Consumer WTP for Blueberry Attributes: A Hierarchical Bayesian Approach in the WTP Space

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Abstract

A stated preference experiment is conducted to elicit consumer willingness to pay (WTP) for various blueberry attributes. A mixed logit model estimated by the hierarchical Bayesian approach (HB) is employed to account for consumer heterogeneity and the distributions of WTPs are directly specified. The results show that locally produced blueberries are preferred over U.S. produced blueberries by most respondents. By contrast, less than 50 percent of the respondents demonstrate positive premiums for organic blueberries. Additionally, hardly any relationship between demographics and WTPs is detected. In this light, the HB approach is critical to the practice of differential marketing strategies.

Key Words: Blueberry Attributes, Differential Marketing, Hierarchical Bayesian, Mixed Logit, Preference Space, WTP, WTP Space

JEL Classifications: D12, Q13

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Introduction

In the late 1990s, scientific research revealed special health benefits of blueberries, including high levels of antioxidant properties. Per capita consumption of fresh blueberries has increased dramatically since 2000 (United States Department of Agriculture, Economic Research Service [USDA/ERS]), with blueberries taking up an increasing market share in the fruit market. This growth reflects both increased consumer awareness of the importance of healthy diets and the proactive effort by the U.S. blueberry industry in publicizing the benefits from blueberry consumption. Faced with such rapid growth of this new market, a systematic study about consumer behavior in blueberry consumption is critical.

Consumer choice of fruit has become complicated, as even the same type of fruit, for example, blueberries, can have multiple attributes. Market segmentation is used to reach different consumer segments. In a market growing as quickly as the blueberry market, understanding consumer choice of these attribute combinations is perhaps even more critical. Production method, origin of production, and form of the fruit (i.e., frozen versus fresh) are among a number of attributes (appearance, flavor, price, etc.) that consumers consider when purchasing fruit. Consumers' choices depend highly on their preferences. Some consumers may prefer fresh blueberries over frozen ones, while other consumers may prefer frozen blueberries because of their long shelf-life. As for the credence attributes, such as production method (i.e., organic) and production location (country of origin), consumers' perception also demonstrates a large deviance. Some consumers may consider country of origin of blueberries a more important attribute than whether the product is fresh or frozen, while to others, country of origin may not be important. Some consumers believe in organic production and thus are willing to pay more for organic blueberries. Though this preference choice has been shown to exist for other fruits (i.e., Lin, Smith, and Huang, 2008; Batte et al., 2007; Yue and Tong, 2009; Loureiro, McCluskey, and Mittelhammer, 2001), it is important to explore the size of the consumer segments specifically for blueberries. Different consumers appreciate different attributes, thus, marketing strategies that fail to take consumer heterogeneity into account are destined to be less efficient.

The explanatory power of demographics for consumption behavior is limited (Frank, Massy, and Boyd, 1967; Yankelovich, 1964), especially for small purchases such as one pint of blueberries in a highly competitive fruit market. This study will compare the importance of different attributes on consumer willingness to pay (WTP) for blueberries at the individual-level. If consumers have a diversity of opinions regarding fruit attributes, especially given the large amount of substitutes in the fruit market, a single marketing strategy might not be ideal. Studying the impact of attributes on different consumers will aid blueberry producers to target different consumers with different marketing strategies.

The objective of this study is to compare consumers' attitudes toward four blueberry attributes and differentiate consumers in terms of their individual-level WTP estimates (i.e., WTP estimates for each respondent). Our work contributes to the literature in two aspects. First, we examine consumers' perception of the attributes of non-processed (fresh) and frozen blueberries. To our knowledge, the literature on blueberry consumption (Hu, Woods, and Bastin, 2009; Hu et al., 2011; etc.) mainly focused on the attributes of processed blueberry products. Non-processed blueberries possess much higher market values and consumer recognition. Additionally, the percentage of fresh use among utilized production of blueberries increased from 27% in 2000 to almost 50% in 2009 (USDA).[1] The percentage is expected to keep rising as more people realize the health benefits of fresh blueberries. Second, our results are based on the individual-level estimates, which provide valuable information about the variety of consumer attitudes, such as diversified attribute importance ranking. Such information is extremely valuable when demographic information is not available or the explanatory power of demographics is marginal. Most previous literature reported only aggregate WTP estimates (i.e., the average WTP) or the distribution of WTPs across consumers, which are much less informative for the implementation of differential marketing. Individual-level estimates provide us with valuable information about individual consumption behavior, which is indispensable for differential marketing strategies. For example, price-cut strategies are expected to be more effective for consumers who are more sensitive to price. Organic labeling may only attract those who prefer organic production. In this light, supermarkets can issue different types of coupons to different consumers based on their individual preferences (Rossi, McCulloch, and Allenby, 1996). In addition, since all kinds of WTP elicitation methods have some shortcomings, the accuracy of the WTP estimate cannot be guaranteed. The comparison of the relative importance of various attributes might be of more practical value. The individual-level estimates enable us to calculate the proportion of consumers that prefer one attribute over another. Such information cannot be obtained from the two estimated distributions of WTPs for the two attributes.

Consumer Attitudes for Food Attributes

[1] The number is based on the production and utilization data of Maine, Michigan, New Jersey, North Carolina, Oregon, Washington, Alabama, Arkansas, Florida, Georgia, Indiana, New York, California and Mississippi.

There is a large amount of literature on the valuation of food attributes. For example, country of origin is among the most popularly discussed food attributes in recent years and is an important characteristic in consumers' purchasing decisions. Umberger et al. (2003) showed that most consumers were willing to pay premiums for the "USA Guaranteed" label on steak. The food safety concerns and belief in higher quality of USA products are generally believed to be one of the main reasons for consumers' recognition of USA products. In addition to the country of origin label, the "locally grown" attribute of fruits or vegetables has been gaining popularity. Dentoni et al. (2009) found that the attribute of "locally grown" directly affected consumers' purchasing behavior for apples. In the study of Hu, Woods, and Bastin (2009), consumers in Kentucky were found to demonstrate higher WTP for "locally produced (within the state of Kentucky)" than for organic and sugar-free attributes of processed blueberry products. Darby et al. (2006) also concluded that consumers were willing to pay more for locally grown strawberries than for those just with "produced in the U.S." label.

In addition to country of origin, there is extensive literature on the choice between organic and conventional products. Wang and Sun (2003) concluded that the organic market had a large consumer base and it's future was promising. Batte et al. (2007) considered multi-ingredient processed organic foods with four levels of organic content under the National Organic Program (100% organic, 95% organic, 70-95% organic, <70%organic). Their results indicated that customers were willing to pay a premium for food with organic content, even those that were not totally organic. Loureiro, McCluskey, and Mittelhammer (2001) showed that consumers with similar perceptions of food security and environmental issues tended to choose the organic apples over the eco-labeled apples when these two types of apples were both available and sold at the same price. Yue and Tong (2009) found that the WTP for organic and that for local were almost the same. However, Hu, Woods, and Bastin (2009) concluded that although organic foods were believed to be one of the solutions for food safety, supporters of organic foods were not so broad and were limited to a certain proportion of consumers. The reason might be that the price of organic foods is generally much higher than that of conventional foods. Other discussions on consumers' perception of the organic attribute can be found in Brooks and Lusk (2010); Bond, Thilmany, and Bond (2008); Lin, Smith, and Huang (2008); Janssen, Heid, and Hamm(2009); Managi et al. (2008); etc.

The Model

Previous research in the field of food marketing has taken into account the diversity of consumer preference. However, most of the literature reported only aggregate estimates. The traditional aggregate estimates (population-level estimates) of WTPs are not very informative as they cannot provide the information of each respondent. In this study, a mixed logit model is estimated by the hierarchical Bayesian (HB) approach. The Bayesian method, which is well-suited to update estimates based on each individual's choice information, is a powerful tool for marketing. The HB approach also has irreplaceable advantages in finite sample inference (Rossi, Allenby, and McCulloch, 2005) and can generate the individual-level estimates as byproducts (Allenby and Rossi, 1998). To obtain more sensible and accurate WTP estimates, we estimate the mixed logit model in the WTP space.[2]

In the mixed logit model, the utility coefficients are assumed random while in the traditional conditional logit model, the coefficients are specified as constant over the consumers.

[2] In the WTP space, WTP is directly estimated instead of derived by the ratio of the coefficients of the attribute and price, as is done in the preference space.

As specified in the mixed logit model in the preference space, the probability that individual *n* would choose alternative *j* in choice situation *t* is:

(1)
$$P_{njt} = \int (\frac{\exp(\mathbf{X_{njt}}\boldsymbol{\beta})}{\sum_i \exp(\mathbf{X_{nit}}\boldsymbol{\beta})}) \phi(\boldsymbol{\beta} \mid \boldsymbol{\theta}) d\boldsymbol{\beta}$$

$\phi(\boldsymbol{\beta} \mid \boldsymbol{\theta})$ is the distributional assumption for the utility coefficient **β**. **θ** is called the population-level parameter (hyper-parameter) as it describes the distribution of **β** over the whole population. All kinds of distributional assumptions can be made for **β** according to the researcher. As **β** is integrated out, the parameter that needs estimation is **θ**.

The latent utility in the WTP space can be derived as:

(2)
$$U_{nit} = \mathrm{X}_{\mathrm{nit}}\boldsymbol{\beta}_{\mathrm{n1}} + \beta_{\mathrm{n2}} \times P_{nit} + \varepsilon_{nit}$$

$$\Rightarrow \frac{U_{nit}}{\beta_{n2}} = \frac{\mathrm{X}_{\mathrm{nit}}\boldsymbol{\beta}_{\mathrm{n1}}}{\beta_{n2}} + P_{nit} + \frac{\varepsilon_{nit}}{\beta_{n2}} = -\mathbf{X_{nit}}\mathbf{W_n} + P_{nit} + \upsilon_{nit}$$

$$\Rightarrow \frac{U_{nit}'}{s_n} = -\frac{\mathbf{X_{nit}}\mathbf{W_n}}{s_n} + \frac{P_{nit}}{s_n} + \frac{\upsilon_{nit}}{s_n}$$

where P_{nit} is the price of alternative *i* in situation *t* face by individual *n*. $\mathbf{X_{nit}}$ is the vector of other attributes, except price. $\mathbf{W_n}$ is the vector of WTPs for attributes of individual *n*. If respondents demonstrate a certain degree of randomness (i.e., the attention they paid to the task varied) in the decision process over the choice situations, it is necessary to divide both sides of the equation by the scale parameter s_n ($s_n>0$) to account for this level of variation (Train and Weeks, 2005).

The probability that individual *n* would choose alternative *j* in choice situation *t* in the WTP space is as follows:

(3)
$$P_{njt} = \int (\frac{\exp(-\mathbf{X_{njt}}\mathbf{W}/s + p_{njt}/s)}{\sum_i \exp(-\mathbf{X_{nit}}\mathbf{W}/s + p_{nit}/s)}) \phi(\mathbf{W}, \frac{1}{s} \mid \boldsymbol{\theta}_1, \boldsymbol{\theta}_2) d(\mathbf{W}, \frac{1}{s})$$

where $\boldsymbol{\theta_1}$ and $\boldsymbol{\theta_2}$ are the population parameters. Distributional assumptions are placed on **W** and $\frac{1}{s}$. Therefore, WTP estimates do not need to be derived by the ratio of two random parameters as is done in the preference space, instead it is directly specified. Sonnier, Ainslie, and Otter (2007);[3] Balcombe, Chalak, and Fraser (2009); and Scarpa, Thiene, and Train (2008) showed that the WTP estimates from the WTP space were more reasonable in terms of magnitude and dispersion than those from the preference space because additional transformation leaded to excessive extreme values.

W is assumed to be multivariate normally distributed and assuming that $\frac{1}{s}$ is distributed as log-normal ensures positive values of the scale parameters.

The prior distribution for the population mean ($\boldsymbol{\theta_1}$) of the multivariate normal distribution is assumed to be diffuse multivariate normal, and that for the population variance ($\boldsymbol{\theta_2}$) is assumed diffuse inverted Wishart. Nonzero covariance is allowed between the elements of **W** and $\frac{1}{s}$.

The joint posterior for $\boldsymbol{\theta}_1, \boldsymbol{\theta}_2, \mathbf{W_n}, \frac{1}{s_n}, \forall n$ can be expressed as follows according to the Bayes' rule:

$$(4) \quad L(\boldsymbol{\theta}_1, \boldsymbol{\theta}_2, \mathbf{W_n}, \frac{1}{s_n}, \forall n \mid \mathbf{Y}) \propto \prod_n \prod_t [\frac{\exp(-\mathbf{X_{ny_{nt}t}} \mathbf{W_n} / s_n + p_{ny_{nt}t} / s_n)}{\sum_i \exp(-\mathbf{X_{nit}} \mathbf{W_n} / s_n + p_{nit} / s_n)} \phi(\mathbf{W_n}, \frac{1}{s_n} \mid \boldsymbol{\theta}_1, \boldsymbol{\theta}_2)] \kappa(\boldsymbol{\theta}_1, \boldsymbol{\theta}_2)$$

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[3] They used the terms "utility model" and "surplus model" instead of "preference space" and "WTP space."

The HB approach relies on the Gibbs sampler to obtain the draws of $\mathbf{W_n}, \frac{1}{s_n}$, based on which population-level parameter estimates are calculated. In this study, 30,000 iterations are taken during the burn-in period (before convergence) and 5,000 every other tenth draw[4] are retained after burn-in to calculate the parameter estimates. Detail of the Gibbs sampler can be found in Robert and Casella (2004) or Casella and George (1992). The HB method is used because it gives out the individual-level estimates as byproducts, so no additional procedures are needed (Allenby and Rossi, 1998). Details of the Bayesian method can be found in Rossi, Allenby, and McCulloch (2005) and Train (2003).

The Stated Preference Experiment and the Data

A stated preference experiment was conducted and distributed online to random consumers living in the Northeast and Southeast regions of the United States. Each respondent was asked to make choices over a series of choice situations. Since multiple observations per respondent were collected, individual-level information can be inferred.

The stated preference experiment approach has been widely used by researchers (i.e., Brooks and Lusk, 2010; Gao and Schroeder, 2007; Alfnes, 2004; Carlsson, Frykblom, and Lagerkvist, 2004). Although there might be some potential problems associated with the stated preference approach, such as exaggerated WTP estimates (Brooks and Lusk, 2010; Johansson-Stenman and Svedsäter, 2008), there are four main reasons for it to be the suitable approach for the study of consumer purchase of blueberries. First, it is not usual for consumers to have access to a great variety of blueberries (all possible sources, forms, or prices) in the same section of the grocery store or other places when they are shopping for blueberries, so this gives reason to

[4] In this way, correlation between subsequent retained draws can be reduced.

question the dependability of the WTP estimates even if we have real transaction data. For example, people might actually prefer frozen blueberries, but end up buying fresh ones because they fail to find the frozen ones. Second, one of the attributes included in this experiment is organic, although organic blueberries are not very common in most marketplaces. Third, the stated preference experiment is relatively simple to conduct, and its convenience in obtaining measurement of the tradeoffs between product attributes is noticeable. Fourth, multiple observations for each respondent are obtained in the stated preference experiment, so estimates for each individual are made possible.

Both main effects and first-order interaction effects are included in the model. The purpose is to see whether the WTP for an attribute will be affected by the existence of other attributes.

We set freshness (fresh and frozen), production method (organic and conventionally produced), price and place of origin (whether they are produced locally, in the United States or imported from other countries) as attributes of blueberries. Four different prices are used for the price attribute: $1.50/pint, $2.50/pint, $3.99/pint, and $5.99/pint. We define “locally produced” blueberries as those produced within the state in which the respondent resides.

Different combinations of the levels of the four attributes form a choice alternative. Each choice situation is designed to contain three alternatives, including “neither” as one alternative. The purpose of including “neither” as one option is to make the choice experiment more similar to real purchase situations where consumers can simply choose not to buy any of the described blueberries. A constant to be estimated is assigned to the utility associated with the “neither” option in the model. Thus, there are two kinds of blueberry specified in each choice situation (no matter whether they exist in reality or not). Respondents choose one kind from these two or they can choose “neither”. A fractional factorial design was used and 12 choice situations were included in the experiment. Each respondent in the survey was asked to make choices in these 12 hypothetical situations. The prices are made negative in the estimation process to ensure that the results have positive signs for the estimated scale parameters. Table 1 lists all the attributes and their corresponding levels included in the experiment. For identification purpose, we set frozen, imported, and conventional as the base and omit them in the model estimation.

Data collection began in December 2010 and ended in January 2011, with approximately 400 participants recruited on a monthly basis. Since the choice experiment is based on hypothetical comparison, we assume there is no seasonal effect and just use the data of the two months, which provide us with 772 responses.

Results

Among the respondents, 65% of them are females. The average age is approximately 47 and the average household income is about $53,403. Eighty-one percent of the respondents are Caucasian, and 11% are Black, or American African. The rest are Asian, Hispanic, etc. Twenty-three percent of the respondents have a high school degree or equivalent, 57% have a four-year college degree or some college, and 11% have attained a postgraduate degree.

Mixed Logit Estimation Result

The estimation results of the mixed logit model are presented in Table 2. Most of the estimated population means of the WTPs are significant at the 5% level. The variances of the WTP distributions of all the attributes are significantly different from zero at the 5% level. Thus, we conclude that consumer heterogeneity does exist. The estimated population means of the WTPs are positive for fresh, locally produced, and U.S. produced. This is consistent with our expectation that U.S. consumers generally prefer fresh blueberries over frozen ones and prefer local and U.S. blueberries over imported ones. However, the mean WTP estimate of organic is not significantly different from zero, which indicates that consumers in general might be indifferent about whether the blueberries are organic or not.

The estimated means for all interaction terms are negative and are significant except for the interaction between fresh and organic. The negative signs of the interaction terms can be explained as the outcome of the concavity of the utility function. Specifically, the utility increase from fresh blueberries to fresh local blueberries should be less than the utility increase from frozen U.S. or imported blueberries to frozen local ones. Similarly, if the blueberries are already local, consumers would not care as much about the organic attribute as they would if the blueberries are imported. Therefore, the utility function is not linear in the blueberry attributes.

Comparison of WTP Estimates from the WTP Space and the Preference Space

When the interaction effects are significant, interpretation based on main effects would be misleading. Therefore, 20 conditional WTPs are calculated to analyze the simple effects of the attributes. Specifically, the WTPs for organic can be classified into WTP for organic conditional on fresh imported (W_{ofi}), fresh local (W_{ofl}), fresh U.S. produced (W_{ofu}), frozen imported (W_{ofroi}), frozen local (W_{ofrol}), and frozen U.S. produced (W_{ofrou}) blueberries. Similarly, the WTP for fresh is conditional on six types of blueberries. WTPs for local and U.S. produced are each conditional on four types of blueberries. Most of these conditional WTP estimates are obtained by adding two or three elements (i.e., $W_{ofi}=W_{org}+W_{fresh\_org}$, $W_{ofl}= W_{org}+W_{fresh\_org}+W_{org\_local}$ for each n) [5] from the estimated **W** in equation (3). The individual-level W_n of each respondent is used to ensure that the elements in **W** are from the same respondent.

[5] W_{ofi} denotes the WTP for organic, conditional on fresh and imported blueberries. W_{ofroi} is the WTP for organic, conditional on frozen and imported blueberries. The rest is deduced by analogy.

In the preference space, the individual-level estimates of the 20 conditional WTPs are obtained by taking the ratio of the draw of the attribute coefficient and the draw of price coefficient in each iteration after burn-in and then taking the average over iterations. The box plots for these 20 individual-level WTPs of the 772 respondents in the WTP space are shown in Figure 1 and the corresponding box plots in the preference space are shown in Figure 2. The spreads of these individual WTPs in Figure 2 are quite large, with nontrivial shares of people willing to pay unreasonably large premiums for the attributes. There are also a large number of outliers represented by the black squares in Figure 2. These enormous WTP estimates are the result of indirect specification. In Figure 1, by contrast, the spreads of these individual WTPs are much smaller and the outliers are sparse. Additionally, there is not much difference between the medians and the means for most of the distributions in Figure 1. This supports the normal distributional assumptions for consumer WTPs.[6]

The means and standard deviations of the individual-level WTPs for fresh blueberries from these two spaces are shown in Table 3. The six means[7] across all the respondents from the preference space are generally much bigger than their counterparts from the WTP space due to the influence of substantial outliers. Two are more than $6/pint for the fresh attribute, which are

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[6] If the distributions of the random WTPs are properly specified and consistently estimated, the average of the distributions of respondents' individual-level WTP estimates should be similar to the estimated population WTP distribution (Train, 2003; Allenby and Rossi, 1998).

[7] Means of individual WTPs are conditional on conventional and imported, conventional and local, conventional and U.S. produced, organic and imported, organic and local, and organic and U.S. produced blueberries.

unrealistic and lack face validity. The standard deviations of these estimates from the preference space are also much bigger than those from the WTP space. These highly dispersed individual-level WTPs with unreasonably high means cannot provide us with an accurate base for the analysis. In contrast, the means and standard deviations of the WTP estimates obtained from the WTP space are much more reasonable, with the highest mean being $2.78/pint and the standard deviations all within the range from 1.70 to 2.50. The table comparisons of the WTPs for other attributes are omitted. In all, the WTP estimates from the WTP space outperform those from the preference space.

Consumers' WTPs for Blueberry Attributes

The proportions of respondents who fall in a certain range of WTP values for each attribute are shown in Tables 4 and 5. This method of summarizing individual-level WTPs is used because of its robustness to extreme values.

The comparison of estimated WTPs for local and U.S. produced blueberries are shown in Table 4. While the proportions of positive WTPs for local and U.S. produced do not show significant differences, the proportions of WTP estimates above $3/pint are all bigger for local than for U.S. produced. These figures indicate that most U.S. consumers hold the identical attitude that U.S produced blueberries are superior to imported ones and, at the same time, some consumers are willing to pay more for local than for simply U.S. produced. The last column of Table 4 lists the percentage of respondents whose WTPs for local are bigger than that for U.S. produced. All of the percentages exceed 60%, with the largest reaching nearly 90%. Therefore, the majority of the respondents prefer local over simply U.S produced blueberries. We conclude that locally produced blueberries can attract a larger price premium than simply U.S. produced blueberries. This is also indicated by the larger population mean of W_{local} compared to $W_{U.S.}$ in Table 2.

Although the population mean of W_{org} (Table 2) is not significantly different from zero, 24.62% to 45.58% of the respondents are willing to pay a positive premium for organic blueberries, depending on the other attributes (Table 5). The largest proportion (45.58%) is for frozen and imported blueberries. Thus, the organic blueberries are most attractive when the other favorable blueberry attributes (fresh and U.S. produced) are not available. Although a certain proportion of respondents are demonstrating positive WTPs for organic attribute, only a small proportion are willing to pay more than $2/pint.

In addition to the stated preference questions, participants answered questions designed to elicit their attitudes towards organic fruits and vegetables. Only 51.9% of the respondents agreed or strongly agreed to the statement of "I trust fruits and vegetables labeled as organic" and only 28.8% of the respondents agreed or strongly agreed to the statement of "I will pay more for fruits and vegetables with an organic label." Therefore, it is not surprising that there are a relatively low proportion of positive WTPs for organic. The result from the stated preference experiment is consistent with the result from the attitude statement questions. Based on the average WTP for each attribute across the other attribute combinations, we find that 95.08% of the respondents are willing to pay more for U.S. produced blueberries than for organic ones and the proportion is 96.37% when we compare local and organic blueberries. Thus, the results indicate that consumers place more emphasis on the country of origin attribute than they do on organic.

One finding from the Bayesian estimates worth attention is that there are a large proportion of negative individual-level WTP estimates for organic. One of the reasons might be the assumption of normal distribution for $\mathbf{W}$, which does not impose any restrictions on the signs of the WTP estimates. The other reason might be that some respondents ignored the attribute of organic because of indifference, especially when they saw other more favorable attributes in the choice sets. Therefore, we might interpret the result as the outcome of a simplified mechanism behind respondents' judgments in the choice experiment.

To investigate the relationship of demographics with individual-level WTP estimates, averages of the conditional WTPs across all types of blueberries are calculated for each respondent. A series of scatterplots that relate income, education, and age to the individual-level WTP estimates for organic and locally produced blueberries are shown in Figure 3. The magnitude of the numbers on the horizontal axis stands for the level of income, education, and age. The relationship between demographic information and WTP for organic blueberries is marginal, so is the relationship between demographics and WTP for locally produced blueberries. Upon further investigation, other demographic information, such as race and gender, is also not found to have a significant relationship. Overall, demographics provide little contribution in explaining consumers' WTPs for these blueberry attributes.

A final example of the individual differences found is shown in Table 6, where WTP values of three respondents (numbers 9, 65, and 618) are shown. In this case, the differences among the participants are clearly seen. For example, participant 65 is willing to pay more for fresh blueberries and respondent 618 is willing to pay more for organic blueberries, while respondent 9 places the highest value on the country of origin attribute. From this simple illustration, differences among consumers and the weights they place on each attribute are demonstrated. Although the average WTP for organic blueberries across all the respondents is nearly zero, there are still respondents who demonstrate substantial positive WTPs for organic blueberries.

The Reliability of the Individual-Level Estimates

To check the reliability of the individual-level estimates, we compute the mean absolute error (MAE) for the within-sample prediction using the population WTP mean and individual-level WTPs separately. The MAE[8] calculated from the population WTP mean is 0.2959 and that from the individual-level WTPs is 0.0592. The in-sample fit improves dramatically by the use of disaggregate information. Therefore, the individual-level estimates have the better performance in terms of in-sample fit.

Moreover, in the experiment, we find that there are 57 respondents who always chose "neither" over the 12 choice situations. These respondents might not be interested in the experiment at all, so we denote them as "nonparticipants." The other respondents are denoted as "participants." It is trivial to expect that the variation and magnitude of the scale parameters of the nonparticipants are smaller than those of the participants. Figure 4 compares the individual scale parameter estimates for non-participants and participants. We can see that the scale parameters of non-participants are much smaller than those of participants and there is not much variation in the non-participants' scale parameters (represented by an almost horizontal line). In addition, from the choices of the respondents, we identify five "organic lovers" who always chose organic blueberries whenever the choice situation included both conventional blueberries and organic blueberries, no matter what other attribute combinations were included. Their averages across the six conditional WTPs for organic, which range from $3.69/pint to $4.00/pint, are also the biggest among all the respondents. Therefore, although the number of observations for each respondent is not big enough (t=12), the updated Bayesian individual-level estimates are fairly informative.

Conclusion and Discussion

In this study, we applied a mixed logit model to the data from a stated preference experiment to explore consumers' WTP for different blueberry attributes. We compared different

[8] A MAE value of 0 indicates that the choices are perfectly predicted.

methods of estimating WTP and found the better way was to estimate the model directly in the WTP space. In this case, the WTP estimates were more reasonable than those from the preference space in terms of magnitude and dispersion.

Our results show that locally produced blueberries elicited the largest WTP values among all the attributes considered. Somewhat surprising is the result that, generally, consumers were indifferent to the production method (organic versus conventional) for blueberries. Less than 50% of the respondents in the experiment had a positive WTP for organic blueberries and more than 95% of the respondents placed more emphasis on the origin attribute than they did on organic. Though potentially surprising when compared to other fruits, this result is supported by the responses to the attitude statement questions. It can also be interpreted as the result of a quickly growing market, in which consumers have not adapted fast enough to demand organic blueberries yet. As a validation method, we estimated the model using additional data (data from the same experiment but different sample of respondents) and the results (i.e., overall ranking of the importance of attributes, estimated parameters) are almost identical.

Consumer preferences and attitudes are highly diversified. The traditional method of relying on demographic information to explain consumer behavior may not always be effective, especially for small purchases like fruits or vegetables. While the purchases of houses or cars might somehow reflect people's economic or educational condition, the choices of fruits might not be well differentiated by demographic characteristics. Our results show that respondents' demographic information makes little contribution in explaining their tradeoffs for blueberry attributes.

The HB approach provides us with valuable disaggregate information that can help retailers differentiate consumers and set up more effective marketing strategies. For example, supermarkets can issue different coupons or leaflets to different consumers based on their individual attitudes instead of distributing them indiscriminately (Rossi, McCulloch, and Allenby, 1996). Coupons or brochures with sales featuring imported blueberries might only work with consumers who do not have a strong bias toward imported fruits (i.e., respondent 65 if compared with the other two respondents in Table 6). Retailers can also issue coupons of different values, depending on the price sensitivities of consumers. Such differential promotion strategies can expand sales volume while increasing retailers' profits. Moreover, consumer preference may not always be stable. The dynamic change in consumer preference or perception can also be captured by Bayesian estimation.

There are several limitations of our study. First, our experiment was constrained by the limited space of the survey and concern on respondent burn-out, so the number of observations per respondent was not enough to make an unbiased estimation of the individual-level WTP estimates, though the estimates already enabled us to compare respondents' valuation of blueberry attributes. Second, only within-sample prediction criterion was used to compare the performances of individual-level estimates and population-level estimates. Out-of-sample prediction should also be conducted for a more comprehensive performance comparison. Our future research would be to include more choice situations for each respondent and evaluate the out-of-sample prediction of individual-level estimates.

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Table 1. Blueberry Attributes and Levels in the Choice Experiment

Attribute	Level 1	Level 2	Level 3	Level 4
Freshness	Fresh	Frozen		
Place of origin	Locally produced	U.S. produced	Imported	
Production method	Organic	Conventional		
Price ($/pint)	$1.50	$2.50	$3.99	$5.99

Table 2. Estimation Results of the Mixed Logit Model in the WTP Space

WTP(**W**)	Distribution	Mean	Variance
Fresh	Normal	2.783**	9.423**
		(0.198)	(1.340)
Organic	Normal	0.008	1.724**
		(0.197)	(0.438)
Local	Normal	3.940**	12.433**
		(0.191)	(1.520)
U.S.	Normal	3.021**	8.472**
		(0.174)	(1.172)
Fresh_org	Normal	-0.382	1.103**
		(0.282)	(0.354)
Fresh_local	Normal	-0.686**	17.230**
		(0.290)	(2.649)
Fresh_us	Normal	-0.733**	15.214**
		(0.331)	(2.227)
Org_local	Normal	-0.846**	1.519**
		(0.142)	(0.375)
Org_us	Normal	-0.579**	2.810**
		(0.217)	(0.513)
Constant	Normal	-1.629**	15.305**
		(0.198)	(2.558)
1/s	Lognormal	4.477	53.771
Simulated Log-likelihood		-5801.7	

Notes: ** and * indicate that the parameter is significant at 5% level and 10% level respectively. Figures in the parenthesis are standard errors. The mean and variance of 1/s are for the simulated distribution of 5000 exponentiated random draws from N (0.8394, 1.3206), which is the estimated distribution of log(1/s).

Table 3. Comparison of Means and Standard Deviations of WTPs for Fresh in the Preference Space and WTP Space

	WTP Space		Preference Space	
	Mean ($/pint)	Standard Deviation	Mean($/pint)	Standard Deviation
W_{fci}	2.78	2.23	6.72	7.89
W_{fcl}	2.10	2.09	3.25	4.86
W_{fcu}	2.05	1.70	3.27	4.17
W_{foi}	2.40	2.45	7.28	9.89
W_{fol}	1.72	2.26	3.81	5.91
W_{fou}	1.67	1.92	3.84	5.07

Table 4. Summary Statistics of Respondents' WTPs for Local and U.S. Produced

Other Attributes	Positive WTP for Local (%)		Positive WTP for U.S. Produced (%)		Respondents who Prefer "Local" over "U.S. Produced" (%)
	>3 $/pint	>0 $/pint	>3 $/pint	>0 $/pint	
Fresh and Conventional	49.35	83.63	35.81	81.15	89.12
Frozen and Conventional	49.47	84.92	44.40	84.57	77.20
Fresh and Organic	38.16	79.03	30.39	66.55	65.67
Frozen and Organic	37.81	80.80	29.45	89.28	66.84

Table 5. Summary Statistics of Respondents' WTPs for Organic

Other Attributes	Positive WTP for Organic (%)		
	$(0,2]$ (%)	$(2,+\infty)$ (%)	Total (%)
Fresh and Imported	28.27	5.54	33.80
Fresh and Local	18.37	6.24	24.62
Fresh and U.S.	22.50	7.66	30.15
Frozen and Imported	42.64	2.94	45.58
Frozen and Local	21.55	3.53	25.09
Frozen and U.S.	29.56	7.18	36.75

Note: The unit of the ranges is dollars/pint.

Table 6. WTPs of Three Respondents

	WTP($/pint)			
Respondent #	Organic	Local	U.S. Produced	Fresh
65	0.04	1.90	0.56	5.04
9	-0.97	4.14	3.36	1.19
618	3.69	2.98	2.17	1.51

Note: The WTP values are the averages across the corresponding conditional WTPs.

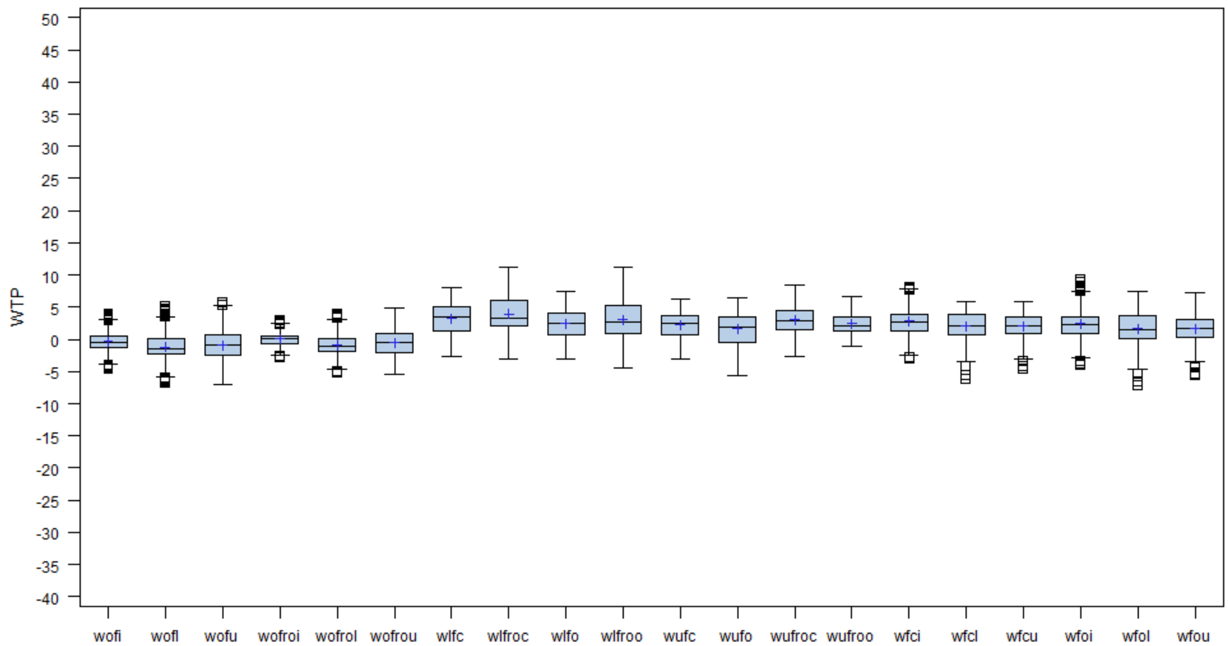

Figure 1. Box plots of individual-level WTP estimates in the WTP space

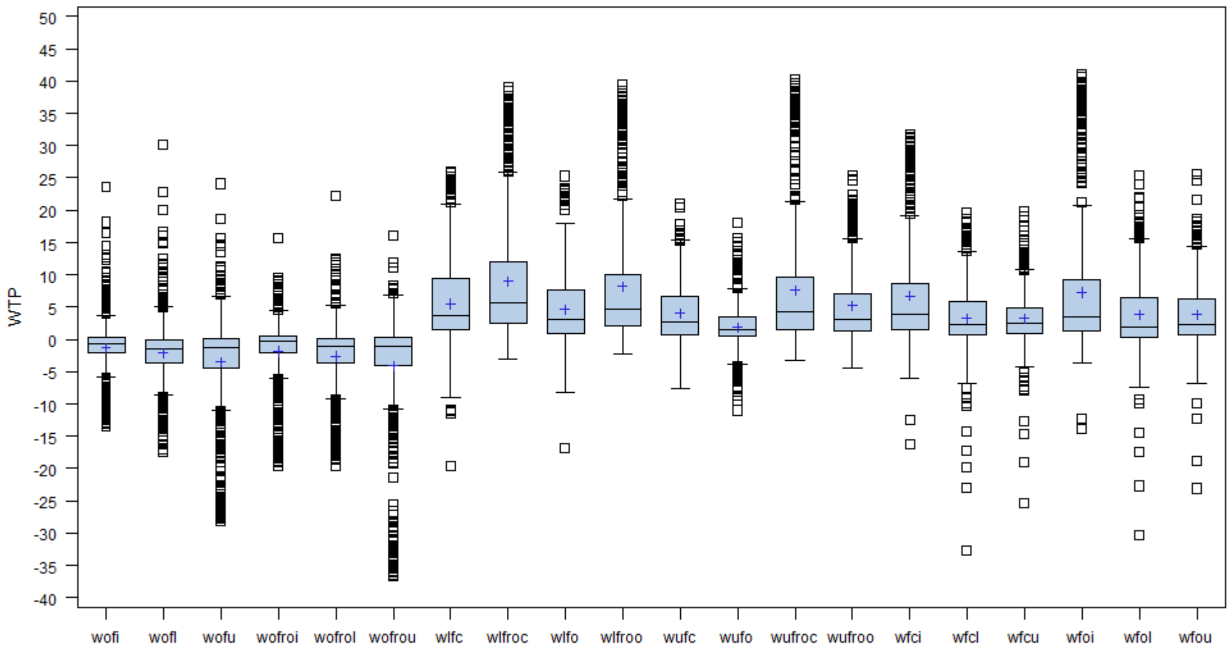

Figure 2. Box plots of individual-level WTP estimates in the preference space

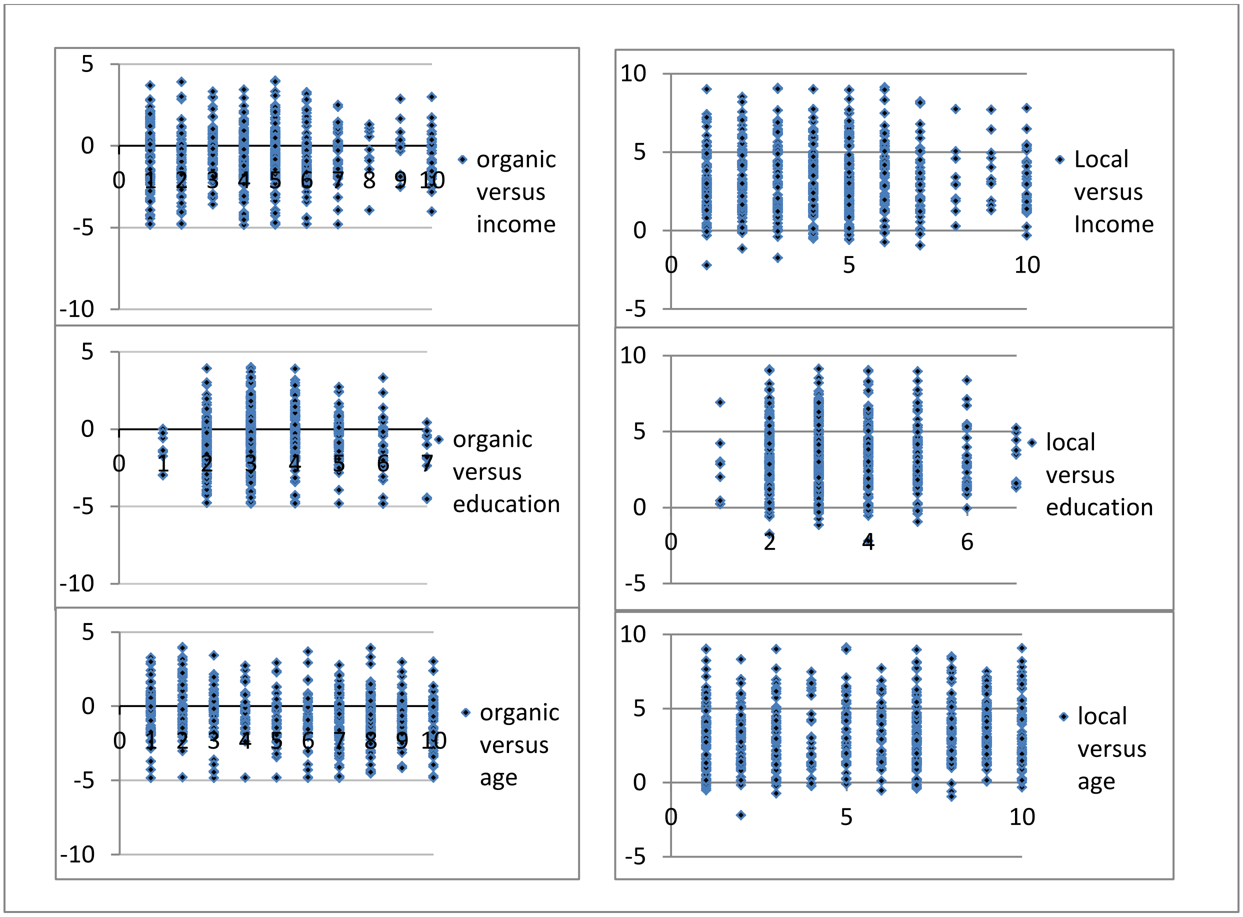

Figure 3. Scatterplots of WTP estimates versus demographic information

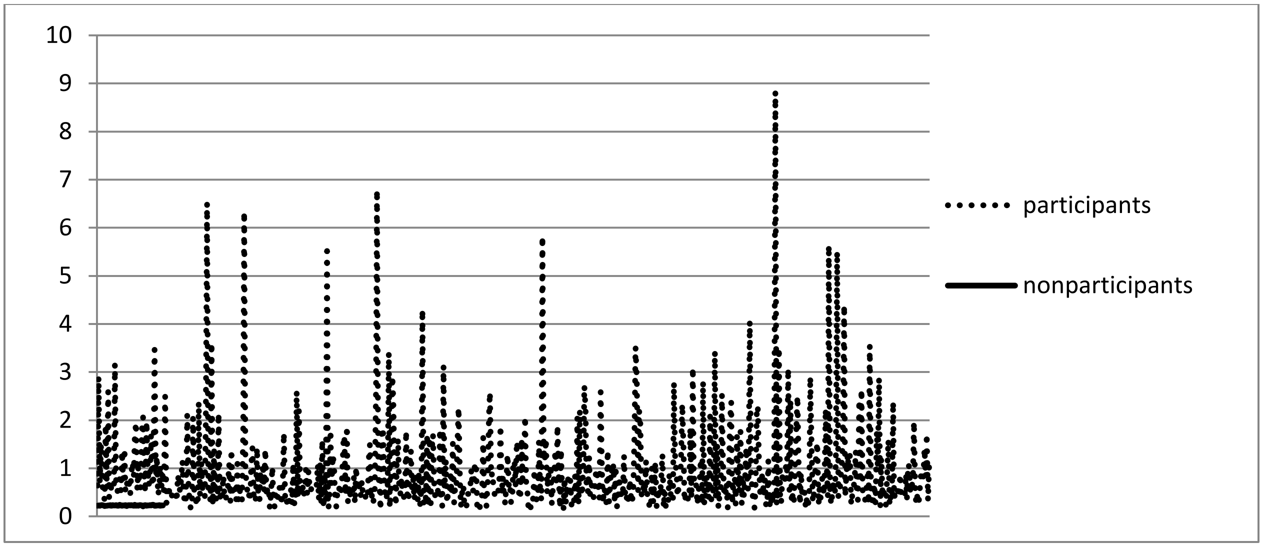

Figure 4. Comparison of scale parameters for participants and non-participants