The Impact of Environmental and Health Motivations on the Organic Share of Produce Purchases

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As demand and supply of organic produce has increased, it has become possible to distinguish between the many individuals that express a preference for organic and the share of their purchases that is organically produced. This study examines the share of a consumer's produce purchases that are organic, and how that is influenced by economic factors, environmental and health motivations, and demographic characteristics. Results from a model of organic preference are compared to those from a model of organic buying proportions. Buying proportion models are also estimated separately for those that preferred organic and those that preferred conventional produce. A limitation in this study is that it evaluates stated buying proportions rather than actual purchases.

Key Words: organic produce share, health, environment

The market for organic food expanded at an annual rate of 20–24 percent during the 1990s and, while estimates vary, appears to be proceeding at a similar pace currently. The rapid growth must be attributed to many factors, as both supply and demand have grown together. The development of the National Organic Program generated increased awareness of, and confidence in, organic labels, and by standardizing requirements appears to have encouraged increased supply as well as demand. The development of natural food stores in supermarket style (e.g., Whole Foods and Wild Oats) and the addition or expansion of organic sections in conventional supermarkets have improved the economy of scale in both retailing and distribution, and have provided a venue that more mainstream customers find familiar or attractive. One aspect of the natural supermarket chains is an emphasis on health; these stores frequently offer herbal and other natural (limited processing/ingredients unrefined) remedies, which coincides with a growth in consumer interest. While market research surveys have registered an association in consumers' minds between health and organic foods, and make numerous claims about the "organic" consumer, market research does not test the impact of health or environmental motivations, and economic studies have yet to fully examine them.

A model based on random utility theory is estimated to evaluate the relative strength of these motivations. In addition to health and environmental motivations, demographic and economic factors are incorporated. In contrast to existing studies of organic choice, the focus is on overall buying proportions for fresh vegetables and for fresh fruit rather than on a single product willingness-to-buy experiment or single purchase choice. The buying proportions parameter estimates are compared to those from a model predicting organic preference.

Produce was selected as the object of study because it still represents the largest fraction of organic food sales and has the longest history of availability; and as it is broadly available, it was expected to show the most variation in proportion of reported purchases by consumers.

Literature and Background

Though a number of studies covering some aspect of the organic market have been published in re-

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cent years, relatively few have looked at the individual consumer;[1] however, the large number of studies presented in academic meetings in the last two years indicates a new generation of studies underway. The existing studies generally focus on either consumer preference for or choice of organic (Huang 1996, Loureiro, McCluskey, and Mittelhammer 2001, Thompson and Kidwell 1998) or willingness to pay a premium for organic (Gil, Gracia, and Sanchez 2000, Govindasamy and Italia 1999, Loureiro and Hine 2002, Wang and Sun 2003), and generally incorporate demographic factors such as gender, income, children, residence, and education, and sometimes more specific questions about the product regarding pesticides and nutrition and consumers' prior knowledge of the alternative product.

In earlier years the main assessment about whether health and wellness or environmental motivations influenced the organic choice or willingness to pay a premium for organic regarded reported concerns about pesticides. However, results from some of these studies, as well as market research, indicate that both health and the environment are motivators for organic purchase. Economic studies have demonstrated this through results indicating that concerns about pesticides increase preference for organic (Huang 1996, Gifford and Bernard 2004). Because comparisons of organic and non-organic buyers find that organic buyers are more concerned about health and food risks (Davies, Titterington, and Cochrane 1995, Jolly 1991, Williams and Hammitt 2000) and because market research continues to find that many consumers believe that organic products are healthier (Dimitri and Greene 2002, Hartman and Wright 1999, Moore 2002) and that many believe that "they don't contain pesticides" (Barry 2002, Hollis 2001), studies that identify consumer concerns about pesticide use are relevant to the study of organic foods.

In addition, a positive willingness to pay a premium for reduced pesticides, pesticide-residue–free produce, or integrated pest management (IPM) has been found in many studies (Boccaletti and Michele 2000, Buzby and Skees 1994, Byrne, Bacon, and Toensmeyer 1994, Byrne, Gempesaw, and Toensmeyer 1991, Eom 1994, Govindasamy, Italia, and Adelaja 2001, Misra, Huang, and Ott 1991, Ott 1990). These findings, along with the misperceptions of consumers about pesticide use in organic production, may impact the market for organic products, because organic standards do allow the use of non-synthetic pesticides.

More broadly, a health motivation for organic is in conflict with the National Organic Standards final rules' restriction on the association of healthfulness with organic in marketing organic products, specifically that "Handlers may not qualify or modify the term ... 'organic,' using adjectives such as ... 'pure' or 'healthy,' e.g., 'pure organic beef" or 'healthy organic celery' " (U.S. Department of Agriculture 2000, p. 125). Currently, those marketing organic foods do not seem to be making direct health claims—but instances can be found where they quote consumers that do it for them. What will consumers do when they learn more about organic production? To understand this, it is important to examine the influence of health and other motivations for buying organic such as environmental protection.

Recently, analysts examining eco-labels have tried to take a more general approach to studying the impact of environmental motivations by using a series of questions to elicit the strength of those motivations (Johnston et al. 2001) or using questions that incorporate the trade-off between decreasing environmental or health risk and lower food costs (McCluskey et al. 2003). A survey of Spanish consumers (Gil, Gracia, and Sanchez 2000) examined willingness to pay for organic by consumer segment (likely consumers, current organic food consumers, and unlikely consumers), assigning consumers to the segments using factors developed from a principal components analysis. The principal components analysis was based on a series of questions that covered lifestyle with respect to food and health, environmental conservation and environmental damage concerns, and attitudes and belief regarding organic food.

The association of organic buying with both environmentally motivated and/or health-motivated consumers found by market research has not been comprehensively examined by economic analysis. In this study, an approach similar to that adopted to examine environmental concerns with respect to preference for eco-labeled seafood (Johnston et al. 2001) is employed to examine the

[1] A more thorough review of the available literature, which includes a large number of papers published in non-economic journals that were not cited here, was published last year (Yiridoe, Bonti-Ankomah, and Martin 2005).

extent to which both health and environmental concerns influence the choice of organic. This method and the source of the environmental and health questions utilized are discussed following the development of the model.

Discrete Choice Model

In modeling consumers' discrete choice decisions, random utility is generally posited as the underlying framework. Underlying random utility theory is the idea that consumers choose the alternative that provides the greatest utility to them. Important in this study, the theory accommodates both heterogeneity of preferences and variations in personal choice, where some of the variation in the individual choice is expected to be random and some systematic. In this particular study the preference to buy organic or conventional fruits or vegetables can be modeled by first describing the utility (U) from the organic choice as $U_o = \beta'_o \mathbf{x} + \varepsilon_o$ and from the conventional choice as $U_c = \beta'_c \mathbf{x} + \varepsilon_c$, where ε_c and ε_o are random components of the individual's utility, $\mathbf{x}$ is a vector of attributes of the consumer that are measurable, and $\beta_{i=c,o}$ is a vector that maps those attributes to the utility of that choice. If the organic product is chosen, it indicates that $U_o > U_c$ and therefore that $\varepsilon_c - \varepsilon_o < \beta'_o \mathbf{x} - \beta'_c \mathbf{x}$. Creating $\varepsilon = \varepsilon_c - \varepsilon_o$ and $\beta'\mathbf{x} = \beta'_o \mathbf{x} - \beta'_c \mathbf{x}$ sets up a framework where a binary choice is treated as the probability that $\varepsilon \leq \beta'\mathbf{x}$. To operationalize this framework a latent variable approach is devised. Under this framework, y, the observed binary decision represented by 0 or 1, relates to the latent variable $y^* = \beta'\mathbf{x} + \varepsilon$, and when $y^* > 0$, $y = 1$, and when $y^* \leq 0$, $y = 0$. Given a suitable functional form, the probability that the dependent variable equals one can be estimated as a function of $\mathbf{x}$. For this purpose a cumulative distribution function (CDF) is suitable; the most commonly used in binary choice analysis are those of the normal (probit) and logistic (logit) distribution.

For the analyses of organic buying share, this framework is being used to look at repeated buying decisions, as measured by the reported organic fraction of produce purchases in the survey, rather than at a single buying decision. Therefore the dependent variable is measuring many decisions to buy organic or conventional produce and averaging over those purchases. The strength of a consumer's motivations for buying organic, versus the perceived or real disadvantages of doing so, will determine how often consumers seek out and buy organic products rather than conventional, and thus how large a fraction of their purchases will be organic.

Though fractional dependent variable models are rarely estimated using the logit or probit models commonly used for binary choice in the economic literature, the probit model was originally developed to estimate a fractional response for dose-response measurement in biology. Comparisons of functional forms for fractional model estimation have indicted that the quasi-likelihood probit for fractional variables proposed by Papke and Wooldridge (1996) was suitable and an improvement over the alternatives (Wagner 2003).

The object of this study is an individual making a discrete choice between organic and conventional produce repeatedly, and the dependent variable aggregates or groups across those choices. Aggregating across multiple decisions of a single unit instead of single decisions by a group of individuals is the same for econometric purposes. A number of software packages now incorporate a fractional response in their non-linear estimators. Limdep 8.0 (Greene 2003) software allows for fractional dependent variables using a number of non-linear CDFs. As suggested by Papke and Wooldridge (1996), these maximize the Bernoulli log-likelihood function,

$$(1)\quad \text{Max}_\beta L = y_i \ln [G(\beta'\mathbf{x})] - (1-y_i) \ln [1 - G(\beta'\mathbf{x})],$$

where y_i is the fractional dependent variable and $G(\cdot)$ is the cumulative distribution function utilized. This process produces consistent parameter estimates; but under possible misspecification regarding the distribution, such as unspecified heteroskedasticity, an incorrect choice of CDF, omitted variables, and so forth, standard error estimates will not be consistent. The asymptotic variance of β is achieved by use of the sandwich estimator (White 1982).

Survey

The survey instrument was designed in a web-based format and pre-tested with students from three undergraduate classes. The students could earn points for extra credit by taking the survey, and each was assigned a code to enter which identified who took the survey. The survey was modified in response to the results, and adopted for use on touch-screen tablet personal computers so that, despite a large number of questions, it could be taken efficiently at market locations. This procedure was also efficient for analysis because data was directly loaded into a file that could readily be imported into a spreadsheet. Though the survey technically contained 31 questions, 7 had multiple parts with the potential for 60 additional pieces of information collected.[2] Based on the student test, consumers were informed that the survey took about 15 minutes. As an inducement to take the survey, participants were offered a $5 certificate to shop at the test location. The novelty of the touch-screen tablet personal computers attracted some individuals for whom the $5 certificate may have been less of an incentive to take the survey.

Survey locations were chosen in such a way to ensure that the population studied incorporated sufficient variation in the variables expected to explain the organic choice without requiring an extremely large sample. Rather than sorting consumers by their organic preference and drawing a higher proportion of those that preferred organic, this variation was accomplished by selecting survey sites that allowed individuals to purchase organic and conventional produce. The locations chosen were a conventional supermarket, a farmers market, and a cooperative in the Portland, Oregon, metropolitan area. One hundred surveys were taken at each location.

Obviously this was not a purely random sample. Literature on sample design supports alternatives to random sampling to reduce costs of data collection if estimator efficiency can be improved. The critical aspect of the procedure is whether the sample is selected based on an endogenous or exogenous variable. The endogenous selection process is termed *choice based* and the exogenous process *stratified* or sometimes *exogenously stratified* (Manski and McFadden 1981).[3] In stratification, a population is broken into groups on the basis of one or more exogenous characteristics, and a random sample is drawn from each group. The aim is to get more variation in the exogenous variables than would be drawn at random from a limited sample, thus reducing the variance of the estimators for a given sample size.

In this study, the sample is stratified based on shopping location. If the choice of shopping location were endogenous this would introduce other difficulties. However, earlier work on the organic shopper (Thompson and Kidwell 1998) found that while selection of organic produce was an influence on choice of shopping location, shopping location was at least weakly exogenous to the choice of organic. Tests of endogeneity for this study, discussed below, also accept weak exogeneity for shopping location.

To model organic preferences and buying behavior, the survey collected information about organic preferences and purchasing levels, consumer demographic characteristics, shopping habits, and consumer rating of characteristics that influence their produce choices (such as seasonality, price, and appearance). In addition it contained numerous questions to rate an individual's environmental and health and wellness concerns. These measures are discussed in the next section.

The survey began with general shopping questions, continued with the central questions for the dependent and explanatory variables of the analysis, and finished with demographic questions. As shown in Figure 1, the principal demographic variables are well dispersed across age and income, but 65 percent of those surveyed had at least a 4-year college degree. Eighty-four percent of those surveyed indicated that they were the primary shopper, and 62 percent were female. The questions used in the analysis are discussed in the following sections, and means, standard deviations, minimums, maximums, and variable definitions and transformations for all of the model variables are reported in Table 1.

Eliciting Environmental and Health Behaviors

The individual's level of environmental and health consciousness was elicited through a series of questions developed in two studies. One of these focused on segmenting consumers for "green" orientation (Roberts 1996) and the other looked at

[2] Due to its length the entire survey is not presented, but is available from the authors.

[3] Using the classic travel choice model as an example, Cosslett (1981) suggests that a stratified sample might select more suburban residents than city center residents.

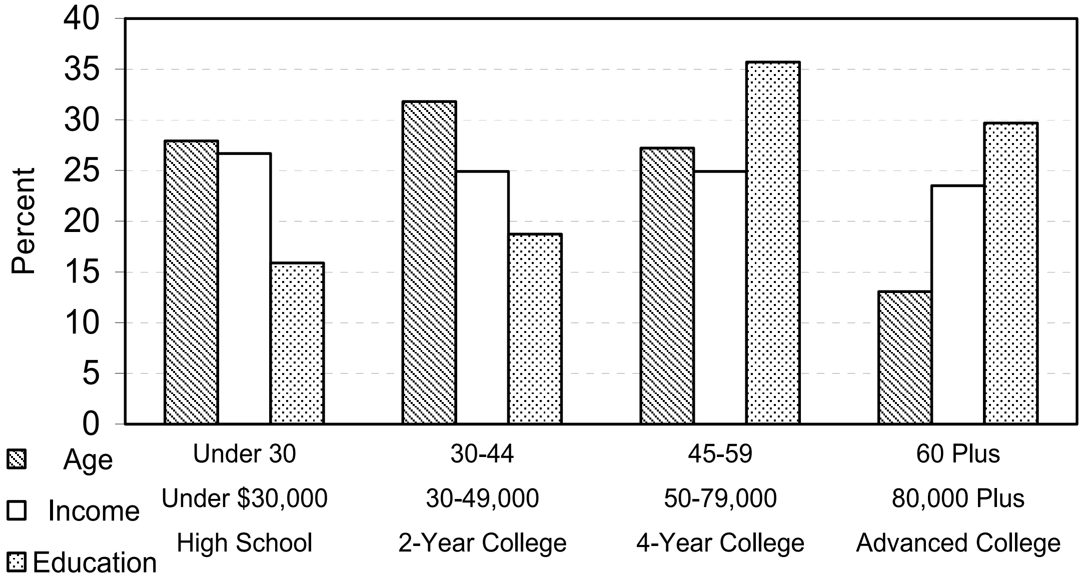

Figure 1. Chart of Population Characteristics

consumers' "wellness" orientation (Kraft and Goodell 1993). Both studies used Likert type 5-point scale questions, with the true question scale being "always true," "mostly true," "sometimes true," "rarely true," and "never true." The scale for the agree question is "strongly agree," "agree," "neither agree nor disagree," "disagree," and "strongly disagree." The Kraft and Goodell study used factor analysis to organize responses to questions about individuals' health and wellness beliefs and behaviors into a set of factors covering specific aspects of health orientation. The Roberts study used factor analysis on 30 questions on consumer behaviors related to environmental considerations and identified two factors. These two studies are the primary basis for the questions used in this survey. A group of questions based on Roberts' work has already been used in a study measuring preferences for eco-labeled seafood (Johnston et al. 2001).

In this analysis, as in the seafood study, some of the "green" orientation questions are combined or generalized. The questions used produced the same factors as they did in the original work by Roberts with similar contributions. The close correspondence between factors produced in this study population and those from the "wellness" study, the "green consumer" study, and the Johnston et al. study, indicates the suitability of these questions for evaluating consumer beliefs across multiple populations.

The rotated factor matrix and set of questions used to generate the environmental factors are shown in Table 2. As in Roberts' work, statements that contribute highly to the first of the environmentally oriented factors, *environmentally conscious consumer behavior* (*EECCB*), are "I have switched products for environmental reasons," "I have convinced members of my family or friends not to buy some products that are harmful to the environment," and "I will not buy from a company if it is ecologically irresponsible." The second environmental factor is *energy conservation and recycling behavior* (*EECRB*). The statement that contributes most highly to this factor is "I buy energy efficient light bulbs for my household."

The rotated factor matrix for the health and wellness series of questions is shown in Table 3. Though using only 13 of the original questions used by Kraft and Goodell (1993) to identify the health-conscious consumer, the same four factors are produced, and the relative contribution of questions to each factor is quite similar. Kraft and Goodell described these as the following: personal health self-responsibility, nutrition and stress management, physical fitness, and health environment sensitivity. Among the health and wellness questions, one factor that seems likely to affect

Table 1. Variable Statistics and Definitions

Name	Definitions	Mean	Std. Dev.	Min.	Max.	N
PRIMARY	Primary shopper = 1	0.84	0.37	0	1	237
FEMALE	Female = 1	0.62	0.49	0	1	237
AGE	From 5-year age ranges between 18–24 and > 70 (assumed 72)	39.5	14	21	72	237
KIDS	Children at home, 1 = yes	0.24	0.43	0	1	237
EDUCAT	1 is high school or less, 2 = 2-year college or technical degree, 3 = 4-year college, 4 = post graduate	2.73	1.05	1	4	237
INCOMET	In $10,000-range midpoints from less than $20,000 (assigned 1.5) to greater than $100,000 (assigned 12)	5.62	3.55	1.5	12	237
EECCB	Environmentally conscious consumer behavior factor score	-0.01	1.02	-3.0	2.0	237
EECRB	Energy conservation and recycling behavior factor score	0.01	1.00	-3.1	2.3	237
HNUTRITI	Nutrition / ingredients factor score	-0.01	0.99	-3.9	2.2	237
HHESENS	Health environmental sensitivity factor score	0.03	0.99	-4.0	2.0	237
HFITNESS	Fitness factor score	-0.02	1.00	-2.9	2.1	237
HPHRESP	Personal health responsibility factor (high score is low responsibility)	-0.05	0.98	-1.4	3.4	237
IMPRICE	Price: 1 = not important, 2 = moderately important, 3 = very important	2.38	0.60	1	3	237
IMAPPEAR	Product appearance: 1 = not important, 2 = moderately important, 3 = very important	2.51	0.58	1	3	237
STORE2	1 = survey taken at conventional supermarket, 0 = other	0.30	0.46	0	1	237
STORE3	1 = survey taken at cooperative, 0 = other	0.34	0.47	0	1	237
Model	Dependent Variables					
Fruit preference	1 = prefers to buy organic fruit, 0 = prefers to buy conventional fruit	0.62	0.49	0	1	237
Veg. preference	1 = prefers to buy organic vegetables, 0 = prefers to buy conventional vegetables	0.63	0.48	0	1	237
Org. fruit fraction	0 = 0%, 0.055 = 5–10%,……, 0.855 = 81–90%, 0.9525 = 91–100%	0.45	0.36	0	0.95	236
Org. veg. fraction	0 = 0%, 0.055 = 5–10%,……, 0.855 = 81–90%, 0.9525 = 91–100%	0.45	0.37	0	0.95	236

organic choice based on market research studies draws highly on questions such as "I'm concerned about my drinking water quality," and "I worry that there are harmful chemicals in my food." This factor was denoted "health environment sensitivity" in the Kraft and Goodell study.

A high rating of questions such as "It is the doctor's job to keep me well" and "My health is outside my control" produces a high ranking on the factor designated as *personal health responsibility* (*HPHRESP*). Thus, this factor is hypothesized to have a negative effect on organic preference and purchases. Other groups were found that could be described as *nutrition management behavior* (*HNUTRITI*)[4] and *physical fitness activity* (*HFITNESS*).

[4] One interesting change occurred in the factors produced. In the Kraft and Goodell (1993) study, the statement "I avoid foods containing nitrites or preservatives" loaded into the *health environmental sensitivity* factor. In this study, the same statement loaded most highly into the *nutrition* factor score. Thus, interpretation of the factor related to nutrition is altered. Rather than considering this factor as "Nutrition and Stress Management," as Kraft and Goodell did, it now seems better to consider it as reflecting interest in food ingredients as well as nutrition (*HNUTRITI*), with stress no longer of great significance.

Table 2. Rotated Component Matrix (Environmental Factors)

Questions	Component 1	Component 2	Factor
I have switched products for environmental reasons.	0.831	0.279	Environmentally conscious consumer behavior
I have convinced family/friends not to buy environmentally harmful goods.	0.817	0.205	
I will not buy from a company if it is ecologically irresponsible.	0.808	0.101	
I have purchased products because they cause less pollution.	0.799	0.338	
I do not buy household products that harm the environment.	0.756	0.356	
I try to buy only products that can be recycled.	0.714	0.426	
I buy energy efficient light bulbs for my household.	0.032	0.827	Energy conservation and recycling behavior
I purchase recycled paper.	0.482	0.639	
I have tried very hard to reduce the amount of electricity I use.	0.281	0.599	
I recycle paper, cans or bottles.	0.290	0.560	

Extraction method: Principal component analysis.
Rotation method: Varimax with Kaiser normalization. Rotation converged in 3 iterations.

All questions are on a 5-point scale: always true, mostly true, sometimes true, rarely true, never true

Table 3. Rotated Component Matrix (Health Factors)

Questions	Type*	Component 1	Component 2	Component 3	Component 4	Factor
My daily diet is nutritionally balanced.	T	0.827	0.043	-0.082	0.163	Nutrition / ingredients
I am interested in information about my health.	T	0.671	0.396	-0.152	-0.108	
I avoid foods containing nitrites or preservatives.	T	0.660	0.293	-0.021	0.027	
I try to avoid stressful situations.	T	0.508	0.027	0.151	0.334	
I try to avoid high levels of cholesterol in my diet.	A	0.464	0.319	0.170	0.191	
I'm concerned about my drinking water quality.	A	0.008	0.822	0.084	0.112	Health environmental sensitivity
I worry that there are harmful chemicals in my food.	A	0.255	0.805	0.020	-0.034	
Good health takes active participation on my part.	A	0.319	0.510	-0.113	0.204	
I read more health related articles than I did 3 years ago.	A	0.374	0.472	0.009	0.228	
My health is outside my control.	A	-0.018	-0.016	0.868	-0.011	Personal health responsibility
It is the doctor's job to keep me well.	A	0.000	0.046	0.846	0.063	
I exercise more than I did 3 years ago.	T	-0.021	0.177	0.112	0.856	Fitness
I try to exercise at least 30 min./day, 3 days a week.	T	0.374	0.066	-0.094	0.721	

Extraction method: Principal Component Analysis.
Rotation method: Varimax with Kaiser normalization. Rotation converged in 3 iterations.

All questions are on a 5-point scale. T type responses are the following: always true, mostly true, sometimes true, rarely true, never true. A type responses are the following: strongly agree, agree, neither agree nor disagree, disagree, strongly disagree.

Except for the *personal health responsibility* factor (*HPHRESP*), whose questions are posed in negative terms, the individual placement along the scale of each of these groupings was expected to have either no effect on organic preferences and purchasing or a positive effect. For example, if you usually made product choices for environmental reasons, you might be motivated to buy organic rather than conventional produce. Similarly, if you are concerned about chemicals in food, you might choose to buy organic for health reasons.

The second factor derived from the environmental series—*energy conservation and recycling behavior* (*EECRB*)—seems unlikely to be related to organic food choices, as was also found in the Johnston et al. (2001) study of seafood eco-labels. The fitness factor score also seems unlikely to directly influence the organic choice. Nevertheless, all six of the factors produced are included in the analysis to test the possibility and to help evaluate the reliability and reasonableness of the factor scores.

Other Variables Used in the Analysis

As noted earlier, Table 1 reports the definitions, transformations, and statistics for all model variables. These are calculated for observations for which all of the questions contributing to the fractional organic vegetable model variables are present. The largest number of dropped observations is due to one or more missing answers to the groups of questions used to develop the factor scores. The demographic factors included in the models include gender, income, having children in the household, educational level, and a variable for whether the respondent was the primary household shopper. In the models presented, the education and income variables are entered in their simplest form—e.g., income and education are treated as linear variables—rather than entered as a number of different dummy variables for different income levels or educational attainments. However, alternative forms were examined, and the utilized linear variables appear to represent the relationship between the dependent variable and these two explanatory factors reasonably well, with no evident improvement in significance or explanatory power over more complicated utilization of the information.

Survey participants were also asked how important various attributes of produce were to them. "How important are each one of the following attributes when buying fruits or vegetables—rate your answers from 'very important' to 'not important.' " This was a 3-point scale with a middle choice of "moderately important." For examination of organic choice, the relevant attributes to include in the models were price (*IMPRICE*) and product appearance (*IMAPPEAR*). Price is obviously a critical variable to include, as organic produce is generally more expensive than conventionally produced produce. Appearance is also important because organic produce is often different in size and can exhibit more cosmetic defects.

The models also include variables for the location where the survey was taken. Location variables are included to ensure that non-random consumer differences associated with shopping location choice are incorporated. The potential endogeneity of the location variables must be considered. In the Thompson and Kidwell (1998) study mentioned earlier, it was pointed out that the choices of organic and shopping location may be intertwined. In this study, because respondents have indicated that they shop for produce in numerous locations, it is not possible to adequately examine the choice of shopping location and organic selection simultaneously; however, the endogeneity can be tested. An examination of the data indicates that store endogeneity is unlikely to be an issue. All three venues carried both conventional and organic products, and the respondents surveyed at the farmers market and the cooperative indicated that they regularly shopped at conventional supermarkets (94 percent and 43 percent of respondents at those locations, respectively) and/or at natural food stores (43 percent and 57 percent). Even at the supermarket, 75 percent of shoppers indicated regular shopping at a farmers market. Thus the local population has adequate opportunity to buy either organic or conventional produce by selecting locations that allow for it. Our expectation is therefore that the location variables are not endogenous and will not produce endogeneity bias. However, this can be readily tested (Rivers and Vuong 1988, Smith 1987). The results of these tests are discussed below.

The dependent variables are based on two sets of questions. The preference dependent variable is based on questions that asked respondents to specify "what type of products you *usually prefer* when buying the following products." The possible choices were "conventional," "organic," "other eco-label," and "don't buy." The purchase question was "What percentage of your fresh fruit purchases is organic?" The possible answers were 0 percent, 1–10 percent, 11–20 percent, 21–30 percent, 31–40 percent, 41–50 percent, 51–60 percent, 61–70 percent, 71–80 percent, 81–90 percent, and 91–100 percent. For estimation, the fraction assigned is the midpoint of the range.

It should be noted that, despite the similarities between means and standard deviations for the dependent variables, there are differences between individuals' answers to both the fruit and vegetable questions, with swapping in both directions, particularly in the buying percentage models. Therefore, results are presented for both fruits and vegetables.

Estimated Models

A binary choice model is estimated to examine both the fresh fruit and vegetable organic versus conventional preferences. The model for the fraction of produce purchases that is organic was estimated in three ways: first using the entire sample of respondents, and then using sub-samples based on whether the respondent indicated preferring organic or conventional produce. The "prefer conventional" model in particular uncovers some interesting information that would not otherwise have been discovered.

Model Findings and Discussion

Goodness-of-Fit and Model Tests

Binary choice models are generally evaluated based on the log-likelihood function achieved measured against the restricted log-likelihood function (all slopes equal to zero), whether directly or in some calculated statistic, and by the accuracy of their predictions. By such measures the preference and the buying percentage models perform remarkably well. The log-likelihood gain in all of the models is significant. For the preference models, the commonly reported likelihood based McFadden R^2 is above 0.40 for both models. An earlier study of organic choice (Huang 1996) reported a Psuedo R^2 of 0.21 for organic preference as compared to a Psuedo R^2 of 0.681 for the organic fruit preference model, and 0.719 for the vegetable preference model in this study. More than 80 percent of observations are correctly predicted for both models.

While there are no comparable results for examining overall buying levels, it is interesting to consider the fit of the fractional models with and without the demographic variables. A version of the Akaike Information Criteria (AIC) recommended for quasi-likelihood regression models, the AIC_c, was developed by McQuarrie and Tsai (1998) (cited in Kieschnick and McCullough 2003). In the McQuarrie and Tsai version the AIC is calculated as the natural logarithm of the mean square error (MSE) of the regression plus the sum of the sample size (n) and the number of coefficients (k), divided by $n - k - 2$, or ln (MSE) + $(n + k)/(n - k - 2)$, which declines as the MSE declines; thus, a better fit is a lower number adjusted for the number of explanatory variables. This statistic provides a useful way to compare alternate sets of the explanatory variables. The AIC_c for the fractional fruit model is -0.1396 for the full set of explanatory variables, -0.1752 for the full set except for the demographic variables, and -0.0322 for the full set except for the factor scores. These results demonstrate that the demographic variables are adding little to the explanatory power of the model, though some are significant (note that though the MSE is higher with the demographic variables, the AIC_c is lower without them).

For fractional models, authors sometimes report an R^2 or evaluate the change in the log-likelihoods using a χ^2 test. Another approach would be to examine the prediction success for the fractional ranges in a way similar to what is done for binary models, by looking at the percentage of predictions that fall into the actual range reported rather than the number of correctly predicted zeros and ones. Thus, if the reported proportion was 31–40 percent and the fitted value was greater than or equal to 0.305 and less than 0.405, the prediction is considered in range. Because meeting a 10 percent range prediction is a fairly rigorous requirement, the number of predictions that fall into the next adjacent range is also calculated. The adjacent range would incorporate observations where the absolute value of the residuals is greater than 0.05 and less than or equal to 0.15. All of these goodness-of-fit measures are reported in Tables 4 and 5 for the fractional models. Prediction success is reported as "% predicted in range" and "% predicted in adjacent range." For fresh vegetable fractions, 30.1 percent of predictions fell in the range indicated by the individual surveyed, and another 28.8 percent fell within the adjacent range; for fresh fruit the percentages are 25.8 and 30.1.

A diagnostic measure adopted by Greene (2002), based on a binary measure goodness-of-fit measure by Hosmer and Lemeshow (2000) but well-suited to examining share or fractional data, is also reported. To calculate the measure, the fitted values, in this case the predicted share of purchases, are sorted in ascending order (along with their associated observed value, y_i) and then divided into 10 approximately equally sized groups, allowing comparison between the fitted and observed fractions by subgroup. $\bar{y}_j$ is the mean of the actual values in the subgroup, and $\bar{F}_j$ is the mean of the fitted values, F_i, in the subgroup j:

$$\text{(2)} \qquad \text{H-L} = \Sigma_j n_j [(\bar{y}_j - \bar{F}_j)^2 / \bar{F}_j (1 - \bar{F}_j)].$$

The breakdown by group and multiplication by each n_j allows the fit along the fractional path to be included in the model assessment. A low score indicates better fit, and the measure has a limiting χ^2 distribution with $J - 2$ degrees of freedom. The H-L values are quite low (high probability value) for all six fractional dependent variable models, indicating a good correspondence between actual and fitted values of the dependent variable.

A further consideration is which non-linear functional form of the discrete choice model to select. A number of functional forms have been introduced for binary choice models, the two most commonly used being probit and logit; in most circumstances there is little difference between results from these two models (Greene 2003, p. 667). Two non-nested tests for functional form—the BRMR (Davidson and MacKinnon 1993) and the method suggested by Silva (2001) (as cited in Greene 2003)—were applied. Neither set of tests rejected the alternate model. For simplicity all models reported are estimated using probit.

The exogeneity tests for location variables accept weak exogeneity, as the χ^2 statistics are 2.432 and 4.168 for the two preference models (vegetables and fruit) and 0.681 and 0.5482 for the buying percentage models respectively. These are all below the critical value of 5.99 for two restrictions for a probability level of 0.95. Thompson and Kidwell (1998) also found that though the selection of organic is not exogenous to location choice, location choice is weakly exogenous to organic selection. This is probably due to the fact that nearly all shoppers shop in multiple types of stores.

Tables 4 and 5 present the parameter estimates, their robust (sandwich estimator) standard errors, and the calculated marginal effects computed at the mean of the explanatory variables. Goodness-of-fit results are also in these tables. For the preference model, the marginal effect is a change in the probability that organic is preferred; for the buying proportions model this is the change in the fraction purchased.

For dummy variables (*PRIMARY*, *FEMALE*, *KIDS*, *STORE2*, *STORE3*), the reported marginal effect is for the change in probability when the dummy variable goes from 0 to 1 rather than from its mean.[5] The factor scores are normalized to have a mean of zero and a standard error of one, and though with some loss in observations due to other missing variables these are no longer exactly zero and one, the means and standard errors are close enough so that comparison of the influences of various factor scores through their marginal effects can be compared directly.

Given the results shown in Tables 4 and 5, it is obvious that the most consistently influential factor score in the models is the one representing environmentally conscious consumer behavior (*EECCB*). In second place is the factor score that associates health with environmental factors, *HHESENS* ("I worry that there are harmful chemicals in my food," "I'm concerned about my drinking water quality"). In the preference models the amounts of influence that *HHESENS* and *EECCB* have are quite similar. However, the health factor

[5] The effect is calculated as the difference between the cumulative distribution function, $G(\beta'\mathbf{X})$, calculated with the dummy variable set equal to one, and cumulative distribution function calculated with the dummy variable equal to zero, with all other variables set at their means.

Table 4. Fruit Preference and Buying Proportions Models

	Preference Model (N = 237), *Proportion Ones = 62.86%*				Buying Proportions Model (N = 236)			
	Coeff.	St. Error	Marginal	St. Error	Coeff.	St. Error	Marginal	St. Error
Constant	3.4709	0.9224***			1.1430	0.3724***		
PRIMARY	-0.3017	0.3079	-0.1015	0.0972	-0.4195	0.1634***	-0.1660	0.0642***
FEMALE	0.0674	0.2216	0.0241	0.0793	-0.0598	0.1139	-0.0235	0.0448
AGE	-0.0191	0.0080***	-0.0068	0.0028***	-0.0089	0.0040***	-0.0035	0.0016***
KIDS	-0.1106	0.2400	-0.0399	0.0873	-0.0022	0.1210	-0.0009	0.0475
EDUCAT	-0.1470	0.1316	-0.0523	0.0469	-0.0798	0.0619	-0.0313	0.0243
INCOMET	0.0086	0.0368	0.0030	0.0131	-0.0006	0.0188	-0.0002	0.0074
EECCB	0.4485	0.1376***	0.1595	0.0489***	0.3992	0.0712***	0.1566	0.0281***
EECRB	-0.0349	0.1058	-0.0124	0.0377	0.0217	0.0542	0.0085	0.0213
HNUTRITI	0.1047	0.1335	0.0372	0.0477	0.0726	0.0776	0.0285	0.0304
HHESENS	0.3848	0.1192***	0.1369	0.0429***	0.2237	0.0624***	0.0877	0.0244***
HFITNESS	0.0198	0.1075	0.0070	0.0383	-0.0084	0.0585	-0.0033	0.0230
HPHRESP	-0.0346	0.1014	-0.0123	0.0360	-0.0961	0.0531**	-0.0377	0.0209**
IMPRICE	-0.4009	0.1787***	-0.1426	0.0634***	-0.2346	0.0985***	-0.0920	0.0386***
IMAPPEAR	-0.1932	0.2027	-0.0687	0.0722	0.0984	0.0931	0.0386	0.0366
STORE2	-1.2424	0.2600***	-0.4544	0.0901***	-0.7928	0.1428***	-0.2913	0.0475***
STORE3	0.4813	0.3025*	0.1633	0.0951**	0.5046	0.1327***	0.1982	0.0514***

Log likelihood function	-91.39	Log likelihood function	-120.54
Restricted log likelihood	-156.34	Restricted log likelihood	-162.53
McFadden R^2	0.415	% predicted in range	0.258
Percentage correctly predicted	0.819	% predicted adjacent range	0.301
Percentage 1's correctly predicted	0.840	Hosmer-Lemeshow Chi-square	1.8963
Percentage 0's correctly predicted	0.778	H-L probability value (8)	0.984

Notes: Marginal effects for dummy variables are $P|x = 1 - P|x = 0$. One asterisk indicates statistically significant at the 0.15 level, two asterisks indicates statistically significant at the 0.10 level, and three asterisks indicates statistically significant at the 0.05 level.

definitely has a smaller impact on the organic share of purchases.

The difference in contribution is made more clear in Tables 6 and 7, where separate analyses are displayed for those who indicated preferences for organic, and those who indicated preferences for conventional produce. The relative impact of *EECCB* is much greater for those that preferred organic. Those that indicated a preference for conventional produce unsurprisingly were not highly affected by either factor, and the effects are nearly equal. However, because the "prefer organic" and "prefer conventional" subsets have different average values for the explanatory variables, it is important to compare the marginal effects by looking at their predicted proportion of organic buying, as it varies with the level of these two critical factor scores. Figure 2 shows the expected fraction of organic purchase, as the factor scores vary throughout the range observed in the data using the fruit model. The top two lines show the results for those that prefer organic and the bottom two show the results for those that prefer conventional using the parameter estimates from Tables 5 and 6. The higher set of lines demonstrates the "prefer organic" group's higher overall buying level, as well as different mean values for the other variables; the slopes of the lines in Figure 2 represent the marginal effects at any base level of the factor score. The steeper slope of *EECCB* for the "prefer" subset is steeper than *HHENS* at all points in the observed factor score range, but there is no appreciable difference between the environmental and health motivation variables for the group that prefers conventional produce.

Recalling that a high factor score for *HPHRESP* indicates low personal health responsibility, we

Table 5. Vegetable Preference and Buying Proportions Model

	Preference Model (N = 237), *Proportion Ones = 62.4%*				Buying Proportions Model (N = 236)			
	Coeff.	St. Error	Marginal	St. Error	Coeff.	St. Error	Marginal	St. Error
Constant	4.4688	0.9749***			1.2533	0.3891***		
PRIMARY	-0.1963	0.3271	-0.0672	0.1078	-0.3568	0.1651***	-0.1412	0.0653***
FEMALE	-0.1261	0.2364	-0.0444	0.0825	-0.0497	0.1177	-0.0195	0.0462
AGE	-0.0234	0.0077***	-0.0083	0.0027***	-0.0083	0.0041***	-0.0033	0.0016***
KIDS	-0.2713	0.2638	-0.0990	0.0984	0.0110	0.1229	0.0043	0.0482
EDUCAT	-0.1296	0.1430	-0.0459	0.0507	-0.1048	0.0589**	-0.0410	0.0231**
INCOMET	-0.0040	0.0373	-0.0014	0.0132	0.0092	0.0190	0.0036	0.0074
EECCB	0.4225	0.1374***	0.1498	0.0487***	0.4230	0.0700***	0.1657	0.0277***
EECRB	-0.0268	0.1099	-0.0095	0.0390	0.0259	0.0551	0.0102	0.0216
HNUTRITI	0.1826	0.1487	0.0648	0.0537	0.0482	0.0808	0.0189	0.0316
HHESENS	0.4533	0.1344***	0.1607	0.0488***	0.2742	0.0645***	0.1074	0.0250***
HFITNESS	0.0790	0.1127	0.0280	0.0399	-0.0323	0.0630	-0.0126	0.0247
HPHRESP	0.0109	0.1015	0.0039	0.0360	-0.1644	0.0542***	-0.0644	0.0214***
IMPRICE	-0.6048	0.1867***	-0.2144	0.0666***	-0.2979	0.0984***	-0.1167	0.0384***
IMAPPEAR	-0.2711	0.2081	-0.0961	0.0743	0.0772	0.0947	0.0302	0.0371
STORE2	-1.3707	0.2799***	-0.4974	0.0932***	-0.7947	0.1390***	-0.2911	0.0460***
STORE3	0.4394	0.3056	0.1493	0.0970*	0.5231	0.1386***	0.2051	0.0536***
Log likelihood function			-84.93		Log likelihood function		-116.76	
Restricted log likelihood			-156.85		Restricted log likelihood		-162.51	
McFadden R^2			0.459		% predicted in range		0.301	
Percentage correctly predicted			0.835		% predicted adjacent range		0.288	
Percentage 1's correctly predicted			0.847		Hosmer-Lemeshow Chi-square		0.88623	
Percentage 0's correctly predicted			0.813		H-L probability value (8)		0.9989	

Notes: Marginal effects for dummy variables are $P|x = 1 - P|x = 0$. One asterisk indicates statistically significant at the 0.15 level, two asterisks indicates statistically significant at the 0.10 level, and three asterisks indicates statistically significant at the 0.05 level.

would expect either no effect or a negative effect on organic preference and buying. In all cases the impact is found to be negative, though significant only in the buying models. This result indicates that those who consider taking care of their health a responsibility of their own, and not just their doctor's, are buying a higher proportion of organic foods.

Location variables have the expected impact in both the preference and buying models. The number of consumers that indicated a preference for organic produce was smallest at the conventional supermarket (20 percent) and highest at the food cooperative (90 percent). As would be expected, the base probability of preferring organic is lowest at the supermarket and highest at the cooperative. The base proportion of organic buying is also lowest at the supermarket and highest at the cooperative. For ease of viewing the results, the farmers market location is the base location in the model. For organic preference the absolute difference between the farmers market and the supermarket (*STORE2*) is larger than that between the farmers market and the food cooperative (*STORE3*). By looking at the results for the separate subsets that prefer organic and prefer conventional (Tables 6 and 7), it appears that there is less of a difference between consumers at the various locations once preference is established. The store variables clearly explain part of the variation in choice; however, it should be noted that their omission from the model has little effect on the relative impact of the remaining variables. That is, there is little difference in the parameter estimates when the store variables are dropped from the analysis, indicating little collinearity with other explanatory variables. One exception to this is the importance of appearance, which will be discussed below.

Table 6. Fruit-Buying Model for Prefer Organic and Prefer Conventional Subsets

	Buying Proportions Model Prefer Organic Subset N = 148				Buying Proportions Model Prefer Conventional Subset (N = 86)			
	Coeff.	St. Error	Marginal	St. Error	Coeff.	St. Error	Marginal	St. Error
Constant	0.7387	0.4392**			-0.6213	0.6056		
PRIMARY	-0.4738	0.1730***	-0.1506	0.0480***	-0.0214	0.2427**	-0.0029	0.0327
FEMALE	-0.0720	0.1328	-0.0252	0.0461	-0.2427	0.1420	-0.0329	0.0211*
AGE	-0.0005	0.0044	-0.0002	0.0015	-0.0118	0.0045***	-0.0016	0.0006***
KIDS	-0.0669	0.1305	-0.0238	0.0469	0.3579	0.1361***	0.0522	0.0238***
EDUCAT	-0.0420	0.0579	-0.0148	0.0204	-0.0306	0.0706	-0.0040	0.0093
INCOMET	-0.0173	0.0223	-0.0061	0.0079	0.0049	0.0209	0.0007	0.0027
EECCB	0.3753	0.0857***	0.1324	0.0301***	0.1089	0.0625**	0.0143	0.0085**
EECRB	0.0830	0.0715	0.0293	0.0253	-0.0622	0.0608	-0.0082	0.0080
HNUTRITI	0.0684	0.0805	0.0241	0.0284	0.0175	0.1101	0.0023	0.0144
HHESENS	0.1069	0.0700*	0.0377	0.0248*	0.1193	0.0497***	0.0157	0.0069***
HFITNESS	-0.0363	0.0742	-0.0128	0.0262	-0.0090	0.0568	-0.0012	0.0075
HPHRESP	-0.0759	0.0615	-0.0268	0.0216	-0.1697	0.0838***	-0.0224	0.0120**
IMPRICE	-0.1319	0.1221	-0.0465	0.0430	-0.0877	0.1168	-0.0115	0.0150
IMAPPEAR	0.1742	0.1037**	0.0614	0.0365**	0.1325	0.1362	0.0175	0.0188
STORE2	-0.3708	0.1875***	-0.1383	0.0720**	-0.4738	0.1361***	-0.0683	0.0211***
STORE3	0.4028	0.1361***	0.1408	0.0474***	0.2564	0.1685*	0.0393	0.0298
Log likelihood function			-83.096				-23.185	
Restricted log likelihood			-94.021				-25.541	
% predicted in range			0.216				0.733	
% predicted adjacent range			0.399				0.209	
Hosmer-Lemeshow Chi-square			1.85412				0.5519	
H-L probability value (8)			0.9852				0.9998	

Notes: Marginal effects for dummy variables are $P|x = 1 - P|x = 0$. One asterisk indicates statistically significant at the 0.15 level, two asterisks indicates statistically significant at the 0.10 level, and three asterisks indicates statistically significant at the 0.05 level.

The differences between locations are possibly due to the fact that consumers with higher levels of interest in food are more likely to frequent farmers markets or food cooperatives. Those that derive higher utility from characteristics of food (e.g., through variety) may seek out shopping venues that offer a different food-buying experience, and these individuals may also have a greater interest in how the food is produced. A noted difference between organic and non-organic shoppers is how they select their primary grocery store. According to a survey (Food Marketing Institute 2001), 90 percent of organic shoppers "rank high quality fruits and vegetables as the number one factor" in selecting their primary grocery store, while 88 percent of non-organic shoppers "chose a clean/neat store as their top factor."

The importance of price variable (*IMPRICE*), which increases with the price sensitivity of the consumer, should be and is always negative. It is significant in all of the full data set models, but once consumers are separated into "prefer organic" and "prefer conventional," it is no longer significant. The insignificance of the importance of appearance (*IMAPPEAR*) must not be taken for granted as it is the one variable that is truly affected by the inclusion of the store variables. The importance of the appearance variable is negative and significant in the preference models when the store variables are dropped from the models. In contrast, in buying-level models, importance of appearance is insignificant with or without the store variables. Thus, appearance does appear to be important in determining preference, though not buying levels. One possible explanation for

Table 7. Vegetable-Buying Model for Prefer Organic and Prefer Conventional Subsets

	Buying Proportions Model Prefer Organic Subset N = 147				Buying Proportions Model Prefer Conventional Subset (N = 87)			
	Coeff.	St. Error	Marginal	St. Error	Coeff.	St. Error	Marginal	St. Error
Constant	0.5832				-0.5231	0.7354		
PRIMARY	-0.3833	0.1698***	-0.1231	0.0489***	-0.0778	0.2554	-0.0108	0.0371
FEMALE	0.0185	0.1434	0.0065	0.0503	-0.2615	0.1499**	-0.0366	0.0231*
AGE	-0.0007	0.0050	-0.0003	0.0017	-0.0068	0.0053	-0.0009	0.0007
KIDS	0.0215	0.1282	0.0075	0.0445	0.2677	0.1561**	0.0384	0.0252*
EDUCAT	-0.0817	0.0533*	-0.0286	0.0187*	-0.1092	0.0871	-0.0146	0.0119
INCOMET	0.0005	0.0198	0.0002	0.0069	0.0176	0.0221	0.0024	0.0030
EECCB	0.4262	0.0843***	0.1490	0.0291***	0.1457	0.0759**	0.0195	0.0109**
EECRB	0.0485	0.0644	0.0170	0.0225	0.0041	0.0575	0.0006	0.0077
HNUTRITI	0.0029	0.0745	0.0010	0.0260	0.0152	0.1291	0.0020	0.0172
HHESENS	0.1738	0.0750***	0.0607	0.0265***	0.1229	0.0528***	0.0165	0.0075***
HFITNESS	-0.0507	0.0830	-0.0177	0.0289	-0.0801	0.0625	-0.0107	0.0085
HPHRESP	-0.1748	0.0640***	-0.0611	0.0221***	-0.2694	0.1007***	-0.0361	0.0151***
IMPRICE	-0.1405	0.1210	-0.0491	0.0424	-0.1612	0.1393	-0.0216	0.0183
IMAPPEAR	0.1701	0.1047*	0.0595	0.0364*	0.1673	0.1678	0.0224	0.0236
STORE2	-0.3339	0.1685***	-0.1234	0.0642**	-0.4115	0.1733***	-0.0597	0.0271***
STORE3	0.4417	0.1365***	0.1532	0.0471***	0.2087	0.2106	0.0316	0.0359
Log likelihood function			-80.91				-23.77	
Restricted log likelihood			-93.02				-26.20	
% predicted in range			0.211				0.713	
% predicted adjacent range			0.401				0.230	
Hosmer-Lemeshow Chi-square			1.9523				1.1877	
H-L probability value (8)			0.9824				0.9968	

Notes: Marginal effects for dummy variables are $P|x = 1 - P|x = 0$. One asterisk indicates statistically significant at the 0.15 level, two asterisks indicates statistically significant at the 0.10 level, and three asterisks indicates statistically significant at the 0.05 level.

the impact on preferences is that the food experiences of farmers market and cooperative shoppers have taught them not to consider appearance as a factor in taste or quality. It may also mean that conventional shoppers are defining appearance as a signal of quality.

Gender, education, children in households, and household income variables make only limited contributions to explaining preferences and buying behavior. This finding is not surprising in that these demographics are intended to be at least partly a proxy for characteristics of consumers that the factors are intended to capture. An example of this in many studies is when the influence of a positive significant demographic variable for children in the family is interpreted as indicating a concern about health. In this study the health concern can be picked up more directly through the health factors. The signs of demographic factors, however, are still generally in agreement with those of earlier studies, indicating that they may still be picking up an additional influence. In looking at the results for the demographic variables it is useful to consider differences between preference and buying and how the buying models' results are changed when the data is separated into the "prefer organic" and "prefer conventional" subsets.

The first demographic variable for *PRIMARY* shopper is negative but not significant in determining preference, but it has a significant downward impact on buying levels. This result seems reasonable, as the primary shopper may be more budget-conscious. Older people are less likely to prefer organic, though even a 10-year increase in age drops the probability of preferring organic only 7–8 percentage points. This downward significant effect of age persists when the full data set

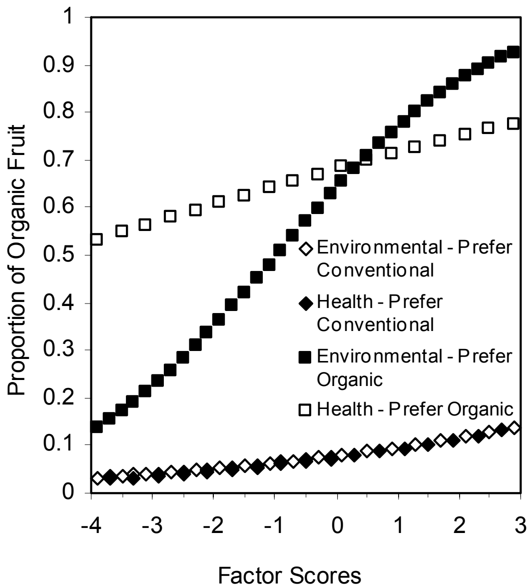

Figure 2. Health and Environmental Factors' Influence on Organic Purchase Proportions

is included in the buying model, but when the "prefer organic" and "prefer conventional" subsets are analyzed separately, the impact, while still negative, declines substantially. While younger consumers have previously been found to be more willing to pay a premium for organic products (Govindasamy and Italia 1999), the results of this study indicate that age does not affect the level of overall buying, once preference has been determined.

A higher level of education, though not significant in preference and only marginally significant in two of the buying models, also has a negative impact. Similar results for education have been found for organic selection (Thompson and Kidwell 1998) and for pesticide reduction (Eom 1994). Having children was generally not found significant in this study, with one notable exception. Having children does have a positive impact on the buying levels of those that indicated their preference was to buy conventional produce (Tables 6 and 7). This finding conforms to that of other studies where having children was found significant in the choice of an organic produce alternative (Thompson and Kidwell 1998) and willingness to pay a premium for an eco-labeled product (Loureiro, McCluskey, and Mittelhammer 2001). Only in this same "prefer conventional" group was there even a moderately significant effect on organic fraction purchase due to gender, with being female having a negative impact on buying level.

Conclusions

This study finds that both personal health and environmental protection are motivations for organic preferences and buying, but that environmental motivations are more influential in determining higher levels of purchases. Using factor analysis to register consumers' placement on indexes from a spectrum of questions intended to capture environmental and health motivations is clearly productive. The factor score information provided a considerable improvement in ability to predict consumer choice over earlier studies that based choice primarily on demographic differences. These findings indicate that product marketing and policy will be better informed if consumers are grouped by interests and motivations rather than factors like education, age, or income. It can be argued that demographic variables are more convenient to marketers, but modern advertising is capable of reaching more specific audiences through analysis of the listeners and readers for specific media. For government and producer groups, this information is important in better understanding consumer motivations and guiding future policy.

Three variables representing age, price sensitivity, and the importance of appearance to the individual are found to influence preferences to a much greater degree than actual buying. That is, once preference is established, buying levels are little impacted by these factors. Two variables worked the opposite way. Being the primary shopper did not appear to impact whether an individual preferred organic produce, but it did reduce the proportion of organic produce the survey taker reported buying. Similarly, individuals with a high score on personal health responsibility (high score indicating low self responsibility) were not significantly less likely to prefer organic, but they were found to have significantly lower levels of buying in all but one of the buying models. It is also interesting to note that among those that did not express a preference for organic, having children in the household seemed to overcome that lack of preference in how much organic was purchased. The impact was somewhat stronger for fruit, which logically parents may be more concerned about since fruit may be more likely than vegetables to be eaten by children without cleaning or parental involvement. In general, differences between the fruit and vegetable results are minor, and a single analysis of all fresh produce would probably be equally informative.

An obvious limitation in this study is that it evaluates stated buying rather than actual purchases. Undoubtedly, evaluation of actual purchase levels would be preferred, but would require a very extensive diary survey. Evaluating a single purchase day would create problems since many consumers shop at a variety of locations to fulfill their shopping wants, which would have a profound influence on a particular day's shopping basket. The greatest advantage of a single survey with overall stated buying is clearly its efficiency. If we assume that (i) consumers are trying to be honest in reporting purchase percentages, and (ii) any error in their statement is unbiased, then the model results should be reasonably good. These assumptions are of course made in any study in which the researcher relies on self-reporting. These results are also taken from a single metropolitan area, and thus must not be over-interpreted. However, the models estimated are intended to evaluate what motivates organic consumers, not how many consumers have this level of motivation.

Given the restrictions on directly marketing organic as a healthier choice, the relative importance of the environmental motivation versus health motivations should be somewhat reassuring for the organic producer and marketer. The results of this study indicate that the environmentally conscious are important to the organic market and should be considered in any future changes in organic production requirements and in eco-labeled production as well. To better inform that process, future research should evaluate why consumers who are active environmentally support organic production.

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