**Consumer Willingness to Pay for Improved Attributes of Fresh Vegetables:**
**A Comparison between Atlanta and Berlin**

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**Abstract**

Consumer willingness to pay for quality attributes of fresh vegetables was analyzed based on surveys conducted in Atlanta and Berlin. Most consumers were willing to pay for the improved attributes. Demographic and socioeconomic characteristics of Atlanta consumers were less sensitive to their willingness to pay than those of Berlin respondents.

**Introduction**

Increasing scientific evidence suggest the link between poor diets and some diseases (e.g., American Cancer Society, 1994; Frazao 1995). Consumers are increasingly aware of the importance of healthy diets that are low in saturated fat and high in dietary fiber. The quality of foods, however, may be just as important to consumers as foods themselves. Several studies indicate that consumers are concerned about food quality and safety. For example, Misra et al. (1991) reported that most consumers recommended testing and certification of pesticide-free fresh produce. Florkowski et al. (1994) found that consumers were generally concerned about pork produced using bioengineering methods. Byrne et al. (1994) indicated that consumers were willing to pay more for pesticide-residue free produce.

Previous studies (e.g., van Ravenswaay,1988; Misra et al., 1991) suggest that perceptions of and attitudes toward food quality among consumers vary depending on the demographic and socioeconomic characteristics of consumers. The same may be also true for consumers from different regions and different countries. This is because consumer perceptions are related to region or country-specific factors such as health education systems and cultures. Knowledge of consumer perceptions of food quality in different regions and countries will aid in the decision making processes of production, marketing, and exports of fresh vegetables.

The purpose of this paper is to analyze the willingness to pay of consumers in Atlanta and Berlin for quality attributes of fresh vegetables. The objectives are to 1)

analyze the impact of demographic and socioeconomic factors on consumer willingness to pay for quality attributes of fresh vegetables, 2) determine the probabilities of consumer willingness to pay for these attributes, and 3) compare the willingness to pay between consumers from Atlanta, Georgia and Berlin, Germany. This study differs from previous studies in that it analyzes consumer perceptions and willingness to pay for certain quality attributes of vegetables and compares the results across cities in different countries.

**Survey data**

The data used in this study are parts of the consumer surveys conducted in Atlanta and Berlin in late 1994. The aim of the surveys was to gather information about consumer attitudes towards and perceptions of fresh vegetables and fruit. A total of 400 questionnaires were mailed to randomly selected residents in metro Atlanta. One hundred and sixty-eight of the questionnaires were returned. The response rate was about 49.4% after taking into account the 60 undeliverable questionnaires. For the Berlin survey, the sample closely resembled the general demographic, income, and educational profile of Berlin residents. Of the 2,773 questionnaires mailed, 525 responses were received. The response rate of 18.9% was considered adequate given the large size of the sample.

In general, the shares of college graduates, females, and respondents in the higher income category were higher in the Atlanta sample than in the Berlin sample. Females represent 70% of the respondents in the Atlanta sample versus 57% in the Berlin sample. Fifty percent of the Atlanta respondents were college graduate in contrast to 44% for Berlin respondents. In addition, 50% of the Atlanta respondents were in the highest income group while the number for Berlin was 31%. The age distributions for Atlanta and

Berlin respondents were similar. The summary statistics of the respondents' demographic and socioeconomic characteristics and variable definitions are shown in table 1.

For the purpose of this study, four questions are selected. They are the willingness to pay for 1) more fiber, 2) quality assurance program, 3) less nitrate, and 3) less chemical residue. All of these attributes referred to quality of fresh vegetables. Those questions were selected because they closely represent consumer concerns about quality and safety of fresh vegetables (see, e.g., Variyam et al. 1995). The willingness to pay was divided into three premium categories of 0%, up to 10%, and more than 10% (coded 0, 1, and 2).

The survey results indicate that the percentages of respondents from Atlanta and Berlin willing to pay for more fiber were similar: Thirty-four percent of the Atlanta respondents were willing to pay up to 10% and 17.8% willing to pay more than 10%, while 28.3% of the Berlin respondents were willing to pay up to 10% and 24.3% willing to pay more than 10%, respectively. More Berlin respondents than Atlanta respondents, in percentage terms, were willing to pay for lower nitrate content and less chemical residue. On the other hand, a higher percentage of Atlanta respondents than Berlin respondents were willing to pay more for a quality assurance program. In spite of these differences, the majority of the Atlanta and Berlin respondents indicated their willingness to pay for each of the four identified quality attributes.

**Modeling procedure**

The foundation of the modeling technique, called random utility models, is based on the theory that a consumer, when facing alternatives, makes choices to maximize his

utility. While the utility is not observable, the choices are. Since the choices are indicative of the utility, it is possible to model the consumer perception based on the choices. Letting y* be a latent variable which maximizes the consumer's utility, a relationship between y* and explanatory variables can be specified:

$$y^* = \beta'X + \varepsilon \qquad (1)$$

where X is a vector of explanatory variables which describe the consumer demographic and socioeconomic characteristics. Assuming the consumer's choice variable is y while facing three alternatives, we can then define

y=0 if y*_0, y=1 if 0<y*_μ, and y=2 if μ_y*.

where μ is a threshold parameter to be estimated. Thus we can substitute the observable y for y* in equation (1) for the purpose of model estimation:

$$y = \beta'X + \varepsilon \qquad (2)$$

where $\varepsilon$ is assumed to be independently and identically normally distributed. Equation (2) can be estimated using maximum likelihood estimation. Probability of y taking on a particular value can be found as

$$\text{Prob}(y=0)=\Phi(-\beta'X), \ \text{Prob}(y=1)=\Phi(\mu-\beta'X)-\Phi(-\beta'X), \ \text{and} \ \text{Prob}(y=2)=1-\Phi(\mu-\beta'X);$$

and marginal probabilities can be computed as

$$\partial \text{Prob}(y=0)/\partial X = -\phi(\beta'X)\beta, \ \partial \text{Prob}(y=1)/\partial X = (\phi(-\beta'X)-\phi(\mu-\beta'X)), \ \text{and}$$

$$\partial \text{Prob}(y=2)/\partial X = \phi(\mu-\beta'X)\beta.$$

Marginal probabilities for binary variables, however, can not be calculated as above since derivatives do not exist for binary variables. Therefore, the marginal

probability for a binary variable is calculated as the differences between the probability of the unrestricted model (with the dummy variable) and the probability of the restricted model (without the dummy variable) while holding all other variables at their means.

The empirical specification of equation (2) in this study is as follows:

WTP=f(female, married, age1, age2, income2, income3, children, adult, employed, student, college, importance).

where WTP is the willingness to pay for a chosen quality attribute (i.e., more fiber, quality assurance program, less nitrate, or less chemical residue). The variables are as defined in table 1. A dummy variable for the country of origin is not created because, by doing so, the effects of demographic and other factors conditional on the country origin can not be identified. Therefore, models based on the Atlanta and Berlin data are estimated separately.

**Estimation results and analysis**

The results of order probit estimation are presented in table 2. The chi-squared statistics from the likelihood ratio test are significant for all the estimated models, indicating the overall explanatory power of the independent variables. Only the variables describing gender, employment status, and attitude were significantly different from zero in the Atlanta models. For the Berlin models, however, most variables were significant except for four variables ( married, age2, adult, and employed). This may indicate that the willingness to pay for the selected attributes of fresh vegetables expressed by Atlanta respondents was more evenly distributed across demographic and socioeconomic factors than that of Berlin respondents. The attitudinal variable (i.e., "importance") was

significant in all models for both the Atlanta and Berlin data.

Willingness to pay for more fiber

Among Berlin residents participating in the survey, older male respondents without college degrees were more willing to pay for more fiber than other respondents. The willingness to pay more for improved food attributes by older consumers and those without college degrees was also reported in previous studies (Zellner et al., 1989; Malone, 1990; Misra et al., 1991). These researchers suggested that more educated consumers did not feel the need for improved food attributes. An alternative explanation was that college-educated consumers tend to expect high quality products without paying a premium (Zellner et al.). For the Atlanta model, none of the demographic and socioeconomic variables were significant, possibly indicating little difference in the willingness of Atlanta respondents to pay a premium for higher content of dietary fiber regardless of their socioeconomic status.

Willingness to pay for a quality assurance program

Berlin respondents in the highest income group were more willing to pay a premium for vegetables produced under the program than those from the median and lowest income groups. Berlin households with more children, however, were less willing to pay for such a program. Atlanta respondents, who were employed, were less willing to pay more for the quality assurance program.

Willingness to pay for less nitrate

The Berlin respondents in the median income group were more willing to pay for lower nitrate level in fresh vegetables than those from the other two income groups. For

the Atlanta model, female respondents were more likely to be willing to pay a premium for less nitrate in fresh vegetables.

Willingness to pay for less chemical residue

Socioeconomic and demographic factors also affected the responses of Berlin respondents in the question of chemical residue in fresh vegetables. Respondents in the highest and median income groups were more likely to pay more for lower level of chemical residue in fresh vegetables than those in the lowest income group. In addition, student respondents from Berlin were more likely to pay more for lower chemical residue than other respondents. Similar to the question on dietary fiber, the variable of less chemical residue was not sensitive to the demographic and socioeconomic factors in the Atlanta models.

Impact of attitude on willingness to pay

The estimated results indicate that respondents' attitudes toward the survey had a great impact on their willingness to pay a premium for fresh vegetables with the four quality attributes. The results were consistent for both the Atlanta and the Berlin respondents. The more important the survey subject was to the respondents, the more likely they were willing to pay more for attributes under consideration.

Likelihood of willingness to pay

Marginal probabilities of willingness to pay were computed for the significant coefficients (tables 3 and 4). As discussed previously, marginal probabilities for binary variables were computed by taking the difference of the probability from the unrestricted model (with the binary variable) and the probability of the restricted model (without the

binary variable) while holding all other variables at their means. The marginal probabilities of non-binary variables were computed by taking probability derivatives with respect to each variable. The marginal probabilities correspond to the estimated coefficients and are interpreted in a similar way. For instance, Berlin female respondents had a 0.11 lower probability of willingness to pay for more fiber than the male counterparts. The Berlin male respondents, on the other hand, had a probability of 0.028 higher to pay up to 10% more and a probability of 0.083 higher to pay in excess of 10% for additional fiber than the female respondents. Similarly, the Berlin respondents who were less than 35 years old had a probability of 0.278 lower than older respondents to pay for additional dietary fiber in fresh vegetables. The probabilities of paying up to 10% and in excess of 10% by older Berlin respondents for additional fiber were 0.096 and 0.182, respectively, more than those of younger Berlin respondents. The probability of college-educated Berlin respondents was 0.196 higher than those without college degrees in paying a premium for more fiber. The marginal probabilities of willingness to pay in excess of 10% are among the highest for Berlin respondents in the highest and median income groups. The marginal probabilities for other variables can be interpreted in a similar fashion.

**Concluding Remarks**

The importance of diets for maintaining health has been well documented. Previous studies linked the willingness to pay for food quality and safety to demographic, socioeconomic, and attitudinal factors. Consumer perceptions and attitudes, however, may vary across countries because of the differences in health education systems, cultures, and other factors. Identification of the impact of differences in these factors on consumer

perception and attitudes is important in today's global economy because it can help producers and exporters in making production and marketing decisions. This study addressed the issue of differences in the willingness-to-pay by the residents of two metropolitan areas in the United States and Germany.

Consumer responses to the questions of willingness to pay for four quality attributes of fresh vegetables reveal that consumers in both Atlanta and Berlin generally had a positive perception on the survey subject and the majority of the respondents were willing to pay a premium for these attributes. The Berlin consumers, however, responded more favorably to the survey subject than the Atlanta respondents as indicated by their ranking of the subject importance. Moreover, a larger percentage of Berlin respondents than Atlanta respondents were willing to pay for improved attributes of fresh vegetables.

Ordered probit models were formulated to analyze the effects of differences in demographic and socioeconomic factors on consumers' willingness to pay for dietary fiber content, quality assurance program, nitrate level, and level of chemical residue. Willingness to pay was classified into three categories of 0%, up to 10%, and more than 10%. For the Atlanta respondents, differences in socioeconomic and demographic backgrounds had little impact on their willingness to pay for quality of fresh vegetables as compared to the Berlin respondents.

Older male respondents without college degrees were more willing to pay a premium for more fiber than other Berlin respondents. Berlin respondents with higher incomes and fewer children were more willing to pay for a quality assurance program. Less nitrate in vegetables was more likely to encourage the Berlin respondents with

median income to pay a premium. Berlin student respondents and those in the median and high income categories were more willing to pay for less chemical residue. Atlanta respondents who were employed were less willing to pay for a quality assurance program while the Atlanta female respondents were more willing to pay for less nitrate. The results also indicate that respondents ranking higher the importance of the subject were more willing to pay a premium for all the quality attributes of fresh vegetables.

Marginal probabilities of the explanatory variables were calculated for each willingness to pay category. For all the quality attributes, the marginal probabilities of paying more than 10% were greater than the marginal probabilities of paying up to 10%. This indicates that those respondents who were more willing to pay up to 10% would be much more inclined to pay even a higher premium than the others.

The findings of this study indicate that the majority of consumers from Atlanta and Berlin were willing to pay for improved quality attributes of fresh vegetables. Therefore, production, marketing, and research oriented toward quality improvement of fresh produce may both meet consumer demand and generate greater profits for the fresh vegetable industry. The willingness-to-pay for fresh vegetable attributes by Berlin respondents provides an opportunity to explore export possibilities of produce to meet consumer demand. The development of a quality assurance program may be necessary in order to satisfy preferences of Berlin consumers with higher incomes because these consumers were willing to pay a premium for quality assurance. Furthermore, the development of vegetables with minimal chemical residue and a system of chemicals tracing and residue testing will encourage Berlin consumers with higher incomes to pay a

premium for fresh vegetables. The differences in consumer perceptions and willingness to pay across different factors and countries may be related to differences in consumer awareness of nutrition and food safety and perceptions of the relative values of quality and higher premium. Therefore, different approaches in educational and marketing campaigns in the two cities may help increase consumer awareness of food safety and improve their perceptions of vegetable quality. Further studies of preferences for specific vegetables and quality attributes are needed to help in the evaluation of European market potentials for fresh vegetables for U.S. exporters.

Table 1. Summary Statistics and Variable Definitions

| Variable Definition | Name | Means | | STD | | Min. | Max. |
|---|---|---|---|---|---|---|---|
| | | Atlanta | Berlin | Atlanta | Berlin | | |
| Willingness to pay for more fiber | Fiber+ | 0.7295 | 0.7426 | 0.7718 | 0.8096 | 0 | 2 |
| Willingness to pay for quality assurance program | Quality+ | 0.9426 | 0.8482 | 0.7193 | 0.8159 | 0 | 2 |
| Willingness to pay for less nitrate | Nitrate- | 0.7295 | 1.2343 | 0.7610 | 0.8105 | 0 | 2 |
| Willingness to pay for less chemical residue | Chemical- | 1.0574 | 1.3597 | 0.7852 | 0.7759 | 0 | 2 |
| Gender: 1=female; 0=male | Female | 0.6967 | 0.5710 | 0.4616 | 0.4958 | 0 | 1 |
| Marital status: 1=married; 0=other | Married | 0.7377 | 0.4984 | 0.4417 | 0.5008 | 0 | 1 |
| Age: 1<=34; 0 otherwise | Age 1 | 0.1967 | 0.2772 | 0.3992 | 0.4484 | 0 | 1 |
| 1=35-59; 0 otherwise | Age 2 | 0.5820 | 0.5479 | 0.4953 | 0.4985 | 0 | 1 |
| 1=above 59; 0 otherwise | Age 3 | 0.2213 | 0.1749 | 0.4168 | 0.3805 | 0 | 1 |
| Income[a]: 1=income 1; 0 otherwise | Income 1 | 0.0820 | 0.2211 | 0.2755 | 0.4157 | 0 | 1 |
| 1=income 2; 0 otherwise | Income 2 | 0.4180 | 0.4720 | 0.4953 | 0.5000 | 0 | 1 |
| 1=income 3; 0 otherwise | Income 3 | 0.5000 | 0.3069 | 0.5021 | 0.4620 | 0 | 1 |
| Number of children in household[b] | Children | 0.6967 | 0.4588 | 0.9866 | 0.8040 | 0 | 4 |
| Number of adults in household[c] | Adult | 1.2131 | 0.8878 | 0.8354 | 0.7767 | 0 | 3/4[d] |
| Employment status: 1=employed; 0 otherwise | Employed | 0.6557 | 0.6106 | 0.4771 | 0.4884 | 0 | 1 |
| 1=student; 0 otherwise | Student | 0.0246 | 0.1089 | 0.1556 | 0.3120 | 0 | 1 |
| 1=unemployed; 0 otherwise | Unemployed | 0.3197 | 0.2805 | 0.4683 | 0.4500 | 0 | 1 |
| Education: 1=college; 0 otherwise | College | 0.5000 | 0.4389 | 0.5021 | 0.4971 | 0 | 1 |
| Rank of importance of subject | Importance | 6.9262 | 7.8218 | 2.3183 | 2.0494 | 1 | 10 |

a: Income 1 = less than $20,000/year for Atlanta and less than or equal to 1800 DM/month for Berlin; Income 2 = $20000-49999/year for Atlanta and 1801-4000 DM/month for Berlin; and Income 3 = more than $4999/year for Atlanta and more than 4000 DM/month for Berlin.
b: 18 year old or younger. c: older than 18. d: 3 for Atlanta and 4 for Berlin.

Table 2. Results of OrderedProbit Estimation

|  | Fiber+ | | Quality+ | | Nitrate- | | Chemical- | |
|---|---|---|---|---|---|---|---|---|
|  | Atlanta | Berlin | Atlanta | Berlin | Atlanta | Berlin | Atlanta | Berlin |
| Constant | 0.27 | -0.83 | 0.18 | -0.25 | -0.78 | -0.68 | -0.61 | -0.38 |
| Female | 0.10 | -0.28* | -0.10 | -0.21 | 0.64** | 0.13 | 0.41 | 0.12 |
| Married | -0.42 | 0.13 | -0.38 | 0.23 | -0.22 | 0.07 | -0.22 | -0.07 |
| Age 1 | -0.18 | -0.72* | -0.03 | -0.24 | 0.29 | -0.34 | 0.46 | -0.09 |
| Age 2 | -0.32 | -0.32 | 0.48 | -0.28 | 0.28 | -0.09 | 0.30 | 0.19 |
| Income 2 | -0.28 | 0.31 | 0.16 | 0.37 | -0.28 | 0.47* | 0.03 | 0.70** |
| Income 3 | -0.07 | 0.14 | 0.06 | 0.53* | -0.62 | 0.41 | 0.02 | 0.75** |
| Children | 0.03 | -0.06 | 0.10 | -0.24* | -0.04 | 0.04 | 0.04 | -0.05 |
| Adult | 0.06 | -0.15 | -0.26 | -0.03 | 0.01 | -0.10 | -0.14 | -0.14 |
| Employed | -0.38 | 0.34 | -0.74* | 0.05 | -0.43 | 0.01 | -0.23 | -0.07 |
| Student | 0.72 | 0.79* | 0.59 | -0.06 | 5.34 | 0.64 | 5.07 | 0.78* |
| College | -0.17 | -0.50** | 0.02 | -0.26 | 0.22 | -0.05 | -0.22 | -0.05 |
| Importance | 0.10* | 0.16** | 0.17** | 0.08* | 0.15** | 0.15** | 0.19** | 0.10** |
| $\mu$ | 1.09** | 0.84** | 1.45** | 0.91** | 1.16** | 0.88** | 1.16** | 0.90** |
| $\chi^2$ | 21.2* | 47.66** | 29.14** | 32.31** | 40.04** | 34.96** | 36.09** | 31.09** |
| p% | 48.87 | 52.44 | 49.23 | 44.58 | 52.71 | 50.45 | 53.79 | 54.90 |

Notes: $\chi^2$ is the chi-squared statistic from the likelihood ratio test. $\mu$ is the threshold parameter. P% is the percentage correctly predicted. "*" and "**" denote significance levels of 0.05 and 0.01, respectively.

Table 3. Marginal Probabilities for the Atlanta Models

| | Fiber+ | | | Quality+ | | | Nitrate- | | | Chemical- | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P0 | P1 | P2 | P0 | P1 | P2 | P0 | P1 | P2 | P0 | P1 | P2 |
| Gender | | | | | | | -0.248 | 0.094 | 0.154 | | | |
| Employed | | | | 0.210 | 0.029 | -0.239 | | | | | | |
| Importance | -0.039 | 0.014 | 0.025 | -0.053 | 0.001 | 0.052 | -0.056 | 0.016 | 0.040 | -0.054 | -0.02 | 0.074 |

Notes: P0, P1, and P2 are the marginal probabilities of paying 0%, up to 10%, and more than 10% respectively.

Table 4. Marginal Probabilities for the Berlin Models

| | Fiber+ | | | Quality+ | | | Nitrate- | | | Chemical- | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P0 | P1 | P2 | P0 | P1 | P2 | P0 | P1 | P2 | P0 | P1 | P2 |
| Gender | 0.110 | -0.028 | -0.083 | | | | | | | | | |
| Age1 | 0.278 | -0.096 | -0.182 | | | | | | | | | |
| Income2 | | | | | | | -0.136 | -0.048 | 0.184 | -0.169 | -0.104 | 0.273 |
| Income3 | | | | -0.195 | 0.016 | 0.179 | | | | -0.157 | -0.127 | 0.284 |
| Children | | | | 0.091 | -0.015 | -0.076 | | | | | | |
| Student | -0.289 | 0.014 | 0.275 | | | | | | | -0.136 | -0.145 | 0.281 |
| College | 0.196 | -0.055 | -0.141 | | | | | | | | | |
| Importance | -0.063 | 0.017 | 0.046 | -0.031 | 0.005 | 0.026 | -0.044 | -0.015 | 0.059 | -0.026 | -0.016 | 0.042 |

Notes: P0, P1, and P2 are the marginal probabilities of paying 0%, up to 10%, and more than 10% respectively.

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