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Assessing Consumers' Valuation of Cosmetically Damaged Apples Using a Mixed Probit Model

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Keywords
Horticulture, Plant Pathology and Microbiology, apples, sooty blotch and flyspeck, organic, cosmetic damage, willingness to buy, mixed probit model

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Abstract

A mixed probit model was applied to survey data to analyze consumers' willingness to buy apples with cosmetic damage caused by the sooty blotch and flyspeck (SBFS) disease complex. The analysis finds consumers will pay a premium for organic production methods and for apples with low amounts of SBFS damage. Behavioral variables such as experience in growing fruit significantly affect the willingness to buy apples of different damage levels. Consumers' tolerance of very blemished apples is limited and they trade off production technology attributes for cosmetic appearance. Better understanding of this trade-off is important to organic producers' decisions about disease control.

Keywords: apples, sooty blotch and flyspeck, organic, cosmetic damage, willingness to buy, mixed probit model.

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Introduction

Coherent risk management strategies are crucial to making good economic and production decisions for apple growers. Apple growers face a complex risk environment that includes single- and multiple-year risks from insect pests, diseases, weeds, vertebrate pests, nutritional imbalances, and volatile apple prices. Decreased profit margins have forced many apple growers out of business, and others have considered shifting to value-added activities, including organic production, to gain a price premium for their fruit (Earles *et al.*, 1999). Organic apples have become popular in farmers markets as well as in grocery stores (Kremen, Greene, and Hanson, 2004). Compared with conventionally grown fruit, the price of fresh organic apples ranges from $3 to $15 higher per 40-pound box (or $0.075 to $0.375 per pound) (Granatstein, 2002). At the same time, the cost of organic production is likely to be higher than that of conventional production because of the lack of chemical thinning agents, less-effective organic pesticides and weed control practices, and less rapidly acting fertility management. One important feature of organic production is its avoidance of perceived toxic and persistent chemical pesticides and fertilizers.

When pest management breaks down, apple crop losses can approach 100% (Grove *et al.*, 2003; Prokopy and Avilla, 2003). Major early-season diseases include apple scab, rust, and powdery mildew. Fire blight occurs sporadically but can devastate highly susceptible cultivars. Late-season diseases include the sooty blotch and flyspeck

(SBFS) complex and summer fruit rots (black rot, white rot, and bitter rot). Most of these diseases pose multiple-year as well as production-season threats since the pathogens survive the winter in the orchard and then re-invade apple crops in subsequent growing seasons.

The threat of economic losses from SBFS is the main reason that apple growers in the northeastern quarter of the United States apply four to eight fungicide sprays from shortly after petal fall until harvest. Dark-colored colonies of the SBFS fungi blemish the fruit cuticle, especially in wet growing seasons. Such defects, although primarily cosmetic and not affecting fresh eating quality, result in culled fruit and reduce the value of an apple crop by up to 90%. Blemished fruit are downgraded from fresh-market to cider grade and become desiccated during storage (Williamson and Sutton, 2000).

Organic apple producers face additional challenges in addressing pest control. For example, organic producers must control weeds, monitor and respond rapidly to harmful diseases and insects, and identify effective and approved products for pest control. Many organic methods are more costly and somewhat less effective than methods used in commercial production (Reganold *et al.*, 2001). Consequently, organic apples may not be as attractive in appearance as conventionally grown apples. Disease or insect damage may occur under certain climatic conditions (e.g., high rainfall) and is more common in certain regions than in others. SBFS is controlled by fungicides during the growing season; if disease is not too severe, the damage may be removed from harvested apples by washing and brushing (Batzer *et al.*, 2002).

Although the additional income from the higher price of an organic product may be attractive, higher costs and risks in production as well as consumers' discounting of inferior appearance may deter apple producers from transitioning from conventional to organic production. These conditions leave open the questions of the extent to which consumers discount apples with cosmetic damage and whether the price response is modified by organic production methods.

Only a few studies consider how appearance affects consumers' preference for a particular food product. The characteristics include intrinsic attributes of color, texture, and other visible differences (see, for example, Acebron and Dopico, 2000, for beef; Alfnes *et al.,* 2005, for salmon; and Wei *et al.,* 2003, for mandarin oranges). Bunn, Lynch, and Sommer (1990) analyzed survey data from a supermarket and found a low acceptance of cosmetically damaged oranges. The acceptance rate increased substantially after consumers were informed that few pesticide sprays were used to produce the oranges.

Most previous studies related to organic foods focus on consumers' preference for organic attributes by assuming equal cosmetic appearance (Larue *et al.*, 2004; Blend and van Ravenswaay, 1999; and Loureiro , McCluskey, and Mittlehammer 2001). Studies focusing on the effect of cosmetic problems find that consumers discount cosmetic damage, but the trade-off with production method and cosmetic appearance is not as well understood. Thompson and Kidwell (1998) estimated the choice between organic and conventional fruits and vegetables (including apples) with consideration of the cosmetic defects. They found that the cosmetic defects that can frequently be observed, such as broken skin, bruises, and degree of waxiness of apples, and flowering bud clusters in broccoli, affected consumers' choice between organic and conventional produce.

Baker (1999) estimated consumer preferences for food safety attributes (specifically, reduced or no pesticide use) in fresh apples and took account of the damage level on the apples. By using cluster analysis, he found consumers in the "Perfect Produce" segment to have higher income levels and a strong preference for cosmetically undamaged fruits. For other identified consumer groups, cosmetic damage was less of a factor in their consumer choices. Roosen et al. (1998) found that consumers bid lower for apples when there is cosmetic damage and that consumers are not willing to buy cosmetically blemished apples. Although cosmetic damage reduced the probability of purchase, it had little effect on the magnitude of the premium for low pesticide input. These studies suggest that cosmetic appearance in fruit is an important attribute in the consumer's purchase decision, though the effect of production method is less well known.

Our study addresses explicitly the trade-off between cosmetic appearance and organic production methods in order to provide estimates of consumers' willingness to pay for organic apples in fresh fruit markets. Unlike previous studies, we use a mixed probit model to analyze consumers' willingness to buy apples with cosmetic damage that allows us to treat two factors simultaneously: production method and cosmetic appearance. We analyze how the two factors affect the willingness to purchase apples. We also analyze the effect of variables related to consumer behavior on the estimate of willingness to purchase the apples.

Theoretical Framework

Consumers' willingness to buy apples with different amounts of cosmetic damage caused by SBFS is expressed as two categories, willing to buy and unwilling to buy. The two categories are used to measure the corresponding latent utilities. Because the respondent variables are categorical instead of quantitative, we use a mixed probit model to estimate the probability of a consumer's willingness to buy the apples. In contrast to a general probit model, the mixed probit model includes a random effect. Because each participant evaluates multiple apples, there is correlation between responses on apples evaluated by the same person. The random individual effect is introduced to capture this correlation.

Suppose U_{ij} is the utility that consumer *i* derives from consuming the type of apple with spot level *j*. Then, U_{ij} can be expressed as follows:

$$U_{ij} = \alpha_j + X_i\tilde{\beta} + \eta_i + \varepsilon_{ij} \quad i = 1,\cdots,n\,;\; j = 1,\cdots J \qquad (1)$$

where α_j is a choice-specific constant that measures the change in utility caused by apple *j* and X_i is the design matrix, which is a row vector of the *i*th consumer's characteristics. These characteristics include the consumer's experience of growing fruits and vegetables, experience of buying organic fruits and vegetables, and the presence of children under a certain age. Vector $\tilde{\beta}$ is a vector of coefficients associated with X_i; η_i is the random effect that captures the correlation between the apples evaluated by the same individual and is assumed to follow normal distribution with mean zero and variance σ_η^2, i.e., $\eta_i \sim N(0,\sigma_\eta^2)$; ε_{ij} is the residual error term that is not captured by α_j, design matrix X_i, and η_i; and ε_{ij} is assumed to follow the standard normal distribution, i.e., $\varepsilon_{ij} \sim N(0,1)$. There are *n* consumers and *J* different levels of damage among the apples. This specification would lead to the variance and covariance of utility U as follows:

$$\begin{bmatrix} M_J & & & & \\ & M_J & & 0 & \\ & & \ddots & & \\ & 0 & & M_J & \\ & & & & M_J \end{bmatrix} \text{ where } M_J = \begin{bmatrix} 1+\sigma_\eta^2 & \sigma_\eta^2 & \sigma_\eta^2 & \sigma_\eta^2 & \sigma_\eta^2 \\ \sigma_\eta^2 & 1+\sigma_\eta^2 & \sigma_\eta^2 & \sigma_\eta^2 & \sigma_\eta^2 \\ \sigma_\eta^2 & \sigma_\eta^2 & 1+\sigma_\eta^2 & \sigma_\eta^2 & \sigma_\eta^2 \\ \sigma_\eta^2 & \sigma_\eta^2 & \sigma_\eta^2 & 1+\sigma_\eta^2 & \sigma_\eta^2 \\ \sigma_\eta^2 & \sigma_\eta^2 & \sigma_\eta^2 & \sigma_\eta^2 & 1+\sigma_\eta^2 \end{bmatrix}$$

The variance-covariance matrix is an $nJ \times nJ$ square matrix with $J \times J$ square matrices M_J as the diagonal matrices ($1+\sigma_\eta^2$ are its diagonal elements and σ_η^2 are its off-diagonal elements) and off-diagonal elements are zeros (*J*=5 in our survey data). The correlation between utilities brought by different apples evaluated by different participants is zero; and the correlation between utilities brought by different apples evaluated by the same participant is $\dfrac{\sigma_\eta^2}{1+\sigma_\eta^2}$.

The utility U_{ij} cannot be observed. What we observe is the *i*th consumer's willingness to buy apple *j*, which is denoted as y_{ij}.

$$y_{ij} = \begin{cases} 1 & U_{ij} > 0 \\ 0 & U_{ij} \le 0 \end{cases} \qquad (2)$$

The structure of equation (2) is a form of censoring for $i = 1, \cdots, n$; $j = 1, \cdots, J$.

In a survey that asks questions about the respondent's opinion, the respondent's intensity of feelings is dependent on the measurable factors *X* and unobservable ε. In many situations, the respondents are not asked to respond to *U* directly. Instead, the respondents give only a set number of possible answers, say, five, to the question of *y*.

Consumers choose the response to a question that most closely represents their own feelings. To simplify the model, we group the answers into two categories: willing to buy ($y_{ij} = 1$) and unwilling to buy ($y_{ij} = 0$). For example, for apple *j*, consumer *i* chooses among the five choices: very unwilling to buy ($y_{ij} = 0$), somewhat unwilling to buy ($y_{ij} = 0$), neutral ($y_{ij} = 1$), somewhat willing to buy ($y_{ij} = 1$), and very willing to buy ($y_{ij} = 1$).

Because ε_{ij} is assumed to be normally distributed across observations, for $i = 1, \cdots, n$; $j = 1, \cdots J$ we have the following probabilities:

$$\begin{aligned} \Pr ob(y_{ij} = 0) &= 1 - \Phi(\alpha_j + X_i \tilde{\beta}_j + \eta_i) \\ \Pr ob(y_{ij} = 1) &= \Phi(\alpha_j + X_i \tilde{\beta}_j + \eta_i) \end{aligned} \qquad (3)$$

where $\Phi(\cdot)$ is the cumulative density function for the standard normal distribution.

For this model, the marginal effects of the regressors *X* on the probabilities are not equal to the coefficients. They are calculated as follows for a continuous regressor:

$$\frac{\partial E(y_{ij} | X_i)}{\partial X_i} = \phi(\alpha_j + X_i \tilde{\beta}\ )\beta \qquad (4)$$

where $E(t)$ is the expectation of *t*; and $\phi(\cdot)$ is the standard normal density function. The marginal effects are often measured at the mean level of *X*, $\overline{X}$. For discrete predictor variables (such as binary variables and indicator variables), the marginal effects can be obtained by calculating the probabilities associated with each choice at the different levels of the predictor variables, holding the rest of the variables at their mean levels. Specifically, the marginal effect associated with a binary variable is the difference in the probabilities of a particular choice, which is calculated when the binary variable equals one and zero, respectively. The marginal effects for discrete variables are summarized by the following formula:

$$\frac{E(y_{ij} \mid \overline{X}_{-I}, I = r) - E(y_{ij} \mid \overline{X}_{-I}, I = s)}{r - s} \qquad (5)$$

where $\overline{X}_{-I}$ denotes a vector of the mean levels of all predictor variables except the discrete predictor variable *I*; and *r* and *s* are two levels of variable *I*.

The maximum likelihood estimation method is employed to estimate the coefficients α_j, $\tilde{\beta}$, and σ_η. The program is compiled in *R*.

Survey Data

This study focuses on one type of damage to apples, cosmetic surface blotches caused by SBFS. Consumers evaluated color photographs of six Golden Delicious apples presented on one sheet of paper. The apple size in the photo was similar to the actual size of an apple. The first apple, identified as apple U, had no blotches. This apple was considered to be “perfect” and was used to make comparisons for other apples. The second apple, identified as V, had blotches that covered 1% of its surface. The third one (W) had 3% coverage of blotches; and the remaining three apples, identified as X, Y, and Z, had blotch coverage of 5%, 7% and 9%, respectively. To concentrate only on the problem of cosmetic damage, the interviewer stated at the beginning of the questionnaire that the surface blotches are caused by SBFS fungi, that the fungi do not harm humans or the taste of apples, and that the damage is strictly cosmetic. The interviewees were asked to look at the photo of the six apples and then decide how willing they would be to buy apples V through Z. They had five choices: very willing, somewhat willing, neutral, somewhat unwilling, and unwilling.

After making the choice of willingness to buy for each of the apples pictured, the consumer was asked to answer several additional questions, which are listed in Table 1. To test whether individuals are more tolerant of cosmetic damages for organic than for conventional apples, and to obtain an indication of the discount associated with the damage, additional questions presented on some of the questionnaires asked consumers to indicate their willingness to purchase the apples if there were a fifteen-cent discount per pound and if the apple were organic. The interviewees received one of four types of questionnaires: conventional apple production; conventional apple production with fifteen-cent discount per pound; organic apple production; and organic apple production with fifteen-cent discount per pound. Each interviewee was asked only to finish one type of questionnaire so as to ensure the survey results would be independent across the organic and discount factors.

The survey was conducted during regional apple festivals at two orchards in Iowa in October 2004. The people entering the festival site were selected randomly. In order to collect a representative sample, this survey was conducted from 10 a.m. to 5 p.m. for more than one day during the festivals in each of the two orchards.

In total, 471 people were surveyed, of which 454 responded to all the questions. Summary statistics and descriptions of the questions are presented in Table 1.

From Table 1 we see nearly one-third (31%) of the respondents buy apples once a week; two-thirds (67%) of them have grown fruits or vegetables in a garden or orchard; 40% of the respondents have bought organic fruits or vegetables; 69% of them think locally grown is important or very important in their purchasing decision; and 47% of them have young children at home.

Table 1. Summary Statistics for Questions on Respondent Characteristics

Variable Name	Question Description	Frequency (%)	Mean	Standard Deviation
Distance	Distance traveled to get to the orchard (miles)		38.04	88.895
Often	How often apples are purchased to eat fresh			
	5= once a week	30.62		
	4= two or three times a month	14.54	3.714	1.170
	3= about once a month	34.14		
	2=only when in season	17.44		
	1= never or less than once a month	3.26		
Appleaweek	Number of apples bought from all sources in a week		5.446	4.284
Grow	Experience of growing fruits or vegetables in a garden or orchard			
	1 if yes		0.671	0.469
	0 if no			
Buyorganic	Experience of buying organic fruits or vegetables			
	1 if yes	40.31	0.403	0.768
	0 if no	59.69		
Local	Importance to purchasing decision that apples are grown locally			
	4= very important	24.01		
	3= important	45.37	2.890	0.816
	2= not very important	26.21		
	1= not at all important	4.41		
Children	Young children (12 years and younger) living at home			
	1 if yes		0.465	0.499
	0 if no			

One issue to consider is whether or not the survey results are representative of consumers in general (Mitchell and Carson, 1989). In our survey, the sample chosen—those who participate in autumn apple festivals—does not necessarily represent all those who would purchase apples, and in this regard there may some bias in the sample selection. It is quite possible that the segment of the population interested in apple festivals and in purchasing local products is more tolerant of cosmetic damage on apples than the general apple-purchasing population. At the same time, the public participating in local apple markets is an important market segment for organic apple producers. However, there may also be population choice bias. The two orchards are located in the center of a midwestern state. Based on the variable "Distance," the average driving distance was estimated to be 38 miles, with 89 miles as the standard deviation. This result indicates that the population was drawn from the local and regional area. We thus view our sample respondents as representing a population of the central Midwest that would travel to local apple markets. Given the potential biases, the extrapolation of our findings to other populations should be made with caution. We interpret the findings relative to the population attending local and regional festivals and markets. Some questionnaires were categorized as invalid, mainly because of incomplete answers. Since only a small percentage of the surveys (4%) were not used in the analysis, sample non-response bias is not considered to be serious.

Empirical Specification and Results

The empirical specification of the utility function underlying the mixed probit model makes references to both price (the fifteen-cent discount) and production technology (organically produced or conventionally produced). The utility function is formulated as follows:

$$U_{ij} = \alpha_j + \beta_1 Distance_i + \beta_2 Often_i + \beta_3 Appleaweek_i + \beta_4 Grow_i + \beta_5 Buyorganic_i + \beta_6 Local_i + \beta_7 Children_i + \beta_8 Organic_i + \beta_9 Discount_i + \eta_i + \varepsilon_{ij} \quad (6)$$

$i = 1, \cdots, 454$; $j = 1, \cdots, 5$. The term U_{ij} is the latent unobservable utility level for consumer *i* by consuming apple *j*. The observed apple rating (degree of willingness to buy) reflects this latent utility.

The variable "Organic" indicates the production technology—organically produced or conventionally produced. The variable "Discount" indicates the price premium for an apple with blotches compared with a "perfect" appearing apple. Specifically, *Organic* is coded as (1,0), where 1 represents organically produced and 0 represents conventionally produced; and *Discount* is coded as (0, 15), where 15 represents fifteen cents per pound discount and 0 represents no discount. A mixed probit model based on the empirical representation of the latent non-observable utility function in (6) is estimated using maximum likelihood method. Estimation results are presented in Table 2.

Table 2. Mixed Probit Results (n=454)

Variables	**Estimated Coefficients**	**Standard Error**
Distance	0.001	0.002
Often	0.287**	0.132
Appleaweek	0.031	0.034
Grow	1.084***	0.290
Buyorganic	0.317*	0.195
Local	0.413**	0.181
Children	-0.010	0.261
Organic	0.341	0.298
Discount	0.039**	0.020
α_V	8.140***	0.147
α_W	5.951***	0.118
α_X	3.874***	0.097
α_Y	1.542***	0.082
σ_η	3.203***	0.470

*** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

From Table 2 we can see that $\hat{\sigma}_\eta$ is quite large and is statistically significant, so the correlation among the evaluation of different apples by the same person cannot be ignored. Ignoring this correlation could lead to the wrong model specification and estimation results. The variable "Often"—how often the respondent buys apples to eat fresh—measures whether the person is a regular apple consumer or not and indicates whether this behavior significantly affects the probability of the reported ratings. The probability of being willing to buy a particular apple is expected to be larger if a person is a regular apple consumer as compared with the willingness of a person who is not a regular consumer. As expected, being a more frequent apple consumer has a positive effect on willingness to buy apples.

The variable "Grow"—experience of growing fruits or vegetables in a garden or orchard—is also expected to affect the probability of willingness to buy in a positive way. The positive and statistically significant coefficient indicates that those who have grown fruits and vegetables tend to like apples more and would be more willing to buy apples with blemishes. The variable "Local"—how important is it that apples are grown locally in determining the purchase decision—has a significant positive effect on the probability of the willingness to buy apples. People who place greater importance on locally grown production also tolerate apples with a greater amount of blemishes, as expected.

Table A.1 in the appendix gives the marginal effects of the variables to the probability of willingness to buy for the five types of apples. The marginal effect measures the impact of each predictor variable on the probability of each consumer's degree of willingness to buy a particular apple.

Consistent with the notion that most consumers like organic apples more than conventional apples, the production technology—organic production—affects the probability of being willing to buy apples in a positive direction. The results show that if an apple is produced organically, the consumer has a higher probability of being willing to buy it, but the effect is not statistically significant (Table 2). However, when given a fifteen-cent discount for the purchase price, the discount has a positive and statistically significant effect on the probability of being willing to buy apples. The presence of a fifteen-cent discount means the consumer is more willing to buy the apples at varying degrees of cosmetic damage

Because the coefficient on Discount, β_9, provides a measure of the marginal utility of income, the value $\frac{\alpha_j}{\beta_9}$ indicates how much more consumers are willing to pay for apple *j* compared with apple *Z* (the apple with blotch coverage of 9%, a level that is highly visible and conspicuously discolored). For apples of type *j*=V,W,X ,Y, the unit is cents per pound. By calculation, we obtain the result that the consumer is willing to pay $2.08 more for one pound of apples of type V, $1.52 more for one pound of apples of type W, $0.99 more for one pound of apples of type X, and $0.39 more for one pound of apples of type Y compared with apples of type Z (the apple with greatest amount of cosmetic damage). Similarly, the ratio $\frac{\beta_8}{\beta_9}$ =$0.09 provides an estimate of how much more consumers are willing to pay for organic apples versus conventional apples with the same spot coverage level. The premium of $0.09 per pound is in the range of the results from earlier studies (e.g., Granatstein, 2002). Perhaps more relevant are the relative premiums paid for apples of various degrees of cosmetic damage, and we summarize these differences in the consumers' willingness to pay in Table 3.

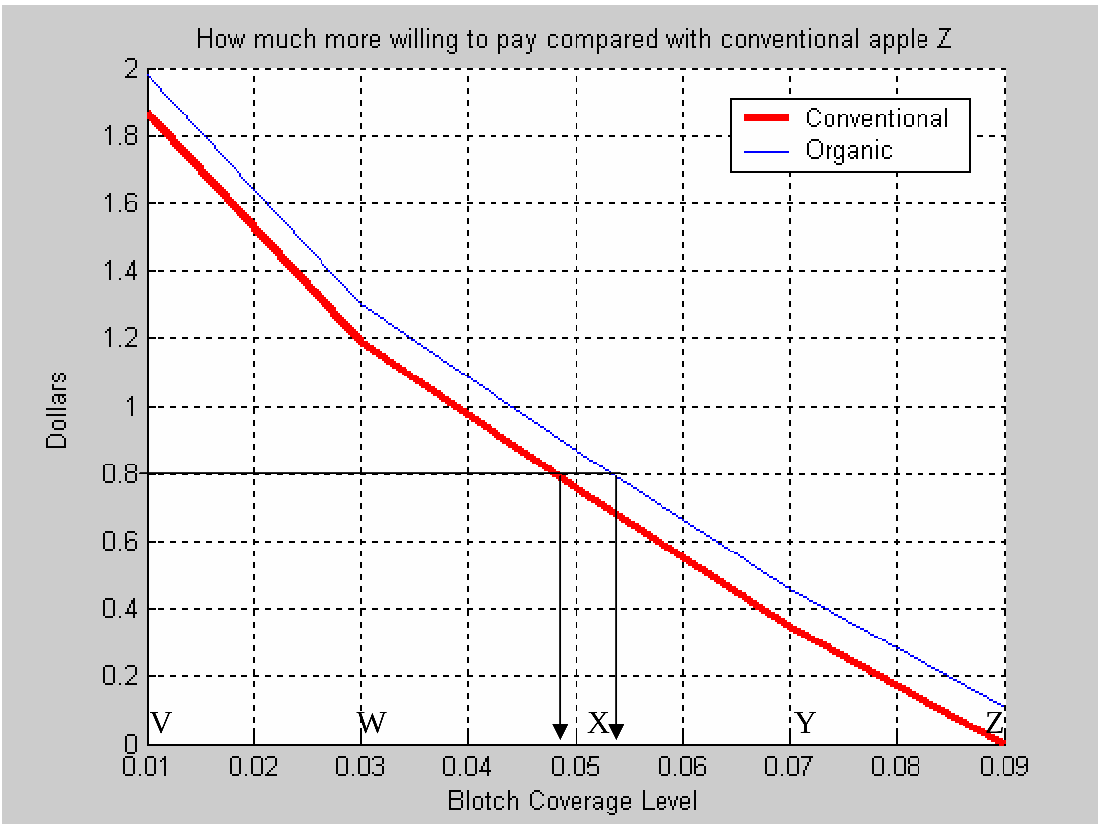
Table 3. Differences in Consumers' Willingness to Pay for Apples with Different Levels of Cosmetic Damage

Comparison of apple types	Difference in willingness to pay (per pound)
V-W	$0.56
W-X	$0.53
X-Y	$0.60
Y-Z	$0.39

From Table 3 we can see that the differences of willingness to pay for apples with different blotch coverage levels shown in the table are greater than the $0.09 premium for organic apples. That is, consumers surveyed are more willing to buy conventional apples with less cosmetic damages (for example, apple V—1% blotch coverage) than for organic apples with relatively "too many" blotches (for example, apple W—3% blotch coverage). This is also illustrated in Figure 1.

Figure 1 indicates how much more consumers are willing to pay for apples with different blotch levels compared with conventional apple Z (an apple produced with conventional methods and having 9% blotch coverage), assuming the willingness to pay for that apple is zero dollars. Figure 1 shows that consumers' tolerance for blotches is limited even if the apple is organically produced. For example, when consumers are willing to pay $0.80 more than conventional apple Z, they will tolerate a blotch coverage level for conventional apples of 4.8% compared with a blotch coverage level for organic apples of 5.3%. If the organic apples' blotch coverage exceeds 5.3%, consumers would rather buy conventional apples with less cosmetic damage (4.8%).

Figure 1. Consumers' Willingness to Pay More for Apples Compared with a Conventional Apple with 9% Blotch Coverage



As mentioned earlier, we would expect consumers to be more tolerant of cosmetically damaged apples if the fruit is produced organically. However, our survey results show that organic production methods do not significantly affect the consumers' willingness to buy apples; the resulting premium is relatively small. In contrast, consumers are relatively sensitive to the occurrence of cosmetic damage.

Conclusion

Our recent survey of consumers in local market settings shows that consumers make a trade-off between production technology and cosmetic appearance of apples, although cosmetic damage weighs significantly in their decision. Because of the survey questionnaire format, we introduced a random effect into the general probit model to evaluate consumers' willingness to buy (organic) apples with different levels of cosmetic damage. Variables that reflect consumer behavior do affect the consumers' willingness to purchase the apples: experience of growing fruits or vegetables, and whether being locally grown is important for the purchase decision.

More importantly, this study estimates the premium that consumers are willing to pay for organic apples and the premium they are willing to pay for apples with different blotch coverage levels. The consumers' tolerance of cosmetic damage on apples is limited. When there are "too many" blemishes on the surface of organic apples, consumers would rather buy conventional ones with better appearance, even if the spots are merely a cosmetic problem.

The presence of cosmetic damage reduces the grade and market value of organic apples. At the same time, the costs of producing organic apples are likely to be higher than for producing apples by conventional growing methods since producers are likely to apply organic pesticides more frequently than conventional pesticides. In the case of SBFS, the use of fungicides at the right production time would minimize significant loss due to cosmetic blemishes. The relatively low consumer acceptance of cosmetic damage to apples narrows the margin of error for organic growers and makes decision making for organic growers challenging. Because of the limited consumer tolerance for cosmetic damage, apple producers must account for the trade-off between production technology and cosmetic damage in their production decisions in order to ensure their profits. Although our results apply only to consumers in the market who attend farmers' markets and festivals, we expect that these consumers would be more tolerant of cosmetic appearance in locally grown, organic apples. It would be useful to apply a similar approach to determine whether these results can be extended to other market settings. It is possible that the organic market has shifted from one in which consumers are tolerant of considerable product variation to one in which consumers have less tolerance for poor cosmetic appeal.

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Appendix

Table A.1. Marginal Effects of Variables

Variable	Interval Points	Marginal Effects
Distance	______	0.000999
Often	P(5)-P(1)	0.000891
Appleaweek	______	0.030972
Grow	P(1)-P(0)	0.004908
Buyorganic	P(1)-P(0)	0.001023
Local	P(4)-P(1)	0.002063
Children	P(1)-P(0)	-0.000031
Organic	P(1)-P(0)	0.001107
Discount	______	0.038964
α_V	P(1)-P(0)	0.000919
α_W	P(1)-P(0)	0.000919
α_X	P(1)-P(0)	0.000919
α_Y	P(1)-P(0)	0.000917