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An empirical study of consumers' willingness to pay for traceable food in Beijing, Shanghai and Jinan of China

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There have been more and more food safety incidents since 1990s in China. Implementation of traceability system is an important way to improve food safety in China. The food traceability system is still in an initial stage and implemented only in limited products and companies in China. Contingent valuation method (CVM) was used to investigate the Chinese consumers' willingness to pay for traceable vegetables and beef. The research was based on 600 face-to-face survey conducted in Beijing, Shanghai and Jinan in China. It shows that: (1) Price of traceable bean sprouts, leccute and beef (BBS), place of purchase (PLACE), consumer perception of food risk (RISK), gender (GENDER), consumer health (HEALTH) and per capita monthly income (LANINCOME) have significant effects on consumers' WTP for traceable food. (2) The respondents' willingness to pay for traceable bean sprouts, leccute and beef are 91.7, 99.2 and 18.4% higher than normal bean sprouts, leccute and beef respectively. (3) Consumers show greater willingness to pay for the traceable food with other quality certification.

Key words: Food traceability system, consumers' willingness to pay, contingent valuation method.

INTRODUCTION

There have been more and more food safety incidents since 1990s in China. In 2008, melamine was found in infant milk powder produced by Sanlu Group in Hebei province at first, then it was found in several other famous milk powder producers. These incidents have caused widely public concern over the food safety and significant effects on the food market in China. Meanwhile, food safety is seriously concerned worldwide nowadays. If the food produced in China cannot be traced, some of them would not be permitted to export to many developed countries, such as USA, Japan and European Union. Therefore, it is necessary to establish food traceability system in China.

In order to improve food safety regulation efficiency in domestic market and overcome trade barrier in international trade, the Chinese government began to construct the traceability system since 2000. In 2004, 8 cities were selected as pilot cities to establish food safety monitoring system by the Ministry of Agriculture of China. Since then food tracing system was established in Beijing, Shanghai, Shouguang, Nanjing etc. The Ministry of Commerce of China began to establish food tracing system in 2010, and 35 cities were ratified as pilot cities for food tracing system until 2013. Despite the Chinese government and producers have made a lot of efforts to establish the food traceability system, the food tracea-

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bility system is still in an initial stage and has been used only in limited products and companies. It is important to have a good sense of consumers' willingness to pay (WTP) for certified traceable food and its affecting factors. The aim of the research was to investigate consumers' willingness to pay (WTP) for certified traceable food and its affecting factors.

Contingent valuation method (CVM) was used to investigate the Chinese consumers' willingness to pay for traceable vegetables and beef. The research was based on 600 face-to-face survey conducted in Beijing, Shanghai and Jinan in China.

The outline of the paper is as follows. The next section is a literature review. The third section is data, sample characteristics and method. The last section is empirical results and discussion.

LITERATURE REVIEW

Traceability system

Traceability is defined as the ability to trace the history, application or location of an entity by means of recorded information (ISO8402, 1994). European Union (EU) defined traceability as the ability to trace or track the information of production, processing and selling (EU, 2002). Traceability system can be divided into four levels: they are product, data, standard, information technology and planning respectively. There are internal company traceability and inter-business traceability (Moe, 1998).

Traceability system was first evaluated according to the depth; width and accuracy in American's agricultural survey report. The report took three industries as the example and evaluated the traceability efficiency in different industries (Carla et al., 2010). It further pointed out that it was very difficult to draft the same standard in different industries (Golan et al., 2003).

By implementing the traceability system, the defected product can be called back through checking recorded information. The scholars showed that food traceability system not only promotes food security supervision but also improves the management decision and reduces the negative effects on public health (Hobbs et al., 2005; Golan et al., 2003; Souza-Monteiro and Casewell, 2004; Linhai et al., 2010). It can also reduce the transaction cost arising from the monitoring of product quality including the production methods of suppliers (Hobbs et al., 2005).

Consumers' willingness to pay

There have been many studies on consumers' willingness to pay for traceable food in the developed countries and regions, such as USA (Dickinson, 2002), Canada (Hobbs et al., 2005), Spain (Angulo et al., 2005), the United Kingdom, Japan (Dickinson and Bailey, 2005).

The research on consumers' willingness to pay for traceability in USA, Canada and Japan showed that

consumers' willingness to pay for traceable produce was different. However, it is common that consumers in the three countries were willing to pay a higher price for traceable produce with both information about food safety and animal welfare (Dickinson and Bailey, 2003).

Willingness to pay for traceable produce is a concern to Chinese scholars in recent years. Linhai (2010) showed that most respondents were willing to pay no more than 30% price premium for traceable produce.

There are various methods employed to elicit consumers' willingness to pay premium for traceable food, such as contingent valuation method, cost of illness, experimental markets, conjoint analysis, prices paid in market, liability costs, trade analysis and so on. Contingent valuation method is widely adopted in research of consumers' willingness to pay (ZhiGang and Yanna, 2006; Huimin et al., 2012; Zhigang et al., 2013; Yong et al., 2014; Zengjin et al., 2014). The categories of traceable food focused by scholars were milk products (Zhigang and Yanna 2006), vegetables (Yong et al., 2014), beef (Zengjin et al., 2014), pork (Huimin et al., 2012; Zhigang et al., 2013) and so on. The results showed that respondents were not certain that the traceable pork were safe food, and their ability to pay was low (Huimin et al., 2012); consumers were willing to pay 22.5% higher price for traceable pork than common pork in Beijing (Zhigang et al., 2013); the attention of consumers for vegetable quality was very high, but the cognition of the traceability of vegetables was very low (Zhigang et al., 2013).

Yong et al. (2014) found that in terms of willingness to pay, most respondents said they were willing to pay more for traceability agricultural products, but the willingness to pay was low; consumers' willingness to pay was driven by gender, age, family population, traceability label trust and paying ability and other factors. Zengjin et al. (2014) analyzed consumers' willingness to pay for traceable beef with 400 questionnaires. The study found that consumers' cognitive level of traceable beef was low, but 95.25% of the respondents were likely to buy traceable food after they were told the benefit of traceability; and the respondents were willing to pay a price premium of 20% for traceable beef.

In conclusion, scholars have researched consumers' willingness to pay for traceable food in various countries and regions, but such researches are still in an initial stage in China. It can be found from previous studies that contingent valuation method is a feasible and popular method to investigate consumers' willingness to pay for traceable food. Chinese scholars mainly focused on several primary traceable foods. Most of the previous studies were only investigating one city and one product in China.

METHOD

Theoretical analysis

The theory of this research is rooted in consumer utility function.

YingHeng (2006) specified the economic principles in estimating consumers' willingness to pay as follows: Assuming all other conditions are constant, food security levels will increase from a lower Q_0 to a higher level Q_1 due to the implementation of traceability system, while consumers will get a greater utility, that is,

$$U_1(Q_1, I, X, \varepsilon_1) > U_0(Q_0, I, X, \varepsilon_0) \tag{1}$$

Where $U(\cdot)$ stands for the consumers utility function, I is consumers income level, X are other factors affecting consumers utility, ε is an error term.

In order to obtain willingness to pay(WTP), let

$$U_1(Q_1, I - WTP, X, \varepsilon_1) = U_0(Q_0, I, X, \varepsilon_0) \tag{2}$$

Then consumers' WTP can be arrived at by statistical method. Derivations are as follows,

Y means consumers' option for traceable food. If consumer chooses traceable food, $Y=1$, if no, $Y=0$.

Bid is the price consumers are willing to pay for traceable food. P is the price for normal food, Z includes food safety level (Q), income (I) and other factors that affect consumers' utility. ε_0 and ε_1 are random error terms. Consumers' utility function for traceable food is $U_{Y=1}(Z, BID, \varepsilon_1)$, while consumers' utility function for normal food is $U_{Y=0}(Z, P, \varepsilon_0)$.

Assuming that consumers' utility function is liner function, and random error ε follows Weibull distribution. When consumers choose traceable food, the utility function takes the form of

$$U_{Y=1} = \alpha_1 + \beta_1'Z + \lambda_1 BID + \varepsilon_1 \tag{3}$$

If consumers choose normal food, the utility function is

$$U_{Y=0} = \alpha_0 + \beta_0'Z + \lambda_0 P + \varepsilon_0 \tag{4}$$

P is the average market price for normal food in formula (4); it means P is the constant in this formula, so formula (4) can be rewritten to

$$U_{Y=0} = \alpha_0' + \beta_0'Z + \varepsilon_0 \tag{5}$$

where $\alpha_0' = \alpha_0 + \lambda_0 P$.

Consumers' utilities in formula (3) and (5) are unobservable, but their options for traceable food or normal food are observable. If

$U_{Y=1} \geq U_{Y=0}$, consumers choose to buy traceable food. If

$U_{Y=1} < U_{Y=0}$, choose to buy normal food.

Let formula (3) minus formula (5), get

$$U_{Y=1} - U_{Y=0} = (\alpha_1 - \alpha_0') + (\beta_1 - \beta_0)'Z + \lambda BID + (\varepsilon_1 - \varepsilon_0) \tag{6}$$

Then it can be rewritten as

$$U^* = \alpha^* + \beta^*Z + \lambda^* BID + \mu^* \tag{7}$$

We can arrive at the probability equation when consumers choose to buy traceable food ($Y=1$), which takes the form of,

$$P(Y=1) = P(U^* > 0) = P[\mu^* > -(\alpha^* + \beta^*Z + \lambda^* BID)] \tag{8}$$

Formula (8) is a logit linear model. Y is the dependent variable; Z and BID are independent variables, α^* , β^* , λ^* are parameters to be estimated, μ^* is stochastic error.

Formula (8) can be rewritten as,

$$P(Y = 1) = \Lambda(U^*) = [1 + \exp(-U^*)]^{-1} \tag{9}$$

Take formula (7) into formula (9), the following linear logit model is obtained

$$\ln \left[\frac{P(Y = 1)}{1 - P(Y = 1)} \right] = \alpha^* + \beta^*Z + \lambda^* BID \tag{10}$$

Consumers' willingness to pay for traceable produce $E(BID)$ can also be got when utility for traceable food(formula (3)) and normal food (formula (4)) are equal.

$$\alpha_0' + \beta_0'Z + \varepsilon_0 = \alpha_1 + \beta_1'Z + \lambda_1 BID + \varepsilon_1 \tag{11}$$

For $E(\varepsilon_0) = E(\varepsilon_1) = 0$, take the mean on both sides of the formula and get

$$E(BID) = - \frac{\alpha_0' + \beta_0' E(Z)}{\lambda_1} \tag{12}$$

Take the coefficient got from formula (10) and the mean of Z into formula (12), $E(BID)$ is obtained.

Then $E(WTP)$ can be got by the following formula

$$E(WTP) = E(BID) - P_0 \tag{13}$$

Data collection and sample characteristics

Data collection

Questionnaire survey with face-to-face talk was used to collect data in the survey. We delivered 600 questionnaires and 576 of them were valid. The effective response rate was 96%. The interviewers brought some traceable vegetables to scan in the POS machine to make respondents understand the questions in the questionnaire better. Moreover, they were trained survey skills before visiting respondents. The contingent valuation method with two-bounded dichotomous choice method is used in the design of the questionnaire to obtain more objective information in the survey. The two-bounded dichotomous choice is a questioning approach derived from dichotomous choice method. The specific question is to ask consumers whether they would like to pay for traceable produce at the price of (B_0); if the consumer answers "yes", then continue to ask his willingness to pay at a higher price of (B_1). If

Table 1. Socio-demographic statistics-gender.

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Male	284	49.3	49.3	49.3
	Female	292	50.7	50.7	100.0
	Total	576	100	100	

Table 2. Socio-demographic statistics-marital status.

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Unmarried	223	38.7	39.2	39.2
	Married	346	60.1	60.8	100.0
	Total	569	98.8	100.0	
Missing		7	1.2		
Total		576	100		

Table 3. Socio-demographic statistics-Education level.

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Primary school	11	1.9	1.9	1.9
	Middle school	67	11.6	11.8	13.7
	High school	169	29.3	29.8	43.5
	Junior College	124	21.5	21.8	65.3
	College	173	30.0	30.5	95.8
	Master and above	24	4.2	4.2	100.0
Total		568	98.6	100.0	
Missing		8	1.4		
Total		576	100		

the consumer answers "no", then continue to ask at a lower price to test his willingness to pay.

As for the survey locations, some supermarkets and shopping centers in Beijing, Shanghai and Jinan were selected. These three metropolises are located in the central, south and middle of China respectively. The traceability system is in the initial stage in China, so its implementation requires certain conditions. The reliability of the survey will be affected if the consumers' income level and cognitive level are too low. So we selected the above 3 metropolises as the survey locations.

The research focused on consumers' willingness to pay for traceable vegetables and beef. Bean sprouts and lettuce were selected for the representative vegetables, because the two vegetables are normal vegetables that people consume in their daily life in China. Beef was selected, because its traceability system was implemented early in both developed countries and China.

Sample characteristics

The survey showed that almost half of respondents (49.3%) were males. Married respondents accounted for 60.8%. Approximately half of the respondents (48%) were under 30 years old, 22% respondents were 30-40 years old, 14.4% respondents were 41-50 years old, 22% respondents were 30-40 years old, 8.3% respon-

dents were 50-60 years old, 5.7% respondents were above 60 years old. Most of the family's average (60.4%) monthly income was less than RMB 4500 yuan (Tables 1-4).

Most respondents (65.3%) who buy food were mainly family members. More than half (51.2%) of respondents expressed willingness to buy vegetables in the open market. 72% of the respondents were willing to purchase beef in the supermarket or specialty stores.

As for respondents' perspective of who to play the major role in food safety, 54.9, 53.4, 51.2, 38.7 and 5.7% respondents answered that the government, the retailers, producers, raw material suppliers, consumers should take the major responsibility in food safety respectively.

Most respondents (89.8%) considered pesticide residues as the most important factor affecting human health, followed by human food additives and preservatives (65.6%), excessive fertilizer (57.5%), animal food additives (56.3%), animal diseases (54.7%), heavy metals contamination (49%), microbial contamination (35.9%), genetically modified food (31.8%) and so on.

The survey showed that 76.2% of the respondents did not have knowledge of traceability system.

Information channels for those who have knowledge of the traceability system were TV (68.2%), newspaper (35.4%), internet (31.3%), radio (21.8%), leaflets (15%) and friends (13.6%) respectively.

When respondents were asked about the reasons why they did

Table 4. Socio-demographic statistics-Monthly family income (unit: RMB yuan).

	Frequency	Percent	Valid percent	Cumulative percent
	<1000	18	3.1	3.2
	1000-1500	63	10.9	14.2
	1500-2500	100	17.4	31.8
	2500-3500	76	13.2	45.1
Valid	3500-4500	87	15.1	60.4
	4500-5500	56	9.7	70.2
	5500-6500	42	7.3	77.5
	6500-7500	39	6.8	84.4
	≥7500	89	15.5	100.0
	Total	570	99.0	100.0
Missing		6	1.0	
Total		576	100	

not know about the traceability system, 56.9% of the respondents said that the government's information service was not enough, 43.1% of the respondents thought that the supermarkets' information service were not enough, 37.3% of the respondents believed that producers' information service was not enough. 28.7% of the respondents thought that the food in open market was safe. When the respondents were asked why they did not want to pay a price premium for traceable vegetables, the respondents' answers were as follows:

First, Majority of the respondents (68.5%) thought that prices of traceable vegetables were too high. Second, 36% of the respondents thought that the food traceability system was the responsibility of the government and producers. Third, 26.8% of the respondents thought traceability system was unreliable due to the limited government regulation. Fourth, 19% of consumers thought information delivered in the food traceability system was unbelievable. At last, a small number of respondents (8.7%) said that they trust the security of normal vegetables and the food traceability system was not necessary.

EMPIRICAL ANALYSIS AND RESULTS

Variable Selection

Table 5 shows definitions of variables, descriptive statistics and expected directions.

Empirical analysis

Table 6 shows that price of traceable bean sprouts, leccute and beef (*BBS*), place of purchase (*PLACE*), consumer perception of food risk (*RISK*), gender (*GENDER*), consumer health (*HEALTH*) and per capita monthly income (*LANINCOME*) have significant effects on consumers' *WTP* for traceable food.

Price of traceable food has a negative effect on consumers' willingness to pay; the higher the price, the lower likelihood for consumers to buy traceable food. *Place of purchase* has a positive effect on consumers' willingness to pay; it indicates that consumers who

usually go shopping in supermarkets rather than open markets are more likely to buy traceable food.

Risk perception has a positive effect on consumers' willingness to pay. Consumers who think that the situation of food safety is serious and it is important in people's health are willing to pay a higher price for traceable vegetables or beef.

Consumer health status (*HEALTH*) has a positive effect on consumers' willingness to pay; the worse the consumers' physical conditions, the higher likelihood for them to pay for traceable food.

Average per capita monthly income (*LAINCOME*) has a positive impact on consumers' willingness to pay; the higher the consumers' average monthly income, the more likely for them to pay a price premium for traceable food.

The price premium of the consumers' willingness to pay for traceable bean sprouts, leccute, and beef can be got according to formula (13). The price of normal bean sprouts, leccute and beef is RMB 4 yuan per kg, RMB 4 yuan per kg and RMB 40 yuan per kg respectively. The results show that the respondents' willingness to pay for traceable bean sprouts, leccute and beef are 91.7, 99.2, and 18.4% higher than normal bean sprouts, leccute and beef respectively. It indicates that consumers' willingness to pay for traceable bean sprouts is RMB 7.666 yuan per kg, traceable leccute is RMB 7.971 yuan per kg, and traceable beef is RMB 47.452 yuan per kg. The prices that respondents would like to pay for these three traceable foods were much lower than their sales price in the surveyed supermarket. The sales prices in the surveyed supermarket were RMB 11.98 yuan per kg, RMB 12.986 yuan per kg and RMB 96 yuan per kg, respectively.

DISCUSSION

This research investigated consumers' willingness to pay for traceable vegetables and beef and its influencing

Table 5. Definitions of variables, descriptive statistics and expected directions.

Variable	Definition	Mean	Standard deviation	Expected directions
BBS1	Maximum price that the consumer is willing to pay for traceable bean sprouts	3.68	0.94	-
BBS2	Maximum price that the consumer is willing to pay for traceable lettuce	7.103	2.276	-
BBS3	Maximum price that the consumer is willing to pay for traceable beef	29.547	4.441	-
PURCHASE	Whether the consumer is the main buyer, 1="yes", 0="not"	0.66	0.47	-
PLACEV	The place to buy vegetables, 1="market", 0="farmers market"	0.48	0.50	+
PLACEB	The place to buy beef, 1="market", 0="farmers market"			+
RISK	Risk perception			+
GENDER	Gender, 1="female", 0="male"	0.51	0.50	+
EDU	Education, 1="high school and above", 0="under high school"	0.86	0.34	+
MAR	Marital status, 1="married", 0="unmarried"	0.62	0.49	+
AGE	Age, 1="less than 30", 2="30-40", 3="40-50", 4="50-60", 5="more than 60"	2.05	1.26	+
HEALTH	Health, 5="very healthy", 4="healthy", 3="general", 2="not good", 1="very bad"	4.09	0.66	+
CHILDREN	Number of children under 13 years old	0.37	0.57	-
ELDER	Number of people over 60 years old	0.63	0.87	+
AINCOME	Per capita family income (RMB yuan)	1389.90	910.89	+

factors. The survey places were Beijing, Shanghai and Jinan in China. It showed that most consumers had never heard of traceability system in China. The major information channels for those who had knowledge of traceable food were TV, newspaper and Internet. The higher the consumers' risk perception, the more likely they were willing to buy traceable food. The reason that consumers were reluctant to buy traceable food at a higher price can be explained as follows: First, the price of traceable food was too high. Second, majority of consumers thought that food safety was not consumers' responsibility but the government's, retailers' and producers' responsibility. Third, unreliable information still existed in the food traceability system. When the prices of traceable food are relatively modest, many consumers prefer to pay for them. The higher the traceable food price, the less likely consumers are willing to pay for them. But, their willingness to pay still declines when the price of traceable food is too high.

Implications

The research provides insights into the marketing strategies of the traceable food producers, retailers. The

research also provides insights into the food traceability system construction of the Chinese government.

The traceable food producers and retailers should consider seriously the consumers' willingness to pay for traceable food to improve their marketing strategies.

Firstly, as the prices of traceable food in China are too high to accept for most consumers, the traceable food producers and retailers should take more measures to reduce the costs and lower the market prices of traceable food.

Secondly, the traceable food producers and retailers should consider to provide more information about the food traceability system to enhance the consumers' understanding of the procedure of traceable food production.

Thirdly, the traceable food producers and retailers should make certain that the tracing food is safety, and it is worth to pay a price premium.

The findings also suggest that the government should take more efforts to improve the food traceability system in China, such as expanding pilots of the food traceability system in more cities, providing more conveniently installation for consumers' information inquiry of traceable food, offering more knowledge of the food traceability

Table 6. Logit regression results for traceable produce.

Explanatory variables	Bean sprouts	Lettuce	Beef
	Coefficients	Coefficients	Coefficients
BBS	-12.449***	-12.85***	-4.97***
PURCHASE	-0.155	0.738**	-0.155
PLACEB/V	0.667**	0.766***	0.792***
RISK	2.215***	3.88***	2.399***
GENDER	1.002***	0.459	0.252
EDU	-0.413	0.377	0.356
MAR	-0.151	-0.626	-0.03
AGE	0.087	0.369***	0.002
HEALTH	0.778***	1.069***	0.676***
CHILDREN	0.408	0.912***	0.371
ELDER	0.322	0.295	0.262**
AINCOME	1.874***	2.111***	1.684***
Number of samples	556	572	560
-2 Log likelihood	228.48	228.93	445.84
Hosmer-Lemeshow Chi-square(Sig.)	13.145(0.107)	10.742(0.217)	7.329(0.502)

Note: ***significance at 1%, **significance at 5%.

system and the relationship between traceability and food safety, supporting the producers and retailers to reduce costs of implementing the food traceability system.

LIMITATIONS

Consumers' willingness to pay is estimated in the simulated situation. The estimation for consumers' willingness to pay cannot stand for the real situation completely. Contingent Valuation Method adopted in the research may engender biases. However, it is widely used and it is suitable for the research. Future studies may select more traceable foods; adopt more advanced research method to make the estimated results more reliable.

Conflict of Interests

The authors have not declared any conflict of interests.

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