The Demand for Organic Food in the U.S.: An Empirical Assessment

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This analysis examines the determinants of organic food purchase behavior of a random sample of U.S. food shoppers. We analyze food expenditures conditional upon whether a household purchases organic foods. The results from our econometric modeling effort identify shopping venue, awareness of the organic label, positive beliefs toward organic foods, a positive attitude toward cooking, and a lack of religious affiliation as being important determinants of organic food purchases. Income was not found to significantly affect the decision to buy organic foods. Our results suggest that the limiting factors of the organic food market are search cost, dietary patterns, and awareness of the organic food label. Given the recent "Wal-Mart" effect on the organic food market, it is anticipated that these search costs will decrease as organic foods become more widely available.

The organic food market has been increasing at approximately 20 percent per year since 1990, when total organic food sales were $1 billion, compared to $17 billion in 2006 (Dimitri and Greene 2002; Klonsky and Greene 2005; Organic Consumers Association 2007). Consumers are attracted to organic foods because of their characteristics, such as being environmental-friendly and pesticide free (Dimitri and Greene 2002). Recent increases in organic food demand can be attributed to the increased availability, which lowers search costs, and increased selection and variety (Dimitri and Greene 2002). Supplementing the traditional sources of organic food (i.e. farmer's markets and natural food stores), conventional supermarkets accounted for 47 percent of organic sales in 2003 (Oberholtzer, Dimitri, and Greene 2005). The decision by Wal-Mart to feature organic foods in their super-centers will undoubtedly increase the market share of organic food sales by supermarkets (Warnier 2006). In addition, many major food manufacturers, such as Kellogg's, Kraft, and Dean Foods, are developing or acquiring organic product lines (Dimitri and Oberholtzer 2005).

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The profits associated with organic foods have also attracted producers to this market. The 1.45 million acres of certified organic cropland in 2003 were 3.6 times the level of 1992 (Dimitri and Greene 2002; Klonsky and Greene 2005). The main factors that prevent conventional farmers from shifting to organic farming include certification costs, the time required for transition from conventional to organic status, lack of understanding of organic production technologies, and generally higher labor costs for organic products (Greene and Kremen 2003). Although the high cost of organic foods can be covered by their higher prices, organic farmers are required to use organic production methods for a three-year transition period prior to being certified organic. During this period, they cannot enjoy the price premium of organic foods, and this can result in substantial reductions in farm income (Dimitri and Greene 2002; Oberholtzer, Dimitri, and Greene 2005).

Prior to 2002, there were numerous organic standards and certification procedures. The implementation of USDA's national organic standards in 2002 has provided consumers with assurance of consistent, standardized production and processing of organically labeled foods (Greene and Kremen 2003). Moreover, USDA also provides cost-share provisions as well as marketing and technical support to help reduce the certification costs and the risk of shifting to organic production systems (Kremen, Greene, and Hanson 2004).

A number of researchers have investigated the determinants of organic food purchases and consumers' willingness to pay the premiums typically associated with organic foods (Thompson and

Kidwell 1998; Wier and Andersen 2003). However, few studies have focused on the determinants of organic food expenditures. The question remains whether households purchasing organic foods behave differently than non-purchasing households. In order to quantify whether there are such differences, we estimate an econometric model that allows us to identify differences across purchasing and non-purchasing households with respect to the discrete choice of purchasing organic foods, as well as total at-home food expenditures conditional on their organic food purchasing status.

Description of the Econometric Model

We postulate that there are significant barriers to the purchasing of organic foods, and the differences between organic and non-organic food shoppers may cause sub-sample heterogeneity that cannot be controlled in a one-stage model of food purchases (Maddala 1983). As a result, an endogenous switching regression model that can control sub-sample (i.e., organic/non-organic) heterogeneity is used as a foundation of our empirical analysis.

For this study we view the food-purchase behavior as being multi-staged. In the first stage, the household is assumed to make the endogenous discrete decision of whether to purchase organic foods by considering the direct economic cost and indirect search costs of purchasing organic foods and the perceived benefits of consuming organic versus conventional foods. In the second stage, the household then determines the level of food expenditures, where these expenditures are conditional on their organic food-purchase status represented in the first stage. The level of food expenditures and the factors affecting them are permitted to differ between conventional and organic food shoppers. We parametrically test whether there are indeed differences in the conditional food-purchase behavior across purchase category.

For a particular household we assume that the choice between organic foods and non-organic foods can be represented by the following utility-maximizing problem:

$$(1)\quad \begin{aligned} &\underset{Qj}{Max}\, U = U(Q_1^o,\ldots,Q_N^o,Q_1^c,\ldots,Q_M^c,C \mid A,D,\delta) \\ &s.t.\ \ Y = \sum_{j=1}^{N} P_j^o Q_j^o + \sum_{k=1}^{M} P_k^c Q_k^c + C\,, \end{aligned}$$

where Q_j^o is the quantity of the j^{th} organic food (with price P_j^o) consumed, Q_k^c is the quantity of the k[th] conventional food (with price P_k^c) consumed, N is the total number of organic food goods, M is the total number of conventional food goods, C represents all other goods (the price of C is normalized to one), A is a $(t \times (N+M))$ matrix of good-specific attributes, t is the number of total attributes for each good, D is a vector of l household demographic characteristics, and δ denotes the unobserved factors in the decision-making process. The utility is maximized subject to the budget constraint, where Y is total household income.

From Equation 1, the Marshallian demand functions, where Q_j^{o*} and Q_k^{c*} solves the consumer's maximization problem given the organic price vector P^o, conventional price vector P^c, and total household income Y, are

$$(2)\quad \begin{aligned} Q_j^{o*} &= Q(P^o,P^c,Y-C \mid A,D,\delta) \quad j=1,\ldots,N \\ Q_k^{c*} &= Q(P^o,P^c,Y-C \mid A,D,\delta) \quad k=1,\ldots,M\,. \end{aligned}$$

The indirect utility function can be obtained by combining Equations 1 and 2:

$$(3)\quad \begin{aligned} V(P^o,P^c,Y) = U(&Q^{o*},Q^{c*} \mid P^{o}{}'Q^{o*} \\ &+ P^{c}{}'Q^{c*} + C = Y, A, D, \delta) \end{aligned} \;.$$

Similar to Thompson and Kidwell (1998), for a representative household, I^* can be defined as the perceived benefit of consuming both organic and conventional foods, compared to only consuming conventional foods.[1] I^* is related to a set of exogenous variables affecting the characteristics of consumers. We can represent I^* as

$$(4)\quad I^* = V_1(P^o, P^c, Y) - V_2(P^o, P^c, Y) = Z\gamma + \upsilon\,,$$

where V_1 represents the utility from purchasing both organic and conventional food, V_2 represents the utility from purchasing only conventional food, Z is an s-vector of consumer characteristics, γ is a $(s \times 1)$ vector of parameters, and υ is a random error. I^* is unobservable to the analyst. However, the binary

[1]Most people cannot consume all organic foods; however, Q^c can be zero if the household only consumes organic food.

variable I is observable and it denotes household choice related to I^* by

$$(5)\quad I_i = \begin{cases} 1 & if \quad \upsilon_i > -Z_i\gamma \\ 0 & if \quad \upsilon_i \le -Z_i\gamma \end{cases},$$

Thus I_i equals 1 if the net benefit of purchasing both organic and conventional foods (I^*) is positive. Equation 5 represents the assumed Stage 1 of the food-purchase process.

Given the decision of whether to purchase organic foods, the household then determines the level of total food expenditures (F). These expenditures are affected by a set of exogenous variables. The importance of these exogenous variables is allowed to vary depending on organic food-purchase status. We can represent this second purchase stage as

$$(6)\quad F_i = \begin{cases} F_{1i} = X_i\beta_1 + \varepsilon_{1i} & if \quad I_i = 1 \\ F_{2i} = X_i\beta_2 + \varepsilon_{2i} & if \quad I_i = 0 \end{cases},$$

where X is a q-vector of household characteristics, F_1 is total food expenditures if the household purchases organic foods, F_2 is food expenditure if the household only purchases conventional foods, β_1 and β_2 are ($q \times 1$) vectors of unknown parameters, and ε_1 and ε_2 are random error terms.

Since there are significant barriers, such as availability and search costs, to the purchasing of organic food, and organic food shoppers may be different than non-organic food shoppers in their views toward food purchases, we postulate that food expenditures are not independent of organic food purchase status.[2] For this analysis we assume that F_1, F_2, and I^* follow a trivariate normal distribution:

$$(7)\quad (F_1, F_2, I^*) \sim N_3\,[(X\beta_1, X\beta_2, Z\gamma), \Sigma]\ ,$$

where Σ is the covariance matrix of the error terms ε_1, ε_2, and υ (Maddala 1983):

$$(8)\quad \Sigma = \begin{bmatrix} \sigma_{11}^2 & \sigma_{12} & \sigma_{1\upsilon} \\ \sigma_{12} & \sigma_{22}^2 & \sigma_{2\upsilon} \\ \sigma_{1\upsilon} & \sigma_{2\upsilon} & 1 \end{bmatrix}.$$

Given the above, one can obtain parameter estimates either using a two-step approach or an approach that uses the sample likelihood function which accounts for the endogenous discrete-choice decision. In the present analysis we use the likelihood-function approach. Following Lee and Trost (1977), the contribution of a particular household to the endogenous switching regression likelihood function can be represented as

$$(9)\quad L(\beta,\sigma) = \prod \left[\int_{-\infty}^{Z_i\gamma} g(F_i - X_i\beta_1, \upsilon_i)\, d\upsilon_i \right]^{I_i} \left[\int_{Z_i\gamma}^{\infty} f(F_i - X_i\beta_2, \upsilon_i)\, d\upsilon_i \right]^{1-I_i},$$

where g is a bivariate normal density function evaluated for (ε_{1i}, υ_i) and (ε_{1i}, υ_i). The total sample likelihood function is simply the product of the above across households.

This modeling structure is applied to situations where the outcome variable (e.g. level of expenditures) is dependent on a regime or treatment status (e.g. purchase organic food). For example, this type of modeling effort has been applied to analyses such as the level of nutrient intake conditioned on the level of health knowledge (Gould and Lin 1994), total food expenditures conditioned on the purchase decision of specific foods (Aguero and Gould 2003), and women's off-farm labor-force participation conditioned on their farm work (Kimhi 1999).

Given the above structure, expected household food expenditures conditioned on whether the household purchases organic food can be shown to be

$$(10)\quad \begin{aligned} E(F_{1i} \mid I_i = 1) &= X_i\beta_1 + \sigma_{1\upsilon}\left(\frac{\varphi(Z_i\gamma)}{\Phi(Z_i\gamma)}\right) \\ E(F_{2i} \mid I_i = 0) &= X_i\beta_2 - \sigma_{2\upsilon}\left(\frac{\varphi(Z_i\gamma)}{1-\Phi(Z_i\gamma)}\right) \end{aligned},$$

[2] As noted by an anonymous reviewer, there may be differences in the relationship between the two purchase stages if one were to examine a particular type of organic food—e.g. organic produce or dairy—in contrast to our total-expenditure approach. Unfortunately our data consists of total household expenditures and is not differentiated by food type.

where φ is the standard normal probability-density function, Φ is the standard normal cumulative-distribution function, and $I_i = 1$ if the household purchases organic food (Aguero and Gould 2003; Gould and Lin 1994; Maddala 1983).

Assuming that Z_i is continuous, the marginal effect of a change in this variable on the probability of purchasing organic food can be represented as

$$Z_i = \gamma_i \varphi\,(Z'\gamma)\ . \tag{11}$$

With Equation 10 defining expected conditional food expenditures, assuming an exogenous variable is continuous and affects both conditional expenditures and the discrete choice of whether to purchase organic food (i.e., is included in both X and Z), the total marginal effect of an exogenous variable on expected conditional food expenditures has two components: a direct effect on expenditures as represented by β on F, and an indirect effect via its impact on the probability of being an organic food shopper:

$$\frac{\partial E(F_1 \mid I=1)}{\partial X_l} = \beta_{1l} - \gamma_l \sigma_{1\upsilon} \left(\frac{\varphi(Z\gamma)}{\Phi(Z\gamma)} \left(Z\gamma + \frac{\varphi(Z\gamma)}{\Phi(Z\gamma)} \right) \right) \quad l=1,\ldots,L$$

$$\frac{\partial E(F_2 \mid I=0)}{\partial X_l} = \beta_{2l} + \gamma_l \sigma_{2\upsilon} \left(\frac{\varphi(Z\gamma)}{1-\Phi(Z\gamma)} \left(Z\gamma + \frac{\varphi(Z\gamma)}{1-\Phi(Z\gamma)} \right) \right), \tag{12}$$

where L is the number of the variables included in both Equations 4 and 6 (Lee and Trost 1977; Poirier and Ruud 1981).

Description of the Data

The data used in this analysis were obtained from the 2003 University of Wisconsin's Study of Food Buying. The objective of this survey was to understand the views of U.S. households toward organic food purchases. At the time this survey was administered, it was unclear whether a telephone or mail survey would be more effective. Therefore, phone and mail versions were launched to compare which method yielded a higher response rate. The survey data were collected from September through November 2003. Both survey samples were randomly chosen from the continental 48 United States. The initial overall sample was 1,430 phone numbers for the phone survey and 1,095 households for the mail survey. The surveys were administered by a university survey center utilizing the Dillman (1978) approach. The overall response rates were 30.3 percent for the phone survey and 47.7 percent for the mail survey. After excluding missing values, there are 726 respondents in the sample, 56.9 percent of which have purchased organic foods occasionally (49 percent) or on a regular basis, i.e., every shopping trip (eight percent). The overall response rates are in line with other phone and mail surveys that have used the Dillman approach.

Respondents were screened to ensure that they were 18 or older and self-identified themselves as the person primarily responsible for food purchasing and preparation. Given this population, it should not be surprising that the majority of the respondents in this study were female (64.7 percent). The sample does have a larger percentage of high-income households as compared to the actual population (U.S. Census Bureau 2003). In addition, the sample includes slightly more households in the South (35.0 percent) and fewer households in the Northeast (18.2 percent) than the actual population (U.S. Census Bureau 2004).

Table 1 provides an overview of the exogenous variables used in the discrete-choice (Equation 4) and conditional-expenditure (Equation 6) components of the model. For Stage 1 of our model, the dependent variable (ORGANIC) was set to 1 when a respondent indicated that their household purchases organic food at least occasionally.[3]

Previous studies have found varying effects of income level on the likelihood of purchasing organic foods (Blisard, Variyam, and Cromartie 2003; Storstad and Bjørkhaug 2003; Zhang, Huang, and

[3] Respondents were asked if they purchased organic food every shopping trip (regularly), occasionally, or never. Organic shoppers are those who responded "regularly" or "occasionally." Again, to place our survey in perspective, our data pertained to shopping habits in 2003. With the significant increase in organic food demand over the last four years, some of these patterns will have changed to reflect the increased organic food market share.

Table 1. Description of Variables Used in the Econometric Models (n=726).

Variable	Description	Mean	Std.	Stage	Sign[a]
Dependent variables					
ORGANIC	1 = Respondent buys organic foods regularly or occasionally 0 = Otherwise	0.5689	------	1	
LNFOODEXP	Log per capita weekly food expenditure in the household (sum of organic and conventional food purchases)	3.8320	0.6372	2	
Independent variables					
Economic					
INC1	1 = Household low income (first quintile: <$15,000) 0 = Otherwise	0.0909	------	1, 2	?, -
INC2	1 = Household low middle income (second quintile: $15,000–$29,999)	0.1667	------	1, 2	?, +
0=Otherwise					
INC3	1 = Household middle income (third quintile: $30,000–$44,999) 0 = Otherwise	0.1832	------	1, 2	?, +
INC4	1 = Household upper middle income (fourth quintile: $45,000–$75,000) 0 = Otherwise	0.2810	------	1, 2	?, +
INC5	1 = Household high income (fifth quintile: >$75,000) 0 = Otherwise	0.2782	------	1, 2	?, +

Table 1. Description of Variables Used in the Econometric Models (n=726). (Continued)

Variable	Description	Mean	Std.	Stage	Sign[a]
Demographic					
AGE	Age of respondent (year/10)[b]	4.9846	1.5270	1, 2	?, ?
AGESQ	Age square of respondent (AGE^2)	27.1744	16.3092	1, 2	?, ?
HIGHEDU	1 = Education at least 4 years of college 0 = Otherwise	0.4105	------	1, 2	?, ?
ADULT	Number of adults in the household	1.9518	0.8414	1, 2	?, +
KID05	Number of kids less than 6 years old in the household	0.2452	0.6241	1, 2	?, +
KID17	Number of kids from 6 to 17 years old in the household	0.5014	0.9348	1, 2	?, +
GENDER	1 = Male respondent 0 = Female respondent	0.3526	------	1	0
RACE	1 = Race: White/Caucasian, non-Latino/Hispanic 0 = Otherwise	0.8361	------	1, 2	-, ?
NOREL	1 = Religious affiliation: None 0 = Otherwise	0.1474	------	1	?
Attitude and knowledge					
NUTRITION	1 = Nutrition or health is the most important characteristic of food 0 = Otherwise	0.4353	------	1	+
SAFETY	1 = Food safety is the most important characteristic of food 0 = Otherwise	0.3691	------	1	+
CONVEN	1 = Convenience is the most important characteristic of food 0 = Otherwise	0.0551	------	1	-
COST	1 = Cost is the most important characteristic of food 0 = Otherwise	0.1405	------	1	-
ENVIR	1 = Respondent belongs to an environmental group 0 = Otherwise	0.0565	------	1	+
ANIMAL	1 = Respondent belongs to an animal rights group 0 = Otherwise	0.0840	------	1	+
NUTMO	1 = Respondent believes organic foods are more nutritious 0 = Otherwise	0.6818	------	1	+
USDA	1 = Respondent has seen USDA's organic label 0 = Otherwise	0.3347	-----	1	+

Table 1. Description of Variables Used in the Econometric Models (n=726). (Continued)

Variable	Description	Mean	Std.	Stage	Sign[a]
Attitude and knowledge					
GMONC	1 = Respondent correctly defines that "organic foods are not genetically modified" 0 = Otherwise	0.7410	-----	1	+
COOKENJ	1 = Respondent enjoys cooking very much 0 = Otherwise	0.4215	-----	1	+
Behavior					
COOP	1 = Obtain groceries at food co-op on a regular basis 0 = Otherwise	0.0758	-----	1	+
HEALTHFS	1 = Obtain roceries at health food store on a regular basis 0 = Otherwise	0.1515	-----	1	+
DIRECT	1 = Obtain groceries directly from a farmer on a regular basis 0 = Otherwise	0.2314	-----	1	+
VEGAN	1 = Someone in the household follows a vegetarian or vegan diet 0 = Otherwise	0.0372	-----	1	+
Region of residence					
MIDWEST	1 = Household located in the Midwest 0 = Otherwise	0.2617	-----	2	?
SOUTH	1 = Household located in the South 0 = Otherwise	0.3499	-----	2	?
WEST	1 = Household located in the West 0 = Otherwise	0.2066	-----	2	?
NORTHEAST	1 = Household located in the Northeast 0 = Otherwise	0.1818	-----	2	?

[a] Expected signs of the variables.
[b] Age is divided by 10 to avoid scaling problems in estimation.
Source: 2003 University of Wisconsin Food Expenditure Survey. Total sample size is 726 households.

Lin 2006). In our survey, respondents provided categorical income data. Five dummy variables (INC1, INC2, INC3, INC4, INC5) identify the income quintile to which a particular household belonged.

The demographic variables in the model include respondent age (AGE), square of age (AGESQ), education (HIGHEDU), household composition (ADULT, KID05, KID17), gender (GENDER), race (RACE), and lack of religious affiliation (NOREL).

Previous studies found both positive and negative relationships between age and organic purchasing behavior (Zhang, Huang, and Lin 2006; Govindasamy and Italia 1999; Wang and Sun 2003). For total food expenditures, Nayga (1995) found older people were more likely to have higher expenditures on conventional fruits and vegetables. A quadratic term is included to examine whether the relationship between age and the dependent variables changes size or direction with age.

The level of education of the food shopper has been found to be both positively and negatively correlated with the probability of purchasing organic foods (Thompson and Kidwell 1998; Zhang, Huang, and Lin 2006), while Wilkins and Hillers (1994) found education was not a significant variable. Since education is correlated with income and income is a categorical variable, only one educational dummy variable (HIGHEDU) was included.

It is expected that household composition will affect food purchasing decisions. The variables of interest are the number of adults (ADULT), the number of school-age children six to 17 years old (KID17), and the number of preschool-aged children (KID05). Zhang, Huang, and Lin (2006) found no significant relationship between organic purchasing behavior and the household size or the presence of children under six years old. Wier and Andersen (2003) indicated that households with older children were less likely to purchase organic foods, and households with young children were more likely to be organic shoppers. Household size clearly has a positive effect on total food expenditures; however, adults and children may contribute differently (Lanfranco, Ames, and Huang 2000; Nayga 1995).

Previous studies found that female consumers were more likely to be organic shoppers (Govindasamy and Italia 1999), while Thompson and Kidwell (1998) found no significant relationship. Since our model reflects household decision-making and we are selecting for those who actually make decisions with respect to food shopping and cooking, we do not expect a gender effect in this study, but have included a variable (GENDER) to test this.

We include a variable (RACE) to examine whether there is any impact of race on the decision to buy organic foods or on the amount of food expenditures. Zhang, Huang, and Lin (2006) found that Hispanics were more likely to purchase organic foods, while Lanfranco, Ames, and Huang (2000) found Hispanics had higher total food expenditures.

Most previous studies have not taken religion into consideration, but Zepeda and Li (2007) found that households without religious affiliation were more likely to purchase organic foods. The religion variable (NOREL) used in the model is equal to 1 when a respondent has no religious affiliation.[4]

Consumer attitudes and concerns have been found to be important factors in organic food purchasing behavior. People with more concerns about nutrition and health were found to be more likely to purchase organic food (Harper and Makatouni 2002; Wier and Andersen 2003). People concerned with the safety of their food were also found to be more likely to be organic food shoppers (Gifford and Bernard 2004). Convenience concerns may also be a factor in organic food purchasing behavior, since availability and the requirement of food preparation skills may prevent households from purchasing organic food. The studies also suggested that people who are more concerned about environmental problems and animal-welfare, especially members of environmental and animal welfare organizations, were more likely to purchase organic foods (Raab and Grobe 2005; Wier and Andersen 2003). In addition, although consumers' preferences may not determine their actual purchasing behavior, positive beliefs toward organic foods may increase the likelihood of purchasing organic foods. As a result, the attitude variables include what the consumer believes is the most important characteristic of food: nutrition or health (NUTRITION), food safety (SAFETY), convenience (CONVEN),

[4] Respondents were asked to choose among 12 different religious affiliations, including "none."

or cost (COST).[5] Households' environmental or animal-welfare concerns are represented by membership in an environmental group (ENVIR) or an animal-rights group (ANIMAL) in the model. Positive attitudes toward organic foods are represented by beliefs that organic foods are more nutritious than conventional foods (NUTMO).

Knowledge of organic labels and organic foods was also found to be important in organic purchase behavior (Gifford and Bernard 2004; Krystallis and Chryssohoidis 2005). Underhill and Figueroa (1996) found that 53 percent of consumers who had seen an organic label indicated that they purchased organic foods regularly or occasionally. The knowledge variables used in this model include the respondents' awareness of USDA's organic label (USDA) and whether the respondents correctly answered a question as to whether certified organic foods can be genetically modified (GMONC).

A positive attitude toward cooking is both an attitude and knowledge variable, which may also represent cooking skills, diet knowledge, and preferred diet patterns. Wilkins and Hillers (1994) found that people with a positive attitude toward cooking and shopping were more likely to buy organic foods. The positive attitude toward cooking (COOKENJ) equals 1 if a respondent enjoys cooking very much, and 0 otherwise.

Behavior variables include shopping venue (COOP, HEALTHFS, DIRECT) and dietary restriction (VEGAN). Shopping venue indicates the place where a respondent buys groceries on a regular basis. It not only represents availability of organic foods, but also represents the indirect economic cost of searching for organic foods. Thompson and Kidwell (1998) found shopping venue was highly related to organic purchase behavior, and people who shopped at food cooperatives were more likely to be organic shoppers or to prefer organic foods. Households with people with dietary restrictions, especially vegetarians, were also more likely to purchase organic foods (Harper and Makatouni 2002; Zepeda, Chang, and Leviten-Reid 2006).

Figure 1 shows the distribution of total food expenditures by organic versus non-organic food purchasing households. A χ^2 test was used to test the null hypothesis that organic food-shopping households have the same distribution as non-organic shoppers. The resulting χ^2 statistic of 10.37 implies we could not reject the above null hypothesis.[6]

The dependent variable in Stage 2 of our model is the natural logarithm of weekly per-capita total household food expenditure (LNFOODEXP).[7] We use per-capita food expenditures to mitigate the occurrence of heteroskedasticity, as food expenditures vary with household size. The explanatory variables used to estimate per-capita food expenditures include income (INC2, INC3, INC4, and INC5), demographic variables, and regional variables (MIDWEST, SOUTH, and WEST) to represent regional price variation. The demographic variables represent age (AGE and AGESQ), education (HIGHEDU), household composition (ADULTS, KID05, and KID17), and race (RACE). The U.S. Consumer Expenditure Survey demonstrates that these demographic, economic and regional factors greatly influence household food expenditures (U.S. Bureau of Labor Statistics 2006).

Determinants of Organic Food purchasing Behavior

The parameters of our switching regression model were obtained by maximizing the likelihood function represented in Equation 9. LIMDEP 8 was used to obtain model parameter estimates. We test the null hypothesis that food expenditures are independent of organic food purchasing status ($H_0 : \sigma_{iv} = \sigma_{2v} = 0$). The implied likelihood ratio obtained from imposing this constraint was 60.72. The value of this test statistic results in our rejecting the null hypothesis of regime independence at a 5 percent level of

[5] We asked the respondents to identify which of the following characteristics is most important to their food purchasing decision: nutrition/health, food safety, convenience, or cost.

[6] $\chi^2_{(22)} = 10.37$, and the p-value is 0.98.

[7] Due to data limitations, this expenditure included expenditures on food for at-home consumption and food for consumption away from home (e.g., restaurants). In the survey, we allowed respondents to provide exact values of typical weekly food expenditures. The 13.0 percent of respondents that found it difficult to provide exact estimates were allowed to select pre-defined food-expenditure categories. These categorical values were changed into continuous value by assigning the midpoint category value. The respondents who used the predefined expenditure categories to provides estimates of food expenditures were found to have lower average weekly expenditures, compared to the respondents who gave the exact estimates of food expenditures ($104.75 vs. $124.99).

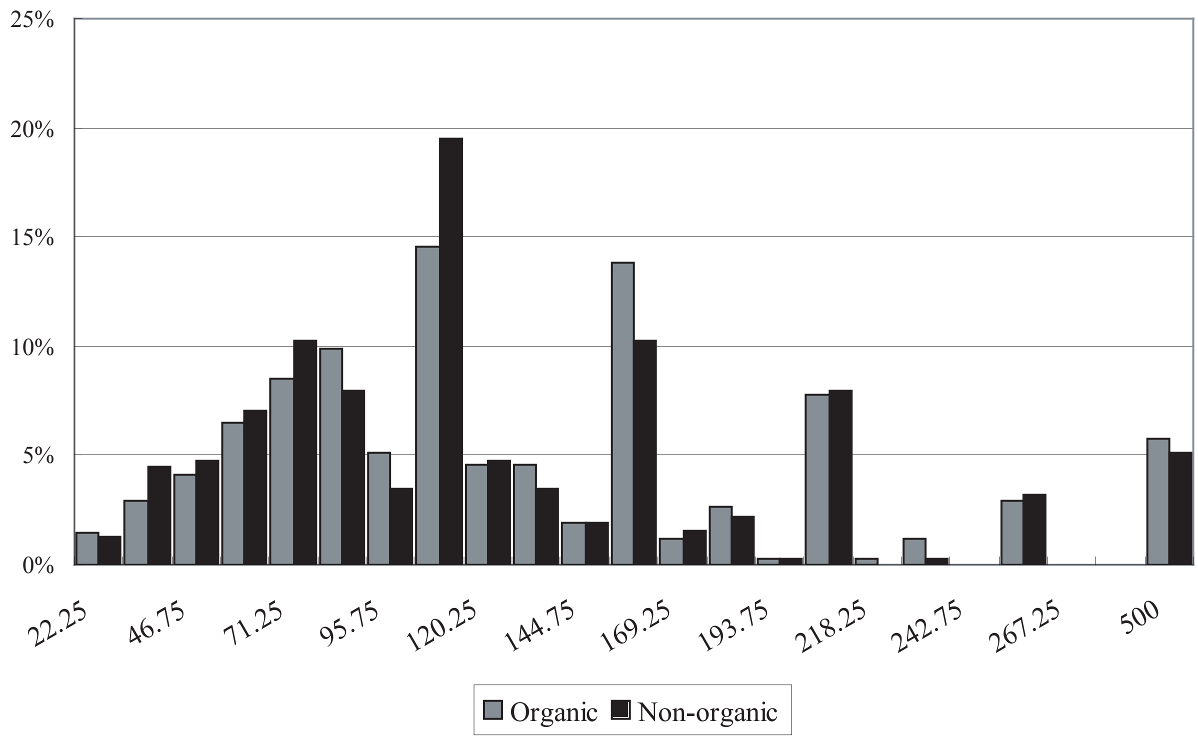

Figure 1. Distribution of Total Weekly Food Expenditures.

Note: The numbers on the x-axis represent midpoints of the ranges except for the last range, which is greater than or equal to $500.

significance.[8] This result suggests that it is desirable to use an endogenous switching regression model and that the use of classical regression methods to examine food-purchase behavior by these two types of households may not be appropriate.

Determinants of Whether to Purchase Organic Food

Table 2 shows the estimated coefficients and marginal (and discrete change) effects of the exogenous variables on the probability of the household purchasing organic foods. Income quintile was not found to significantly affect the likelihood of purchasing organic food.

Given that demographic variables are included in demand models as proxies for preferences, it is not surprising that prior studies (e.g. Blisard, Variyam, and Cromartie 2003; Govindasamy and Italia 1999; Storstad and Bjørkhaug 2003; Thompson and Kidwell 1998; Wang and Sun 2003; Zhang, Huang, and Lin 2006) had conflicting results. In this study, attitudes and behaviors are included along with demographic variables, and, not surprisingly, attitudes and behaviors appear to be better measures of preferences than do the demographic variables. Among the demographic variables, only the number of school-age children (KID17) is found significant at the 10 percent level. One additional child age six to 17 years decreases the probability of a household buying organic food by 4.2 percent. This result fits the finding of Wier and Anderson (2003), which suggested that households with older children were less likely to purchase organic foods.

Another interesting result found in this study is that household food shoppers who have no religious affiliation (NOREL) are more likely to purchase organic foods. The marginal effect of no religious affiliation increases the probability of buying

[8] With a $\chi^2_{(2)} = 60.72$, and critical value of $\chi^2_{(2),0.05}$ being 5.99; the resulting p-value is greater than 0.999.

Table 2. Estimated Parameters of the Probability of Purchasing Organic Food.

Variable	Coeff	SE	Marginal [a]
Intercept	-0.2173	0.5931	-0.0839
Economic			
INC2 [b]	0.0235	0.2228	0.0090
INC3	-0.2647	0.2219	-0.1038
INC4	-0.1785	0.2140	-0.0695
INC5	-0.1844	0.2212	-0.0718
Demographic			
AGE	0.0141	0.2157	-0.0440
AGESQ	-0.0128	0.0200	
HIGHEDU	0.1845	0.1201	0.0709
ADULT	-0.0245	0.0675	-0.0095
KID05	-0.0958	0.0981	-0.0370
KID17	-0.1097 *	0.0586	-0.0424
GENDER	-0.0299	0.1062	-0.0115
RACE	-0.1078	0.1489	-0.0412
NOREL	0.3149 **	0.1629	0.1171
Attitude and knowledge			
NUTRITION [c]	0.1533	0.1590	0.0590
SAFETY	0.1995	0.1544	0.0764
CONVEN	-0.1841	0.2455	-0.0723
ENVIR	0.2088	0.2669	0.0783
ANIMAL	0.1971	0.1871	0.0742
NUTMO	0.4068 **	0.1091	0.1586
USDA	0.4445 **	0.1202	0.1668
GMONC	0.1148	0.1168	0.0446
COOKENJ	0.2338 **	0.1037	0.0897
Behavior			
COOP	0.4536 *	0.2552	0.1626
HEALTHFS	0.8563 **	0.2093	0.2870
DIRECT	0.2192	0.1441	0.0831
VEGAN	0.5054	0.3679	0.1775

The correct prediction rates are 72.26 percent for organic and 63.18 percent for non-organic food shoppers. The log-likelihood of the endogenous switching regression model is –953.11.

* $p < 0.10$.

** $p < 0.05$.

[a] The marginal effects of dummy variables are obtained by: $\Phi(Z'\gamma, Z_i = 1)$ $\Phi(Z'\gamma, Z_i = 0)$.

[b] The income reference group is INC1.

[c] The reference group of NUTRITION, SAFETY, and CONVEN is COST.

organic foods by 11.7 percent. Religion may be related to some specific cooking and diet habits, culture, or lifestyle, and consequently may influence households' food choices. Few studies have included a religion variable, and future studies may wish to look at the relationship between religion and household diet.

The attitude and knowledge variables that are significant at the five-percent level are awareness of the USDA organic label (USDA), positive beliefs toward organic foods (NUTMO), and positive attitude toward cooking (COOKENJ), and all of these results fit our expectations of Table 1. Organic food shoppers may be more likely than conventional shoppers to be aware of the USDA organic label because they see them on the organic foods they buy. One hypothesis is that awareness of the organic label increases households' purchases of organic foods and that lack of awareness of organic foods is a factor that prevents conventional food shoppers from purchasing organic foods.[9] Moreover, even for consumers wanting to buy organic foods, the lack of awareness of the USDA organic label can increase their in-store search cost for organic foods. Belief that organic foods are more nutritious increases the probability that a household will purchase organic foods by 15.9 percent,[10] while awareness of the USDA label increases the probability by 16.7 percent and enjoyment of cooking by nine percent. The latter may reflect greater knowledge of or preferences for particular qualities of food; it may also be that households enjoy cooking because they believe it is a good way to eat healthier.

Contrary to expectations, variables related to convenience, nutrition, food safety, and environmental concerns, as well as knowledge of organic foods, are not significant in organic food purchasing behavior. The implication is that these beliefs are not tied to actual behavior and hence are not good predictors of organic food purchases. The results indicate that a household food shopper's beliefs about the most important characteristics of food may have little direct effect on organic purchasing behavior. It may be that, instead of the most important factor, the extent and ranking of different food concerns may be related to organic food purchases.

Shopping venues are significant explanatory variables for organic food purchases. Shopping at a food cooperative (COOP) increases the probability that one purchases organic foods by 16.3 percent, while shopping at a health food store (HEALTHFS) increases the probability by 28.7 percent. At first blush, one might presume that shopping venue is endogenous to the decision to buy organic food. In the past this may have been the case, as these may have been the only venues from which to purchase organic foods. While these venues may feature organic foods more prominently than do conventional stores, nearly half of all organic food sales occur in the latter (Oberholtzer, Dimitri and Greene 2005). While venue may influence the type of food purchased by reducing search cost, the data in this survey indicate that not all health food and food-cooperative shoppers are organic food shoppers; approximately 21 percent of the food-cooperative shoppers and 12 percent of the health food shoppers never buy organic foods. Nor do all organic food shoppers shop at those venues. Less than 11 percent of organic food shoppers in the sample shop at food cooperatives, compared to three percent of non-organic shoppers. The contrast is somewhat greater for health food stores, where 23 percent of organic food shoppers and only three percent of non-organic food shoppers shop. Clearly, those who shop at food cooperatives and health food stores are more likely to buy organic foods, but shopping there does not guarantee that one will buy organic foods.

Overall, the results confirm that demographic variables are poor predictors of organic shopping behavior. Attitudes and behaviors better reflect preferences and hence are better predictors. Furthermore, variables that reflect search costs and availability, such as shopping venue, are significant in predicting the probability of organic food shopping behavior.

Important Determinants of Per-Capita Food Expenditure across Organic Food Purchase Status

Table 3 presents our estimates of model parameters and marginal (discrete change) effects of per-capita food expenditures conditional on the decision to

[9] There are many ways that consumers might become aware of the label, including government promotion, in-store displays, nutrition awareness outreach programs, etc.

[10] Some recent research has shown that organic foods may indeed be more nutritious (e.g., Ellis et al. 2006) however, whether it is true or not, consumers act on beliefs.

Table 3. Endogenous Switching Results of the Food Expenditure Stage.

	Organic food shopper			Non-organic food shopper		
Variable	Coeff	SE	Marginal[a]	Coeff	SE	Marginal[b]
Intercept	3.6597**	0.2959		3.7719**	0.3431	
Economic (ref: INC1)						
INC2	0.2223**	0.1097	0.2265	0.2964**	0.1171	0.2966
INC3	0.2707**	0.1112	0.2209	0.3852**	0.1187	0.3832
INC4	0.3850**	0.1051	0.5308	0.4439**	0.1127	0.7573
INC5	0.5649**	0.1074	0.2228	0.7587**	0.1238	0.0998
Demographic						
AGE	0.2283**	0.1175	0.0210	0.1001	0.1041	-0.0230
AGESQ	-0.0210*	0.0121	-0.0123	0.0097		
HIGHEDU	0.0099	0.0603	0.0432	0.0380	0.0748	0.0395
ADULTS	-0.2019**	0.0410	-0.2064	-0.1976**	0.0343	-0.1973
KID05	-0.1638**	0.0420	-0.1813	-0.2454**	0.0530	-0.2442
KID17	-0.2133**	0.0362	-0.2333	-0.1926**	0.0340	-0.1911
RACE	-0.0062	0.0689	-0.0255	-0.0430	0.0913	-0.0438
Region (ref: NORTHEAST)						
MIDWEST	-0.0702	0.0814	-0.0702	-0.1470	0.1062	-0.1470
SOUTH	-0.0055	0.0844	-0.0055	-0.0920	0.0922	-0.0920
WEST	-0.0427	0.0764	-0.0427	-0.0422	0.1245	-0.0422
Error Variances/Correlation Coefficients						
σ_{jj}	0.5571	0.0267		0.4950	0.0194	
ρ_j	-0.5656	0.1208		-0.0227	0.2642	

σ_{jj} is the variance of conditional food expenditure equation error term defined in Equation 8; ρ_j is the correlation coefficient between σ_{jv} and σ_{jj} in Equation 8, and $\rho_j = \frac{\sigma_{jv}}{\sigma_{jj}}$. The Log-likelihood of the endogenous switching regression model is –953.11.

* $p < 0.10$.

** $p < 0.05$.

[a] The marginal effects of dummy variables are obtained by $E(F|X_i = 1, I = 1)$ $E(F|X_i = 0, I = 1)$ for organic food shoppers.

[b] The marginal effects of dummy variables are obtained by $E(F|X_i = 1, I = 0)$ $E(F|X_i = 0, I = 0)$ for non-organic food shoppers.

buy organic foods. As expected, the estimated household-income coefficients were positive in both conditional regressions. The discrete change effects were also found to be positive.

For organic food shoppers, age (AGE) significantly affects their per-capita food expenditures level, while age has no significant impact on per-capita food expenditures for conventional food shoppers. The results show that for organic food shoppers, per-capita food expenditures increase at a diminishing rate with age and will eventually decline. This is correcting for household composition, so it may reflect an age effect or a cohort effect.

Coefficients associated with household composition (ADULTS, KID17, KID05) are significant for both organic food shoppers and non-organic food shoppers. All reduce per-capita expenditures; presumably there are some economies of scale that allow per-capita expenditures to decrease with household size. The results indicate that an additional adult in the household decreases per-capita food expenditures by 20.6 percent for households that purchase organic foods and by 19.7 percent for households that do not purchase organic foods. The effect of an additional child five or under is to reduce per-capita food expenditures by 18.1 percent and 24.2 percent for organic and conventional-only food purchasers, respectively. School-age children between six and 17 decrease per-capita household food expenditures by 23.2 percent and 19.1 percent for households that purchase organic foods and those that purchase on conventional food, respectively.

Other variables, including higher education (HIGHEDU), race (RACE), and region (MIDWEST, SOUTH, WEST), are not found to be significantly related to per-capita food expenditures of organic food shoppers or non-organic food shoppers. Education and race may not be significant because they are generally correlated with income. Region is likely not significant because there is greater heterogeneity within regions than between regions.

Conclusions

Using national survey data, an endogenous switching regression model of food purchase behavior is estimated. A likelihood-ratio test indicates that such an approach is preferred over classical regression techniques when differentiating U.S. households by organic food purchase behavior.

Given the low response rate among the poor, there is a general caveat that our results may not be entirely representative of the U.S. population. However, the results suggest that the limiting factors of the organic food market are search costs, diet patterns, and awareness of the organic label. It seems that income does not directly influence households' selection of organic food purchases, but that the most important economic factor for organic food purchases is the indirect effect of search cost. One reason may be that the organic food expenditures only account for a small proportion of total food expenditures in the household. As a result, households may find the indirect (search) costs more "expensive" than the direct economic costs (price).

Increasing the available shopping venues and the availability of organic foods in conventional stores can help reduce search cost for organic foods. Increasing awareness of the organic food label may also help reduce the search cost within stores, since the label can help food shoppers distinguish organic foods from conventional foods and can build their trust in organic foods. This is consistent with Conner and Christy (2004) and Zepeda, Chang, and Leviten-Reid (2006), who find that due to consumers' misunderstanding of organic food labels, their motivation for buying organic foods is not consistent with their purchases.

Since households that buy organic foods are more likely to enjoy cooking very much, and organic produce is the largest category of organic foods and generally requires preparation, households with more cooking skills may be more likely to purchase organic foods. As a result, one could target promotion of organic foods to those interested in cooking and could provide preparation information to encourage others to try organic foods. This may also explain the growth in organic convenience foods—they may attract households interested in organic foods but who lack skills to prepare meals from raw ingredients.

Alternatively, households with positive attitudes toward cooking may be the ones who emphasize a healthier diet. Thus, positive attitudes toward cooking along with lack of religious affiliation may be related to specific diet patterns or lifestyle of a household. Future investigation clarifying the potential background of the cooking variable and lack of religious affiliation may provide details on the factors that really affect organic food purchases, and consequently may help marketers promote organic foods more efficiently.

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