimate of the increase in the cost of producing and distributing organic relative to conventional versions of the same commodity.

In the regression analysis of WTP premium for organic (relative to a conventional version of the same commodity), participants who had more education and higher per-capita household income were willing to pay significantly more for the organic than conventional commodity. In addition, members of environmental groups and undergraduate students were also willing to pay a significantly higher premium for organic than conventional food, other things being equal. Hence, attributes of participants explain some of the difference in the average WTP premium for organic relative to conventional food products. In this regression model, the size of the average WTP premium for "at least 97% organic" and "at least 99% organic" ingredients relative to "at least 95% organic" ingredients was not significantly different from zero; hence, the organic purity level did not significantly explain the average WTP premium. Overall, "marginal" impacts of regressors that had coefficients that were significantly different from zero seemed economically small relative to a 50% increase in the cost of producing most organic food, relative to conventional food products.

The main policy implication of this study is that subjects displayed no willingness to pay a premium for organic purity of at least 97% or 99% (or 100%) organic purity relative to the USDA standard of at least 95% organic purity. For these reasons, the retail market for 100% ingredients will not support the added cost. Hence, the retail market for 100% organic purity is small, and we conjecture it is not expected to grow. Given major transaction costs of segregating and maintaining diverse channels—especially for fruits, vegetables, grains, oilseeds, fresh meat, and eggs and display space in grocery stores for organic products with different purity levels—and arguments can be made for eliminating 100% organic as a retail commodity in the United States.

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