Consumer Willingness to Pay for Pesticide-Free Fresh Produce

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The study uses primary data collected from a survey conducted in Georgia to analyze consumer preferences for testing and certification of fresh produce and consumers' willingness to pay for fresh produce that is certified as free of pesticide residues (FPR). An ordered probit model was estimated to identify the impacts of various exogenous variables on the probability of consumers' willingness to pay for a number of alternative price premiums. The results indicate that consumers' willingness to pay differs with respect to a number of factors. The study concludes that most of the consumers recommend testing and certification, but they oppose large price markups for certified-FPR fresh produce.

Key words: food safety, fresh produce, Likert scale, ordered probit, pesticide residues, risk perception, willingness to pay.

In an interview published in *Choices,* U.S. Secretary of Agriculture Clayton Yeutter responding to a question on the importance of food safety said:

> Unfortunately, our food safety debates have recently been characterized by too much emotion, too few facts. Hired public relations firms have manipulated the media with dubious "studies" and charges in an attempt to convince America that our food supply is unsafe. Well, that's not true! In debating this issue we need to eliminate the hysteria and allow science and good reason to prevail. . . . We must strike a delicate balance in this area so that we have a safe food supply, farmers are not driven from the land, and our environment is preserved. (Schertz, p. 7)

The emotion conveyed by the Secretary probably was inspired by themes of numerous articles and debates regarding consumer concern about pesticide residues in fresh produce. Whether the hysteria has been propagated by dubious accusations or not, researchers (Sachs, Blair, and Richter; Zellner and Degner; Zind) indicate that there is a high level of perceived risk among American consumers about pesticide residues. Consumer concerns about the potentially adverse effects of pesticide residues on human health have prompted some supermarket chains and food retailers, particularly on the West Coast, to use private testing programs such as NutriClean to advertise and promote their produce (van Ravenswaay 1989). Others have offered organically grown produce.

How important is it to consumers that fresh produce should be tested and certified as free of pesticide residues? How will consumers react to these marketing initiatives? Additional testing and monitoring programs increase costs of production. Are consumers willing to pay a higher price for "cleaner" or safer produce? There is little available information and there are few empirical studies addressing these questions. According to one study, consumers appear to be ambivalent to new food-safety-oriented marketing labels touting "no detectable residues" (Cook). Recently, sales of organic produce reportedly have been minuscule or dismal (Dowdell). There seems to be some confusion in the marketplace, and fresh produce producers and retailers are at a loss about how to satisfy the consumer's demand for safer food products.

Most previous studies have been primarily descriptive in nature, and little empirical re-

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search has focused on measuring how much food safety the consumer wants or is willing to pay for. There is a need for better understanding of consumers' risk perceptions and attitudes toward pesticide use on fresh produce. Producers and retailers need to assess consumer demand for food safety more accurately so that product developments and marketing strategies can be effectively and successfully implemented. In addition, public officials and regulatory agencies need more thorough assessments about how consumers perceive the safety of food they eat and about how safe our food supply should be (van Ravenswaay 1988).

The purpose of this article is to address these questions and to help provide the needed information. Results of the study should provide insights to producers and retailers with regard to how much the consumer would be willing to pay in the marketplace for reductions in perceived risks. Knowledge of consumers' perceptions and attitudes toward risk should help in formulating regulations that ensure the safety of the food supply and help in communicating risks and assessing benefits to restore consumer confidence and trust.

Theoretical Framework

A number of theoretical approaches that are directly relevant to analysis of food safety issues and for estimating willingness to pay for risk reduction have been developed in the demand literature. One method of analyzing food safety issues is an extension of the classical demand models where an information variable is used within a demand analysis as an indirect means of evaluating consumer risk perceptions (Swartz and Strand). Another approach is to incorporate information and risk perception variables in a household production model to examine how changes in consumer risk perceptions affect food demands (Smallwood and Blaylock). A third approach for analyzing demand for food safety can be developed based on Lancaster's theory of demand for attributes and characteristics of goods (Hammit). However, application of the Lancasterian framework to estimate willingness to pay for regulatory actions that reduce risk is a complicated task because risk is not a characteristic of a product that is generally known to consumers (van Ravenswaay 1988).

Alternatively, the contingent valuation method provides a direct approach for obtaining consumers' willingness to pay for certain benefits. The theory of contingent valuation and its applications for measuring willingness to pay have been discussed by Randall and Stoll. Using this method, survey respondents may be presented with a risk-reducing option and asked what they would be willing to pay for its implementation. The contingent valuation approach is less costly than actual market experiments. Contingent valuation methods usually require the use of a bidding procedure with the assistance of trained interviewers. A modified contingent valuation method may use a checklist of payment ranges from which the respondents are asked to select their willingness-to-pay amount. The checklist method has the advantage of minimizing the occurrence of a starting point bias (Mitchell and Carson). Furthermore, the checklist method can be administered with a mail survey.

For the purposes of this study, the checklist approach is employed to elicit consumers' willingness to pay for produce that is certified as free of pesticide residues (FPR). Given the nature of the study, a qualitative choice model based on the premises of random utility maximization developed by McFadden provides the appropriate theoretical foundation for model formulation. In particular, an ordered probit model derived from the random utility maximization process is developed for empirical implementation.

Consider a sample of T consumers, each facing a set of M discrete alternatives. Each alternative i ($i = 1, \ldots, M$) provides utility, U_i, to consumer t ($t = 1, \ldots, T$). An individual is said to choose an alternative i that maximizes his utility among M alternatives. The maximum utility attainable given each alternative i can be expressed as:

$$(1)\quad U_i = u(\boldsymbol{A}_k, \boldsymbol{S}_n), k = 1, \ldots, K; \qquad n = 1, \ldots, N.$$

Where U_i is the maximum utility attainable when alternative i is chosen; $\boldsymbol{A}_k$ is a vector of K attributes or characteristics associated with alternative i; and $\boldsymbol{S}_n$ is a vector of N sociodemographic characteristics of the individual t. For estimation purposes, the $u(.)$ is assumed to be a linear function of $\boldsymbol{A}_k$ and $\boldsymbol{S}_n$, and it can be decomposed into a deterministic component $(\boldsymbol{A}_k, \boldsymbol{S}_n; \boldsymbol{\theta})_i$ and a stochastic component (ξ_i). Thus, equation (1) can be rewritten as:

$$(2)\qquad U_i = (\boldsymbol{A}_k, \boldsymbol{S}_n; \boldsymbol{\theta})_i + \xi_i,$$

where θ is a vector of parameters associated with A_k and S_n.

In the decision-making process, an individual is assumed to evaluate and compare the utility derived from each alternative i as specified in (2). An individual will choose alternative j, if and only if it provides the highest utility,

$$(3) \quad U_j \geq \max (U_i \mid i = 1, \ldots, M; j \neq i).$$

In practice, U_j represents a latent variable, which is unobservable, and only the outcome of the decision process is observed. Thus, let Y be the observed variable that is ordinal in nature and $Y = j$ is the observed outcome when response category j is chosen. It follows that a regression relation implied by equation (3) can be specified and estimated with appropriate statistical procedures:

$$(4) \quad Y_t = X_t\beta + \epsilon_t,$$

where

$$Y_t = j, \text{ if } \mu_{j-1} < Y_t \leq \mu_j \rightarrow U_{j,t} \geq U_{j-1,t}, \quad j = 2, \ldots, M,$$

and

$$(5) \quad \Pr(Y_t = j \mid U_{j,t} \geq U_{j-1,t}) = \Phi[(\mu_j - X_t\beta)/\sigma] - \Phi[(\mu_{j-1} - X_t\beta)/\sigma],$$

where X_t is a matrix of explanatory variables that represent A_k and S_n in equation (2) and β is a vector of unknown parameters; ϵ_t is a vector of error terms assumed to be independently and identically normally distributed, i.e., $\epsilon_t \sim N(0, \sigma^2)$; $\mu_1, \ldots, \mu_M$ are the category thresholds for the underlying response variable (Y_t) with $\mu_1 \leq \mu_2 \leq \ldots \mu_M$, and $\mu_1 = -\infty$ and $\mu_M = +\infty$; and $\Phi(.)$ denotes the standard normal cumulative distribution function. The model presented in equation (5) is underidentified since any linear transformation applied to the underlying response variable and threshold value μ_js would lead to the same model. To identify the model, it can be assumed without loss of generality that $\mu_1 = 0$ and $\sigma = 1$. Thus, the log-likelihood function for the model is:

$$(6) \quad \log L(\beta, \mu_2, \ldots, \mu_{M-1}) = \sum_{t=1}^{T} \sum_{j=2}^{M} C_{jt} \log[\Phi(\mu_j - X_t\beta) - \Phi(\mu_{j-1} - X_t\beta)],$$

where

$$C_{jt} = 1, \text{ if } \mu_{j-1} < Y_t \leq \mu_j,$$
$$C_{jt} = 0, \text{ otherwise.}$$

Consistent parameter estimates for the β vector and the μ_js that maximize the log-likelihood function can be obtained by applying the ordered probit procedure available in the LIMDEP computer package (Greene).

The Consumer Survey

During the spring of 1989 a mail survey was conducted among 580 households participating in the Georgia Consumer Panel (Huang and Misra). The purpose of this survey was to assess and determine consumers' perceptions of food safety and their attitudes toward use of pesticides in the production of fresh produce. The survey design and implementation followed methods recommended by Dillman to minimize nonresponse bias. Participants were asked a variety of questions concerning their fresh produce purchasing practices, their attitudes toward the use of chemical pesticides on fresh produce, and their absolute concern for pesticide residues as well as relative to other health-related food concerns. Information related to respondents' sociodemographic characteristics such as ethnic background, age, income, marital status, family size, and employment status was also collected. The survey resulted in 389 returned questionnaires, representing a response rate of 67%. Table 1 presents a summary of the survey results with respect to consumers' food concerns, attitudes toward pesticide use on fresh produce, and willingness to pay for certified-FPR produce.

In one question, respondents were asked to indicate how important it is that fresh produce should be tested and certified as free of pesticide residues. Of the 381 responses, 215 indicated that it is very important (56%). Another 33% of the respondents considered testing and certification to be somewhat important. Only slightly more than 4% of the respondents considered it not important, and the rest of the respondents were not sure. Respondents were also asked to express their opinion concerning the use of man-made pesticides in growing fresh produce. Of 365 responding to this question, about half of the respondents indicated that pesticides can be used safely but there should be increased testing and monitoring of pesticides used on fresh produce. Thirty-five percent of the respondents suggested that some unsafe pesticides should be banned and greater restrictions should be placed on those remain-

ing in use. Only 11% of the respondents suggested a complete ban on all pesticides. The remaining 4% thought that consumer concern over pesticide residues is not warranted. The results suggested that testing and certification of fresh produce as residue free is a strongly preferred action for a large number of consumers.

With regard to consumers' willingness to pay, survey participants were initially asked if they were willing to pay a higher price for fresh produce that had been tested and certified as residue free. Respondents who answered positively were asked to indicate how much more they would pay, relative to current prices, from a checklist of price premiums ranging from "no more than 5%" to "more than 20%," with 5% increments. Out of 379 responses, 46% of the respondents expressed a willingness to pay a higher price for tested and certified-FPR fresh produce. Twenty-six percent of the respondents refused to pay a higher price and 29% of the respondents were not sure.

The data used in this study for model estimation were based on a subset of 168 sample observations.[1] Socioeconomic characteristics for the subsample of responding households are given in table 2. The sample tended to be demographically upscale with better educated and higher income consumers slightly overrepresented in comparison with census statistics. The sample average household size of two individuals matches closely with the projected state average for 1989. The racial composition of the state is approximately 74% white as compared with 80% white households represented in the sample. The mean age (42 years) of the respondents for the subsample, however, is closer to the state's average.

Table 1. Summary of Survey Results

Food Concerns that Georgia Consumers Ranked Most Important (N = 314) (%)		
Food grown using pesticides		30
Food poisoning		20
Food prices too high		13
Foods high in cholesterol		12
Proportion of Respondents that Rated the Following to be Riskier than Eating Produce Grown with Pesticides (N = 344) (%)		
Eating foods high in cholesterol		62
Eating foods high in saturated fats		54
Eating foods high in salt		52
Eating foods high in sugar		42
How Important that Fresh Produce Should be Tested and Certified as Free of Pesticide Residues (N = 381) (%)		
Very important		56
Somewhat important		33
Not important		4
Consumers' Attitudes toward the Use of Pesticides on Fresh Produce (N = 365) (%)		
Pesticides can be used safely but there should be more testing and monitoring		51
Ban unsafe pesticides and place greater restrictions on those remaining in use		35
Ban all pesticides used on fresh produce		11
Pesticides are safe to use		4
Consumers' Willingness to Pay a Higher Price for Certified Residue-Free Produce (N = 379) (%)		
Yes		46
Amount willing to pay		
No more than 5%	54	
6–10% more	33	
11–15% more	6	
16–20% more	7	
More than 20%	1	
No		26
Not sure		29

Note: N denotes sample size. Percentages may not sum to 100 due to rounding.

Model Specification

For estimation purposes, the responses for the willingness-to-pay variable were collapsed into three categories representing "not willing to pay a higher price," "willing to pay a price premium up to 10%," and "willing to pay more than 10%," respectively. Based on the subsample, a majority of the respondents (54%) was willing to pay up to 10% more than what they are paying now. However, only 9% of the respondents in the subsample were willing to pay a price premium of more than 10%. Variables that were hypothesized to influence consumers' willingness to pay for certified FPR included a set of proxy variables that measured

[1] The sample size was substantially reduced due to exclusion of respondents who failed to provide complete answers to a number of questions used in the variable construction or information associated with socioeconomic characteristics. A t-test was conducted of the hypothesis that the means of a few selected variables of the survey sample and the subsample selected for empirical analysis are the same. It was found that the two samples do not differ statistically at the .05 significance level as far as means of respondent education, household income, and household size are concerned. However, age of the respondent did differ significantly between the survey sample and the subsample selected for empirical analysis.

Table 2. Sample Characteristics of Survey Respondents

Characteristic	European Origin	Afro-American Origin	Other Origin	Total
		%		
Sex				
Male	27.4	6.5	0.6	34.5
Female	52.4	11.9	1.2	65.5
Age				
Less than 25 years old	5.9	2.4	0.0	8.3
26–35 years old	22.0	5.4	0.6	28.0
36–45 years old	20.2	7.1	0.6	27.9
46–65 years old	25.6	3.0	0.6	29.2
More than 65 years old	6.0	0.6	0.0	6.6
Education				
Up to high school	33.4	10.7	0.6	44.7
College	33.3	7.1	1.2	41.6
Post graduate	13.1	0.6	0.0	13.7
Marital Status				
Single	8.3	3.6	0.0	11.9
Married	61.3	5.9	0.6	67.8
Divorced/Separated	6.6	7.7	1.2	15.5
Widowed	3.6	1.2	0.0	4.8
Household Income				
Less than $5,000	0.0	1.2	0.0	1.2
$5,000–$14,999	10.1	6.0	0.6	16.7
$15,000–$24,999	16.0	6.0	0.0	22.0
$25,000–$34,999	15.5	1.8	1.2	18.5
$35,000 or more	38.1	3.5	0.0	41.6
Household Size				
1 person	4.8	4.1	0.0	8.9
2–4 persons	65.5	11.9	1.8	79.2
5 or more persons	9.5	2.4	0.0	11.9
Place of Residence				
Urban	39.3	14.3	0.6	54.2
Rural	40.5	4.1	1.2	45.8

Note: Sample size = 168.

the respondents' risk perceptions and attitudes toward certified-FPR fresh produce as well as the socioeconomic characteristics of the respondents.

Consumer concern about pesticide residues is a psychological construct that cannot be observed or measured directly. In order to provide a measurement of consumers' risk perceptions, a composite variable was constructed from a number of survey questions to capture the respondent's mental status and processes. Previous research (Mueller; Kalton and Schuman) suggested that high reliability is achieved if psychological constructs are developed based on multiple items instead of a single item. Furthermore, Mueller points out that respondents usually evaluate the attitudinal objects within a relative context. This study applied the Likert Attitude Scaling procedure (Mueller) to measure consumer concern about use of chemical pesticides on fresh produce.

A pool of six questions was used to quantify consumer risk perceptions about pesticide residues. One survey question pertained to consumers' ranking of top three food concerns. If "food grown using man-made pesticides" was ranked as the first, second, or third concern, then a consumer's risk perceptions about pesticide residues were assumed to be high, moderate, or low, respectively. If "food grown using pesticides" was not one of the top three concerns, no risk perceptions about pesticide residues were assumed. To facilitate a direct comparison of consumers' risk perceptions between pesticide residues and other food-related health concerns, four health risk questions

were asked. The four health risks were eating foods high in (*a*) cholesterol, (*b*) fat, (*c*) salt, and (*d*) sugar. For each comparison, the respondents would rate the health risk as much lower, somewhat lower, no difference, somewhat higher, or much higher than eating produce grown with pesticides. A consumer's risk perceptions about pesticide residues were assumed to be high if he or she rated the health risk of eating foods high in cholesterol, fat, salt, and sugar to be much or somewhat lower than eating foods grown using pesticides. A response of "no difference" corresponded to moderate risk perceptions. Similarly, low or no risk perception was assumed if the relative health risk was rated as somewhat higher or much higher. The last question was an opinion statement concerning the use of man-made pesticides on fresh produce. Suggestions to ban all pesticide uses, to ban some while imposing restrictions on the remaining pesticides, to increase testing and certification, or to do nothing were translated into high, moderate, low, and no pesticide risk perceptions, respectively.

In terms of item scores, "high concern" received three points, "moderate concern" received two points, "low concern" received one point, and "no concern" received no points. To construct the concern variable, the item scores for each respondent were first summed to obtain a total score. The total concern scores were then expressed as an index of relative risk perceptions ranging from zero to 100. An index value of 100 corresponded to the highest possible total score of 18 points. Furthermore, a reliability test based on the Cronbach α coefficient[2] was conducted to check the internal consistency of the constructed index of relative risk perceptions (Mueller; Cronbach). The calculated α coefficient was .78 suggesting that the pool of questions was measuring the same underlying psychological construct consistently 78% of the time.

Our study assumes that the certified-FPR produce provided a desirable attribute for consumers who had great concerns about the safety of food they consumed. A consumer's opinion about the importance of testing and certification of fresh produce was also expected to have a positive impact on his or her willingness to pay. Therefore, a greater importance attached to testing and certification should correspond to a greater willingness to pay for certified FPR. In addition, a respondent's expectations about his or her future financial condition were also postulated to have a positive effect on willingness to pay.

Perception and risk assessment of food safety differ vastly among individuals. Theoretically, sociodemographic characteristics such as age, sex, race, and education are presumed to have direct influences on an individual's risk perception and assessment, which in turn would impact on willingness to pay. However, to limit the scope of this study, consumer perception and assessment of risk were considered predetermined and, hence, the linkages between the concern index and demographic variables were not specifically examined (Misra and Huang). Given this limitation, it is appropriate to specify and estimate the willingness to pay directly in a reduced-form specification that incorporates both the concern index and demographic characteristics. This specification allows the demographic variables to capture some aspects of willingness to pay that were not directly accounted for by the assessment of risk. Furthermore, van Ravenswaay (1988) suggested that it is useful to examine whether variation in willingness to pay is explained by demographic characteristics. Based on previous research (Malone; Zellner and Degner), each respondent's race, sex, age, education, income, and location of residence were incorporated in the model. On a priori basis, household income was hypothesized to have a positive influence on a consumer's willingness to pay. The income variable provided a measure of a respondent's ability to pay and, hence, a positive relationship was expected. However, no a priori relationships were hypothesized for race, sex, education, and location of residence variables due to lack of applicable theoretical paradigms and limited empirical evidence. Table 3 presents a summary of variable definitions and related descriptive statistics.

Empirical Results

Table 4 presents the estimation results from the ordered probit model. In addition, several goodness-of-fit measures are reported. One

[2] The Cronbach α coefficient is defined as: $\alpha = (k/k - 1) \times (1 - \sum_{i=1}^{k} s_i^2/s_t^2)$, where k is the number of test items, s_i^2 is the variance of responses of the ith test item, and s_t^2 is the variance of total scores.

Table 3. Definitions and Summary Statistics of the Variables Used in the Model

Variable Definition	Variable Name	Mean	Standard Dev.	Max.	Min.
Willingness to Pay for Certified-FPR Produce	*WTP*	0.7202	0.6183	2	0
Pesticides Concern Index	*CONCERN*	49.206	23.682	100	0
Importance of Testing and Certification					
1 = not important					
2 = somewhat important					
3 = very important	*TESTIMP*	1.4167	0.5730	3	1
Expectation of Future Financial Status					
1 = better off; 0 otherwise	*EXPBETTER*	0.8095	0.3939	1	0
Race of Respondent					
1 = European origin; 0 otherwise	*WHITE*	0.7976	0.4030	1	0
Sex of Respondent					
1 = male; 0 for female	*MALE*	0.3452	0.4769	1	0
Age of Respondent					
1 = 35 or less; 0 otherwise	*AGE* 35	0.3631	0.4823	1	0
1 = between 36 and 60; 0 otherwise	*AGE* 36–60	0.5357	0.5002	1	0
1 = above 60, 0 otherwise	*AGEGT* 60	0.1012	0.3025	1	0
Education of Respondent					
1 = college; 0 otherwise	*COLLEGE*	0.5536	0.4986	1	0
Household Income					
1 = less than $25,000; 0 otherwise	*INCOME* 1	0.3988	0.4911	1	0
1 = between $25,000 to $35,000; 0 otherwise	*INCOME* 2	0.1845	0.3891	1	0
1 = more than $35,000; 0 otherwise	*INCOME* 3	0.4167	0.4945	1	0
Place of Residence					
1 = urban; 0 otherwise	*URBAN*	0.5417	0.4998	1	0

Note: Sample size = 168.

measure is the log-likelihood ratio. A second measure used is the pseudo-R^2 (Maddala, p. 40). A third measure examines how well the model classified the respondents correctly based on the estimated probabilities. These measures indicate that the model had satisfactory explanatory power and fitted the data reasonably well. The results suggest that the overall ability of the model to yield correct predictions on consumer willingness to pay was 64%.

Most of the estimated coefficients were statistically significantly different from zero at the .1 level. The positive sign for the *CONCERN* variable supports the hypothesis that the probability of consumer willingness to pay a price premium for certified-FPR produce increases as concerns about pesticide residues on fresh produce increase. As might be expected, the coefficients for the attitudinal variables, *TESTIMP* and *EXPBETTER*, were significant. The result suggests that the probability that a consumer would be willing to pay a higher price increases with the degree of importance assigned to testing and certification for residue-free produce. The positive effect associated with *EXPBETTER* suggests that respondents who expect a better financial condition in the future would have a greater probability of willingness to pay more for certified-FPR produce.

Among the socioeconomic characteristics, race, age, income, and education were identified by the model to have significant impacts on the probability of willingness to pay. Results suggested that respondents of European origin (*WHITE*) more likely were willing to pay a higher price for certified-FPR produce than respondents of other ethnic backgrounds. Respondents who were between 36 and 60 years of age (*AGE*36–60) were less willing to pay a higher price for certified-FPR produce than those who were above 60 years old. The implication that older consumers were more willing to pay a higher price than their younger counterparts is in agreement with Zellner and Degner's finding that respondents who were

over 65 years old were more willing to pay for safer chicken. The estimated signs associated with both *INCOME*1 and *INCOME*2 were negative implying that consumers in the lower income group were less willing to pay a higher price than consumers in the higher income group.

With respect to education, the results suggested that respondents with a college education were less likely to be willing to pay more for certified-FPR produce. Malone, and Zellner and Degner also reported a negative relation between willingness to pay and educational level. Malone suggested that the unwillingness of more educated consumers to pay higher prices for irradiated food products may result from the feeling that there was no particular safety problem. Consumers with more formal education probably have a better understanding of the true risks associated with residue contamination on fresh produce. Therefore, they are more likely to believe that the benefits derived from FPR produce do not justify the additional cost. Another possible explanation for the negative relationship between education and willingness to pay may be that college-educated consumers tend to expect higher quality and demand a safe product without having to pay extra for it (Zellner and Degner).

For qualitative choice models, the estimated coefficients should be interpreted in the sense that they affect the probability that a certain event would occur. This interpretation can be obtained by computing the probability derivatives or marginal probabilities from the estimated model. The marginal probability is used to measure the change in probability of each choice with respect to a change in each explanatory variable. The probability derivatives for binary variables, however, do not exist. Therefore, the predicted probability for a given binary variable was calculated by holding all other variables at the sample means. Table 5 presents the estimated marginal probabilities and probabilities of selecting one of the three categories of willingness to pay. For each row in table 5, the sum of marginal probabilities is equal to zero and the sum of probabilities is equal to one. The sum of marginal probabilities is always zero because an increase in the probability in one category must be offset by corresponding probability decreases in another category or categories.

As shown in table 5, a unit increase in consumer concern for pesticide residues (*CONCERN*) increases the probability of willingness to pay a higher price by .003. This result suggests that as the degree of concern increases, consumer choice will shift from unwillingness to willingness to pay a higher price, primarily to the up to 10% category. Similarly, if testing and certification become more important (*TESTIMP*) to consumers, the probabilities of willingness to pay a higher price would increase at the expense of unwillingness to pay a price premium. The respondent's expectation of future financial status affects the probabilities of willingness to pay significantly. Those respondents who had an expectation of better financial outlook (*EXPBETTER*) had a much greater probability of choosing to pay a higher price up to 10% for certified-FPR produce. For those who did not expect a better financial situation in the future, the estimated probabilities of unwillingness and willingness to pay were about equal.

With respect to socioeconomic characteristics, the results suggest that nonwhite consumers had the highest probability of not being willing to pay a price premium for certified-

Table 4. Regression Results of Willingness to Pay for Certified Pesticide Residues-Free Produce (Ordered Probit Analysis)

Variable	Estimated Coefficient	Asymptotic *t*-ratio	Level of Significance
Constant	−2.0210**	−2.098	0.036
CONCERN	0.0087*	1.902	0.057
TESTIMP	0.9357***	4.341	0.000
EXPBETTER	0.4840*	1.758	0.079
WHITE	0.7275***	2.671	0.008
MALE	0.1156	0.507	0.612
AGE 35	−0.5575	−1.132	0.258
AGE 36–60	−1.0328**	−2.092	0.036
COLLEGE	−0.4742**	−2.141	0.032
INCOME 1	−0.8379***	−3.018	0.003
INCOME 2	−0.6488**	−2.094	0.036
URBAN	0.1067	0.512	0.609
μ_2	2.1331***	9.931	0.000

Summary Statistics:
Number of observations = 168
−2 × Log-likelihood ratio = 41.859[a]
Pseudo-R^2 = .348
Percent correctly classified = 64

Note: A single asterisk indicates significance at the .10 level; double asterisks indicate significance at the .05 level; triple asterisks indicate significance at the .01 level.
[a] The likelihood ratio statistic is distributed as Chi-square with 11 degrees of freedom and is significant at the .01 level.

Table 5. Estimated Marginal Probabilities and Probabilities by Willingness-to-Pay Category

Variables	Willingness-to-Pay Categories		
	0%	Up to 10%	10% or more
	Marginal Probability		
CONCERN	−.003	.002	.001
TESTIMP	−.341	.254	.087
	Probability		
Expectation of Future Financial Situation			
EXPBETTER = 1	.303	.644	.053
EXPBETTER = 0	.487	.495	.018
Race			
WHITE = 1	.284	.657	.059
WHITE = 0	.562	.427	.011
Age			
AGE 36–60	.267	.668	.065
AGEGT 60	.119	.711	.170
Education			
COLLEGE = 1	.416	.557	.027
COLLEGE = 0	.246	.680	.074
Household Income			
INCOME 1	.410	.562	.028
INCOME 2	.484	.498	.018
INCOME 3	.190	.705	.105

FPR fresh produce. Respondents of other socioeconomic characteristics have the highest probabilities of choosing to pay up to a 10% price premium. In particular, respondents who were older than 60 years of age (*AGEGT*60) and respondents who earned more than $35,000 a year (*INCOME*3) had a probability of greater than .71 of being willing to pay up to 10% more for certified-FPR fresh produce. Furthermore, respondents older than 60 years of age were more likely to choose to pay a higher price than not to pay a price premium. In most cases, the probabilities of willingness to pay a price premium of more than 10% were relatively small as compared with other categories.

Concluding Remarks

Testing and certifying fresh produce to be free of pesticide residues was found to be a strongly preferred action for a majority of Georgia consumers surveyed. The survey suggested that 89% of respondents considered testing and certification to be either very important or somewhat important. Survey respondents also suggested that monitoring the use of chemical pesticides on fresh produce should be increased. However, consumers in general were not willing to pay a higher price for certified-FPR fresh produce. The survey found that as many as 54% of the respondents would either refuse to pay a higher price or were not sure. Among those who were willing to pay a higher price, 87% were willing to pay a maximum of only 10% more for certified-FPR fresh produce.

An ordered probit model was formulated and used to estimate the probabilities of consumers' willingness to pay for FPR produce. The analysis suggests that the more the consumers were concerned about health effects of pesticide residues on fresh produce, the more likely they would be willing to pay a higher premium for certified-FPR produce. The results also show that consumers' attitudes toward testing and certification and future expectations play a significant role in influencing their willingness to pay. Furthermore, the study found that the probabilities of willingness to pay were the highest among respondents who were 60 years of age or older and whose annual total household incomes were greater than $35,000. Nonwhite respondents were most likely to be unwilling to pay a price premium for FPR produce. The probabilities of willingness and unwillingness to pay a higher price were about equal for those respondents who did not have a better financial outlook and who had an annual income between $25,000 and $35,000. These findings should help fresh produce producers in developing market strategies and identifying target markets for certified-FPR fresh produce.

Some policy ramifications emerge from this study. Consumers are greatly concerned about chemical residues on fresh produce and are demanding increased testing and monitoring of the use of pesticides. Although consumers are receptive to certified-FPR produce, they apparently are unwilling to pay a price premium of more than 10%. Consumer reluctance to pay a higher price poses an interesting issue for advocates of intensified testing and certification processes. It is possible that consumers consider food safety as a public good. Therefore, they expect that the government is obligated to ensure that fresh produce is free of pesticide residues. A price increase of over 10%

for certified-FPR produce is very likely to meet with great consumer resistance.

This study is one of the first analytical attempts to measure consumers' willingness to pay for certified-FPR fresh produce. It has a number of limitations. Aside from the small sample size, conclusions and implications to be drawn from this study are also limited by the geographical coverage of the survey. Attempts to generalize and apply the results of this study to a broader context should be exercised with caution. In addition, it is recognized that the survey did not collect any information on why some consumers are unwilling to pay a higher price for FPR fresh produce. The availability of this information would provide further insight for studying consumers' decision-making processes and further the development of a better model for predicting their choice behavior.

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