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

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Willingness-to-pay for organic food products and organic purity: Experimental evidence

by

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DEDICATION

I would like to dedicate this thesis to my mother and father; their sacrifices and kindness guide me to this day.

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ABSTRACT

The market for organic products has been growing rapidly over the past decade, and is now available not only in specialty stores like Whole Foods but also in Hy-Vee and other large grocery stores and super markets. Even Wal-Mart and Target carry organic produce and dairy products. This paper uses information collected in laboratory experiments to test the hypothesis that some consumers are willing-to-pay more for organic than conventional food and that they will pay more for organic food with higher degrees of organic purity. The participants in the experiments are from the Ames, Iowa area. The experimental products are organic and conventional coffee, maple syrup and olive oil. We found that participants were willing to pay higher prices for an organic product with high levels of organic purity. Also, individuals with more education were willing to pay more for organic relative to conventional products, and additional household income (per capita basis) increased willingness-to-pay for organic products up to $85,400, and willingness-to-pay decreased as per capita household income increased above $85,400.

CHAPTER 1. INTRODUCTION

The market for organic food in the United States has steadily grown over the past two decades. These products must carry a label to differentiate them from conventional products. Various organic groups, e.g., California Certified Organic Farmers, and a few states, e.g., California and Texas, developed organic standards first. However, as organic standards proliferated, some organic producers and consumers raised concern and lobbied for a recognizable national standard. Small organic producers, however, did not want an expensive organic certification/inspection system. The 1990 farm bill included the Organic Foods Production Act. The Act asked the Secretary of Agriculture to establish a national list of allowed synthetic substances that may be used, and a list of prohibited substances that could not be used in organic production and handling operations. The USDA's Agricultural Marketing Service developed these standards, which are known as the National Organic Program (NOP) and they first went into effect in October, 2002.[1]

Production standards for organic are "process based," i.e., the national organic standards address the "production process" or the methods, practices, and substances used in producing and handling crops, livestock, and processed agricultural products. The requirements apply to the way that products are created, not to measurable properties of the resulting product itself. Although specific practices and materials used by organic operations may vary, the standards require every aspect of organic production and handling to comply with the provisions of the Organic Foods Production Act (USDA: AMS, 2000), including the list of approved and prohibited practices, methods and substances (USDA: AMS, 2011). Also, annual audits of records are required of USDA certified organic food.

Under the NOP, different purity levels exist, and those products with the highest degree of

[1] See Huffman and Strzok for more information.

purity may carry the USDA's "Organic Seal." Products consisting of all ingredients that are organically sourced can be labeled as "100 percent organic" and carry the USDA seal. Products that are sourced with at least 95% organic ingredients may be labeled as "organic," and they may also carry the USDA's organic seal. Those products which contain at least 70% organically produced ingredients may be labeled as "made with organic ingredients" but cannot display the USDA's organic seal. Any product with less than 70% organically sourced ingredients cannot display "organic" except upon the ingredients statement, and the USDA seal may not be used. In contrast in the EU, only products which are 95% or greater organically sourced may be labeled as "organic." [2]

The production of organic food raises the cost of production relative to conventional products, and the production of organic products with higher percentages of organic ingredients also raise the cost of production. Hence, a key issue is whether consumers are willing to pay more for these products. There exist a number of studies which show that consumers exhibit a greater willingness-to-pay (WTP) for organic products over conventional products with identical appearance. For example, in a study of organic versus conventional apples with identical appearance, Yue, Alfes and Jensen (2009) show 75% of participants were willing to pay more for the organic apples. However, to the best of our knowledge we know of no literature dealing with specific levels of organic purity of food products and at the impact of socio-economic factors.

This paper uses information collected in laboratory experiments to test the hypothesis that consumers are willing to pay more for organic than conventional food, and that they will pay more for organic food with higher degrees of organic purity. The participants in the experiments are from the Ames, Iowa area, and are perhaps best described as employees of Iowa State University (ISU). Approximately 85% of the participants are employed by or are students of

[2] On February 15, 2012 (effective June 1, 2012), the "U.S. - European Union Organic Equivalence Arrangement" was made, which means the EU and the United States will recognize each other's organic production rules and control systems as equivalent for three years. In this particular case the EU will label "100 percent organic" and "organic" products from the United States simply as "organic." For products "made with organic ingredients" from the United States, the EU will reference the organic ingredients on the ingredients statement. Several additional requirements must be met by producers which can be found by visiting the European Commission's website - ec.europa.eu or the USDA's website - usda.gov.

ISU. The experimental products are organic and conventional coffee, maple syrup and olive oil.[3] We design a random n^{th}-price auction to elicit values from participants. Although Vickrey's (1961) second-price auction is demand revealing in theory and has an endogenous market-clearing price, off-margin bidders can bid insincerely with few consequences if these bids fall below the market-clearing price, see Shogren et al. (2001). For this reason, a random n^{th}-price auction, which can also induce sincere bidding in theory, is used instead of second-price (or some other known n^{th}-price) auction for better empirical results. This paper unfolds in the following chapters.

[3]The goods were chosen as they are considered credence goods in the experiment (goods were not consumed in the experiment) as-well-as in use for many consumers.

CHAPTER 2. RECRUITMENT

To obtain subjects for our experiments, we reduced the cost by advertising in the Ames area. We advertised the opportunity to participate in a short experiment in economic decision making with food, during July 2012, with the experiment already approved by ISU's Office for Responsible Research Institutional Review Board.[1] Interested parties were informed that participants were required to be between 18 and 65 years of age and all would be paid $20 for participation. 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.

Our goal was to have frequent purchasers of groceries participate in a study which focuses on the buying habits of the representative consumer. Hence, we excluded people under the age of 18 and people over the age of 65. We believe that people under 18 are more likely to live with their parents, not be the main purchaser of groceries, or are less involved in food preparation and planning. Similarly, we excluded people aged 65 and over as they are more likely to have different purchasing habits, unique dietary concerns, and may have their meals provided for them than the representative consumer.

We requested each potential participant to tell us three different session times which would work for them. This gave us some flexibility to combine individuals into groups of 12–20 per session. Once participants were assigned to a session, we notified them of their session date and time. We also sent an additional reminder notification approximately 24 hours before their session with directions and the time of their session. We obtained 154 volunteers for our experiments.

[1] ISU IRB ID 12–260

CHAPTER 3. EXPERIMENTAL METHOD AND DESIGN

At the experiment location all participants were first asked to sign a consent form. Then they were given an ID number to insure anonymity, an instructions and bid packet (hereafter packet), and then told to enter the lab. Once in the lab, they were told to complete a short questionnaire (asking socio-economic questions, knowledge about organic foods, and whether they read food labels). To reduce concerns about a cash constraint, the participants were paid $20 as promised and signed a receipt. This occurred before any instructions about the auctions were read.

Sessions were run one at a time by one monitor and one assistant. The packet participants received included information on the experimental products that were to be bid on, 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 three experimental commodities, that only one of several rounds of biding would be binding, and asked that all bids submitted be non-negative in value. They were also informed that there would be a practice round using candy bars, but this would not be binding. At this point they were also informed that winning experimental products may come in a different container than those shown in the lab experiments. Participants were also asked to refrain from communicating with other participants, and that any questions should be directed to the monitor.

The (private value) random n^{th}-price auction was chosen because of its superior performance in auctions of relatively new products. Participants were told that in a random n^{th}-price auction, each participant places a bid on all auctioned products. 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 price of the winning bid (the n^{th}-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 are likely multiple winners. Participants were also told that their best strategy (a weakly dominant strategy) was to bid sincerely (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 went over the correct answers and provided explanations when questions were raised. The practice round and an auction of candy bars followed. Participants came to the front to examine the candy on a table at the front of the lab. After the monitor collected all bids, they 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 three experimental products - coffee, maple syrup, and olive oil. The coffee was $\frac{1}{4}$ pound whole bean Arabica French roast, the maple syrup was 250 milliliters US Grade A dark amber, and the olive oil was 250 milliliters cold-pressed extra virgin. These are widely purchased commodities by U.S. households and are available in the market as USDA "100 percent organic" ingredients. The latter attribute permitted us to accurately label our organic lab products as having at least 95%, 97%, or 99% organic ingredients. Conventional versions of these products were also readily available in local grocery stores.

Experimental products were properly grouped and placed under bins on a table at the front of the lab. Across sessions, the ordering of the groups of products was randomized to minimize sequencing effects. Participants were then asked one-by-one to the front of the room to view and examine the products. Then, they were to return to their seat and write down bid prices on the bid sheets provided in their packet. When this was complete, the participants laid the bid sheet face down and the assistant picked them up. After all bids were collected in a session (three rounds of bidding), they were ranked-ordered by commodity with participants ID numbers displayed. The random n was generated and winners were identified.

The auction of experimental commodities consisted of two "treatments." The first treatment included an organic product and a conventional product of the same type, e.g., coffee. Organic products might contain at least 95%, 97%, or 99% organic ingredients. Under the second treatment, participants were asked to bid on a product differing in the purity of organic ingredients, e.g., coffee with at least 95%, 97%, or 99% organic ingredients. We ran eight sessions under the first treatment, and two sessions under the second treatment. Participants were randomly assigned among sessions. Under the first treatment, we show an example of how the rounds of bidding in a session might look as presented:

Round 1- Olive Oil: Two products shown, one labeled "conventional" and one "organic," with additional information in the packet stating the "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 information in the packet stating the "coffee labeled as organic is at least 99% organic."

Under the second treatment, an example of how the rounds of bidding in a session might look as presented:

Round 1- Olive Oil: Three levels of organic purity and products with the following labels shown, "at least 95% organic," "at least 97% organic," and "at least 99% organic."

Round 2 - Maple Syrup: Three levels of organic purity and products with the following labels shown, "at least 95% organic," "at least 97% organic," and "at least 99% organic."

Round 3 - Coffee: Three levels of organic purity and products with the following labels shown, "at least 95% organic," "at least 97% organic," and "at least 99% organic."

By presenting the participants with three different levels of purity of coffee, maple syrup, or olive oil, we anticipated we could exaggerate the differences in WTP for small differences in organic purity levels. Why run such a treatment? This is similar to how the products are often presented at grocery stores; partially organic, organic, and 100% organic items are frequently side-by-side.

CHAPTER 4. DATA AND RESULTS

We ran ten sessions at the Nutrition and Wellness Research Center at ISU Research Park in Ames, Iowa during July 2012. Eight sessions (129 participants, although one participant's data was missing) were run with the first treatment, and two sessions (25 participants) of the second treatment were run. Sessions ranged in size from 11 to 21 participants. Please see Table A.1 for characteristics and additional data summaries of participants, and Table A.2 for numbers of participants for each product and purity level.

4.1 Data Analysis

In the following sections we will present the analysis of the data collected from the two treatments. For both treatments we test for equality of mean bid prices. Next, we conduct a regression analysis of bid price data from individual observations on prices of organic and conventional food products, and run equality of means tests of the differences.

4.1.1 Equality of Means

4.1.1.1 Treatment One

We tested equality of means for each good between conventional and a certain percentage of organic, and between different percentages of organic. Due to the design of the experiment we have WTP bids for the conventional products for each participant, but only approximately one-third as many WTP bids for each organic good of a certain percentage of purity. We ran t-tests between the means of the organic bids and conventional bids, looking for significant differences as-well-as between the means of the organic goods (different percentages). These are run with all bids, and again with bids of zero omitted. Our hypothesis of equal means was rejected in most cases; often, consumers have a greater WTP for higher organic purity. In cases of interest, when it is not rejected, it is discussed. We use a conventional confidence level of 10%; we present confidence levels if they were equal to 10% or greater.

Coffee For coffee, mean bids for an organic product are significantly larger than the mean for the conventional product. The mean bid for organic coffee with at least 97% organic ingredients has the highest bids. We fail to reject the null hypothesis that the mean bid of organic coffee of at least 95% organic ingredients is equal to the mean price of organic coffee with at least 99% organic ingredients. However, we reject the null hypothesis that the mean price of coffee with at least 97% organic ingredients is equal to the mean of coffee with at least 99% organic ingredients, forcing us to fail to reject the alternative hypothesis that coffee with at least 97% organic ingredients is greater than coffee with at least 99% organic ingredients.

When omitting bids of zero, we faced many more cases where we failed to reject the null hypothesis of equal mean bid prices. We failed to reject the hypothesis that the mean price of coffee with at least 95% organic ingredients is equal to the conventional mean prices, and coffee with at least 99% organic ingredients. We also failed to reject the hypothesis that the mean price of coffee with at least 99% organic ingredients is equal to the conventional mean prices of coffee. Again, we failed to reject the alternative hypothesis that coffee with at least 97% organic ingredients is greater than coffee with at least 99% organic ingredients. For more equality of means analysis for coffee please see Table A.3.

Maple Syrup For syrup, we fail to reject the null hypothesis of equal mean bid prices for syrup with at least 95% organic ingredients and the mean prices of conventional syrup; similarly for syrup with at least 97% organic ingredients. After eliminating zero bids for syrup, we see the same results but with some different significance levels. See Table A.4 for all significance levels and additional equality of mean prices.

Olive Oil For olive oil, the mean bid price for olive oil with at least 95% organic ingredients is the highest. We reject the null hypothesis that the olive oil with at least 95% organic ingredients is equal to the mean bids for conventional olive oil. However, we fail to reject the null hypothesis that olive oil with at least 95% organic ingredients is equal to the mean price of olive oil with at least 97% and at least 99% organic ingredients. We also fail to reject the null hypothesis that the mean price of olive oil with at least 97% organic ingredients is equal to the conventional mean prices, olive oil with at least 99% organic ingredients. Additionally, we fail to reject the null hypothesis of olive oil with at least 99% organic ingredients is equal to the conventional mean from all bids on olive oil.

When omitting zeros we reject the null hypothesis that the mean bid for olive oil with at least 95% organic ingredients is equal to the mean bid of olive oil with at least 97% and at least 99% organic ingredients. We fail to reject the null hypothesis of equality for organic olive oil with at least 97% organic ingredients with conventional means and at least 99%. See Table A.5 for additional information.

4.1.1.2 Treatment Two

In these data, no participants bid zero so we have one set of results. The tests performed are that mean bid prices for two different purity levels of organic ingredients of a given food type are equal using a t-test. For all three goods, coffee, maple syrup, and olive oil, mean bid prices increase with the purity level. For example, with olive oil, the mean bid price for olive oil with at least 95% organic ingredients is \$5.83, for olive oil with at least 97% organic ingredients is \$6.03 and for olive oil with at least 99% organic ingredients is \$6.33. To confirm that these differences are statistically significant, we conducted a series of null hypotheses that pairs of mean bid prices are equal. In all cases, the null hypothesis was rejected at the 1% significance level. See Table A.6 for more details.

4.2 Regression Analysis of Bid Prices

We develop a multiple regression model to test the hypothesis that economic and personal attributes can explain some of the differences in bid prices for organic and conventional products of the same type across participants under the first treatment. We first propose a model to explain the price of the organic or conventional version of a given food type and proceed to transform the model into one explaining price differences. Equation (4.1) is the model of the bid price for a given food product.

$$Y_{ij}^{g} = \delta_{i0}^{g} + \boldsymbol{\delta_i^g X_j} + \sigma_{io}^{g} D_o + \phi_{i0}^{g} P_0 + \phi_{i1}^{g} P_1 + \mu_{ij}^{g}, \tag{4.1}$$

where: g (goods) = c,s, and o (c = coffee, s = maple syrup and o = olive oil),

i = 1,2 (1 = plain label and 2 = organic of some % purity),

j=individual,

Y= WTP bid.

In equation (4.1), $\boldsymbol{X_j}$ is the vector of exogenous variables, i.e., economic and social attributes of a participant; D_m is a dummy variable for $m = s$ (maple syrup), o (olive oil); and P_n is a dummy variable for $n = 0$ ($\geq$ 97 % organic ingredients), 1 ($\geq$ 99% organic ingredients). The zero mean random disturbance term μ_{ij}^{g} represents the effect of other (excluded) variables on WTP and δ_{i0}^{g} is the intercept term.

Now consider the difference in an individual's WTP for an organic version of a food product relative to a conventional version of the same product. Hence, we can take the difference in bid price equations for the organic and conventional version of (4.1) to obtain equation (4.2).

$$Y_{2j}^{g} - Y_{1j}^{g} = \beta_0 + \boldsymbol{\beta X_j} + \gamma_s D_s + \gamma_o D_o + \rho_0 P_0 + \rho_1 P_1 + \epsilon_j, \tag{4.2}$$

where $Y_{2j}^{g} - Y_{1j}^{g}$ is the bid price difference for the j^{th} individual of good g, β_0 ($=\delta_{20}^{g} - \delta_{10}^{g}$) is the intercept term, β ($=\delta_{2}^{g} - \delta_{1}^{g}$) is the vector of estimated coefficients associated with $\boldsymbol{X_j}$, the vector of endogenous variables, γ_s ($=\sigma_{2s}^{g} - \sigma_{1s}^{g}$) is the coefficient for the dummy variable D_s for good syrup, γ_o ($=\sigma_{2o}^{g} - \sigma_{1o}^{g}$) is the coefficient for the dummy variable D_o for good oil, ρ_0 ($=\phi_{20}^{g} - \phi_{10}^{g}$) is the coefficient for the dummy variable P_0 for at least 97% organic ingredients, ρ_1 ($=\phi_{21}^{g} - \phi_{11}^{g}$) is the coefficient for the dummy variable P_1 for at least 99% organic ingredients, and ϵ_j ($=\mu_{2j}^{g} - \mu_{1j}^{g}$) is a new zero mean random disturbance term. For each dummy variable, a yes is designated as a 1 and any other response is designated as a 0. We then use coffee and at least 95% organic purity as our respective reference commodity and purity level.

We now define the difference equation for each good, $g = c$, s, and o;

$$Y_{2j}^{c} - Y_{1j}^{c} = \beta_0 + \boldsymbol{\beta X_j} + \rho_0 P_0 + \rho_1 P_1 + \epsilon_j, \tag{4.3}$$

$$Y_{2j}^{s} - Y_{1j}^{s} = \beta_0' + \boldsymbol{\beta X_j} + \gamma_s D_s + \rho_0 P_0 + \rho_1 P_1 + \epsilon_j', \tag{4.4}$$

$$Y_{2j}^{o} - Y_{1j}^{o} = \beta_0'' + \boldsymbol{\beta X_j} + \gamma_o D_o + \rho_0 P_0 + \rho_1 P_1 + \epsilon_j''. \tag{4.5}$$

Dummy variables for goods are omitted in the previous equations for ease of notation when a variable would have a value of zero. Equations (4.3), (4.4), and (4.5) can be stacked together to make a regression model pooled over product types (coffee, maple syrup, and olive oil) using 370 observations.

4.2.1 Empirical Model

The exact empirical specification of the stacked version of equation (4.3), (4.4) and (4.5) is as follows:

$$\begin{aligned}\Delta Y_j = {} & \beta_0 + \beta_1 age + \beta_2 age^2 + \beta_3 ed + \beta_4 undrg + \beta_5 incmpp + \beta_6 incmpp^2 \\ & + \beta_7 labmore + \beta_8 infmore + \beta_9 emag + \beta_{10} envr + \beta_{11} healthy \\ & + \gamma_s D_s + \gamma_o D_o + \rho_0 P_0 + \rho_1 P_1 + \epsilon_j.\end{aligned} \tag{4.6}$$

This specification was chosen because it included most of the variables for which we had information and for which we anticipated might explain bid price differences. See Table A.7 for exact definitions of regressors.

We built the model thinking age^2, *ed*, *undrg*, *incmpp*, *labmore*, *infmore*, *envr*, *healthy*, P_0 and P_1 will all have positively signed coefficients, and *age*, $incmpp^2$, *emag* will have negatively signed coefficients. We agree with some other studies which show education and income have positive relationships with WTP for organic goods. Additionally, we think that people who are more interested in food ingredients and organics have become more informed because of their preferences for organics, suggesting a positive relationship for WTP. Similarly, many health conscious consumers read food labels before purchasing a product, which we think will be positively correlated with WTP. As we are unable to tell if a participant is employed in organic agriculture or farming, and less than 1% of Iowa's land acreage is organically certified, we believe *emag* will have a negative sign (even as Iowa has the 5^{th} most certified organic operations in the United States as of 2008) (USDA: ERS, 2010). One of our study questions is whether consumers are willing to pay more for higher levels of organic purity and we think they will, implying P_0 and P_1 will have positively signed coefficients.

In Table A.8, the following variables had coefficients that were significantly different from zero: education and being a member of an environmental group are significantly different from zero at the 5% level. Additionally, being an undergraduate student, income per person, and how well an individual was informed about organic foods have coefficients significantly different from zero at the 10% level, but not at the 5% level. Next we performed a series of joint null hypotheses that coefficients of two or more related variables had coefficients that were zero: (i) age and age^2 (ii) $incmpp$ and $incmpp^2$, (iii) D_s and D_o, and (iv) P_0 and P_1. The results of these tests are reported in Table A.9. In this equation, the R^2 is 0.102. Based on the reported t- and F-tests, roughly P-values larger than 10%, and a little experimentation, we performed a test of the joint null hypothesis that the coefficients on the following variables were zero: *age*, *age*2, *labmore*, *emag*, *healthy*, D_s, and D_o. The sample value of the F statistic is 2.68 and the tabled value of the F statistic with 8 and 362 degrees of freedom is 4.38. We fail to reject the null hypothesis at the 5% level (Prob >F = 0.626).

Table A.10 reports the estimated coefficients of our refined model (where this last set of variables has been excluded). We exclude these regressors as they are both individually and jointly non-significant and do not focus directly on the question our study wished to address. The results in this regression are quite interesting. Additional education of an individual increases WTP for organic relative to a conventional version of a good. An individual being an undergraduate student increases willingness to pay for organic relative to conventional for a good. The more informed that an individual is about organics, and being a member of and environmental group, the more they are willing to pay for organic relative to a conventional good. Finally, other things equal, below $85,400 of household income per person, an increase in income increases WTP for organic relative to conventional for a good. But above this level, additional income per capita reduces WTP. This non-linear marginal effect is graphed in Figure B.1. See the Appendix C for derivation and additional information. The dummy variable for at least 97% organic purity is negative and the dummy variable for at least 99% purity is positive. However, these coefficients are not significant. Finally, in this refined model, the R^2 is 0.088.

4.2.2 Equality of Means of Differences

We run single variable F-tests to determine if there is a significant difference in the difference in WTP for the products, i.e., testing if at least 95% organic coffee less conventional coffee is equal to at least 97% organic coffee less conventional coffee. We fail to reject the null hypothesis of equality in all cases other than with at least 95% and at least 99% organic maple syrup (at least 95% organic syrup less conventional syrup is equal to at least 99% organic syrup less conventional syrup; Prob $>$F = 0.037).

CHAPTER 5. DISCUSSION AND CONCLUSIONS

Our choice of products in the auctions was significantly limited due to availability of products as 100% organic and conventional. Questions during the experiment often resulted in inquiries as to what some of the products were. For example, participants frequently did not know what maple syrup was (often international participants had never seen or used it before). We suggested maple syrup was a natural sweetening product from maple tree sap similar to honey but with a much lower relative viscosity and stronger taste. Another problem is that coffee seems to be polarizing; it is either loved or hated. We think this accounts for the higher number of zero bids.

From Table A.1 we can see that many of the characteristics of the participants have high variance relative to the means. This is not a problem itself but these means and variances might not be representative of the general consumer. Income per person really stands out with a mean of approximately \$30,500 and a standard deviation of \$23,500. We attempted to gather a representative sample of the population for our study but ideally we would have run the experiment in multiple locations within the Midwest with more participants.

Our data suggests that consumers are generally willing to pay more for organic food products relative to conventional (see Table A.11 for maximum and minimum bid amounts). Interestingly, participants in Treatment One bid zero for most of the products (all but two) whereas in Treatment Two no zero bids were recorded. Participants, however, were not necessarily willing to pay more for higher purity of organic food products already at a relatively high level of organic purity (at least 95%). Additional education, being an undergraduate student, being more informed about organics, being a member of an environmental group, and individual income up to \$85,400 all contribute positively to WTP for organic goods relative to conventional goods.

APPENDIX A. TABLES

Table A.1 Characteristics of Participants (N=154)

Variable	**Definition**	**Mean**	**S.D.**
Age	Participant's age in years	37.06	15.48
Gender	1 if participant is male	0.44	0.50
Married	1 if participant is married	0.41	0.49
White	1 if participant is white	0.72	0.44
Agriculture	1 if employed in agriculture or farming	0.08	0.27
Undergraduate	1 if participant is an undergraduate student	0.10	0.30
Household	Number of individuals in participant's household	2.39	1.17
Education	Years of schooling completed	17.02	2.69
Income per person	Household income per person in $1,000s	30.55	23.54

Table A.2 Treatment One Bids

	≥95%	≥97%	≥99%
Coffee bids	40	39	50
– Number of bids omitted	5	1	5
Maple Syrup bids	50	40	39
– Number of bids omitted	2	2	0
Olive Oil bids	39	50	40
– Number of bids omitted	0	1	1

Table A.3 Equality of Means for Conventional and Organic Coffee (Treatment One)

Coffee*		
	Conventional (name)	**Organic** (name)
Mean WTP (from con. vs $\geq$ 95% bids)	1.609 (con95 mean)	2.134 (95 mean)
Mean WTP (from con. vs $\geq$ 97% bids)	1.859 (con97 mean)	2.481 (97 mean)
Mean WTP (from con. vs $\geq$ 99% bids)	1.458 (con99 mean)	1.916 (99 mean)
Mean WTP from all bids (con. from all)	1.626 (con all mean)	
t–test for mean of 95% (95 mean = "")	**Hypothesis Test****	**Significance Level**
con all mean	$H_a >$	0.025
con95 mean	$H_a >$	0.022
97 mean	$H_a <$	0.094
99 mean	Fail to reject null	
t–test for mean of 97% (97 mean = "")	**Hypothesis Test**	**Significance Level**
con all	$H_a >$	0.001
con97	$H_a >$	0.007
99 mean	$H_a >$	0.013
t–test for mean of 99% (99 mean = "")	**Hypothesis Test**	**Significance Level**
con all	$H_a >$	0.076
con99	$H_a >$	0.013
Coffee - Omitting Zeros		
	Conventional (name)	**Organic** (name)
Mean WTP (from con. vs $\geq$ 95% bids)	1.950 (con95 mean)	2.445 (95 mean)
Mean WTP (from con. vs $\geq$ 97% bids)	1.908 (con97 mean)	2.546 (97 mean)
Mean WTP (from con. vs $\geq$ 99% bids)	1.778 (con99 mean)	2.129 (99 mean)
Mean WTP from all bids (con. from all)	1.873 (con all mean)	
t–test for mean of 95% (95 mean = "")	**Hypothesis Test**	**Significance Level**
con all mean	Fail to reject null	
con95 mean	Fail to reject null	
97 mean	$H_a <$	0.059
99 mean	Fail to reject null	
t–test for mean of 97% (97 mean = "")	**Hypothesis Test**	**Significance Level**
con all	$H_a >$	0.008
con97	$H_a >$	0.012
99 mean	$H_a >$	0.078
t–test for mean of 99% (99 mean = "")	**Hypothesis Test**	**Significance Level**
con all	Fail to reject null	
con99	Fail to reject null	

* All means in USD (Tables A.3, A.4, A.5, and A.6)

** Interpretation of "Hypothesis Test" - if reject null, hypothesis alternative (H_a) signed

Table A.4 Equality of Means for Conventional and Organic Maple Syrup (Treatment One)

Maple Syrup		
	Conventional (name)	**Organic** (name)
Mean WTP (from con. vs $\geq$ 95% bids)	2.347 (con95 mean)	2.738 (95 mean)
Mean WTP (from con. vs $\geq$ 97% bids)	2.949 (con97 mean)	2.937 (97 mean)
Mean WTP (from con. vs $\geq$ 99% bids)	2.234 (con99 mean)	4.068 (99 mean)
Mean WTP from all bids (con. from all)	2.485 (con all mean)	
t–test for mean of 95% (95 mean = "")	**Hypothesis Test**	**Significance Level**
con all mean	Fail to reject null	
con95 mean	Fail to reject null	
97 mean	Fail to reject null	
99 mean	$H_a <$	0.001
t–test for mean of 97% (97 mean = "")	**Hypothesis Test**	**Significance Level**
con all	Fail to reject null	
con97	Fail to reject null	
99 mean	$H_a <$	0.004
t–test for mean of 99% (99 mean = "")	**Hypothesis Test**	**Significance Level**
con all	$H_a >$	0.000
con99	$H_a >$	0.000
Maple Syrup - Omitting Zeros		
	Conventional (name)	**Organic** (name)
Mean WTP (from con. vs $\geq$ 95% bids)	2.470 (con95 mean)	2.852 (95 mean)
Mean WTP (from con. vs $\geq$ 97% bids)	2.949 (con97 mean)	3.092 (97 mean)
Mean WTP (from con. vs $\geq$ 99% bids)	2.377 (con99 mean)	4.068 (99 mean)
Mean WTP from all bids (con. from all)	2.585 (con all mean)	
t–test for mean of 95% (95 mean = "")	**Hypothesis Test**	**Significance Level**
con all mean	Fail to reject null	
con95 mean	Fail to reject null	
97 mean	Fail to reject null	
99 mean	$H_a <$	0.000
t–test for mean of 97% (97 mean = "")	**Hypothesis Test**	**Significance Level**
con all	Fail to reject null	
con97	Fail to reject null	
99 mean	$H_a <$	0.004
t–test for mean of 99% (99 mean = "")	**Hypothesis Test**	**Significance Level**
con all	$H_a >$	0.000
con99	$H_a >$	0.000

Table A.5 Equality of Means for Conventional and Organic Olive Oil (Treatment One)

Olive Oil		
	Conventional (name)	**Organic** (name)
Mean WTP (from con. vs $\geq$ 95% bids)	2.125 (con95 mean)	3.303 (95 mean)
Mean WTP (from con. vs $\geq$ 97% bids)	2.525 (con97 mean)	2.531 (97 mean)
Mean WTP (from con. vs $\geq$ 99% bids)	2.159 (con99 mean)	2.560(99 mean)
Mean WTP from all bids (con. from all)	2.259 (con all mean)	
t–test for mean of 95% (95 mean = “”)	**Hypothesis Test**	**Significance Level**
con all mean	$H_a >$	0.001
con95 mean	$H_a >$	0.001
97 mean	$H_a >$	0.012
99 mean	$H_a >$	0.015
t–test for mean of 97% (97 mean = “”)	**Hypothesis Test**	**Significance Level**
con all	Fail to reject null	
con97	Fail to reject null	
99 mean	Fail to reject null	
t–test for mean of 99% (99 mean = “”)	**Hypothesis Test**	**Significance Level**
con all	Fail to reject null	
con99	$H_a >$	0.060
Olive Oil - Omitting Zeros		
	Conventional (name)	**Organic** (name)
Mean WTP (from con. vs $\geq$ 95% bids)	2.125 (con95 mean)	3.303 (95 mean)
Mean WTP (from con. vs $\geq$ 97% bids)	2.525 (con97 mean)	2.582 (97 mean)
Mean WTP (from con. vs $\geq$ 99% bids)	2.249 (con99 mean)	2.624(99 mean)
Mean WTP from all bids (con. from all)	2.295 (con all mean)	
t–test for mean of 95% (95 mean = “”)	**Hypothesis Test**	**Significance Level**
con all mean	$H_a >$	0.002
con95 mean	$H_a >$	0.001
97 mean	$H_a >$	0.017
99 mean	$H_a >$	0.023
t–test for mean of 97% (97 mean = “”)	**Hypothesis Test**	**Significance Level**
con all	Fail to reject null	
con97	Fail to reject null	
99 mean	Fail to reject null	
t–test for mean of 99% (99 mean = “”)	**Hypothesis Test**	**Significance Level**
con all	Fail to reject null	
con99	Fail to reject null	

Table A.6 Equality of Means Across Purity Levels (Treatment Two)

	Coffee		
	$\geq$ **95%** (name)	$\geq$ **97%** (name)	$\geq$ **99%** (name)
Means	5.537 (95 mean)	5.725 (97 mean)	5.94 (99 mean)
	t–tests	**Hypothesis Test**	**Significance Level**
	95 mean = 97 mean	$H_a <$	0.001
	95 mean = 99 mean	$H_a <$	0.001
	97 mean = 99 mean	$H_a <$	0.001
	Maple Syrup		
	$\geq$ **95%** (name)	$\geq$ **97%** (name)	$\geq$ **99%** (name)
Means	6.567 (95 mean)	6.884 (97 mean)	7.365 (99 mean)
	t–tests	**Hypothesis Test**	**Significance Level**
	95 mean = 97 mean	$H_a <$	0.008
	95 mean = 99 mean	$H_a <$	0.002
	97 mean = 99 mean	$H_a <$	0.002
	Olive Oil		
	$\geq$ **95%** (name)	$\geq$ **97%** (name)	$\geq$ **99%** (name)
Means	5.831 (95 mean)	6.029 (97 mean)	6.327 (99 mean)
	t–tests	**Hypothesis Test**	**Significance Level**
	95 mean = 97 mean	$H_a <$	0.003
	95 mean = 99 mean	$H_a <$	0.004
	97 mean = 99 mean	$H_a <$	0.009

Table A.7 Regression Analysis: Variable Names and Definitions

age	Age	Age of participant in years
age^2	Age x age	Age of participant in years squared
ed	Education	Years of education of participant
$undrg$	Undergraduate (=1)	Dummy variable for an undergraduate student (unmarried, 18–22 years of age, and no more than 4 years of higher education)
$incmpp$	Income per person	Household income (in $1,000s) divided by the number of people per household
$incmpp^2$	Income per person x income per person	Household income (in $1,000s) divided by the number of people per household squared
$labmore$	Read label more (=1)	How often the participant looks at a food label - more often than not
$infmore$	Relatively more informed about organics (=1)	How well the participant is informed about organics well to extremely well
$emag$	Employed in agriculture or farming (=1)	Dummy variable for employment in agriculture or farming
$envr$	Member of environmental group (=1)	Dummy variable for being a member of an environmental group
$healthy$	Physically healthy participant (=1)	Dummy variable for participant in good to excellent health
D_s	Maple syrup (=1)	Dummy variable for maple syrup
D_o	Olive oil (=1)	Dummy variable for olive oil
P_0	At least 97% organic (=1)	Dummy variable for organic purity of at least 97%
P_1	At least 99% organic (=1)	Dummy variable for organic purity of at least 99%

Table A.8 OLS General Model of Price Differences: Organic less Conventional

Regressors	**Coefficients**	**Standard Errors**
Intercept	-1.149	0.771
Age	-0.011	0.035
Age x age	-0.0001	0.0004
Education	0.067**	0.028
Undergraduate (=1)	0.410*	0.219
Income per person	0.015*	0.010
Income per person x income per person	-0.0001	0.0001
Read label more (=1)	-0.032	0.119
Relatively more informed about organics (=1)	0.223*	0.119
Employed in agriculture or farming (=1)	-0.222	0.216
Member of environmental group (=1)	0.414**	0.165
Physically healthy participant (=1)	-0.171	0.218
Maple syrup (=1)	0.165	0.124
Olive oil (=1)	-0.047	0.123
At least 97% organic (=1)	-0.079	0.122
At least 99% organic (=1)	0.060	0.123
R^2	0.102	

∗ Statistical significance at the 10% level

∗∗ Statistical significance at the 5% level

Table A.9 OLS General Model Joint Tests

Regressors/Hypothesis Test	**Probability >F (or P values)**
$age = 0$ $age^2 = 0$	0.934
$incmpp = 0$ $incmpp^2 = 0$	0.030
$D_o = 0$ $D_s = 0$	0.188
$P_0 = 0$ $P_1 = 0$	0.518
$age = 0$ $age^2 = 0$ $emag = 0$ $healthy = 0$ labmore $= 0$ $D_o = 0$ $D_s = 0$	0.626

Table A.10 OLS Refined Model of Price Differences: Organic less Conventional

Regressors	**Coefficients**	**Standard Errors**
Intercept	-0.979**˜	0.503
Education	0.066**	0.027
Undergraduate (=1)	0.357**	0.180
Income per person	0.012*˜	0.008
Income per person x income per person	-0.0001	0.0001
Relatively more informed about organics (=1)	0.179*˜	0.110
Member of environmental group (=1)	0.392**	0.163
At least 97% organic (=1)	-0.098	0.122
At least 99% organic (=1)	0.043	0.123
R^2	0.088	

*Statistical significance at the 10% level
** Statistical significance at the 5% level
˜marginal significance (within 1% of being significant)

Table A.11 Bid Ranges in USD

Treatment One Bids		
Coffee	**Max**	**Min**
Conventional	4.50	0.00
$\geq$ 95% Organic	6.50	0.00
$\geq$ 97% Organic	7.00	0.00
$\geq$ 99% Organic	5.00	0.00
Maple Syrup	**Max**	**Min**
Conventional	4.50	0.00
$\geq$ 95% Organic	9.95	0.00
$\geq$ 97% Organic	12.00	0.00
$\geq$ 99% Organic	11.11	0.25
Olive Oil	**Max**	**Min**
Conventional	10.00	0.00
$\geq$ 95% Organic	9.00	0.25
$\geq$ 97% Organic	10.00	0.00
$\geq$ 99% Organic	6.50	0.00
Treatment Two Bids		
Coffee	**Max**	**Min**
$\geq$ 95% Organic	4.30	0.13
$\geq$ 97% Organic	4.50	0.13
$\geq$ 99% Organic	5.00	0.13
Maple Syrup	**Max**	**Min**
$\geq$ 95% Organic	8.0	0.30
$\geq$ 97% Organic	8.00	0.40
$\geq$ 99% Organic	10.00	0.50
Olive Oil	**Max**	**Min**
$\geq$ 95% Organic	4.40	0.50
$\geq$ 97% Organic	4.60	0.50
$\geq$ 99% Organic	5.00	0.50

APPENDIX B. FIGURES

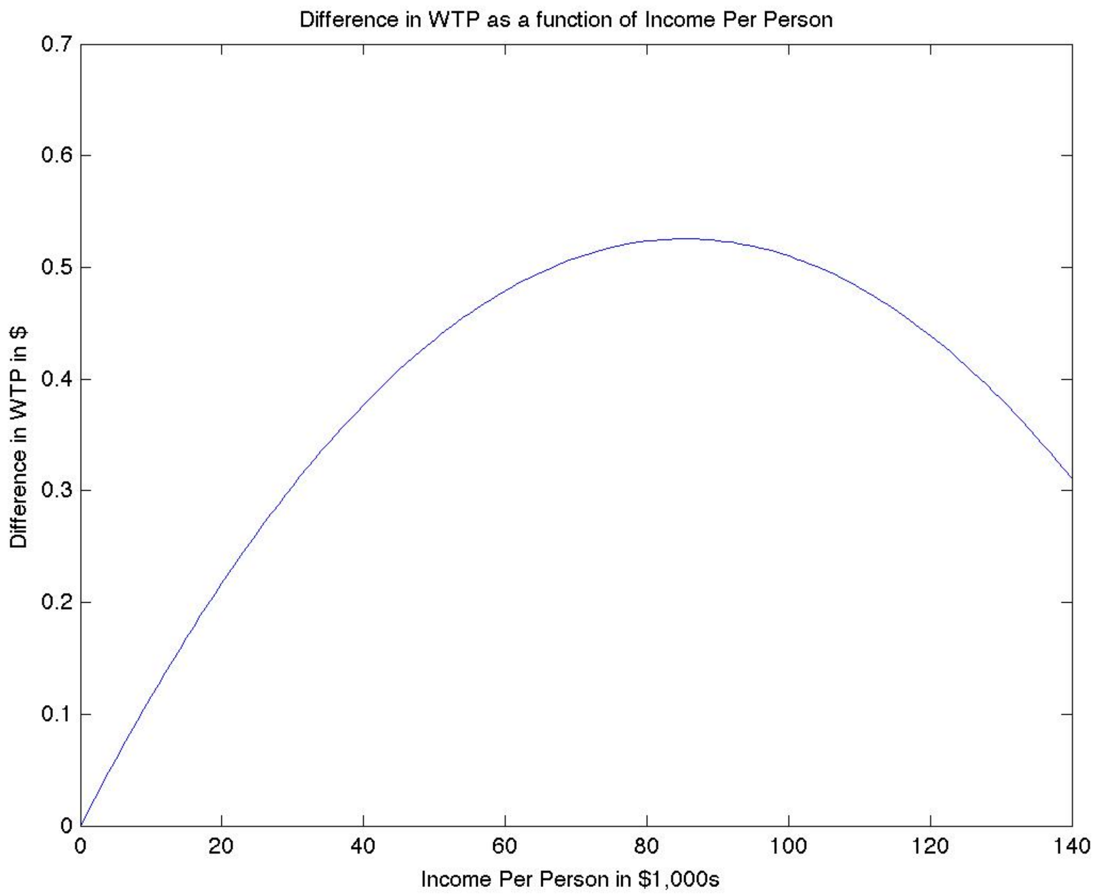

Figure B.1 Difference in WTP as a Function of Income Per Person

APPENDIX C. ADDITIONAL MATERIAL

Nonlinear marginal effects of income per capita

With age and income per person we look at the two following equations to find the minimum and maximum amounts respectively:

$$Y = \alpha_0 + \alpha_1 incmpp + \alpha_2 incmpp^2, \tag{C.1}$$

Taking the derivative of (C.1) with respect to income per person, setting the equation equal to zero, and substituting in the estimated coefficients we get the following:

$$\frac{dY}{dincmpp} = \alpha_1 + 2\alpha_2 inc\hat{m}pp = 0, \tag{C.2}$$

$$inc\hat{m}pp = \frac{-\alpha_1}{2\alpha_2} = \frac{-0.012}{2 * (-0.0001)} = 85.378.^{1} \tag{C.3}$$

From equation (C.1) and results from Table A.10 we plot the effect of per capita household income on the differenced WTP (Figure B.1).

[1] Coefficients used in actual estimation have greater precision than shown.

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