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Chinese consumers' preferences and willingness to pay for traceable food attributes: The case of pork

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ABSTRACT

China is a large consumer and producer of pork. However, pork is a common food that frequently suffers from safety problems in China. Thus, the safety of pork is of important strategic significance to China's food safety. The food traceability system is considered a major tool for the fundamental prevention of food safety risks. In this study, four attributes, i.e., traceability information, quality certification, appearance, and price, were set for traceable pork on the basis of previous studies. Levels were set for the attribute traceability information based on the major processes of safety risk in the Chinese pork supply chain. For the level setting of quality certification, domestic and international third-party certification was included in addition to government certification. Levels of price were set by appropriately increasing the average price of pork in cities surveyed in September 2013 according to the premiums that consumers were willing to pay for particular attribute levels in a random nth price auction. Based on the above experimental design, a survey was conducted in 1,489 consumers in seven pilot cities designated by the Chinese Ministry of Commerce for construction of a meat circulation traceability system. On this basis, consumer preferences and willingness to pay for traceable pork attributes, as well as influencing factors, were investigated using choice experiments. According to the results from both mixed logit

and latent class models, quality certification was the most important characteristic, followed by appearance, and traceability information. In addition, “government certification”, “fresh-looking”, and “traceability information covering farming, slaughter, and processing, and circulation and marketing” were the most preferred levels of quality certification, appearance, and traceability information, respectively. Significant heterogeneity was observed in consumer preferences for the attributes of traceable pork. Consumers’ preferences and willingness to pay for traceability information and quality certification were significantly influenced by age, monthly family income, and education level. It is hoped that the findings of this study will provide a useful reference for the Chinese government in improving traceable food consumption policies.

Keywords: Traceable pork attributes; Consumer preferences; Willingness to pay; Choice experiment

Food safety risks are a worldwide problem, the essential characteristic of which is information asymmetry (Sarig et al., 2003). Inclusion of credence attributes of food, such as traceability, quality and safety information, and quality certification, helps bridge the information gap between market players and reduce inefficiencies that arise from asymmetric information (Ortega et al., 2013). A food traceability system possesses the ability to monitor food production and distribution by providing a

reliable and continuous flow of information in the supply chain, as well as the ability to identify the source of problems and recall related products through traceability; therefore, it is considered a major tool for the fundamental prevention of food safety risks (Van Rijswijk et al., 2008). Meat is one of the most commonly consumed foods worldwide, thus traceable meat has been very popular in Europe and America since the 1990s. In 2012, with a pork production of 53.55 million tons, which accounted for approximately 64% of the total domestic production of meat, China contributed to approximately 45% of the world's pork production. China is not only a large producer of pork, but also a large consumer. In 2012, with a per capita pork consumption of 38.7 kg, China's pork consumption accounted for more than 60% of domestic meat consumption, and approximately 50.2% of the global consumption of pork (Wu et al., 2013). In addition, China is the world's major pork exporter. Table 1 shows China's main pork export markets in 2012, as well as corresponding trade values and volumes. From January to October 2013, China exported 59,580.4 tons of pork, amounting to $ 260 million, with a year-on-year growth of 11.6%. In total, 57,939.6 and 1,640.8 tons of pork were exported to Asia and Europe, respectively.[1] Therefore, the quality and safety of pork in China not only relates to the health and safety of Chinese consumers, but also affects quality and safety of pork markets worldwide to some extent, especially in Asia and some European and American countries.

[1] Source: Food & Beverage Online, 2013. Monthly Statistical Report on Pork Exports from China in October 2013. http://www.21food.cn/html/news/35/1167662.htm (in Chinese).

Unfortunately, pork is a food that frequently suffers from safety problems in China. Table 2 shows the typical pork safety news events occurring in China during 2005-2013. The dumping of dead pigs into the Huangpu River in Shanghai, China in early March 2013 had widespread effects and was derided as “free pork soup”. In the ensuing months, floating dead pigs were also found in other areas of China. This series of pork safety incidents that have occurred in recent years indicates great potential risks in pork production, supply, and consumption in China. Therefore, it is imperative to build and improve upon a pork traceability system according to China’s conditions.

In fact, China has been exploring the building of food traceability systems since 2000. After the Sanlu milk powder scandal, a major food safety incident that occurred in 2008, the Ministry of Commerce and the Ministry of Finance made improved efforts to construct meat traceability systems in several pilot cities.[2] At present, a pilot beef and mutton quality and safety traceability system involving the entire industry chain has been constructed in Inner Mongolia by the Ministry of Industry and Information Technology. However, for more than 10 years, no substantial progress has

[2] Since 2010, a meat and vegetable circulation traceability system has been ongoing in 35 pilot cities, such as Shanghai, Chongqing, and Dalian, in three batches with the support of the Chinese Ministry of Commerce and Ministry of Finance, in order to explore market management using information technology, and strengthen industrial management of food safety in circulation. On the basis of the pilot project, the project construction has been further expanded to 15 cities, including Qinhuangdao, Baotou, Shenyang, and Jilin, in 2013 (Chinese Ministry of Commerce Website, http://traceability.mofcom.gov.cn/static/zy_gongzuodongtai/page/2013/12/1386040135787.html).

been made toward the construction of traceable meat market systems (Wu et al., 2010). Some of the important reasons for this are that the current government-led meat traceability systems do not give sufficient consideration to consumer preferences, cannot fully meet the needs of most consumers, and do not include third-party certification bodies in the market system construction. Both market and government failures occur in the traceable meat market in China (Zhu et al., 2013).

Whether China's traceable pork market can be effectively developed in nature depends on consumer attitudes toward traceability, quality certification, and other related attributes, as well as the resulting demand. In the present study, different levels of quality and safety attributes of traceable pork were set based on risk points in the entire pork supply chain system and in light of the real situation in China. Furthermore, while fully considering the heterogeneity in consumer preferences, consumers' preferences and willingness to pay (WTP) for the attributes of traceable pork were intensively investigated using choice experiments, and mixed logit and latent class models. The results of this study are expected to provide a policy-making reference for the popularization and promotion of traceable food and the improvement of traceable food consumption policies in China.

Literature review

The encephalopathy crisis and dioxin contamination of livestock feed in Europe and America caused a scare over meat safety in consumers. As a result, consumers'

preferences and WTP for country of origin labeling, traceability information, quality certification, animal welfare, and other attributes of meat have quickly become an international research focus; this has promoted the development and improvement of meat traceability system and food labeling policies in Europe and America (Dickinson and Bailey, 2002; Enneking, 2004; Loureiro and Umberger, 2007).

Traceability information and quality certification labels are believed to be an important way to help restore consumer confidence in food safety (Verbeke, 2001). Dickinson et al. (2003) evaluated U.S. and Canadian consumers' preferences and WTP for red-meat traceability, enhanced quality assurances, and animal welfare using experimental auctions, and found that consumers in both countries were willing to pay a premium for beef and pork traceable to the farm of origin. Dickinson and Bailey (2002 and 2005) and Hobbs et al. (2005) found that consumers in various countries were generally willing to pay a premium for food with traceability and other quality assurance attributes. These studies also suggested that a greater value would be delivered to consumers if traceability were bundled with other characteristics demonstrating food safety. Angulo and Gil (2007) investigated Spanish consumers' WTP for traceable and certified beef and the influencing factors, and found the major factors affecting Spanish consumers' WTP for safe beef to be income, beef consumption, price, and the risk perception of beef safety. Mennecke et al. (2007) studied U.S. consumers' preferences for beef attributes using conjoint analysis, and found that region of origin was the most important attribute for consumers, followed

by animal breed, traceability to the farm, and animal feed, and that consumers believed that the ideal beef should be locally produced, fed a mixture of grain and grass, and traceable to the farm of origin. Taking consumers' risk perception regarding food safety into account, Ortega et al. (2011) investigated Chinese consumers' preferences for pork quality and safety attributes using choice experiments, and demonstrated heterogeneity in consumer preferences, and a higher WTP for government certification, followed by third-party certification, traceability, and product detail labeling. Loureiro and Umberger (2007) came to similar conclusions in the study of U.S. consumers' preferences and WTP for beef quality and safety attributes. Ubilava and Foster (2009) demonstrated a higher WTP for pork traceability compared with quality certification in Georgia consumers, as well as a substitutional relationship between the two attributes. However, Verbeke and Ward (2006) found, through a survey in Belgium, that consumers placed high emphasis on quality assurance and shelf-life, while little importance was attached to traceability and region of origin.

Color, appearance, and freshness are usually external cues used by consumers to judge the quality of food. Alfnes et al. (2006) studied consumers' WTP for salmon fillets that varied in color, and the impact of information of color sources on consumers' WTP. The results of that study indicated that color was one of the most important quality attributes of salmon, and that consumers regarded color as a quality indicator and were generally willing to pay a premium for salmon that was redder in

appearance. Grunert (1997) demonstrated that tenderness was the most important attribute when evaluating beef quality for consumers in France, Germany, Spain, and the UK, while region of origin and farming information did not affect the quality perception of consumers.

Among various credence attributes of food, region of origin is an important attribute affecting consumers' food choice (Mennecke et al., 2007). This conclusion has been repeatedly confirmed by researchers. For example, Roosen et al. (2003) and Chung et al. (2009) demonstrated that region of origin was the most important affecting factor in consumers' choice and purchase of beef, and that it affected consumers' WTP in combination with other factors. Alfnes et al. (2004) and Lim et al. (2013) found that consumers' preferences and WTP were significantly higher for domestic steaks than for imported steaks. In addition, increasing consumer concern about animal welfare has been affecting food and livestock markets (Tonsor, 2009). Olesen et al. (2010) analyzed Norwegian consumers' WTP for organic and welfare-labeled salmon using non-hypothetical choice experiments and concluded that consumers were equally concerned about animal welfare and environmental effects of farming, and they were willing to pay a premium for animal welfare and environmental protection labeling.

Burton et al. (2001) and Loureiro and Umberger (2004) touched on the influences of individual and social characteristics of consumers on food preferences. Gracia et al. (2011) and Lim et al. (2013) measured the influences of consumer

characteristics on choice by introducing consumers' age, gender, income, education level, and other characteristics and attributes into the model in the form of interaction. Lim et al. (2013) suggested that consumers' preferences and WTP for region of origin and other food safety attributes were significantly affected by gender, age, education, and income levels.

Over the past decade, the choice experiment has been widely used for evaluating consumer preferences and WTP for meat (Lusk et al., 2003; Tonsor et al., 2005; Loureiro and Umberger, 2007), genetically modified food (Burton et al., 2001; James and Burton, 2003; Hu et al., 2005), organic food (Rousseau and Vranken, 2013), and functional food (Barreiro-Hurle' et al., 2008). For meat, consumers' emphasis on and preferences for different attributes vary among countries due to differences in consumer culture and national conditions, but the unanimous conclusion is that consumers generally attach importance to the region of origin, quality certification, traceability, appearance, and animal welfare. The summary of available literature reveals that the setting of food attributes and levels is unlikely to be suitable for China's national conditions in studies examining consumer preferences for food attributes with choice experiments. For example, in the consumption of animal products, consumers in some developed countries are very concerned about animal welfare, which has not been a widespread concern in Chinese consumers. Therefore, whether the research conclusions of existing international literature are applicable in China has yet to be verified.

Although China is an important producer and consumer in the global pork market, few studies have been performed on Chinese consumers' preference for safety attributes of pork in the international community. In fact, as the only example of such a study, Ortega et al. (2011) defined the pork traceability as “yes or no” only, and did not go into consumer preferences for traceable pork with complete safety information attributes. The goal of the present study was to evaluate the traceable pork quality and safety attributes completely and systematically, define levels of traceability information, classify the issuers of quality certificates, and investigate consumer demand in the traceable pork market based on realities, especially the current major safety risks in the Chinese pork supply chain system, in order to provide a decision-making reference for the popularization of traceable food in China.

Research framework

Our research was based on the Lancasrian consumer theory and random utility theory. Lancaster proposed that individuals derive utility from product characteristics rather than from the products themselves (Lancaster, 1966). The traceable pork in this study here can be considered as a combination of attributes, including traceable information, quality certification, appearance, and price. According to the random utility theory, it is assumes that individuals act rationally, and thus would select an alternative that yields the highest utility. As a result, the probability of selecting a certain alternative will be higher if the utility provided by such alternative is the

highest among the different choices.

According to the independence from irrelevant alternatives (IIA) assumption, make U_{nit} the utility obtained by consumer n choosing traceable pork profile $\boldsymbol{i}$ among the J subset in task C under choice situation t, and then U_{nit} includes two parts: the deterministic component V_{nit} and the stochastic component ε_{nit}, i.e.,

$$U_{nit} = V_{nit} + \varepsilon_{nit} \tag{1}$$

The choice of traceable pork profile $\boldsymbol{i}$ by consumer n is made based on $U_{nit} > U_{njt}$ is true for $\forall j \neq i$. Thus, the probability for consumer n in choosing traceable pork profile $\boldsymbol{i}$ under choice situation t can be expressed as:

$$P_{nit} = prob(V_{nit} + \varepsilon_{nit} > V_{njt} + \varepsilon_{njt};\ \forall j \in C, \forall j \neq i) \tag{2}$$

$$= prob(\varepsilon_{nit} - \varepsilon_{njt} > V_{njt} - V_{nit};\ \forall j \in C, \forall j \neq i) \tag{3}$$

According Maddala (1997), if it is assumed that ε_{nit} follows a type I extreme value distribution,

$$F(\varepsilon_{nit}) = \exp(-\exp(\varepsilon_{nit})) \tag{4}$$

Then the model is termed the conditional logit model, so that the conditional probability in (3) can be transformed into the following form:

$$P_{nit} = \frac{\exp(V_{nit})}{\sum_j \exp(V_{njt})} \tag{5}$$

Where $V_{nit} = \beta' X_{nit}$. Where β' is the part-worth vector for consumer n and X_{nit} is the attribute vector of traceable pork profile $\boldsymbol{i}$.

According to the conditional logit model, it is assumed that a linear relationship exists between utility and attribute parameters, and the error term is required to be

identically and independently distributed. Conditional logit models, however, assume preference homogeneity across respondents and subject to the independence of irrelevant alternatives. In general, recent scholars have emphasized the importance of heterogeneity in determining consumer preferences (Ortega et al., 2011; Hu et al., 2005).

The coefficients of attributes are assumed to follow some specific distribution according to a set of parameters of individuals, rather than being fixed. $f(\beta)$ is the probability density function for β, and the probability for consumer n to choose traceable pork profile $\boldsymbol{i}$ under choice situation t can be expressed as:

$$P_{nit} = \int \frac{\exp(V_{nit})}{\sum_j \exp(V_{njt})} f(\beta) d\beta \tag{6}$$

Eq. (6) can be denoted as a mixed logit model, an appropriate approach for capturing heterogeneity in consumers' decision making (Hu et al., 2005). It was demonstrated by McFadden and Train (2000) that a mixed logit model could approximate any random utility model. This approach is of particular use when considering models of repeated choice by the same decision maker (Brownstone and Train , 1999), as is the case in this study.

When the parameters are fixed at c, i.e., $\beta = c$, $f(\beta) = 1$; and $f(\beta) = 0$ otherwise.

If it is further assumed that $f(\beta)$ is discrete, taking S distinct values (Train, 2003), then (6) can be converted into the latent class model. In this model, the

individuals are sorted into a number of S latent classes, each of which is composed of homogeneous consumers (Boxall and Adamowicz, 2002). The probability that individual n selects option $\boldsymbol{i}$ in given choice situation t, unconditional on the class, is represented by:

$$P_{nit} = \sum_{s=1}^{S} \frac{\exp(\beta_s' X_{nit})}{\sum_j \exp(\beta_s' X_{nit})} R_{ns} \tag{7}$$

where β_s' is the specific parameter vector for class s, and R_{ns} is the probability that consumer n falls into class s. This probability can be given by (Ouma et al., 2007):

$$R_{ns} = \frac{\exp(\alpha_s' Z_n)}{\sum_r \exp(\alpha_r' Z_n)} \tag{8}$$

where Z_n is a set of observable characteristics that affects the class membership for consumer n, and α_s' is the parameter vector for consumers in Class s.

Experimental design and statistical description

Experimental design

Currently, pork safety risks mainly occur in pig farming, slaughter and processing, and circulation and marketing in China. The table in the appendix lists the recent studies on safety risks in major processes of the Chinese pork supply chain. Safety risks in farming, the initial process of the pork supply chain, play a very important role in the protection of pork quality (Sun et al., 2012). Risks in pig farming have been clearly manifested in frequent epidemics and inefficient disease prevention

and control caused by deterioration of the environment and illegal use of veterinary drugs and related hormone additives in feed (Wu et al., 2007; Dong et al., 2010). Major potential risks in slaughter and processing are slaughter without authorization, and the production and selling of pork from dead diseased pigs and water injected pork (Liu et al., 2009). Microbial growth and corruption resulting from improper temperature control, unclean environments, and improper use of packaging materials often occur during circulation and marketing (Jiang et al., 2009).

Based on previous studies and the main safety risks in the entire pork supply chain, four attributes of traceable pork, traceability information, quality certification, appearance, and price, were set in this study. Level settings of these attributes are shown in Table 3. For traceability information, three levels were set, i.e., information of farming, information of farming and slaughter and processing, and information of farming, slaughter and processing, and circulation and marketing.

In order to effectively eliminate the influence of other pork quality characteristics on consumer choice, a specific part of pork, pork hindquarters, was selected for the setting of prices. Prior to the formal survey, a random nth price auction was carried out in Wuxi, Jiangsu Province, China to investigate consumers' WTP for each level of quality and safety attributes, and 64 samples were obtained. Statistical results of the experimental auction indicated that, compared with ordinary pork, consumers were willing to pay a premium of 1.55, 2.33, and 2.99 yuan for pork “with information of farming”, “with information of farming, and slaughter and

processing, and “with information of farming, slaughter and processing, and circulation and marketing”, respectively, and a premium of 2.72, 2.68, and 2.42 yuan for pork certified by the government, a domestic third party, and an international third party, respectively. The average price of pork hindquarters was 12 yuan/500g in seven cities surveyed in September 2013 in this study. As shown in Table 3, four price levels were set according to the base price of 12 yuan/500g, and the average premiums were determined by the random nth price auction.

The questionnaire design of the choice experiment was divided into two parts. The first part was devoted to the choice experiment, and the goal of the second part was to find out basic demographics, pork purchasing behavior, and knowledge of and trust in traceability information, etc. of consumers surveyed. In this study, traceable pork was regarded as a combination of quality and safety attributes with other attributes, such as price and appearance. Using a fractional factorial design, respondents were instructed to choose from two different traceable pork profiles, and were also provided with an opt-out option. A total of $4 \times 4 \times 4 \times 4 = 256$ traceable pork profiles can be obtained according to the settings in Table 3. However, it is unrealistic to ask respondents to choose from $256 \times 255 = 65280$ choice sets in a real choice situation. In general, respondents will become fatigued when questioned for more than 20 or 30 min (Allenby and Rossi, 1998). Therefore, the number of tasks in the questionnaire was reduced to 12 (Figure 1 shows a sample task in the choice experiment), and 10 different versions were designed using SSIWeb 7.0 to ensure the

high design efficiency of the overall questionnaire.

Experimental area

Harbin, Heilongjiang Province, Jinan, Shandong Province, Wuxi, Jiangsu Province, Ningbo, Zhejiang Province, Zhengzhou, Henan Province, Changsha, Hunan Province, and Chengdu, Sichuan Province were surveyed. Figure 2 presents the geographic distribution of the sample cities. The seven cities are designated by the Chinese Ministry of Commerce as pilot cities for construction of a meat and vegetable circulation traceability system. They are located in northeast, east, central, south central, and west regions of China, with differences in the level of economic development, as well as living habits and consumer culture. Therefore, we consider it to be appropriate to roughly characterize the Chinese consumers' preferences for traceable pork with attributes at different levels based on survey data collected from these seven cities. For the survey locations, supermarkets, meat shops, and farmer's markets with a large flow of customers were selected. Experience tells that these types of places are the most important channels for Chinese consumers with regard to buying pork (Wu et al., 2012). Experiments were performed via direct face-to-face interviews by trained interviewers. To ensure the randomness of respondents, it was determined that the third consumer coming into view should be interviewed (Wu et al., 2012). Prior to the interviews, interviewers would explain to the respondents that a choice profile represented a pork product with particular attributes, as well as the

specific meaning of each level. The interviewers ensured that the respondents fully understood the choice experiment tasks prior to the actual interview. Each interview took approximately 15-30 minutes. Respondents were compensated 20 yuan for completion of the interview. The survey was performed in September 2013 in the above seven cities. Overall, 250 questionnaires were distributed in each city, and 235, 242 , 238 , 221 , 247, 235, and 240 questionnaires, and 204, 216, 206, 206, 222, 215, and 220 valid questionnaires were recovered from Harbin , Jinan , Wuxi, Ningbo , Zhengzhou, Changsha, and Chengdu, respectively. A total of 1,489 valid questionnaires were collected, with a valid response rate of 89.81%.

Demographics

Table 4 describes the basic demographics of respondents. Of the total number of respondents, females accounted for 51.44%. This was slightly higher than the proportion of males, which was consistent with the fact that most family food purchasers are female in China. Most respondents were 26-40 (34.79%) or 41-65 (35.33%) years of age. Most had a senior high school or lower degree (49.56%) or a junior college or Bachelor's degree (46.14%). Most respondents had a family size of three (39.70%) and a monthly family income of 4000-5999 yuan (25.86%). In addition, 45.53% of the respondents had a child(ren) under the age of 18 years in the family.

Statistics revealed that 45.94% of the respondent families purchased pork 2-5

times weekly, and that 44.80% consumed 500-1000g of pork weekly. Overall, 54.26% of the respondents had a neutral attitude toward local food safety, 59.00% did not know about traceable food, only 4.84% and 0.81% knew about and knew much about traceable food, respectively. Overall, 54.20% believed that traceability information could guard against pork safety risks. Not surprisingly, 43.25% and 35.12% of the respondents were dubious about and somewhat believed in the authenticity of traceability information, respectively. Most of the respondents somewhat believed in certification by the government (45.13%), a domestic third party (43.32%), and an international (46.74%) third party. In terms of traceability information, 64.74% believed farming information to be the most important. In order to reveal respondents' perception about pork safety issues, questions were devoted to clarifying knowledge about the incident involving "dead pigs floating in the Huangpu River" and judgment on whether they had purchased pork produced from dead diseased pigs. Statistics showed that 28.68% of respondents knew about the "dead pigs floating in the Huangpu River", and that 46.81% were not sure whether they had purchased pork produced from dead diseased pigs.

Model results

Analysis of mixed logit model results

Effect coding was used for attribute assignment of traceable pork in the model. The parameters of levels were random and normally distributed (Ubilava and Foster,

2009). The coefficients of “opt-out” variable, price, and interaction term were fixed. Simulations were based on 1000 Halton draws using NLOGIT 5.0. Table 5 presents the parameter estimation results of two mixed logit models. The difference was that model 1 only included the parameter estimates of the main effect to analyze consumer preferences for the different levels and calculate the relative importance of each attribute. On the basis of model 1, interaction terms between the demographics (including gender, age, monthly family income, and education level) and three levels of traceability information, three different types of certification were introduced to model 2 to measure the impact of basic demographics on the choices of traceability information and quality certification.

In model 1, in terms of traceability information, “traceability information covering farming, slaughter and processing, and circulation and marketing” had the highest part-worth utility. In terms of certification, “government certification” had the highest parameter estimate. In terms of appearance, “fresh-looking” had the highest part-worth utility. The proportion of the difference between the highest and lowest part-worths of an individual attribute in the sum of the differences between the highest and lowest part-worths of each attribute was used as the basis for importance evaluation. Accordingly, the descending order of relative importance [3] was quality

[3] The importance of the *i*th attribute, I_i, was calculated as the utility range (the difference between the lowest and highest part-worth utility for that attribute): $I_i = \max(\beta_i) - \min(\beta_i)$. The relative WTP for the *i*th attribute, W_i, was calculated by normalization of I_i: $W_i = I_i / \sum I_i$.

certification (46.53%), appearance (30.07%), and traceability information (23.40%). Therefore, except for price, quality certification was the most important attribute for respondents.

McFadden R^2 was 0.2292 in model 2, slightly greater than the 0.2272 in model 1, indicating that model 2 was more accurate than model 1. Therefore, the estimation results from model 2 were used for the analysis of interaction terms and further calculation of WTP. Both “traceability information covering farming, slaughter and processing, and circulation and marketing”, and “domestic third-party certification” had a negative interaction with age, indicating that young consumers were more likely to choose traceable pork with comprehensive information or certified by a domestic third party. Gender, education level, and monthly family income had a significant positive interaction, and age had a significant negative interaction, with international third-party certification, indicating that young, male consumers with higher education and income levels had higher preferences for traceable pork certified by an international third party.

As shown in Table 5, standard errors on “FULL TRACE”, “PAR TRACE”, and “MINI TRACE”, “GOV CERT”, “DOM THIRD CERT”, and “INT THIRD CERT” were significantly different from 0, indicating obvious heterogeneity in consumer preferences.

Nine specific types of consumers (Table 6) were selected according to gender, age, education, and income. The relative WTP of the nine types of consumers for

traceability information and quality certification was calculated according to Eq. (9). Because most respondents were female in this study, for simplicity, it was assumed that consumers were female, and education and income were regarded as positively correlated factors (Lim et al, 2013):

$$WTP_k = -2\frac{\beta_k + \gamma' \times d}{\beta_p} \tag{9}$$

$$d = [Gender = 0, Age, Edu, Income]$$

where β_k is the estimated coefficient of the main effect of the *k*th quality and safety attribute level, $\gamma' \times d$ is the interaction term, and β_p is the estimated coefficient of price. Due to the use of effect codes in variable assignment, the calculation formula of relative WTP should be multiplied by 2 (Lusk et al., 2003). Untraceable, uncertified, ordinary pork was used as the basic reference. In other words, relative WTP was calculated as the premium that consumers were willing to pay compared with the cost of ordinary pork. Specific results are shown in Tables 6 and 7. A parametric bootstrapping method, suggested by Krisnky and Robb (1986), was employed to obtain the standard error on the WTP estimates. The Krisnky Robb bootstrapping procedure simulates WTP estimates by drawing 10000 times from a multivariate normal distribution parameterized with the mean coefficient and variance-covariance matrix of the mixed logit model.

As shown in Table 6, young consumers at all income and education levels had a higher WTP for “traceability information covering farming, slaughter and processing, and circulation and marketing”, and “traceability information covering farming, and

slaughter and processing". For consumers in the same age group, a higher WTP for "traceability information covering farming, slaughter and processing, and circulation and marketing", and "traceability information covering farming, and slaughter and processing" was observed with higher income and education levels. A lower, and even negative, relative WTP for "traceability information covering farming" was observed with higher income and education levels. Older consumers had a relatively high WTP for "traceability information covering farming". Consumers with the same education and income levels in the same age group had a lower WTP for less comprehensive traceability information in general. For example, for 35-year-old female consumers with a monthly family income of 14,000 yuan and a Bachelor's degree, the WTP was 10.95yuan/500g for "traceability information covering farming, slaughter and processing, and circulation and marketing", but it was 8.13yuan/500g for "traceability information covering farming, and slaughter and processing", representing a decrease of 25.72%.

At all income and education levels, older consumers had a higher relative WTP for government certification, and a lower WTP for domestic and international third-party independent certification. In the same age group, consumers with higher education and income levels had a higher WTP for domestic and international third-party independent certification. This finding has certain similarities with the conclusion of Bai et al. (2013) that consumers will have more confidence in third-party certification bodies with the improvement of education and income in the

future (Table 7).

As shown in Table 8, overall, consumers had a higher WTP for appearance, with the highest WTP for “fresh-looking” and a negative WTP for “passable-looking”. This indicated that appearance was one important factor affecting consumers’ evaluation of pork quality and safety, which is related to the large emphasis placed on “color, smell, taste, and appearance” in traditional Chinese food culture. The confidence intervals in Table 8 were also obtained using a parametric bootstrapping method suggested by Krisnky and Robb (1986).

Analysis of latent class model results

The latent class model analyzes consumer preference heterogeneity from the perspective of differences in group preferences. Akaike information criterion (AIC), modified Akaike information criterion (AIC3), Bayesian information criterion (BIC), and the maximum of the Akaike Likelihood Ratio Index (ρ^2) were used as the information criteria of latent classification (Gupta and Chintagunta, 1994; Swait, 1994; Hu et al., 2004). In comparison with information criteria in Table 9, minimum AIC and BIC values were obtained when the number of classes was four, which indicated that the model with 4 classes fit the data best. Therefore, the latent class model with four classes was selected. In addition, gender, age, education, and income had a significant effect on the classification of consumers. The final latent class model regression results are shown in Table 10.

Respondents were divided into four classes, i.e., certification-preferred (52.7%), price-sensitive (12.6%), appearance-preferred (20.8%), and scared consumers (13.9%). For the certification-preferred consumers, the estimated coefficients of government certification, and domestic third-party certification were relatively large. Gender had a significant positive relationship with the probability of falling into this class, indicating a higher likelihood for male consumers to be in this class. As for the price-sensitive class, consumers with an older age and lower income level were more likely to be in this class. This conclusion is consistent with the argument of Ortega et al. (2011) that the higher the income level, the lower probability for consumers to be in the price-sensitive class. For the appearance-preferred class, the estimated coefficients of "very fresh-looking" and "fresh-looking" were relatively large. Moreover, "traceability information covering farming, slaughter and processing, and circulation and marketing" was also preferred. This class of consumers might have a relatively high family income. The class of scared consumers presented a positive estimated coefficient for the opt-out option. This class of consumers might not trust the quality and safety of pork, or like to choose from the traceable pork profiles in the choice experiment due to the effect of the food safety events. If they had to make a choice, government certification, and domestic third-party independent certification would be preferred.

According to Eq. (10), the estimation results of latent class model were further transformed into WTP of each class of respondents for the quality and safety attributes

of traceable pork, as well as appearance. Confidence intervals in Table 11 were obtained using the parametric bootstrapping method suggested by Krisnky and Robb (1986).

$$WTP_k = -2\frac{\beta_k}{\beta_p} \tag{10}$$

As shown in Table 11, certification-preferred respondents had a higher WTP for government certification and domestic third-party certification. Price-sensitive respondents had a much lower WTP for the quality and safety attributes and appearance of traceable pork than other classes of respondents, which was closely related to the low income of respondents in this class. Appearance-preferred respondents had a highest WTP for “very fresh-looking” and “fresh-looking”. Scared respondents had a significantly higher WTP for quality certification and appearance than other classes of respondents, as well as a relatively high WTP for traceability information.

Conclusions and policy recommendations

In this study, four attributes, traceability information, quality certification, appearance and price, as well as corresponding levels, were set for traceable pork. On this basis, consumer preferences and WTP for traceable pork attributes were investigated using choice experiments and mixed logit and latent class models, based on a survey in 1,489 consumers in seven pilot cities designated by the Chinese Ministry of Commerce for the construction of a pork circulation traceability system.

The main conclusions of this study are summarized as follows:

(1) Consumers showed the highest preferences for quality certification, followed by appearance, and traceability information. “Government certification”, “fresh-looking”, and “traceability information covering farming, slaughter and processing, and circulation and marketing” were the most preferred levels of quality certification, appearance, and traceability information, respectively. Consumer preference for government certification was similar to the conclusions of Loureiro and Umberger (2007) and Ortega et al. (2011). During the exploration and initial construction of traceability systems in China, credible institutions are required for quality certification of traceable pork, because of the fact that consumers do not know about or trust traceability information. In this instance, the government is undoubtedly the most credible institution.

(2) Heterogeneity was observed in consumer preferences for the attributes of traceable pork. Consumers’ preferences and WTP for traceability information and quality certification were significantly influenced by gender, age, monthly family income, and education level. Young consumers were more likely to choose traceable pork with comprehensive information or certified by a domestic third party, which means that knowledge of pork safety risk prevention may be related to age. In addition, young, male consumers with higher education and income levels had higher preferences for traceable pork certified by an international third party. This conclusion was in line with objective reality and consumer behavior: male consumers are more

willing to try new things, and consumers with higher education and income levels have a greater ability to obtain information and may tend to pay more attention to a higher quality of life, and thus the high quality that is supposed to be ensured by an international certification label. Younger consumers or consumers with higher income and education levels had a higher WTP for “traceability information covering farming, slaughter and processing, and circulation and marketing”, “domestic third-party certification”, and “international third-party certification”. Overall, consumers had a high WTP for appearance.

The findings of this study provide the basis for three recommendations as a useful reference for the Chinese government in improving traceable food consumption policies. First, the government should strengthen the promotion of scientific knowledge regarding traceability system to improve the general public’s knowledge about traceability systems, in order to generate effective market demand. Second, the development of food traceability systems should be combined with a labeling system for quality certification; moreover, domestic and international third-party certification should be introduced for quality certification of traceable food in a timely manner, in order to meet the different preferences of different consumer groups. Third, producers should be encouraged and supported to produce traceable food with different traceability levels and different quality certification types to meet the diverse needs of consumers, in order to promote the construction of traceable food market systems step by step.

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Table 1 . China's Main Pork Export Markets in 2012

Partner	Trade Value ($)	NetWeight (kg)	Percentage
China, Hong Kong	229273416	51185087	77.71%
Kyrgyzstan	27491681	6742000	9.32%
China, Macao SAR	16877093	3636481	5.72%
Singapore	8392277	1197181	2.84%
Albania	5973561	1765000	2.02%
Mongolia	2304800	536000	0.78%
Malaysia	1539800	284000	0.52%
Georgia	917946	312000	0.31%
Dem. People's Rep. of	631800	135000	0.21%
Tajikistan	500000	100000	0.17%
Brunei Darussalam	330542	94100	0.11%
Lebanon	283787	77500	0.10%
Armenia	270775	76500	0.09%
Viet Nam	120759	52504	0.04%
Angola	82815	14000	0.03%
USA	47061	35790	0.02%

Source: Un comtrade, http://comtrade.un.org/db/dqBasicQueryResults.aspx?

Table 2. Summary of Pork Safety News Events

Date	Site	Primary cause(s)	Key process(es)
2005	Beijing	Water injected pork	Slaughter and processing
2006	Beijing	Illicit trade of dead diseased pigs	Slaughter and processing
2007	Jiangmen, Guangdong	Clenbuterol	Farming
	Zhuzhou, Hunan	Excessive veterinary drug residues	
2008	Xiangtan, Hunan	Clenbuterol	Farming
	Guangzhou, Guangdong	Clenbuterol	
2009	Chongqing	Heavy metal additives	Farming
	Guangzhou, Guangdon	Clenbuterol	
2010	Beijing	Forged quarantine seal	Slaughter and processing
2011	Beijing	Swill-fed pigs	Circulation and marketing
	Guangdong	Garbage-fed pigs	Farming
	Many places in China	Shineway clenbuterol	Farming
2012	Yantai, Shandong	Pork from dead diseased pigs	Slaughter and processing
	Jinjiang,Fujian	Pork from dead diseased pigs	Circulation and marketing
	Guangdong	Slaughter of dead pigs without authorization	Slaughter and processing
	Liaoyuan,Jilin	Water injected pork	Slaughter and processing
2013	Shanghai	Pig slaughter plants without licenses	Slaughter and processing
	Maoming,Guangdong	Pork from dead diseased pig, excessive veterinary drug residues	Farming, Circulation and marketing
	Zhangzhou, Fujian	Pork from dead diseased pigs	Circulation and marketing
	Fujian and Zhejiang	Excessive heavy metals in pig feed	Farming

Source: China Food Safety News Archives, http://www.zccw.info/index.

Table 3. Traceable Pork Attributes and Level Settings

Attribute	Level	Abbreviations	Description
Traceability information	Traceability information covering farming, slaughter and processing, and circulation and marketing	*FULL TRACE*	Specific farming information covers pig farm , farming environment, feed, and veterinary drug; information of slaughter and processing covers slaughter time, and location of slaughter and processing; information of circulation and marketing, covers wholesaler, transportation, and carrier
	Traceability information covering farming, and slaughter and processing	*PAR TRACE*	
	Traceability information covering farming	*MINI TRACE*	
	No Traceability information	*NO TRACE*	
Quality certification	Government certification	*GOV CERT*	Products are certified by the government, or a domestic or international third party to ensure the quality and safety of food
	Domestic third-party certification	*DOM THIRD CERT*	
	International third-party certification	*INT THIRD CERT*	
	No certification	*NO CERT*	
Appearance	Very fresh-looking	*FRESHNESS1*	Consumers judge freshness of pork according to appearance, and color, etc.
	Fresh-looking	*FRESHNESS2*	
	Passable-looking	*FRESHNESS3*	
	Bad-looking but edible	*FRESHNESS0*	
Price	12 yuan	*PRICE*	The prices in RMB that respondents were willing to pay for 500 g of the chosen pork
	14 yuan		
	16 yuan		
	18 yuan		

Table 4. Socio-demographic Statistics

Variable	Group	Freq.	Percent(%)
Gender	Male	723	48.56
	Female	766	51.44
Age	≤25	365	24.51
	26-40	518	34.79
	41-65	526	35.33
	> 65	80	5.37
Education	High school and lower	738	49.56
	Undergraduate	687	46.14
	Graduate/professional	64	4.30
Household size	1	18	1.21
	2	119	7.99
	3	591	39.70
	4	371	24.91
	≥5	390	26.19
Household monthly income(RMB)	< 2k	128	8.60
	2K-3.999K	335	22.50
	4K-5.999K	385	25.86
	6K-7.999K	227	15.24
	8K-9.999K	154	10.34
	10K-11.999K	104	6.98
	12K-13.999K	55	3.69
	> 14K	101	6.78
Child(ren) under the age of 18	No	811	54.47
	Yes	678	45.53

Table 5. Mixed Logit Model Parameter Estimates

Categories	Attributes	Model1			Model2		
		Coef.	S.E.	P value	Coef.	S.E.	P value
Price	PRICE	-0.0907***	0.0062	0.0000	-0.0914***	0.0062	0.0000
	NONE	-1.1572***	0.0964	0.0000	-1.1640***	0.0964	0.0000
Traceable Information	FULL TRACE	0.3950***	0.0347	0.0000	0.3826**	0.1919	0.0461
	PAR TRACE	0.2835***	0.0309	0.0000	0.2142	0.1708	0.2098
	MINI TRACE	0.0175	0.0311	0.5740	0.1068	0.1735	0.5383
Quality Certification	GOV CERT	0.6828***	0.0373	0.0000	0.6341***	0.2064	0.0021
	DOM THIRD CERT	0.4447***	0.0310	0.0000	0.7230***	0.1727	0.0000
	INT THIRD CERT	0.3595***	0.0347	0.0000	-0.2231	0.1948	0.2522
Appearance	FRESHNESS1	0.6335***	0.0293	0.0000	0.6279***	0.0293	0.0000
	FRESHNESS2	0.5205***	0.0275	0.0000	0.5182***	0.0275	0.0000
	FRESHNESS3	-0.3854***	0.0233	0.0000	-0.3827***	0.0232	0.0000
Interaction terms	FULL TRACE * GENDER				-0.0126	0.0665	0.8502
	FULL TRACE * AGE				-0.0054**	0.0024	0.0269
	FULL TRACE * EDU				0.0096	0.0114	0.3979
	FULL TRACE * INCOME				0.0110	0.0092	0.2323
	PAR TRACE * GENDER				0.0095	0.0590	0.8719
	PAR TRACE * AGE				-0.0008	0.0022	0.7211
	PAR TRACE * EDU				0.0012	0.0102	0.9073
	PAR TRACE * INCOME				0.0118	0.0082	0.1515
	MINI TRACE * GENDER				-0.0218	0.0605	0.7186
	MINI TRACE * AGE				0.0017	0.0022	0.4545
	MINI TRACE * EDU				-0.0065	0.0104	0.5310
	MINI TRACE * INCOME				-0.0073	0.0084	0.3803
	GOV CERT * GENDER				0.1377*	0.0713	0.0535

GOV CERT * AGE				0.0049*	0.0026	0.0628
GOV CERT * EDU				-0.0099	0.0123	0.4220
GOV CERT * INCOME				-0.0091	0.0098	0.3520
DOM THIRD CERT *GENDER				-0.0427	0.0599	0.4754
DOM THIRD CERT * AGE				-0.0047**	0.0022	0.0329
DOM THIRD CERT * EDU				-0.0125	0.0103	0.2228
DOM THIRD CERT * INCOME				0.0112	0.0083	0.1780
INT THIRD CERT * GENDER				0.1654**	0.0677	0.0146
INT THIRD CERT * AGE				-0.0054**	0.0025	0.0320
INT THIRD CERT * EDU				0.0391***	0.0116	0.0008
INT THIRD CERT * INCOME				0.0238**	0.0093	0.0108
Distns. of RPs. Std.Devs or limits of triangular						
STDEV（FULL TRACE）	0.6125***	0.0432	0.0000	0.6057***	0.0442	0.0000
STDEV（PAR TRACE）	0.3180***	0.0590	0.0000	0.2755***	0.0701	0.0001
STDEV（MINI TRACE）	0.2684***	0.0715	0.0002	0.3030***	0.0610	0.0000
STDEV（GOV CERT）	0.8500***	0.0390	0.0000	0.8353***	0.0390	0.0000
STDEV（DOM THIRD CERT）	0.5221***	0.0407	0.0000	0.5142***	0.0411	0.0000
STDEV（INT THIRD CERT）	0.7493***	0.0390	0.0000	0.7095***	0.0385	0.0000
STDEV（FRESHNESS1）	0.5998***	0.0350	0.0000	0.5932***	0.0348	0.0000
STDEV（FRESHNESS2）	0.5547***	0.0351	0.0000	0.5583***	0.0352	0.0000
STDEV（FRESHNESS3）	0.0627	0.0747	0.4012	0.0456	0.0750	0.5434
Log likelihood	-15170.12440			-19630.0044		
McFadden R^2	0.2272			0.2292		
AIC	30380.2			30349.0		

Note: ***,**, and*indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6. Willingness to Pay Estimations for Traceable Information of Selected Profiles following Mixed Logit Model (yuan/500g)

	FULL TRACE		PAR TRACE		MINI TRACE	
	WTP	S.E.	WTP	S.E.	WTP	S.E.
Higher income, higher education						
Income=14k, education =16years						
Age=35	10.9504***	2.9604	8.1344***	2.6102	-0.9170	1.3886
Age=45	9.7754***	2.9726	7.9637***	2.6391	-0.5494	1.3552
Age =60	8.0128***	2.7416	7.7077***	2.6056	0.0020	1.3101
Medium income, medium education						
Income =5k, education =12years						
Age =35	7.9393***	2.9276	5.7171**	2.6502	1.0937	1.3489
Age =45	6.7642**	2.9418	5.5464**	2.6743	1.4613	1.3398
Age =60	5.0016*	2.8951	5.2904**	2.6761	2.0127	1.3418
Lower income, lower education						
Income=2.5k, education =9years						
Age =35	6.7048**	2.8506	4.9969*	2.6205	1.9201	1.3370
Age =45	5.5298*	2.8960	4.8262*	2.6339	2.2877*	1.3127
Age =60	3.7672	2.7951	4.5702*	2.6162	2.8391**	1.3456

Note: ***,**, and*indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7. Willingness to Pay Estimations for Quality Certification of Selected Profiles following Mixed Logit Model (yuan/500g)

	GOV CERT		DOM THIRD CERT		INT THIRD CERT	
	WTP	S.E.	WTP	S.E.	WTP	S.E.
Higher income, higher education						
Income=14k, education =16years						
Age=35	11.3454***	4.4017	11.2246***	3.6370	12.0344***	4.1387
Age=45	12.4220***	4.6601	10.1918***	3.8326	10.8637***	4.1773
Age =60	14.0369***	4.6086	8.6426**	3.8891	9.1077**	4.1871
Medium income, medium education						
Income =5k, education =12years						
Age =35	14.0093***	4.5162	10.1218***	3.7708	3.9248	4.1945
Age =45	15.0859***	4.5143	9.0889**	3.7182	2.7541	4.1911
Age =60	16.7008***	4.5796	7.5397**	3.7353	0.9981	4.1976
Lower income, lower education						
Income=2.5k, education =9years						
Age =35	15.1573***	4.5141	10.3325***	3.7321	0.0568	4.1832
Age =45	16.2338***	4.5683	9.2997**	3.7272	-1.1139	4.1727
Age =60	17.8487***	4.5277	7.7504**	3.7971	-2.8699	4.1893

Note: ***,**, and*indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8 . Marginal Willingness to Pay Estimates from Mixed Logit Model

	Coef.	S.E.	95% C.I.
FRESHNESS1	13.7386	0.6406	[12.4622,14.9844]
FRESHNESS2	11.3461	0.6012	[10.1446,12.5217]
FRESHNESS3	-8.3667	0.5143	[-9.3644,-7.3460]

Table 9 . Information Criteria used in Determining Number of Classes in the Latent Class Model

Number	Number of	Log-Likelih	AIC	ρ^2	AIC3	BIC
2	27	-14255.547	28565.0952	0.2724	28592.0952	14354.1767
3	43	-13902.440	27890.8812	0.2896	27933.8812	14059.5166
4	59	-13392.061	26902.1224	0.3148	26961.1224	13607.5841
5	75	-13495.117	27140.2343	0.3087	27215.2343	13769.0869
6	91	-13482.184	27146.3684	0.3085	27237.3684	13814.6008
7	107	-13356.915	26927.83152	0.3141	27034.8315	13747.7793

Note: Restricated Log-likelihood=-19630.0043;ρ^2 = [1−AIC/2 Restricated LL];AIC3 =(−2LL + 3P).

Table 10 . Latent Class Model Parameter Estimates

Variable	certification-preferred		price-sensitive		appearance-preferred		scared consumers	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
PRICE	-0.1436***	0.0084	-0.7974***	0.0447	-0.3241***	0.0224	-0.0440	0.0234
NONE	-1.7704***	0.1527	-6.4098**	0.6622	-2.1074***	0.3377	0.9657**	0.3851
FULL TRACE	0.3210***	0.0351	0.0190	0.0838	0.5365***	0.0781	0.1397	0.1726
PAR TRACE	0.1621***	0.0337	0.1720*	0.0786	0.3775***	0.0715	0.0573	0.1575
MINI TRACE	-0.0732**	0.0355	0.0974	0.0717	0.0034	0.0788	-0.1533	0.1608
GOV CERT	0.4617***	0.0350	0.1794**	0.0834	0.3986***	0.0833	1.3007***	0.1534
DOM THIRD CERT	0.3554*	0.0317	0.0404	0.0803	0.3937***	0.0742	0.5744***	0.1371
INT THIRD CERT	0.2386*	0.0336	0.1648*	0.1001	0.5752***	0.0845	0.2069	0.1862
FRESHNESS1	0.2931***	0.0294	0.1664*	0.0899	1.7795***	0.0869	0.3416***	0.0945
FRESHNESS2	0.2697***	0.0300	0.0636	0.0676	1.5400***	0.0800	0.3531***	0.0751
FRESHNESS3	-0.2440**	0.0289	0.0422	0.0643	-1.0032***	0.0794	-0.2500***	0.0823
Latent Segment Parameter Estimates								
Constant	0.6790	0.6031	-1.6901**	0.7826	-1.3800*	0.7127	-	-
GENDER	0.3614**	0.1783	-0.2299	0.2575	0.1533	0.2173	-	-
AGE	-0.0021	0.0086	0.0367***	0.0102	0.0005	0.0098	-	-
EDU	0.0356	0.0368	0.0830*	0.0456	0.0791*	0.0437	-	-
INCOME	0.0108	0.0283	-0.1489***	0.0449	0.0904***	0.0326	-	-
Class probability	0.527		0.126		0.208		0.139	
Log likelihood	-13635.0612							
McFadden R^2	0.3054							
AIC	26902.1224							

Note: ***,**, and*indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 11 . Willingness to Pay Estimates from the Latent Class Model

Attributes	certification-preferred	price-sensitive	appearance-preferred	scared consumers
	WTP [95% C.I.]	WTP [95% C.I.]	WTP [95% C.I.]	WTP [95% C.I.]
FULL TRACE	5.2452 [3.5924,7.6567]	0.1817 [0.1499,0.2145]	3.4005 [3.3104,3.4989]	4.9113 [4.4308,5.3014]
PAR TRACE	2.6790 [1.7369,4.0349]	0.5049 [0.4871,0.5239]	2.3720 [2.3188,2.4301]	2.2521 [2.0385,2.4204]
MINI TRACE	-1.3048[-1.9523,-0.8809]	0.2045 [0.1930,0.2149]	-0.0504 [-0.0690,-0.0332]	4.6855 [4.2684,5.0650]
GOV CERT	8.8200 [5.1948,14.3450]	0.7838 [0.6974,0.8788]	3.0517 [2.9066,3.2071]	40.6010[37.1935,43.6932]
DOM THIRD CERT	6.2821 [4.0241,9.6753]	0.2987 [0.2523,0.3479]	2.7104 [2.6189,2.8096]	18.1632[16.5997,19.5591]
INT THIRD CERT	4.0636 [2.5679,6.2527]	0.5447 [0.5140,0.5756]	3.6411 [3.5598,3.7289]	7.0678 [6.4739,7.5702]
FRESHNESS1	5.1550 [2.7477,8.4733]	0.6939 [0.6217,0.7691]	10.9458[10.7356,11.1618]	12.4399[11.5179,13.2201]
FRESHNESS2	4.7614 [2.5858,7.7737]	0.4124 [0.3474,0.4808]	9.4893 [9.3041,9.6807]	12.5045[11.5602,13.3076]
FRESHNESS3	-4.1783[-6.5152,-2.5126]	-0.0762[-0.1237,-0.0302]	-6.2057 [-6.3402,-6.0761]	-8.7364 [-9.3282,-8.0386]

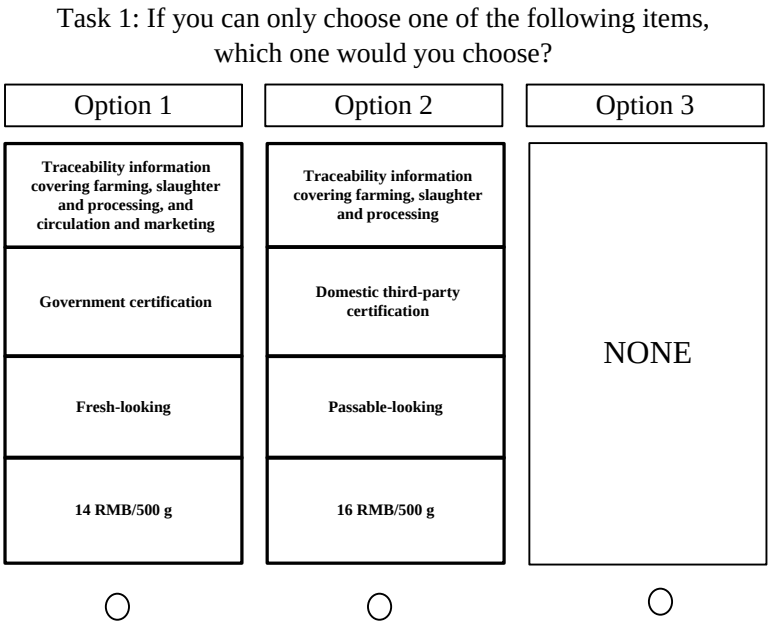

Figure 1. Sample choice experiment task

Figure 2. The Geographic distribution of the sample cities

Specific safety risks in the major processes of pork supply chain and literature sources

Process(es)	Specific risks in each supply chain	Literature support
Farming	Farming environment	Wang Z., 2009; Zhang Y., He H., 2010; Jiao S., 2011
	Veterinary medicine	Wu X., 2006; Guo W., 2008 Chen Y., 2009; Zhou W., 2010
	Feed and additives	Yu Y., 2003; Zhang L., Zhang X., 2006;
	Epidemics	Guang Y., 2007; Liu J., 2009; Dong Y., 2010
Slaughter and processing	Slaughter without authorization, and production and selling of pork form dead diseased pigs and water injected pork	He H., 2009; Liu J., 2009;
	Microbial contamination.	Yang K., 2008; Jiang L.,2009
	Absence of inspection and quarantine items	Liu Q., 2009; Luo B., 2010
Circulation and marketing	Improper temperature control, Unacceptable refrigeration measures	Lin C., 2009
	Microbial corruption, Presence of potential sources of pollution	Jiang L.et al., 2009