# Consumer Willingness to Pay for Food Safety in Beijing: A Case Study of Food Additives

**Yuanyuan Liu[1], Yinchu Zeng[2], Xiaohua Yu[3]**
**[1]School of Agricultural Economics and Rural Development**
**Renmin University of China**
**liuyuanyuanruc@gmail.com**
**[2]School of Agricultural Economics and Rural Development**
**Renmin University of China**
**zengyc@ruc.edu.cn**
**[3]Courant Research Center-CRC**
**University of Göttingen**
**xyu@uni-goettingen.de**

***Contributed Paper prepared for presentation at the International Association of Agricultural Economists Conference, Beijing, China, August 16-22, 2009***

# Consumer Willingness to Pay for Food Safety in Beijing:

# A Case Study of Food Additives*

**Abstract:** Constructing a theoretical framework and using a survey data of 294 customers from 25 supermarkets in Beijing, this paper studies the willingness to pay (WTP) for additive-free Mooncakes in Beijing and finds that age and income are important for WTP for "food safety" in China. Income is positively correlated with the WTP and there is an inverted-U-shaped relationship between age and WTP. This study indicates that consumers in Beijing are willing to pay 5.80 Yuan more for an additive-free Mooncake, which provides a good policy benchmark for the government regulation on food additives. Furthermore, the theoretical framework also provides a good benchmark for understanding WTP in the future study of food safety.

**Key words:** Food Safety; Willingness to Pay; Double-Bounded Dichotomous Choice; Additive-Free Mooncakes

**JEL:** I12, Q18

*The authors thank the financial supports from Chinese National Natural Science Foundation (No: 70473092); Doctor Fund Project (No: 03JB790042) of the Ministry of Education in China; and "985 Project" of Renmin University of China (No: 2006XNZD010). The earlier version of this paper was presented at the 8th China Economics Annual Conference, and we thank the helpful comments from the participants, in particular from Prof. Zhigang Li of the University of Hong Kong. We are also grateful to Professor David Abler at the Pennsylvania State University and Dr. Yong Zhu at Renmin University of China for their precious suggestions.

# Consumer Willingness to Pay for Food Safety in Beijing: A Case Study of Food Additives

## Introduction

The demand for food quality is increasing as income increases in China and food safety is a very important component in food quality (Yu and Abler 2009). Recent crises associated with food safety, such as the baby milk powder incident, Bovine Spongiform Encephalopathy (Mad Cow disease), Avian Influenza (Bird Flu) have raised public concerns about food safety not only in China but also in the world. Chinese government has adopted a series of policies to strengthen the regulation on food safety. The cost-benefit approach is prevailing for the evaluation of food safety policies; though in practice, it is a big problem to define costs and benefits accurately. Generally, we use the consumer willingness to pay (WTP) for food safety to measure the benefits for consumers（Golan and Kuckler 1999）.

The benefit of food safety is a non-market value, and it is difficult to get the information of the revealed preferences of consumers. We in general adopt the stated preference methods to assess the value[1], of which the contingent valuation method (CVM) is the most important and also the most popular one (Zhang et.al., 2003)[2]. Golan and Kuckler (1999), and Antle (2001) are good reviews for both the theoretical and empirical studies of consumer WTP for food safety.

[1] Bockstael and Freeman (2005) is a good review of the development, status and controversies about the revealed and stated preference methods.
[2] Carson and Hanemann (2005) summarize the development and current situation of CVM.

As the concern about food safety is increasing in China, there is a large body of literature studying consumer willingness to pay for food safety (Wang, 2003; Zhou, 2004; Chen, 2006; Huang et al., 2006; Huang et al., 2007; Zeng et al., 2008). However, the existing researches of the WTP for food safety in China have some shortcomings. (1) These papers are mainly focusing on the analysis of consumer attitudes, perceptions and willingness to buy; and they lack the analysis of consumers' willingness to pay, specifically short of calculation of WTP. For example, Dai et al. (2006) only analyzes consumers' purchase behavior and the determinants of WTP. There are only a few exceptions. For in stance, the results of Zhou et al. (2006) indicate that the mean WTP for food safety to reduce pesticide residues of B. Chinensis is￥5.36 per kilogram, which indicates a very high value of food safety as well as the benefits of government regulations. If we do not calculate a specific number of WTP, it can not give an appropriate evaluation of food safety policies. (2) Compared with a large volume of empirical studies, so far there are little theoretical frameworks to explain the empirical results. (3) There is little literature studying willingness to pay for "additive-free food".

There are many types of food additives, and the preservatives are one of the most prevailing but controversial varieties. Preservatives can help store food for a longer time, but they may harm consumer health. How to regulated food additives is strongly hinged on the consumer benefits from the regulation, which can be measured by the consumer willingness to pay.

In this study, we will take the Mooncakes as an example to study consumer willingness to pay for additive-free Mooncakes in China. The Mooncakes are Chinese traditional pastries consumed during the Mid-Autumn Festival (August 15 of the lunar calendar). The Mid-Autumn is very important for family unions and the Mooncakes are offered between friends and family members.

The structure of this paper is outlined as follows: first, this study constructs a theoretical framework to explain the willingness to pay for food safety; second, uses a survey data of willingness to pay for "additive-free food (Mooncakes)" of 294 customers from 25 supermarkets in Beijing to empirically study the determinants of willingness to pay for "additive-free food" in China, and to test the theoretical hypotheses as well; and finally, gives the conclusion.

**Theoretical Framework**

In order to simplify the study, we assume that there are only two types of Mooncakes with different safety levels in a market: one contains preservatives, and the other does not. If a consumer only consumes additive-free Mooncakes, the indirect utility function is $V(p_F, h, m, Z)$, given a price of the additive-free Mooncake $p_F$, consumers' health stock $h$, current income $m$, and a vector of some other exogenous variables $Z$.

The additive-free Mooncakes usually have a shorter stock period, and this will increase the cost of producers, so that the price might be higher. If the Mooncakes contain preservatives, the price of Mooncake will decrease to $p_F - t$.

Assuming the market is competitive and in equilibrium and the information about additives is symmetric, $t$ is a mark-up in cost after adding the preservatives from the perspective of producers; on the other hand, $t$ is the consumer willingness to pay for additive-free Mooncakes from the perspective of consumers. It is also known that the preservatives can damage consumers' health, and then the health stock of the consumer may decrease from $h$ to $h-d$ if he chooses to consume the Mooncakes with preservatives. So, if a consumer only consumes the Mooncakes containing the preservatives, the indirect utility function will be $V(p_F - t, h-d, m, Z)$. Market equilibrium shows that

$$V(p_F - t, h-d, m, Z) = V(p_F, h, m, Z) \tag{1}$$

Taking the first-order approximation of $V(p_F - t, h-d, m, Z)$, we have

$$V(p_F - t, h-d, m, Z) \approx V(p_F, h, m, Z) - \frac{\partial V}{\partial p_F} t - \frac{\partial V}{\partial h} d \tag{2}$$

Combining (1) and (2), we have

$$t = -\frac{\partial V / \partial h}{\partial V / \partial p_F} d \tag{3}$$

By Roy's identity,

$$t = \frac{d}{x_n} \frac{\partial V / \partial h}{\partial V / \partial m} \tag{4}$$

Where $x_n$ is the Marshallian demand for the additive-free Mooncakes. Assuming the demand elasticity of Mooncakes is very small. That is, regardless of whether the Mooncake contains preservatives or not, the total consumption of Mooncakes is constant for the consumer. Define $k = \frac{d}{x_n}$; denoting the health damage from consuming per unit Mooncake, and for a certain consumer, $k$ is a constant. Rewriting equation (4),

$$t = k \frac{\partial V / \partial h}{\partial V / \partial m} \tag{5}$$

$\partial V / \partial h$ is defined as the marginal utility of health； $\partial V / \partial m$ is defined as the marginal utility of money. By Equation (5), we can give two hypotheses as follows:

1. Consumers' willingness to pay food safety is positively correlated with the marginal utility of health. In our real world, the youth have longer life expectations than the elder, so that it is expected that the youth's marginal utility of health is bigger than the elder due to time. But, considering that young people are easy to recover from injury, very young person's marginal utility of health may be very low. Adding up the two effects, $\partial V / \partial h$ would first increase and then decrease as the ages of consumers increase. According to this, we can have the first testable hypothesis: consumers' willingness to pay for additive-free food would first increase and then decrease as the age increases.

2. Consumer willingness to pay for food safety is negatively correlated with the marginal utility of money. In our real world, the rich usually have smaller $\partial V / \partial m$, so

that we can have the second testable hypothesis: consumer willingness to pay would increase as income increases.

In the next part, we will use the survey data of willingness to pay for additive-free Mooncake of 294 consumers from 25 supermarkets in Beijing of China to test the above hypotheses and give the policy implications as well.

**Econometric Model**

The contingent valuation method (CVM) has many different elicitation formats, and different formats would influence the results greatly. Researchers have gradually developed two types of methods to elicit consumer WTP: (1) the Continuous Method, in practice, including the payment card (PC) approach and the open-ended (OE) approach; (2) the Discrete Method, in practice, mainly including dichotomous choice (DC) approach. Ready, Buzby and Hu (1996) point out that a continuous format generates a lower estimated WTP than a dichotomous choice format due to more yes-saying among DC respondents. In practice, the discrete method is more popular. In 1993, the National Oceanic and Atmospheric Administration (NOAA) panel gave some important guiding principles about the application of CVM, and NOAA recommended the dichotomous choice approach for eliciting WTP for non-market goods (Arrow et al., 1993)[3]. The DC approach also has different elicitation formats. Single-bounded dichotomous choice (SBDC) and double-bounded dichotomous

[3] This format had many advantages. Such as, it can have a better simulation of the market price, and reduce the strategic bias to get more reliable and accurate valuation of the WTP.

choice (DBDC) are the most important ways. Technically, the estimation methods of SBDC and DBDC are completed by Hanemann et al., in 1984 and 1991, respectively.

Based on the principles of utility maximization, consumers would choose different levels of food safety. According to McFadden (1974)'s random utility model (RUM),the economic principle of CVM can be described as follows: other things being equal, when the level of food safety rises from a relatively low level $Q_o$ (additive food) to a higher level $Q_1$ (additive-free food), consumers can gain more utility, as mentioned above, that is,

$$V_1(Q_1, p_F, m, Z, \varepsilon_1) > V_0(Q_0, p_F, m, Z, \varepsilon_0)$$

$\varepsilon_o$ and $\varepsilon_1$ are the random error terms. CVM uses the survey method to reveal consumer preferences, and we can derive the equilibrium utility at different levels of food safety from the above theoretical framework, so that

$$V_1(Q_1, p_F + t, m, Z, \varepsilon_1) = V_0(Q_0, p_F, m, Z, \varepsilon_0)$$

Then, we can use statistical methods to derive $t$, which represents the consumer willingness to pay (Zhou et al., 2006).

This paper uses the DBDC approach as the specific elicitation format, and the following part will introduce its principles and the mathematical derivation. The DBDC approach was first proposed by Hanemann (1985) and then developed by Hanemann et. Al (1991). It asks the respondents to engage in two rounds of bidding: participants respond to a first dollar amount and then face a second question involving

another dollar amount, higher or lower depending on the response to the first question (Hanemann et al., 1991).

In this paper, respondents are presented with the following questions: "If the price of the Mooncake without preservatives is $B_i$ Yuan per unit higher than the conventional Mooncake, are you willing to pay?" then followed up with: "What about $B_i^u$ (or $B_i^d$ )?" $B_i$ is the initial bid, $B_i^u$ is the second bid if the response to the first bid was "yes"; $B_i^d$ is the second bid if the response was "no". In this way, the respondent's answers will be four possible combinations :( yes, yes), (no, no), (yes, no), (no, yes).Hanemann et al. (1991) first constructed the log-likelihood function of the DBDC approach, and verified that the DBDC approach was shown to be asymptotically more efficient than the conventional SBDC approach, although the analysis of data is more complex.

Following Watson and Ryan (2007), Let $t_1$ be the base bid at the initial dichotomous choice question (DC1) and $t_2$ be the follow up bid at the second dichotomous choice question (DC2). The above possible responses are:

1) When respondent's answer is "yes-yes", $WTP \geq t_2$
2) When respondent's answer is "no-no", $WTP < t_2$
3) When respondent's answer is "yes-no", $t_1 \leq WTP < t_2$
4) When respondent's answer is "no-yes", $t_1 > WTP \geq t_2$

Following this:

$$WTP_{ij} = \beta' x_{ij} + \varepsilon_{ij} \quad (6)$$

where $WTP_{ij}$ is the WTP of individual $j$, and $i=1,2$ represents DC1 and DC2, respectively; $x_{ij}$ ($i=1,2$)is a vector of explanatory variables, including the bids (B),consumers' demographic characteristics(such as income, age, gender, education and so on) ,supermarket's characteristics (S, for example, the size of supermarket); $\beta$ is a corresponded vector of coefficients. The error term, $\varepsilon_{ij}$, incorporates both individual and question specific error.

By Equation (6), for instance, the probability of respondent $j$ answering "yes" to DC1 and "no" to DC2 is expressed as:

$$\Pr(\text{yes-no}) = \Pr(WTP \geq t_1, WTP < t_2).$$

That is,

$$\Pr(\text{yes-no}) = \Pr(\beta' x_{1j} + \varepsilon_{1j} \geq t_1, \beta' x_{2j} + \varepsilon_{2j} < t_2).$$

Then, incorporating all response combinations in the likelihood function, gives

$$\begin{aligned} L_j(\beta' x_{ij} | t) &= \Pr(\beta' x_{1j} + \varepsilon_{1j} \geq t_1, \beta' x_{2j} + \varepsilon_{2j} < t_2)^{YN} \\ &\times \Pr(\beta' x_{1j} + \varepsilon_{1j} > t_1, \beta' x_{2j} + \varepsilon_{2j} \geq t_2)^{YY} \\ &\times \Pr(\beta' x_{1j} + \varepsilon_{1j} < t_1, \beta' x_{2j} + \varepsilon_{2j} < t_2)^{NN} \\ &\times \Pr(\beta' x_{1j} + \varepsilon_{1j} < t_1, \beta' x_{2j} + \varepsilon_{2j} \geq t_2)^{NY} \end{aligned} \quad (7)$$

Assuming the error terms $\varepsilon_{1j}$ and $\varepsilon_{2j}$ are normally distributed with mean zero and variances $\sigma_1^2$ and $\sigma_2^2$, respectively, and the correlation coefficient between DC1 and DC2 is expressed by $\rho$. The Equation (7) can be estimated using the bivariate probit model (Cameron and Quiggan, 1994) [4].Thus, we can get the estimators for the

[4] A restricted version of the bivariate probit model is the interval data model (Hanemann et al., 1991).

constant $\alpha^*$ and the coefficients $\beta_M^*$ 、 $\beta_S^*$、 $\beta_B^*$, so that we can calculate the mean WTP:

$$E(WTP) = -\frac{\alpha^* + \beta_M^{*\prime} E(M) + \beta_S^{*\prime} E(S) - \frac{n_1}{n}}{\beta_B^*} \qquad (8)$$

where $\beta_M^*$ 、 $\beta_S^*$和$\beta_B^*$ are the estimated coefficients for consumers' demographic characteristics, supermarket's characteristics and the bids respectively. $E$ （•）represents the mean of the corresponded variables. $n$ is the whole sample, $n_1$ is the amounts of respondents whose answer is "yes".

**Data Description**

Data used in this paper is from a survey of willingness to pay for "additive-free Mooncakes" in Beijing, conducted by the School of Agricultural Economics and Rural Development at Renmin University of China in October 2006.Using the face-to-face interview, this survey covered the main areas of Beijing. Based on the results of pre-survey and the study of Cooper (1993), we finally adopted three sets of bids (1、1.6、2.5);(1.6、2.5、1);(2.5、3.5、1.6). This survey includes 294 effective samples. Table 1 shows the descriptive statistics of the sample.

**[Insert Table 1 & Figure 1]**

From Table 1, we can find that the sample size is distributed evenly in each set of the bids, and each set has about 100 questionnaires. However, as shown in Figure 1, we find that the number of answering "yes-yes" is a little bit high, and the proportion

is 65.31%, perhaps resulting from (1) yea-saying bias and (2) starting point bias as Ready Buzby and Hu stated (1996). Also, the number of the respondents with a bachelor degree shares about half of the sample, and there may exist some bias in the sample, even though China's overall educational level is increasing. However, Beijing is a cultural center in China which might be another reason to explaining a higher proportion of high-educated people. In our sample, about 58.8% are women; it might be explained by the fact that women usually play a more important role in family food shopping. We also find that the average age of respondents is 34.87 years old, and the median and mode are 30-year-old and 23-year-old respectively; and it might indicate that the analysis in this study might bias to the youth.

We choose monthly income as the indicator of family welfare status. In our sample, monthly income below 3,000 Yuan accounts for 53.1%, and above 8,000 Yuan only 7.1 percent. There are 127 or 43.6% unmarried persons and the rest 164 or 56.4% are married. This proportion is close to some existing studies (Zhou et al 2006). We have two questions to survey the “sensitive” groups (Zeng et al., 2007); and in the survey, 32.3% of the families have children under 12, while 62.9% have old people above 65, because the two groups within the family may affect the respondents’ preferences.

In our survey, consumers’ concern about food safety is measured by five-point Scale. Statistic results show that, the level of concern is very high. We use the question “have you heard of the incidents of unqualified Mooncakes?” to specifically

measure the level of consumers' cognition of food safety, and the majority of consumers have heard some negative incidents. Mooncakes are very traditional pastries in China, and our survey finds that 82% of the respondents consume Mooncakes during the Mid-Autumn Festival.

In addition, consumer habits may differ in different supermarkets due to the hierarchical effect. For instance, the size of the supermarket may matter (Zeng et. Al 2008). We use small/medium/large to measure the size of supermarkets. In our survey, we request that every district must have at least one of the three types (small, medium and large). Usually, there are fewer customers in the small-scale supermarket, so that we get relatively a small sample of respondents in the small supermarkets, only accounting for 16.3% of the whole sample.

**Empirical results**

As we have pointed out, there are many factors that influence consumers' willingness to pay for the food safety, including food's prices, the level of consumers' awareness, consumers' purchasing habits, consumers' socio-economic variables as well as the characteristics of supermarkets. At the same time, it is worth noting that pre-set value of the bids (Bid) will also have an impact on consumers' WTP. We also expect that consumers' response to additive-free Mooncakes is that the higher "price" (Bid) is, the lower the probability consumers are willing to pay for it.

**[Insert Table 2]**

We collect 294 valid observations. Table 2 gives the explanations to the variables included in the regression. Based on the theoretical framework above, we mainly concern about the influence of consumers' age and income on WTP, controlling other variables. The specific bivariate probit model [5]can be set as follows:

$$\begin{aligned}\text{Wtp1} &= \alpha_0 + \alpha_1\text{Bid1} + \alpha_2\text{Income} + \alpha_3\text{Age} + \alpha_4\text{Age2} + \alpha_5\text{Elder} + \alpha_6\text{Edu} \\ &\quad + \alpha_7\text{Favor} + \alpha_8\text{Cog} + \alpha_9\text{Concern} + \alpha_{10}\text{Size2} + \alpha_{11}\text{Size2} + \varepsilon_1 \\ \text{Wtp2} &= \beta_0 + \beta_1\text{Bid2} + \beta_2\text{Income} + \beta_3\text{Age} + \beta_4\text{Age2} + \beta_5\text{Elder} + \beta_6\text{Edu} \\ &\quad + \beta_7\text{Favor} + \beta_8\text{Cog} + \beta_9\text{Concern} + \beta_{10}\text{Size2} + \beta_{11}\text{Size2} + \varepsilon_2\end{aligned} \qquad (9)$$

Equation (9) is estimated by Stata 9.2 software. Table 3 reports the estimation results. The chi-square test for the model is statistically significant at 1%, which indicates that the model fits the data very well.

**[Insert Table 3]**

As shown in Table 3, the coefficients for Bid, Income, Age, Age2, Cog and Size2 are statistically significant. The most important results are: (1) income is positively correlated with the WTP; (2) there is an inverted-U-shaped relationship between age and WTP, and the turning point is at 32-year-old. Both the signs of the interested coefficients are highly consistent with the theoretic framework.

The level of consumers' cognition of food safety (Cog) has a positive impact on WTP. Compared with the consumers who have not heard of the incidents of unqualified Mooncakes, those who have heard are willing to pay a higher price for the additive-free Mooncake. Consumers who pay attention to the information of food

[5] The dummy variables of "Baby" and "Marital Status" are is dropped in the regression due to multicollinearity with age and "Elder".

safety also have higher level of awareness, and their demand for food will transfer from “eating fully”,” eating well” to “eating safely”. So, they will pay more for additive-free Mooncake.

Compared to those in the large-scale supermarkets, consumers shopping in the medium-sized supermarkets (Size2) have a lower probability of willing to pay. The greater the size of the supermarket is, the more consumers’ WTP for the additive-free Mooncake; and this is consistent with the reality. The reason may be that consumers who concern more about food safety usually have a higher possibility to choose the large-scale supermarket for shopping (Zeng et al., 2008).

The results also show that the coefficients for Edu, Elder, Freq, Concern, Size3 and other variables don’t have significant influence on WTP statistically.

One of the main purposes of food safety research is to calculate the value of WTP, and it can provide a benchmark for assessing the policy. According to the method of calculating the mean WTP as shown in equation (8), we can put the estimated coefficients and corresponding mean of all the variables into equation (8), and we calculated the mean WTP for the additive-free Mooncake is 5.80 Yuan per unit. Using Krinsky and Robb Monte Carlo simulation, we obtain a 95% confidence interval for WTP which is 5.34～6.43 Yuan ( Jeanty 2007). It is a relatively high value for the willingness to pay for an additive-free Mooncake in China. The results also indicate that the consumers’ concern on food additives is very high in China and

therefore the benefits of the government regulation on food additives are also very high.

By the way, we added a question of willingness to pay for additive-free Mooncakes with an open-ended format in the same questionnaire as the previous studies did. We calculated the mean of the WTP of the open-ended format, and find that the WTP for the additive-free Mooncakes is about 5.5 Yuan, which is highly consistent with the above result from the DBDC format .

**Conclusion**

This study finds that income could be positively correlated with the WTP and there is an inverted-U-shaped relationship between age and WTP from a theoretical perspective. These hypotheses are tested by the survey data of WTP for additive-free Mooncakes from 294 customers in 25 supermarkets in Beijing. Such a theoretical framework provides a good benchmark of understanding WTP in the future study of food safety.

This study also indicates that consumers in Beijing are willing to pay 5.80 Yuan more for an additive-free Mooncake, which shows consumers' high concern about the problem of food preservatives is very high in Beijing. The result provides a good policy benchmark of the benefits from the government's regulation on food additives. On the other hand, it may stimulate producers to develop substitutional technologies for food additives to increase consumers' welfare.

**References**


Antle J. M. 2001. “Economic Analysis of Food Safety”. B. L. Gardner & G. C. Rausser (ed.) *Handbook of Agricultural Economics*, Vol.1B (Chapter 19): 1083-1136.

Arrow, K.R., P.R. Solow, E.E. Portney, R. Leamer, R. Radner, and H. Schuman. 1993. “Report of the NOAA Panel on Contingent Valuation.” Federal Register 58: 4601-4614.

Bockstael N. E. and A. M. Freeman.2005. “Welfare Theory and Valuation”. *Handbook of Environmental Economics*, Chapter 12, Vol.2: 517-570.

Cai C., C. Gao , X. Qiao, X. Zheng. 2007. “Comparison of Single Bound and Double Bound Dichotomous Contingent Valuation Technique——a Case of Estimate Health Economic Loss by Air Pollution of Beijing” (in Chinese). *China Environmental Science*, 27 (1):39-43.

Cameron,T. and J.Quiggan.1994. “Estimation using Contingent Valuation Data From Dichotomous Choice with Follow up Questionnaire”, *Journal of Environmental Economics and Management*, Vol. 27(3):218–234.

Carson R.T. and W. M. Hanemann.2005. “Contingent Valuation”. *Handbook of Environmental Economics*, Chapter 17, Vol.2: 821-936.

Chen Zhiying. 2006. “Willingness to Purchase Pollution-Free Agricultural Products and Buying Behavior Analysis of the Impact of Factors——an Example in Beijing ”. *Journal of Agrotechnical Economics* 2006(1):68-75.

Cooper, J.C. 1993. “Optimal Bid Selection for Dichotomous Choice Contingent Valuation. Surveys”, *Journal of Environmental Economics and Management*, Vol.24:25-40.

DAI Y., B. Zhu, and R. Yao. 2006 . “Consumers Choice on Food Safety: a Case Study of Organic Vegetable Purchasing Behavior in Nanjing.”. *Journal of Nanjing Agricultural University* (Social Sciences Edition) (in Chinese ), 2006 (1):47-52.

Golan E. and F. Kuckler. 1999. “Willingness to Pay for Food Safety: Costs and benefits of Accurate Measures”. *American Journal of Agricultural Economics*, Vol.81 (5): 1185-1991.

Hanemann W.M. 1984. “Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses”. *American Journal of Agricultural Economics*, Vol. 66(3): 332-341.

Hanemann, W.M. 1985. “Some Issues in Continuous- and Discrete-Response Contingent Valuation Studies”. *Northeast. J. Agr. Econ.* Vol.14(1): 5-13.

Hanemann,W.M., J.Loomis and B.Kanninen.1991. “Statistical Efficiency of Double Bounded Dichotomous Choice Contingent Valuation”, *American Journal of Agricultural Economics*, Vol.73(4):1255-1263.

HE P., J. Jin, H. N. Liu, 2007. “Consumers Concerned about Food Safety Investigation and Analysis” (in Chinese ). *Statistics and Decision*, 2007(23):114-116.

Huang J., C. Canton, J. Bai, Carl Pray. 2006. “Urban Chinese Consumers on Genetically Modified Foods in the Awareness Levels of Acceptance and Willingness to Purchase.” (in Chinese) *Soft China* 2006(2):61-67.

Huang J., P. Xu. 2007. “Consumer Awareness of Pollution-Free vegetables and Buying Behavior of the empirical analysis——based on consumer surveys in Wuhan” (in Chinese ), *Journal of Agrotechnical Economics* 2007(6):62-66.

Jeanty P.W. 2007. “Constructing Krinsky and Robb Confidence Interval for Mean and Median WTP Using Stata”. North American Stata Users' Group Meetings, 2007.

Jin J. and S. Wang. 2006. “A Comparative Study of Economic Valuation of Solid Waste Management in Macao Using CVM” (in Chinese). *Advances in Earth Science* 2006(6):605-609.

Qiu H., J. Huang and J. Yang. 2007. “Consumers Trust in Government and its Impact on Their Acceptance toward Genetically Modified Food.” *Economic Research Journal*, 2007(6):65-74 .

Ready R.C., J.C.Buzby and D.Hu .1996. “Differences between Continuous and Discrete Contingent Value Estimates”. *Land Economics*, Vol. 72, (3): 397-411.

Wang Z.. 2003. “Awareness of Food Safety and Consumer Decisions: Tianjin on the Empirical Analysis of Individual Consumers”(in Chinese). *Chinese Rural Economy* (4):41-48.

Watson V. and M.Ryan. 2007. “Exploring Preference Anomalies in Double Bounded Contingent Valuation”. *Journal of Health Economics*, Vol. 26(3): 463–482.

Yu X., and D Abler.2009 . “The Demand for Food Quality in Rural China”. *American Journal of Agricultural Economics,* vol. 91(1):57-69.

Zeng Y, Liu Y., Yu X.. 2008. “Application of the Hierarchical Models to the Analysis of Consumer’s Willingness to Pay for Food Safety——A Case Study of WTP for Mooncake Additives in Beijing” (in Chinese). *Journal of Agrotechnical Economics* 2008 (1): 84-90.

Zeng Y., W. Xia, B. Huang . 2007. “Consumer’s Purchase and Cognition for Green food in Beijing.” (in Chinese). *Consumer Economics* (1):38-42.

Zhou J. 2004. “Consumer Attitude, Awareness and Buying Behavior on Safer Vegetables —— Consumer Survey in Zhejiang Province-Based Cities and Towns” (in Chinese). *Chinese Rural Economy,* 2004(11):44-52.

Zhou Y., X. Peng , 2006. “Consumer Willingness to Pay for Food Safety in Jiangsu Province China: A Case Study of Reduced Pesticide Residues B.Chinensis.” (in Chinese*). China Economic Quarterly* Vol.5(3):1319-1342.

Table 1 Descriptive Statistics

| Variables | Description | Num. | Percentage | Variables | Description | Num. | Percentage |
|---|---|---|---|---|---|---|---|
| $B_i$ | 1 | 87 | 29.6 | $B_i^u$ (or $B_i^d$) | 0.5 | 14 | 4.8 |
| | 1.6 | 105 | 35.7 | | 1 | 23 | 7.8 |
| | 2.5 | 102 | 34.7 | | 1.6 | 94 | 32 |
| Wtp1 | no | 58 | 19.7 | | 2.5 | 83 | 28.2 |
| | yes | 236 | 80.3 | | 3.5 | 80 | 27.2 |
| Cognition | no | 146 | 49.7 | Wtp2 | no | 94 | 32 |
| | yes | 148 | 50.3 | | yes | 200 | 68 |
| Preference for Mooncake | Eat every year | 176 | 59.9 | Size of supermarket | large | 127 | 43.2 |
| | Eat frequently | 65 | 22.1 | | middle | 119 | 40.5 |
| | Almost do not eat | 53 | 18 | | small | 48 | 16.3 |
| Education | Illiterate | 4 | 1.4 | Gender | female | 172 | 58.5 |
| | Primary school | 2 | 0.7 | | male | 122 | 41.5 |
| | Junior high school | 59 | 20.1 | Baby | no | 199 | 67.7 |
| | Senior high school | 86 | 29.3 | | yes | 95 | 32.3 |
| | College | 127 | 43.2 | Elder | no | 109 | 37.1 |
| | Master and above | 16 | 5.4 | | yes | 185 | 62.9 |
| The average monthly family income (Yuan) | <500 | 2 | 0.7 | Age | <25 | 95 | 32.3 |
| | 500－1000 | 21 | 7.1 | | 25-30 | 59 | 20.1 |
| | 1000－2000 | 54 | 18.4 | | 31-40 | 49 | 16.6 |
| | 2000－3000 | 79 | 26.9 | | 41-50 | 42 | 14.3 |
| | 3000－4000 | 49 | 16.7 | | 51-60 | 26 | 8.9 |
| | 4000－5000 | 35 | 11.9 | | >60 | 23 | 7.8 |
| | 5000－8000 | 33 | 11.2 | Concern for food safety | Very much | 123 | 41.8 |
| | >8000 | 21 | 7.1 | | Relatively | 124 | 42.2 |
| Marital status | Married | 164 | 56.4 | | Average | 31 | 10.5 |
| | Unmarried | 127 | 43.6 | | Indifferent | 8 | 2.7 |
| | others | 0 | 0 | | Not care | 8 | 2.7 |

Table 2 Variables included in the Estimation

| Variables | Description | Mean | Std. Dev. |
|---|---|---|---|
| Bid1 | The base bid at the initial dichotomous choice question | 1.7347 | 0.6088 |
| Wtp1 | Respondent's answer to the initial question,1=yes,0=no | 0.8027 | 0.3986 |
| Bid2 | The follow up bid at the second dichotomous choice question | 2.2718 | 0.9211 |
| Wtp2 | Respondent's answer to the second question,1=yes,0=no | 0.6803 | 0.4672 |
| Income | The average monthly family income (Yuan)<br>1～8 represents eight levels from low to high, respectively | 4.6803 | 1.6952 |
| Age | Respondent's age | 34.8742 | 15.0651 |
| Age2 | The square of age | 1442.3910 | 1281.2420 |
| Elder | Whether respondent's family have old people above 65,<br>1=yes,0=no | 0.6293 | 0.4838 |
| Edu | Respondent's education，<br>1～6 represents six levels from low to high, respectively | 4.2857 | 0.9599 |
| Freq | The frequency of eating Mooncakes in the Mid-Autumn Festival, representing the level of consumers' preference<br>1＝Eat every year，2＝Eat frequently，3＝Almost do not eat | 1.5816 | 0.7784 |
| Cog | Have you heard of the incidents of unqualified Mooncakes? representing the level of cognition, 1=yes,0=no | 0.5034 | 0.5008 |
| Concern | Respondent's concern for food safety，1＝Very much，<br>2＝Relatively，3＝Average，4＝Indifferent，5＝Not care | 1.8231 | 0.9215 |
| Size1 | Large-scale supermarket，1＝yes，0＝no | 0.4320 | 0.4962 |
| Size2 | Medium-sized supermarket，1＝yes，0＝no | 0.4048 | 0.4917 |
| Size3 | Small-scale supermarket，1＝yes，0＝no | 0.1633 | 0.3702 |

Table 3 Estimation of the Bivariate Probit Model

| Variables | Coef. | Stand Error |
|---|---|---|
| Bid（1&2） | -0.3830 | 0.0448*** |
| Income | 0.1462 | 0.0473*** |
| Age | 0.0504 | 0.0270* |
| Age2 | -0.0008 | 0.0003** |
| Elder | -0.0973 | 0.1588 |
| Edu | 0.0001 | 0.0835 |
| Freq | -0.0244 | 0.1002 |
| Cog | 0.3552 | 0.1534** |
| Concern | -0.0581 | 0.0794 |
| Size2 | -0.2976 | 0.1659* |
| Size3 | -0.2696 | 0.2221 |
| Constant | 0.3275 | 0.6460 |
| $\rho$ | 0.9989 | 0.6690 |
| Log Likelihood | -270.9069 | |
| Mean / Median WTP | 5.80 | |
| 95%C.I. | 5.34—6.43 | |
| Number of Obs. | 294 | |

Note: (***), (**), (*) denote significance at the 1%, 5% and 10% levels, respectively.

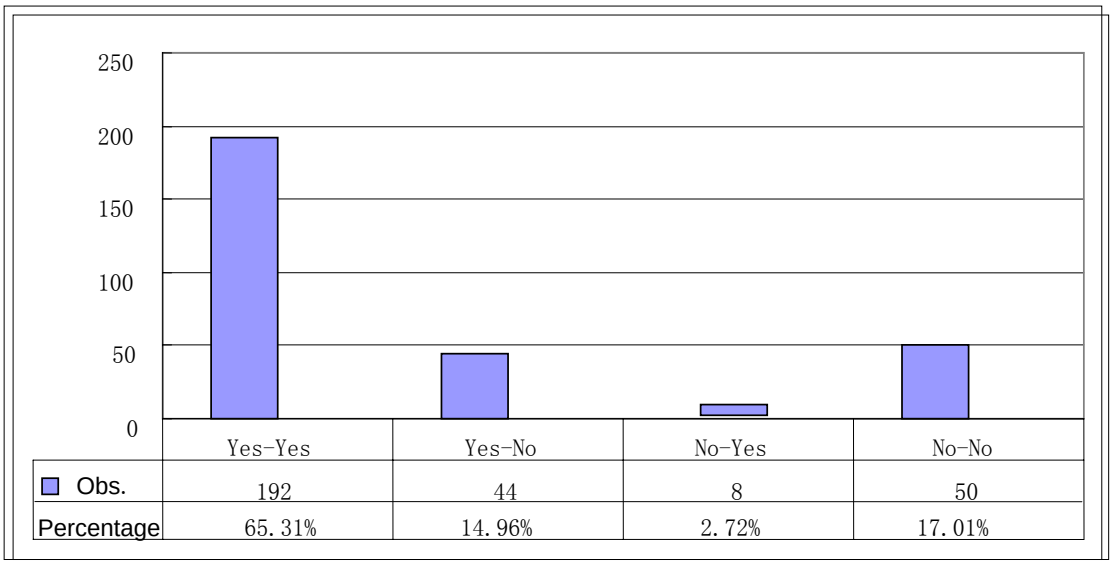


Figure 1 Distribution of WTP