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Amount of information and consumers' willingness to pay for food traceability in China

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This study employs random nth price auction to investigate consumers' willingness to pay (WTP) for food traceability system with both abbreviated and detailed information. Results show that consumers have a positive WTP for both kind of food traceability systems, and on average the premium for apples with detailed information is 10 percent higher than that of apples with abbreviated information. Males, the married and those with relatively low level of education have high premiums for detailed traceability information, while the self-reported healthy consumers would not like to pay much more premium for detailed information. The results also show that consumers show much interest in information of quality certificate and chemical fertilizers/pesticides used in food production provided by food traceability system. Implications for implementing food traceability system were discussed.

Keywords: Consumer, information, food traceability system, willingness to pay, China

JEL codes: L15, Q18, D1





1. Introduction

The information asymmetry often leads to consumers' increasing anxiety, uncertainty and sharply declining of confidence (Akerlof, 1970; Nelson, 1970; De Jonge et al., 2004; Hobbs, 2004; Halawany et al., 2007; Houghton et al., 2008). To restore and consumer confidence, it is essential and effective to provide more information (Golan et al., 2004; van Rijswijk & Frewer, 2012; Resende-Filho & Buhr, 2010; Kher et al., 2013), which can be achieved by traditional food labels (e.g., Kehagia et al., 2007) and food traceability system with modern technology as well (e.g. Liddell & Bailey, 2001; Golan et al., 2004; Hobbs et al., 2005; Liao et al., 2011).

Labelling is a conventional means of food information provision and it still plays an important role in communicating with consumers (Kehagia et al., 2007). While space limitations on the simple hand-written or printed labels place limits on how much information can be conveyed (Verbeke & Ward, 2006; Halawany et al., 2007; Cornelisse-Vermaat et al., 2008; Jin & Zhou, 2014). As technologies and devices are improved continuously, IT enabled food traceability systems such as barcode, radio frequency identification (RFID) devices and optical systems are widely developed and used (Chrysochou et al., 2009; Dabbene et al., 2014). Due to the increased efficiency, effectiveness, security, reliability, the increasing amount of information included as well as more precision, IT-based traceability system are rapidly replacing labels gradually (Food Standards Agency, 2002; Dabbene et al., 2014).

In terms of the amount of information conveyed, there are two types of food traceability systems. Taking beef traceability system as example, the first type is a kind of relatively simple traceability system, for example, the voluntary United States beef traceability systems which are mainly private and motivated by economic incentives (Monjardino de Souza Monteiro & Caswell, 2004). The US beef traceability systems¹ are record-keeping systems for the purpose of controlling supply-chain, facilitating food safety control, differentiating foods attributes and monitoring animal diseases (Golan et al., 2004; Schulz & Tonsor, 2010). In terms of the amount of information provided, the US beef traceability system lags far behind those of Japanese and

¹ The National Animal Identification System (NAIS) is a voluntary program, it is the most comprehensive effort in the United States to implement food traceability (Schroeder et al., 2009).



EU (Smith et al., 2005). The other is a kind of detailed traceability system, e.g. Japanese beef traceability system. The mandatory system has more depth and breadth than the EU² traceability system (Monjardino de Souza Monteiro & Caswell, 2004). According to Jin & Zhou (2014), the Japanese Beef Traceability Law³ requires the following information to be recorded in the beef traceability system: an Individual Identification Number, the date of birth or country of origin, the sex, the Individual Identification Number of the maternal parent, the location (prefecture name) of the raising facilities, the start and end of the breeding in the breeding facilities, the date of slaughter, the breed of the cattle, the name of the exporting country (for imported cattle), the title and location of the abattoir where the cattle were slaughtered, and the country of origin (for imported cattle). Except the information required by law, beef retailers⁴ could provide more additional information voluntarily for better assurance of food safety and quality (Clemens, 2003).

However, it is not the case that the more information provided the better, many barriers such as the participating producers' liability (Breiner, 2007; Schulz & Tonsor, 2010), reliability of technology (Schroeder et al., 2009; Schulz & Tonsor, 2010) and willingness of information provision (Golan et al., 2004) exist in the process of implementing food traceability system when providing detailed information. And the most concerning issue is that providing information comes at costs (Golan et al., 2003; FMRIC, 2008). Relatively speaking, the more amounts of information and more detailed a traceability system is, the higher the costs (Monjardino de Souza Monteiro & Caswell, 2004). Food producers concern the critical issue (Breiner, 2007) that who will pay for the cost (Monjardino de Souza Monteiro & Caswell, 2004), they would not like to provide detailed information if cost totally imposed on their burden.

² According to Monjardino de Souza Monteiro & Caswell (2004), EU is a main driver in establishing world standards and leads the introduction of traceability system worldwide.

³ Law for Special Measures Concerning the Management and Relay of Information for Individual Identification of Cattle (abbreviated as Beef Traceability Law, Law No. 72) put in force to implement full traceability from farm to fork in 2004. Japanese beef traceability system was implemented by the National Livestock Breeding Center with the support of the Ministry of Agriculture, Forestry and Fisheries (Clemens, 2003; Jin & Zhou, 2014)

⁴ For example, Jusco Supermarkets (Aeon Company, Ltd) constructed the most comprehensive assurance system, providing consumers with the story of how the meat was produced, the photos and name of the producers on product package, BSE testing, an official stamp of Aeon, etc. (Clemens, 2003).



Therefore, to clarify whether the consumers want to pay for the traceability information is of great importance to implement food traceability system; however, scarcely any related researches yet. Amount of researches have been conducted related to food traceability systems just mainly focus on the premiums consumers pay for the traceability attribute or associated quality assurance attributes (e.g. Dickinson & Bailey, 2002; Hobbs et al., 2005; Verbeke & Ward, 2006; Loureiro & Umberger, 2007; Ubilava & Foster, 2009; Cicia & Colantuoni, 2010; Xu & Wu, 2010; Lee et al., 2011; Ortega et al., 2011; Wu et al., 2011&2012; Zhang et al., 2012; Bai et al., 2013). Based on experimental auction in Hangzhou, China, this study compares two kinds of systems, i.e. the abbreviated one with some basic information and the detailed one with more amount of precise information, aimed to

- 1) reveal and compare Chinese consumers' WTP and preference for two types of food traceability systems;
- 2) investigate the factors affecting consumers' WTP for food traceability system, and
- 3) identify what kinds of information do consumers show interest in.

Our research focuses on China for the reason that China is a typical emerging country and still at a preliminary stage of implementing food traceability system, the government and food industry have been endeavoring to implement food traceability system in recent years. It is of great importance to identify consumers' attitudes and preference for food traceability information to guide the development, implementation and maintaining of food traceability system in China. And Hangzhou is among the first batch of pilot cities to implement meat and vegetables traceability systems sponsored by the Ministry of Commerce and the Ministry of Finance, so it is a good representative.

The remainder of the paper was organized as follows. Following the introduction is the background and process of implementing food traceability system in China. The third part is the methodology and data description, then following the result and discussion part including bids analyzing, affiliation test, bids model and regression result, and identifying information demand, the final comes along with the conclusion and implications.



2. Background on food traceability system in China

China began to explore the implementation of food traceability system at the beginning of new century. On May 24th, 2002, the Ministry of Agriculture released *Management Regulations for Animal Vaccination Identification Tag* and stipulates that pigs, cattle, and sheep must wear immunity ear tags and the immunity archives management system must be established, which indicated that China started to construct food safety traceability system.

In 2004, *Regulation of Exit Aquatic Products Traceability*, *Beef Products Tracing and Tracking Guidelines*, and *Vegetables and Fruits Traceability Guidelines* were released, for the reason that, the European Union imposed a mandatory traceability on imported beef, aquatic products and vegetables etc. after the outbreak of BSE. To improve the export exchange of such agricultural products and regain consumer confidence, the Chinese General Administration for Quality Supervision, Inspection and Quarantine, the Article Numbering Center of China enacted these guidelines and regulations in succession.

In addition, to ensure the quality and safety of agricultural products, *Law of the People's Republic of China on Agricultural Product Quality Safety*⁵ and *Food Safety Law of the People's Republic of China*⁶ were enacted in 2006 and 2009 respectively. Both of them require the food

⁵ *Law of Agricultural Product Quality Safety* requires that food enterprise shall set up records on production of agricultural products and the required information is as follows (Article 24): The names, sources, usage, dosage of agricultural input products in use, the date of using it and the date disusing it; The information on occurrence, prevention and control of animal epidemic diseases as well as plant diseases, pests and disasters; and The date of harvest, slaughter or fishing.

⁶ *Food Safety Law* stipulates that food producers, processors, packers, and retailers must implement record systems which should be preserved for at least two years for all inputs and outputs (Article 35-41 & Article 53).

Food producer should record the state, use pesticides, fertilizers, growth regulators, veterinary medicines, feeds, feed additives and other agricultural inputs, etc.;

In terms to raw materials, food additives and food-related products, contents as the names, specifications and quantities of the food raw materials, food additives and food-related products, names and contact information of the suppliers, and purchase dates should be recorded.

A food ex-factory check record system should include the name, specifications, quantity, production date, production batch number and inspection compliance certificate number of food, name and contact information of purchasers, date of sale, etc.

Record for an enterprise engaging in the business operation of food should convey the name, specifications, quantity, production batch number, shelf-life of the food, name and contact information of the supplier, purchase date, etc.



enterprises to establish information record for the procurement, production, processing, packaging, circulation link of the supply chain.

However, due to the high cost and technical constraint, only limited food categories were covered by food traceability system and food safety events broke out frequently in China last decade (Wu et al., 2012; Bai et al., 2013). To avoid and reduce the harm of unsafe food, *Management Regulations for Food Recall* was released in 2007. The same year, *Certificate and Invoice Asking System* and *Purchase and Sale Ledger System* were encouraged to establish by the State Administration for Industry and Commerce to improve the management of food circulation; and 9 categories 69 kinds of major products (among which 45 kinds are food products) were listed to implement electronic supervision, electronic supervision code must be attached to the package before sale. These efforts promote the establishment of the traceability system.

In order to further E-enabled ‘*Certificate and Invoice Asking System*’ and ‘*Purchase and Sale Ledger System*’, and to improve the level of circulation and package of meat and vegetables, the Ministry of Commerce and the Ministry of Finance began to fund ten capable cities including Shanghai, Chongqing, Dalian, Qingdao, Ningbo, Nanjing, Hangzhou, Chengdu, Kunming and Wuxi as the first batch of pilot cities to establish food circulation traceability system in 2010. This project focuses on meat and vegetables because they are among the highest consumption varieties in ‘shopping basket’ in China. However, it is difficult to identify the origin of meat and vegetables in case of food safety problem. With the purpose of realizing the informatization of traceability system nationwide, the pilot cities should be unified in acquisition index, coding rules, transmission format, interface specification and traceability procedures, to ensure the information communication between different modes of traceability technology and seamless joint cross-regionally. At the initial stage, large wholesaling markets, large and medium-sized supermarket chains and mechanized designated slaughterhouses are the main targets. From 2011 to 2014, another four batches of 48 pilot cities⁷ in all were included in this project to expand the

⁷ Another 48 pilot cities sponsored by the Ministry of Commerce and the Ministry of Finance are the following:

The second batch of pilot cities (2011): Tianjin, Shijiazhuang, Harbin, Hefei, Nanchang, Jinan (in Shandong province), Haikou, Lanzhou, Yinchuan and Urumchi.

The third batch of pilot cities (2012): Beijing, Taiyuan, Hohhot, Changchun, Zhengzhou, Changsha, Nanning, Guiyang, Xi'an,



implementation of food traceability system across the country. The meat and vegetables circulation traceability system can serve as an example to drive the implementation of traceability system for other agricultural products. Following the establishment of meat-vegetable traceability system, China began to establish traceability systems for tea, milk powder, aquatic products etc. in different regions.

The Chinese food traceability system can provide much more information after the implementation of E-enabled '*Certificate and Invoice Asking System*'. However, whether the food traceability system being constructed in China should record detailed information like EU and Japan or just convey abbreviated information like the U.S. system simply to improve the supply-side management is controversial topic and has not reached an agreement yet. It is an issue of great importance because China is still at a preliminary stage of implementing food traceability system with limited food categories covered.

3. Methodology & Data

3.1. Methodology

Taking apples research carrier⁸, we design two treatments, i.e., the first scenario is apple with abbreviated information including 'Brand Name, Producer, Place of Origin, Size, On-sale Date, Shelf Life, Storage Instructions and E-business website'; and the second scenario is apple with detailed information including 'Brand Name, Producer, Place of Origin, Size, Date of Picking, On-sale Date, Shelf Life, E-business Website, Storage Instructions, Contact Way, Pesticide Residuals, Logistics Information, Nutrient Content (Calorie, Fat, Dietary fiber, Protein, Carbohydrate, Carotene, Vitamin A, Vitamin B1, B2, B3, Vitamin C, Vitamin E; Cholesterol, RAE, K, Ca, Fe, Zn, P, Na, Mg, Mn, Cu, Se). In order to compare consumers' preference for two types of food traceability systems with different amounts of information, experimental auction is

Xining, Suzhou, Wuhu, Weifang, Yichang and Mianyang.

The fourth batch of pilot cities (2013): Qinhuangdao, Baotou, Shenyang, Jilin, Mudanjiang, Xuzhou, Fuzhou, Yantai, Zibo, Luohe, Xiangyang, Xiangtan, Zhongshan, Zunyi and Tianshui.

The fifth batch of pilot cities (2014): Lhasa, Jinzhong, Haidong, Tongren, Shihezi, Wuzhong, Weihai and Linyi.

⁸ Apple is a most common kind of fruits that is familiar to almost every one, it is easy to store and available nearly all the year round, there is little heterogeneity for the experiment respondents in understanding the products.



employed, which is incentive compatible and popular in non-market valuation elicitation (Lusk, 2003; Lusk et al., 2007; Lust & Shogren, 2007). We selected the random n th⁹ (Shogren et al., 2001) price sealed-bid auction, it works as follows: in quiet experimental environment, each participant submits a sealed bid and then all bids are ranked in descending order; the experiment monitor selects a uniformly-distributed random integer n , $n \in \{2, 3, \dots, k\}$ (k bidders); then all the $n-1$ highest participants buy a unit of the auctioned good at the n th price.

The experiment was divided into two stages. An initial ‘gel pen auction’ was conducted as pre-experiment to familiarize subjects with the auction mechanic. Afterwards, formal auction experiment was conducted following the steps:

Step one: At the beginning, the experiment instructions was explained both in written and oral form¹⁰. Then a unique ID number and 500g apples with no traceable information together with 10 CNY experiment budget were endowed to each participant.

Step two: Another 500g apple was showed with a barcode but the other else characteristics are the same. Inputting the barcode into a website, the abbreviated information shows up. Each subject submitted his/her sealed truthful WTP for exchanging the traceable apples with the endowment ones with no traceability information on the bidding sheet. Then experiment assistant collected the sealed bids and ranked them from highest to lowest and drew a random number n . Soon afterwards, the highest bid, the lowest bid, the random n th bid (market price) and winners’ ID in that trial were posted on the blackboard. Three additional rounds were repeated.

Step three: The monitor showed another 500g apples nearly the same as those with abbreviated information and endowed ones, with a barcode carries much detailed information, then four rounds of auction were conducted the same as ‘step two’.

⁹ The random n th price auction (Shogren et al., 2001) shares the characteristics of both BDM (Becker et al., 1964) and the Vickrey second price auction mechanism (Vickrey, 1961) that all participants including off-margin bidders bid against other people in an active market environment.

¹⁰ During the experiment progress, all participants should keep quiet and not communicate with each other.



Step four: A post-questionnaire followed the auction including subjects' demographic information, fruit purchasing behavior, information needed in traceability system, etc. And then the only binding round was selected randomly from all the eight trials of the experiment session to determine the traceable apple would be purchased. The only binding round was randomly selected from a cage with labelled balls (#1-8), each ball was marked with a number that represented one round of the session. The winner of the randomly selected binding round paid the market price (the random n th price of that round). The binding selection process was introduced at the beginning of the auction experiment and the likelihood of each round being selected was the same, all the participants received the participation fee but would not pay for the other 7 non-binding rounds.

3.2. Data

The experiment was conducted in January to February, 2013. All subjects signed up randomly and voluntarily, and recruited by leaflet and on-site recruiting from Hangzhou which is among the first batch of pilot cities sponsored by the Ministry of Commerce and is one of the forefront cities in implementing food traceability system in China. Ninety nine people signed up for auction experiment and 88 consumers showed up finally. The auction design had nine sessions and each consisted of six to twelve adult participants, three of the nine sessions are university students. The summary statistics on selected sample characteristics is reported in Table 1.

[insert Table 1 here]

From table 1, the female ratio of the sample is 60 per cent, higher than the ratio in China (48.73 per cent), considering that females often play the role of buying food for the household, so we recruited relatively a larger proportion of female. The ratio of university students and higher is relatively high (about 61.4 per cent) for the reason that university students are an major group of fruits consumers, and concerning that the elders (over 60 years old) could not



understand the auction mechanism very well so that the proportion of elders is accordingly low. About 63 per cent of participants got married and nearly 85 per cent of participants' household monthly income below 11000 CNY. The majority of participants are self-reported healthy and about 89 per cent of subjects are fond of apples, and 46 per cent of subjects care about news on food safety. While but in terms of risk perception, 28.4 per cent of participants cannot perceive the risk that apple they consume may contain chemical residues (score less than 4) and 58 per cent per cent of subjects can perceive the risk of apple quality and safety; with respect to risk attitude, the average score is 3.49, which shows that the subjects are generally risk avoiding; on average most subjects (62.5 per cent) are risk averse (score less than 4), and about 26 per cent of subjects are risk taking when they consume apple (score larger than 4).

4. Results & Discussion

In this part, the comparison of bids between the two treatments, factors influencing consumers' WTP, as well as what type of information do consumers prefer are analyzed.

4.1. *Bids comparison between treatment*

Table 2 shows the average bids of subjects in each round. Consumers' WTPs for apples with abbreviated traceability information range from about 1.85 CNY to 2.22 CNY and average WTPs for apples with detailed traceability information is around 2.7 CNY. The stabilize index of last two rounds in the treatment of abbreviated information and detailed information is 1.28 & 1.35 and 1.47 & 1.42 respectively, which shows that the bids tend to stabilise¹¹.

[insert Table 2 here]

Table 3 shows the mean bids across the two treatments. Based on average price of ordinary apples sold in market (6 CNY/500g) without traceability, results indicate that consumers would like to pay a 34.3 and 44.5 per cent premium for apples with abbreviated traceability information

¹¹ The stabilize index was calculated by dividing the mean bid prices by the standard deviation in each round (Lee et al., 2011).



and detailed traceability information over similar apple without traceability respectively. Results also suggest that detailed traceable information resulted in higher WTP values. The significant estimate of simple mean equality t-test indicates that consumers response sensitively to information treatment, on average they would like to pay 10 percent more premium (about 0.61 CNY/500g) for apples with detailed information over similar apples with abbreviated information.

[insert Table 3 here]

4.2. Affiliation test, Bids model & Regression result

Before the model introduction and analyzing regression result, bids affiliation test is conducted first.

4.2.1. Test of bids affiliation

In experiment auction, posting market price can cause learning effect which could provide participants experience and enable them to incorporate market information into their bidding and valuation (List & Shogren, 1999; Corrigan et al., 2012), while it can also cause consumers' private bids get affiliated (Milgrom & Weber, 1982; List & Shogren, 1999).¹² It is essential to test whether bids affiliation exists (List & Shogren, 1999) and the model follows Alfnes & Rickertsen (2003) and Chern & Chang (2012):

$$\Delta B_{i,t} = \beta_1 + \beta_2 t + \beta_3 P_{i,t-1} + \varepsilon_{i,t}$$

where $\Delta B_{i,t}$ is participant i 's bid in round t minus bid in round $t-1$; $P_{i,t-1}$ denotes the difference between the posted price and participant i 's bid in round $t-1$, and ε is an error term. β_3 measures the affiliation, if $\beta_3 > 0$, there was a trend that the participant would increase his/her bid in later rounds and if his/her bid was lower than the posted price. The explanatory variable round

¹² Refer to Milgrom and Weber (1982) for better understanding about affiliated private values in auctions.



number t is to test whether there is a trend that the participant bids increased (if $\beta_2 > 0$) or decreased (if $\beta_2 < 0$) throughout the repeated trials. The parameters can be estimated by ordinary least squares (OLS). The test result is showed in the Table 4.

[Insert Table 4 here]

The affiliation test shows that the bids influenced by the round variable t in the treatment of abbreviated information but not in the treatment of detailed information,. It suggests that there is not obvious increasing or decreasing trend of the bids during the whole auction. The posted prices significantly influence the bids in both treatments, which means that the participant would like to increase his/her bid if his/her last bid was lower than the posted bid but the amount of premium they would like to increase (the coefficient of $P_{i,t-1}$, 0.25 and 0.15 CNY respectively) is not large. One likely explanation for the positive trend is that it takes some time for participants to fully understand the auction mechanism (List & Shogren, 1999). It is somewhat an evidence that participants engaged in the auction attentively and they submitted their truthful WTP by adjusting bids slightly in different rounds taking revealed market price as reference.

4.2.2. Bids models

A regression model was developed to investigate how various factors affecting consumers' preference for different amounts of information recorded by food traceability system. We assume that the bid premium for food with traceability information is a function of demographic and individual characteristics of subjects as well as information treatments. Consider that the assumption of linearity would not be held because there existed some zero bidders for apples with traceability information, and for the panel nature of our data, it is a typical censoring problem, so we adopted a random effect tobit model.

The Tobit model can be defined as (Wooldridge, 2006):

$$y_i^* = \beta_0 + \beta' x_i + \mu_i, \quad \mu_i \sim N(0, \sigma^2)$$



$$y_i = \begin{cases} y_i^* & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases}$$

Where y_i^* is a latent variable, it has a normal, homoskedastic distribution with a linear conditional mean. y_i is the observed censored variable, x_i is a vector of independent variables and μ_i is the error term assumed to have normal distribution. Because y_i^* is normally distributed, y_i has a continuous distribution over strictly positive values. β' measures the partial effects of the x_i on $E(y_i^*|x)$.

In our study, the subjects' WTP (y_i) is non-negative, the probability density function is shown as:

$$\text{prob}(y_i^* > 0) = f(y_i|y_i > 0) = \phi_i\left(\frac{\beta'x_i}{\sigma}\right)$$

Where $\Phi_i\left(\frac{\beta'x_i}{\sigma}\right)$ is a cumulative standard normal distribution function. The expected WTP for consumer i can be computed as:

$$E(y_i^*) = E(y_i|y_i > 0, x) \times f(y_i|y_i > 0, x) + E(y_i|y_i = 0) \times F(y_i = 0)$$

$$\text{Where } E(y|y > 0, x) = x'\beta + \sigma\lambda\left(\frac{\beta'x}{\sigma}\right)$$

Then

$$E(y_i^*) = \beta'x_i\phi\left(\frac{\beta'x_i}{\sigma}\right) + \sigma\varphi\left(\frac{\beta'x_i}{\sigma}\right)$$

Where $\lambda(\beta'x/\sigma) = \varphi(\beta'x/\sigma)/\Phi(\beta'x/\sigma)$ is called the inverse Mills ratio.

4.2.3. Regression results

Table 5 exhibits the parameter estimates of our WTP model. The log likelihood=-1016.8483 and Prob>chi²=0.0000. Overall, these appear to be reasonably good results.¹³

¹³ According to Lusk & Shogren (2007), data from repeated sealed-bid auction can be considered as panel data.



[Insert Table 5 here]

The significantly positive sign for treatment indicates that consumers are willing to pay more for apples with detailed traceability information over similar apples with abbreviated traceable information. The possible reason may be that due to the information asymmetry in food market, consumers desire detailed information and value such detailed information.

Compared with female, Chinese male consumers would like to pay more premium for food with traceability information. And according to Jin & Zhou (2014), Japanese male consumers are more likely to retrieve information through food traceability system. This may indicate that male cared more about food safety and interpret why male consumers value traceability information much than the female.

Marital status significantly influence the WTP for food with traceability information. Those married would like to pay more premium on apples with detailed traceability information probably for the reason that they are aware of the benefits of a food traceability system with detailed information and they may take more responsibility on family and care more about food safety than the singles.

Education level is also a very important factor affecting consumers' WTP on food with traceability information. As previous studies mentioned, the impacts of education on consumers' WTP are not definitive (Chakraborty, 2005; Froehlich et al., 2009). In this study, compared with consumer who have received junior high school or lower level of education, those who have higher education or even master degree or higher would not like to pay more premium for apples with traceability information, although their bids are nearly all positive, the result is in line with Lee et al. (2011). The probable reasons as follows, firstly, education is a key to changing consumers' perceptions (Nayga et al., 2006), as Sckokai et al. (2014) claimed, mycotoxins and GMP are elusive to the general consumers, it is likely the same case to *food traceability system*, the general public especially the less educated consumers may consider this elusive concept as a general proxy for safer food and the associated "safer apples" WTP is higher than the actual marginal value of food traceability. Secondly, in the experiment, the detailed information



treatment with more information especially in nutritional content, the high educated consumers are more rational, although they are highly educated, they may not have the necessary nutritional knowledge to process such nutritional information such that the given product is enriched by and the related amount, so they would not want to pay for such information beyond their power. And also, highly educated consumers may not trust the detailed information provided by the food traceability in context of China.. Our finding is similar to Chakraborty (2005) and Boccaletti & Nardella (2000), who found that the U.S. and Italy consumers with higher education were less likely to pay a premium for rBST-free milk and pesticide free fresh fruit- and-vegetables respectively.

The self-reported healthy consumers do not want to pay more premium for apples with traceability information. In fact, food traceability system was originally designed as one element of a firm's supply side management system and production strategy for tracing and tracking food information about production, logistic and retail (Golan et al., 2004). The self-reported healthy consumers probably think that it is safe as long as the food traceability system exists no matter how much information it provides and it is the government and food firms to bear the cost of establishing food traceability system instead of the consumers.

4.3. Demand for specific food safety and quality information

Information recorded by food traceability system should be of the type that consumers show interest in (Verbeke, 2005) because it can affect consumers' perception toward food they consumed significantly (Dickinson & Bailey, 2002). In this study, respondents were asked to rank their preference for 8 different kinds of information and the statistical result shows in Figure 1.

[Insert Figure 1 here]

The results show that consumers show interest in almost all the information surveyed, as food traceability system is of credence attribute, consumers with higher degree of confidence often show less satisfaction with the amount of information available and desire for more amount



of additional information (Grunert, 2000), thus the result may be a symbol that consumers have confidence in food traceability system and the effort government has been taken to establish food traceability system has significant effect.

Among all the information provided, consumers are most interested in quality certificate, only 5.68 per cent consumers do not care about this information and no one does not want to know it. Quality certificate is readily interpretable indications of quality and quick to process, thus consumers prefer this kind of information well much (Hobbs et al., 2005; van Rijswijk et al., 2008), especially in the case of food safety incidents, consumers trust more on quality certification marks and eager to know such information (Hobbs et al., 2005). The second kind of information respondents always want to know is chemical fertilizers and pesticides used in production process, the proportion is about 91 per cent. For the reason that the abuse of chemical fertilizers and pesticides is very serious and excessive pesticide residues are detected is of common occurrence in China, many kinds of fruits have high content of heavy metals residuals from various sources (Fang & Zhu, 2014), so consumers are more concerned about the information about of fertilizers and pesticides. Whether the food products meet production standards and the on-sale-date rank highly at the third place (86.36 per cent) concerning about the freshness and shelf life.

From this study, the top four kinds information that Chinese consumers are interested in are quality certificate, chemical fertilizer and pesticides, production standard, and on sale date. And in line with Jin & Zhou (2014), who find that harvest date, production method, certification of production method and pesticide (drug) used in production are the top four kinds of information Japanese consumers care about. The finding of these two studies is somewhat similar, probably because consumers in East Asia may have similar preference for food information.

While relatively low interest in 'nutrition' content (73 per cent) and place of origin (64 per cent) may due to consumers are usually familiar with daily food they consume or they just follow their consumption habit. Chinese consumers are identified to show least interest in the circulation process and the name of producer, the probable reason may be that the circulation system in China have not been perfectly constructed, information about food circulation and producer is difficult to obtain and the reliability is questionable either.



5. Conclusion and implications

Information asymmetry in the food market can be reduced effectively by means of food traceability system to restore consumer confidence. Food traceability system is originally designed to control the supply chain management by providing traceability assurance with abbreviated information; it can also serve as an effective tool of information provision about product credence attributes besides traceability assurance. As the cost is the main obstacle for producers' information provision, whether consumers have WTP for traceability information to share the cost is very important in developing food traceability system. In this study, we conducted random n th price auction to reveal consumers' WTP for food with both abbreviated and detailed traceability information in China. To our best knowledge, there are no such similar studies conducted before. The seminal idea and Chinese context have many implications not only for China and even for developed countries.

The results showed that consumers have a positive WTP for both kinds of information, in accordance with Yang & Wu (2009) and Zhang et al. (2012), who found that Chinese consumers have a positive WTP premium for food traceability system. The premiums consumers want to pay are significantly different. Generally speaking, apples with no traceability information, consumers want to pay higher for apples with detailed traceability information (the average premium is 44.5 per cent) than those with abbreviated traceability information (the average premium is 34.3 per cent), the premium difference is about 10 per cent. This result suggests that consumers value much for detailed information, and detailed information is beneficial to producers to achieve extra gain and expand the market. The amount of the premium and the difference of premium can also serve as a reference for the pricing products with different amount of traceability information, that is, the price of fresh produce with detailed information can have about 10 per cent higher price than those with abbreviated information.

In terms of the factors affecting consumers WTP, males and the married would like to pay more for food traceability system than the females and the singles respectively. While although the self-reported healthy consumers and consumers who received higher level education all submitted nonnegative WTP for both abbreviated and detailed information, they would not like to pay much more premium for food traceability system. The result suggests that when



implementing food traceability system, social demographic characteristics and market segmentation should be taken into consideration because consumers with different social demographic characteristics have different information preference, this is also emphasized by Jin & Zhou (2014), Kehagia et al. (2007) and Pieniak et al. (2007). When new products are introduced to market mainly targeted the males, the self-reported healthy, the married, those with low level of education, food traceability system should be established to attract such kinds of consumers. Moreover, distrust in food traceability information is a probable reason for the low premium from consumers with high level of education, so it is urgent for government and food firms to solve the distrust problem.

The survey result shows that consumers prefer the quality certificate, which is the most popular information. This confirms that quality certificate associated with food traceability system is of more value (e.g. Hobbs et al., 2005; Verbeke & Ward, 2006). Consumers also concern about the chemical fertilizer and pesticides used in the process of food production and processing. By comparison, the information of food producer and food circulation and logistic information are the two least popular ones. This can serve as reference for the policy makers and food firms when deciding what kinds of information should be recorded by food traceability system. Under the limited cost budget, the quality certificate is the most important and following the fertilizer and pesticides information, and others information is superior.

What is more, with rapid development of electronic technology and widespread use of mobile phone, it takes less cost to retrieve information, so it is likely that more and more consumers will show interest in various kinds of information. Besides, taking the limited time and capability of processing information into consideration, the philosophy of 'more information is better' takes the risk of 'information overload' (Jacoby et al., 1974), because excess or irrelevant information may prevent consumers making optimal choices (Teisl & Roe, 1998; Salaün & Flores, 2001). So it is worth studying the appropriate amount of information should be recorded by food traceability system in future researches basing on larger samples.



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Tables and Figures

Table 1. Summary statistics on select sample characteristics

Variables	Definition and coding	Mean	Sd
Information treatment	0=abbreviated information group; 1=detailed information group		
Gender	0 = female; 1 = male	0.40	0.49
Age	Age of the participant (not less than 18 years old). Real age	39.14	18.01
Marital status	0=Unmarried; 1=married	0.63	0.49
Education	Education level.		
	1 = Junior high school or lower; 20.45%		
	2 = Senior high school or technical secondary school; 18.18%		
	3 = Bachelor or college degree; 47.73%		
	4 = Master or above. 13.64%		
Income	Household income per month (CNY)		
	2=5000-6999; 23.86%		
	3=7000-8999; 18.18%		
	4=9000-10999; 18.18%		
	5=11000 and above. 14.77%		
Self-reported Health	1=healthy, 0=others.	0.93	0.254
Preference for apple	Degree of preference for apple. 1=like, 0=others.	0.89	0.318
News	Care about the news about safety of agricultural product.	0.46	0.498
Risk Perception ¹⁴	Consumers' perception towards food safety.	4.44	1.065
Risk Attitude ¹⁵	Consumers' attitude towards food safety.	3.49	1.044

¹⁴ The Risk Perception interprets the chance to be exposed to the risk related to food safety, it was tested by the following three questions, and the Mean is the average sum-score of the three indicators' mean, and Sd is the average sum of the three indicators' standard deviation (Pennings et al., 2002).

Q1. At present, the fruit market is generally safe although incidents like excessive pesticide residues, illegal use of preservative and industrial wax happened occasionally. (1=Disagree completely, 7=Agree completely)

Q2. At present, fruits containing above chemical substances make up a large proportion of the fruit market and do harm a lot. (1=Disagree completely, 7=Agree completely) reverse (1= Agree completely, 7= Disagree completely)

Q3. At present, fruits containing above chemical substances do little harm to consumers' health. (1=Disagree completely, 7=Agree completely)

¹⁵ The Risk Attitude reflects a consumer's predisposition to risk or how much a consumer dislike the risk, it was tested by the following three questions, and the Mean is the average sum-score of the three indicators' mean, and Sd is the average sum of the three indicators' standard deviation (Pennings et al., 2002).

Q4. Although I often hear about the bad news such as excessive pesticide residues, illegal use of preservative and industrial wax, it doesn't affect my purchasing behavior of fruits. (1=Disagree completely, 7=Agree completely)



Table 2. Mean bids by the round and stabilization index for bid price

Treatment	Abbreviated information				Detailed information			
	Trial				Trial			
	1	2	3	4	1	2	3	4
Min	0	0	0	0	0	0	0	0
Max	6.8	6.5	6.5	6.0	9.0	8.0	8.0	8.0
Median	1.5	2.0	2.0	2.0	2.5	2.2	2.0	2.2
Mean	1.85	2.04	2.13	2.22	2.67	2.71	2.69	2.63
SD	1.43	1.40	1.66	1.64	1.72	1.80	1.84	1.85
Mean/SD	1.29	1.46	1.28	1.35	1.55	1.51	1.47	1.42

Unit: CNY, the number of subjects is 88.¹⁶

Table 3. Mean bids and T-test for equality of WTP means across the information treatments

		mean	median	SD	mean WTP difference	t-value
information	abbreviated	2.06	2.0	1.537	0.61***	9.30
	detailed	2.67	2.2	1.796		

***Denote significance at 1% level.

Q5. I never worry about the residue of pesticide, preservative and industrial wax when eating fruits.(1=Disagree completely,7=Agree completely)

Q6. I completely cannot accept the risk unacceptable of the health risk by eating fruits which have the above chemical substances. (1=Disagree completely, 7=Agree completely) reverse (1= Agree completely, 7= Disagree completely)

¹⁶ At the time of auction, market price of apples without traceable information was 6 CNY/500g, and 1\$= 6.30 CNY roughly.



Table 4. Bid affiliation test results

Variable	Treatment	
	Abbreviated information	Detailed information
Constant	0.393* (0.205)	-0.489 (0.462)
t	-0.112* (0.066)	0.053 (0.065)
P	0.251*** (0.034)	0.149*** (0.029)
N	264	264
Adj-R2	0.167	0.089

Notes: the symbols numbers in parentheses are estimated standard errors. N is the number of observations, and the sample size is 88.

*, **, *** Significant at the 10% , 5%, 1% level respectively.



Table 5. Regression results on bids (Tobit)

	Coefficient	Standard Error
Treatment	0.662***	0.069
Gender	0.524*	0.284
Age	0.003	0.012
Marital status	0.798*	0.419
Education		
High school	-0.497	0.427
Undergraduate	-1.052***	0.414
Master and above	-1.819***	0.537
Income (CNY)		
5000-6999	0.080	0.355
7000-8999	0.081	0.389
9000-10999	0.142	0.396
11000 and above	0.383	0.460
Health Condition	-1.245**	0.575
Preference for apple	0.299	0.420
News	0.420	0.272
Risk Perception	-0.143	0.128
Risk Attitude	-0.090	0.126
Constant	3.579**	1.264
sigma_u	1.073***	0.090
sigma_e	0.905***	0.026
Log likelihood=-1018.7726	Wald chi ² (16)=161.31	Prob>chi ² =0.0000
N. of cases = 704	Uncensored cases = 678	

*, **, *** Significant at the 10% , 5%, 1% level respectively



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