Urban Chinese Consumers’ Willingness to Pay for Pork with Certified Labels: A Discrete Choice Experiment

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Abstract: The paper aims to investigate Chinese consumers’ willingness-to-pay (WTP) for pork characterized by four attributes, namely food safety certification labels, location-of-origin, “free from veterinary drug residues” label, and price, based on a choice experiment conducted among 844 consumers from Jiangsu and Anhui provinces, China. A Random Parameter Logit model was estimated to elicit consumers’ WTP. The results showed that Jiangsu consumers’ WTP for pork with a “Organic Food” certification (26.78 Yuan) was the highest among all attributes, followed by “Green Food” certification (20.22 Yuan), “free from veterinary drug residues” label (23.18 Yuan), and location-of-origin (12.77 Yuan). However, there was only a moderate preference for “Safe Food” certification (8.10 Yuan). In addition, respondents from the more developed region (i.e., Jiangsu) had significantly higher WTP for all attributes than respondents from Anhui, a less developed region. The Random Parameter Logit model shows that better educational attainment and higher income were two factors that were associated with a higher WTP. The main policy recommendations are that public awareness of the different types of verifications should be improved and that authorization of certification logos should be enforced strictly so that food with certification logos are always reflective of the standard being followed.

Keywords: Discrete Choice Experiment; willingness to pay; food safety

1. Introduction

Food safety is one of the most crucial issues faced by the agricultural sector. Consumers residing in the developing countries are paying an increasing attention to health, the environment, as well as food safety [1,2]. Meat consumption in China has been continuously increasing from 37.1 g per day in 1992 to 64.3 g per day in 2012 [3]. China currently consumes half of pork worldwide, making China world’s largest pork consumer [4]. However, a series of recent food safety scandals in China (i.e., contaminated baby milk formula and pork produced using clenbuterol), have aroused tremendous attention among the media and the public. China’s pork industry has been facing food safety challenges in its various stages of the supply chain. In response to those events, improving food safety has been a priority of the Chinese government.

Food safety risk is a result of information asymmetry where producers owning full information induce consumers to purchase their products, a purchase which would not have happened if the full information was exposed [5]. The quality of a food product is represented by its attributes, e.g., color, smell, taste, production process, nutritional status, and price etc. If these attributes can be exposed to consumers before the purchase by labeling on the package, the disadvantaged
position that consumers are put in as a result of information asymmetry can be eliminated [6,7]. Consequently, labeling the quality of a food product is an important marketing strategy for producers to increase consumers’ willingness to pay for foods with certified logos [8]. From the perspective of improving food safety, a well understanding of consumers’ needs is necessary so that food producers will respond to consumers’ needs by producing safe foods [9]. However, one should note that the price of a food product is expected to increase as a result of meeting the requirements of meeting specific standards (such as organic). Different consumers are likely to respond differently to certified-label products because they are heterogeneous in terms of their incomes, awareness of the certification labels, and perceived risks of food safety [10]. How to predict consumers’ preferences and willingness to pay for label information is of interest only to food producers but also to academics as well as government policymakers [11].

Several studies have investigated consumers’ willingness to pay for certified labels in the Chinese context. For instance, based on a survey of 257 consumers in Beijing, Ortega et al. (2016) investigated consumers’ willingness to pay for beef with four attributes reflecting beef quality, namely food safety claims (WTP: 116 Yuan or $19.14), following animal welfare practice (no significant higher WTP), “Green Food” certification (WTP: 69 Yuan or $11.22), and “Organic Food” certification (25 Yuan or $4.13) [12]. Yu et al. (2014) surveyed 408 consumers from Hebei and Tianjin and reported that consumers were willing to pay an extra price of 47% for the vegetables with “Green Food” logo compared to conventional products, whereas the meat with “Green Food” logo received 40% more WTP [13]. Next, Liu et al. (2017) utilized an choice experiment to measure 435 Chinese consumers’ preferences for eco-labeled rice and reported that the WTP for the four attributes of interest were: 1.11 Yuan/500 g for national branded rice compared to none, 2.35 Yuan/500 g for “Green Food” logo compared to no label, 2.97 Yuan/500 g for “Organic Food” logo compared to no label, and 2.31 Yuan/500 g for labelled geographical origin compared to without [14]. Furthermore, a WTP study on pork traceability information by Wu et al. (2016) reported that consumers from Wuxi, China were WTP 4.38 Yuan/500 g for the pork with traceable farming information, 1.57 Yuan/500 g for slaughter and processing information, 1.07 for distribution and marketing information, and 4.93 Yuan/500 g for government certification [15]. However, the studies did not investigate consumers’ willingness to pay for a specific type of government certification, nor did they look at the WTP difference of residents from regions with different levels of economic development.

To fill this gap, the main objective of the paper is to investigate consumers’ willingness to pay for three types of government certifications available on the market, as well as the location of origin, “free from veterinary drug residues” label, among 844 Chinese consumers surveyed in Jiangsu, a more economically developed province, and Anhui province, a less developed province. The rest of the paper is organized as follows. Section 2 reviews the literature on the design of attributes on meat products. Section 3 describes the method, i.e., choice experiment. Sample selection and data were introduced in Section 4 and results reported in Section 5. Policy recommendations and discussed are given in Section 6.

2. Literature Review

Certification provides a signal to consumers to eliminate the uncertainty that consumers are facing when purchasing food products [8,16,17]. Consequently, it is considered as a useful instrument to prevent unsafe foods. And consumers often trust it as a sign of a good-quality product [6,18]. Based on a survey of 1077 US consumers, Gao and Schroeder (2009) found that consumers’ willingness to pay for the “Certified U.S. Product” beef steak attribute was significantly higher than that of other attributes such as guaranteed tender, guaranteed lean, and enhanced nutrition [11]. Similarly, Van Loo et al. (2011) reported that the willingness to pay of US consumers for organic chicken was much higher when the product had a “USDA certified organic” label than that of a general organic label [19]. In a study on the willingness to pay for organic yogurt, De Marchi et al. (2016) observed that, among the 173 US consumers surveyed, the willingness to pay for healthy and environmentally-friendly
food labels was the highest for the “USDA organic” logo, followed by the willingness to pay for health attributes, i.e., diets low in saturated fat and cholesterol, and the environmentally-friendly label, i.e., carbon trust label [20]. In contrast, a sample of 334 Belgium surveyed consumers were not prepared to pay a higher price premium for a beer with an organic label, compared to a similar beer without the label [21]. Thus, we consider government certification labels as the main focus of the study.

Country-of-origin traceability of a product also plays an important role in consumers’ decision-making during their purchase of products. In developed countries like the US, it is required to provide country-of-origin of food products such as shells, fresh vegetables, and fruits [17]. Loureiro and Umberger (2007) reported that US consumers were prepared to pay an extra of 1.90 dollars per lb. for the steak with a country-of-origin logo than without [22]. It was also reported that consumers were more inclined to purchase local products than products produced elsewhere [23,24]. For instance, Gracia (2014) found that Spanish consumers were prepared to pay 9% higher price for fresh lamb with a “locally grown” logo than without [25]. Wägeli et al. (2016) revealed that German consumers were willing to pay a price premium of 41–56% for local organic animal products produced with local feed [26]. The rationale behind this motivation is that the production processes are often transparent to consumers and that the short transportation distance ensures the freshness of the foods [27]. Another reason is that consumers are often included to support the local economy by purchasing foods produced locally [26]. However, a study in the Chinese context revealed that consumers were prepared to pay more for imported than domestic beef, although the willingness to pay for beef imported from countries suffered from bovine spongiform encephalopathy (BSE) outbreak was much lower [12].

Livestock feed is an important attribute to determine the quality of meat products, however, a few studies have taken it as an attribute in choice experiments. Although not a choice experiment study, Bernuès et al. (2003) is an exemption who investigated consumers’ preferences for proper animal feeding and found that it was even more important than the preference for origin/region of production [28]. Another study is Font i Furnols et al. (2011) who found that a proper feeding system was an important cue to determine a consumer’s purchasing intention whereas price information was a minor factor for 391 European consumers [29]. Despite the little evidence, we argue that feed information is an important attribute in the Chinese context. This is because several notorious food safety outbreaks happened in China, i.e., the scandals that baby milk formula was contaminated by melamine, and that fresh pork contaminated by clenbuterol [30,31]. Other studies conducted in developed societies have also focused on animal welfare. For instance, Bernuès et al. (2003) discovered that European consumers demanded information on animal welfare when purchasing meat. Based on data from 449 UK consumers [28], Erdem (2015) found that welfare-improved chickens received approximately seven times more WTP for better animal welfare than for conventional chickens [32]. However, we argue that Chinese consumers generally have a low awareness of animal welfare [33] and thus did not consider it as an attribute.

3. Methods: Discrete Choice Experiment

Lancaster (1966)’s Random Utility Theory suggested that a consumer’s utility from a product is a function of attributes of the product [34]. Consumers subject to a budget constraint are expected to choose the set of attributes that maximize their utilities [35]. Following this rationale, consumers are hypothesized to maximize their utilities by making tradeoffs between the attributes of a pork product. Assuming a linear function, the utility of a consumer can be expressed as:

\[ U_{ij} = \beta X_{ijk} + \epsilon_{ij} \] (1)

where \( U_{ij} \) represents the \( i \)th consumer’s utility from pork \( j \), \( X_{ijk} \) represents the \( k \)th attribute of pork \( j \) for consumer \( i \), \( \beta \) is a vector of coefficients which are homogenous across consumers, and \( \epsilon_{ij} \) is assumed to
be an i.i.d. type I extreme value (EV1) distributed error term. Then, a consumer’s utility associated with the alternative \( j \) can be written as:

\[
U_{ij} = V_{ij} + \epsilon_{ij}
\]

where \( V_{ij} \) represents the utility determined by the pork attributes and \( \epsilon_{ij} \) is a stochastic element. The probability that the alternative \( j \) is preferred by consumer \( i \) is expressed as:

\[
P_{ij} = \text{prob}(V_{ij} + \epsilon_{ij} > V_{is} + \epsilon_{is}; \forall s, j \in T_i, \forall s \neq j)
\]

where \( T_i = \{t_1, t_2, \ldots, t_T\} \) represents the choice occasions faced by respondent \( i \).

According to Loureiro and Umberger (2007) [22], the probability of consumer \( i \) choosing alternative \( j \) can be expressed by the multinomial logit (MNL) model:

\[
P_{ij} = \frac{e^{V_{ij}}}{\sum_{j=1}^{J} e^{V_{ik}}}
\]

Note that the MNL assumes that all consumers have the same preferences, which is likely to be violated [36]. This assumption is relaxed in the Random Parameter Logit model (RPL) which allows that consumers’ preferences be heterogeneous across respondents [37,38]. In the Random Parameter Logit context, the deterministic component of the utility function takes the following form:

\[
V'_{ij} = (\beta' + \sigma_i)X_{ijk} + \epsilon_{ij}
\]

where \( \beta' \) is a vector of attribute coefficients in the population level and \( \sigma_i \) is individual-specific deviation from the mean \( \beta' \). When an RPL is assumed, the unconditional choice probability is the integral of the logit formula over all possible values of random parameters:

\[
P_{ij} = \int \frac{e^{V'_{ij}}}{\sum_{k=1}^{K} e^{V'_{ik}}} g(\beta|\theta) d\beta
\]

where \( g(\beta|\theta) \) denotes the joint density of random parameters. Next, the probability of consumer \( i \)'s choices over the \( T = \{t_1, t_2, \ldots, t_T\} \) choice occasions, \( P_{ij(t_1t_2\ldots t_T)} \), can be expressed as [39]:

\[
P_{ij(t_1t_2\ldots t_T)} = \int \prod_{t=1}^{T} \left[ \frac{e^{V'_{ij}}}{\sum_{k=1}^{K} e^{V'_{ik}}} \right] g(\beta|\theta) d\beta
\]

4. Experimental Design and Sample Selection

4.1. Attributes

When it comes to the designing of a choice experiment, a reasonable number of attributes is necessary. Too many attributes cause fatigue and cognitive burden to respondents whereas too few attributes lead to attributes that are unrepresentative to a product in question [40]. The four attributes considered in this study include governmental certification, location-of-origin, “free from veterinary drug residues” label, and price. Governmental certification available in China’s food market has four levels: no certification (NOCERT thereafter), “Safe Food” certification (CERT1), “Green Food” certification (CERT2), and “Organic Food” certification (CERT3). The “Safe Food” certification logo is issued by local authorities to be labeled on the raw or crude food that is produced by a process that meets the requirement of the national standards. Note that pesticides and fertilizers are allowed to produce foods with “Safe Food” certification logos, however highly-toxic types of pesticides with
A high level of residues are not permitted. In theory, all foods sold in the market should meet this standard, however, in practice, this is not true. Next, foods with a “Green Food” logo indicates a production process with a higher safety standard and stricter quality control than “Safe Food”. Similar to “Safe Food”, the “Green Food” logo was closely watched by local authorities who take responsibilities to authorize the logos. Finally, the “Organic Food” logo, also known as “eco-foods”, is labeled on the foods which are purely natural, no pollution, safe, and with ample nutrition. Foods with this logo have to strictly comply with the standards of organic farming where synthetic fertilizers are not used, and foods are not permitted to be processed using industrial solvents or synthetic food additives, nor are genetically modified foods considered as organic. In addition, organic farming also takes into consideration species diversity, sustainability of resources, and the balance of the ecological system etc. The definitions of the three labels had been shown to respondents before they made choices.

**ORIGIN** refers to a label which shows the information on the location where the pork is produced. **DRUG-FREE** means that the product has a label that shows that pork is free from veterinary drug residues and clenbuterol. The foods with Organic Food labels are indeed drug-free. Nevertheless, we expect consumers to have a higher willingness to pay for the food with both Organic Food and Drug-free labels than for Organic Food alone. The reason is that the more labels a food has, the more likely consumers believe the food is safer. To exclude the influences of other pork characteristics that are irrelevant to our study, the pork considered limits to hindquarter pork only. According to our observation of the local markets, an ordinary hindquarter pork is sold for approximately 25 Yuan/500 g, which is set as a baseline. In terms of the levels for the price attribute, we considered three levels (for 500 g pork): 15 Yuan, 25 Yuan, and 40 Yuan. The levels of the four attributes and effect coding are shown in Table 1.

### Table 1. Four pork attributes, attribute levels, and effect coding.

| Attributes                  | Levels                           | Description                                      | Effect Coding |
|-----------------------------|----------------------------------|--------------------------------------------------|---------------|
| Government certification    | “Safe Food” (CERT1)              | Has a logo that shows a certain certification    | CERT1 = 1; CERT2 = 0; CERT3 = 0 |
|                             | “Green Food” (CERT2)             |                                                  | CERT1 = 0; CERT2 = 1; CERT3 = 0 |
|                             | “Organic Food” (CERT3)           |                                                  | CERT1 = 0; CERT2 = 0; CERT3 = 1 |
|                             | No certification (NOCERT)        |                                                  | CERT1 = −1; CERT2 = −1; CERT3 = −1 |
| Location-of-origin          | Yes (ORIGIN)                     | Has information on the location where the pork is produced | ORIGIN = 1   |
|                             | No (NOORIGIN)                    |                                                  | NOORIGIN = −1|
| Drug-free                   | Yes (DRUG-FREE)                  | Has a label that shows that pork is free from veterinary drug residues and clenbuterol | DRUG-FREE = 1 |
|                             | No (NODRUG-FREE)                 |                                                  | NODRUG-FREE = −1|
| Price                       | 15 Yuan                          | Price per 500 g pork                              | PRICE = 15; PRICE = 25; PRICE = 40 |
|                             | 25 Yuan                          |                                                  |               |
|                             | 40 Yuan                          |                                                  |               |

### 4.2. Experimental Design

A full factorial design results in \((4 \times 2 \times 2 \times 3)^2 = 2304\) combinations of choice sets, making it infeasible to present all choice sets to respondents. It was reported that fatigue is likely to happen after being presented with approximately 15–20 choice sets [41]. To avoid systematic deviation from the attributes considered while ensuring efficiency, a fractional factorial design was used to obtain 12 choice sets using JMP 11.0 (SAS Institute, North Carolina, United States), based on D-error efficiency [42]. An example choice set is shown in Table 2. The D-efficiency value was 96.29, suggesting an acceptable design. Each choice set is composed of three alternatives, i.e., Option A and Option B offer a pork with certain levels of attributes, respectively, whereas Option C is an “opting out” choice. The design of an *Opting C* (ASC thereafter) choice makes sure that consumers are not forced to make choices which might not reflect their real preferences [43,44]. Respondents were also asked to answer some questions eliciting their socio-demographic information.
Table 2. An example choice set.

| Option A                                      | Option B                                      | Option C                        |
|-----------------------------------------------|-----------------------------------------------|---------------------------------|
| “Organic Food” certification                  | No certification                              | I chose neither Option A or     |
| No location-of-origin information             | No location-of-origin information             | Option B                        |
| No label showing pork free from               | Has a label showing pork free from            |                                 |
| veterinary drug residues and clenbuterol      | veterinary drug residues and clenbuterol      |                                 |
| Price: 40 Yuan/500 g                          | Price: 25 Yuan/500 g                          |                                 |

4.3. Data

A survey was conducted in Jiangsu and Anhui provinces, which are located in eastern China, with the former province more economically developed than the latter. We only focused on urban areas, where food markets are mature. To take into consideration the geographical location of the provinces, three cities (i.e., Suzhou, Wuxi, and Changzhou) from northern Jiangsu were selected, three cities (i.e., Nantong, Yangzhou, and Taizhou) from middle Jiangsu were selected, and three cities (i.e., Huaian, Suqian, and Xuzhou) from south Jiangsu were selected. For the Anhui province, one city (i.e., Bengbu) from the northern part of the province, one (i.e., Hefei) from the middle, and one (Xuancheng) from the south were selected. All enumerators had been trained to familiarize themselves with the questionnaire prior to the survey. Face-to-face surveys were conducted in July 2017 randomly in supermarkets, traditional food markets, and stores etc. (We do not anticipate that the socio-demographic characteristics of participants surveyed in one specific location are systematically differentiated than participants from the other locations.). Interviewees were randomly approached at different times of the day and were asked whether they are the ones who often buy pork for their families. Each interview took about 20–30 min. A total number of 984 consumers were interviewed, among which 844 questionnaires (475 from Jiangsu province and 369 from Anhui province) were intact and considered as valid responses (a response rate of 85.77%).

4.4. Sample Characteristics

Table 3 shows the socio-demographic characteristics of the sample. Female respondents account for 57.26% of the total number surveyed in Jiangsu province and 54.47% in Anhui, respectively. The fact that there are more female than male respondents is in line with the reality in China that females are more likely than males to do shopping for their families. Respondents aged 30 or younger and the respondents aged 40–49 account for more than half of total respondents, a figure consistent in both provinces. In terms of educational attainment, both provinces have similar percentages of respondents with secondary-school education or lower (about 28%), followed by high-school or vocational school (26%), and college education or higher (30%). Respondents in Jiangsu tended to be richer with 35.16% of respondents had a household income higher than 100,000 Yuan, in contract to Anhui with a percentage of 25.75%. This is in line with the economic status of the two provinces. A percentage of 53.26% of respondents from Jiangsu had children under 18, which is higher than that of Anhui (43.36%). In the Discrete Choice Experiment analysis, Gender was coded as 1 if a consumer is a male, and 0 if a female. Age was coded as 1 if a consumer was younger than 30 years old, 2 if between 31–39, 3 if between 40–49, 4 if 50–59, and 5 if older than 60 years old. Education attainment is denoted by EDU, which equals 1 if a consumer had secondary education or lower, 2 if high-school or vocational school, 3 if vocational college, 4 if bachelors’ degree and 5 if Master’s degree or higher. Household income of a consumer is denoted by INCOME which equals 1 if his/her household income is lower than 50,000 Yuan, 2 if 50,000–80,000 Yuan, 3 if 80,001–100,000 Yuan, and 4 if more than 100,000 Yuan.
Table 3. Sample characteristics.

| Variables                  | Characteristics          | Jiangsu     | Anhui     |
|----------------------------|--------------------------|-------------|-----------|
|                            |                          | N   | %   | N   | %   |
| Gender                     | Male                     | 203 | 42.74 | 168 | 45.53 |
|                            | Female                   | 272 | 57.26 | 201 | 54.47 |
| Age                        | ≤30                      | 141 | 29.68 | 114 | 30.89 |
|                            | 30–39                    | 91  | 19.16 | 60  | 16.26 |
|                            | 40–49                    | 127 | 26.74 | 96  | 26.02 |
|                            | 50–59                    | 74  | 15.58 | 60  | 16.26 |
|                            | ≥60                      | 42  | 8.84  | 39  | 10.57 |
| Education attainment       | Secondary school         | 137 | 28.84 | 111 | 30.08 |
|                            | High school or vocational school | 120 | 25.26 | 100 | 27.10 |
|                            | Vocational college       | 62  | 13.05 | 53  | 14.36 |
|                            | Bachelor’s degree        | 130 | 27.37 | 90  | 24.39 |
|                            | Master’s degree and higher | 26  | 5.47  | 15  | 4.07  |
| Household income           | <50,000 Yuan             | 64  | 13.47 | 48  | 13.01 |
|                            | 50,000–80,000 Yuan       | 116 | 24.42 | 98  | 26.56 |
|                            | 80,001–10,000 Yuan       | 128 | 26.95 | 128 | 34.69 |
|                            | >100,000 Yuan            | 167 | 35.16 | 95  | 25.75 |
| Whether the household      | Yes                      | 253 | 53.26 | 160 | 43.36 |
|                            | has children (age < 18)  | 222 | 46.74 | 209 | 56.64 |

5. Results

The estimation followed three stages. In the first stage, it was estimated a main effect model which did not include the interaction terms between attributes and the socio-demographics. In the next stage, a PRL model with interaction terms was estimated. Finally, the overall WTP for each of the attributes as well as the WTP estimates for sub-groups categorized by income and education were calculated and reported.

5.1. Main Effect Models

The Nlogit 5.0 software was used to estimate the RPL model. Because of the heterogeneity of the sample from the two provinces, two separate models were estimated respectively for each province. Table 4 presents the main effect model where interaction terms are absent. All attributes had significant coefficients, although the level of the coefficients differs. It can be seen that CERT3 has the largest coefficient (0.6448) among all three types of certification, which is slightly higher than CERT2 (0.6356) and much higher than CERT1 (0.3294). This suggests that respondents in Jiangsu have similar preferences for CERT2 and CERT3. In contrast, respondents from Anhui have a high preference for CERT2 (0.6202), which is significantly higher than CERT1 (0.1133) and slightly higher than CERT3 (0.5607). Next, ORIGIN received a modest preference from respondents in both provinces (0.4040 and 0.4330, respectively), which was lower than DRUG-FREE (0.6451 for Jiangsu and 0.6574 for Anhui). These results suggest that DRUG-FREE is more preferred than ORIGIN.

5.2. RPL Model with Interaction Terms

In this section, the interaction terms between attributes and socio-demographic variables were added to the RPL model and results are reported in Table 5. It can be seen that the Pseudo R2 is higher in the models with interaction terms (0.2271 in the Jiangsu model and 0.2037 in the Anhui model) than without (0.2214 in the Jiangsu model and 0.2007 in the Anhui model), suggesting that the inclusion of interaction terms has increased model fit of both models. As a result, the prediction of WTP is based on the results in Table 5.
Table 4. Estimated RPL model (main effects).

| Attributes | Jiangsu | | Coefficients | S.E. | Coefficients | S.E. |
|------------|---------||----------------|-----|----------------|-----|
| PRICE      | −0.0474 *** | 0.0023 | −0.0481 *** | 0.0026 |
| ASC        | −2.0211 *** | 0.0681 | −1.9077 *** | 0.0755 |
| CERT1      | 0.3294 *** | 0.0438 | 0.1133 ** | 0.0506 |
| CERT2      | 0.6556 *** | 0.0423 | 0.6203 *** | 0.0452 |
| CERT3      | 0.6448 *** | 0.0432 | 0.5607 *** | 0.0423 |
| ORIGIN     | 0.4040 *** | 0.0271 | 0.4330 *** | 0.0253 |
| DRUG-FREE  | 0.6451 *** | 0.0254 | 0.6574 *** | 0.0352 |

Standard Deviation

| Attributes | Jiangsu | | Coefficients | S.E. | Coefficients | S.E. |
|------------|---------||----------------|-----|----------------|-----|
| CERT1      | 0.4070 *** | 0.0702 | 0.5062 *** | 0.0691 |
| CERT2      | 0.1880 | 0.1363 | 0.0005 | 0.0449 |
| CERT3      | 0.3495 *** | 0.0715 | 0.5062 *** | 0.0691 |
| ORIGIN     | 0.1358 ** | 0.0997 | 0.1418 *** | 0.0388 |

Sample size 475 369

log likelihood −4875.4582 −3888.1100

McFadden Pseudo R² 0.2214 0.2007

AIC 9774.9 7800.2

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

Table 5. RPL model with interaction terms.

| Attributes | Jiangsu | | Coefficients | S.E. | Coefficients | S.E. |
|------------|---------||----------------|-----|----------------|-----|
| PRICE      | −0.0474 *** | 0.0023 | −0.0481 *** | 0.0026 |
| ASC        | −2.0198 *** | 0.0681 | −1.9115 *** | 0.0756 |
| CERT1      | 0.1921 | 0.1929 | 0.1739 | 0.2912 |
| CERT2      | 0.4793 *** | 0.1808 | 0.4254 * | 0.2529 |
| CERT3      | 0.6350 *** | 0.1809 | 0.4570 ** | 0.2301 |
| ORIGIN     | 0.3027 *** | 0.1171 | 0.2653 * | 0.1426 |
| DRUG-FREE  | 0.5496 *** | 0.1058 | 0.3716 * | 0.1938 |

Standard Deviation

| Attributes | Jiangsu | | Coefficients | S.E. | Coefficients | S.E. |
|------------|---------||----------------|-----|----------------|-----|
| CERT1      | 0.3971 *** | 0.0715 | 0.4936 *** | 0.0699 |
| CERT2      | 0.1401 | 0.1653 | 0.0033 | 0.3130 |
| CERT3      | 0.4401 *** | 0.0604 | 0.2150 * | 0.0992 |
| ORIGIN     | 0.3254 *** | 0.0324 | 0.1060 | 0.0728 |
| DRUG-FREE  | 0.1327 *** | 0.0604 | 0.4032 *** | 0.0389 |

Interaction terms

| Attributes | Jiangsu | | Coefficients | S.E. | Coefficients | S.E. |
|------------|---------||----------------|-----|----------------|-----|
| CERT1 × GENDER | −0.0389 | 0.0862 | 0.0133 | 0.1005 |
| CERT1 × AGE   | 0.0279 | 0.0384 | −0.0445 | 0.0500 |
| CERT1 × EDU   | 0.0745 * | 0.0412 | −0.0949 * | 0.0522 |
| CERT1 × INCOME| −0.0365 | 0.0430 | 0.0965 * | 0.0505 |
| CERT1 × GENDER| 0.0397 | 0.0810 | −0.0534 | 0.0879 |
| CERT1 × AGE   | −0.0586 | 0.0358 | 0.0115 | 0.0435 |
| CERT1 × EDU   | −0.0304 | 0.0389 | 0.0165 | 0.0454 |
| CERT1 × INCOME| 0.1324 *** | 0.0401 | 0.0488 | 0.0437 |
| CERT1 × GENDER| 0.0590 | 0.0806 | −0.0195 | 0.0797 |
| CERT1 × AGE   | −0.0948 *** | 0.0360 | −0.0294 | 0.0397 |
| CERT1 × EDU   | 0.0233 | 0.0385 | −0.0310 | 0.0412 |
| CERT1 × INCOME| 0.0583 | 0.0402 | 0.0900 ** | 0.0398 |
| ORIGIN × GENDER| 0.0218 | 0.0524 | 0.0005 | 0.0495 |
| ORIGIN × AGE   | −0.0599 ** | 0.0233 | 0.0128 | 0.0246 |
| ORIGIN × EDU   | −0.0499 ** | 0.0251 | 0.0301 | 0.0256 |
| ORIGIN × INCOME| 0.1318 *** | 0.0262 | 0.0187 | 0.0248 |
| DRUG-FREE × GENDER| −0.0078 | 0.0472 | −0.0491 | 0.0671 |
| DRUG-FREE × AGE | 0.0096 | 0.0210 | −0.0115 | 0.0334 |
| DRUG-FREE × EDU | −0.0098 | 0.0225 | 0.0015 | 0.0346 |
| DRUG-FREE × INCOME| 0.0355 | 0.0235 | 0.1107 *** | 0.0336 |

Sample size 475 369

log likelihood −4840.1524 −3873.6442

McFadden Pseudo R² 0.2271 0.2037

AIC 9744.3 7811.3

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
Among the Jiangsu respondents, the interaction terms with Age which had significantly negative coefficients were $\text{CERT3} \times \text{AGE} (-0.0948)$ and $\text{ORIGIN} \times \text{AGE} (-0.0599)$, suggesting that younger consumers had stronger preferences for $\text{CERT3}$ and $\text{ORIGIN}$. Next, $\text{CERT1} \times \text{EDU}$ had a positive and significant coefficient ($0.0745$), indicating that better-educated consumers tended to prefer $\text{CERT1}$ over no certification. However, $\text{ORIGIN} \times \text{EDU}$ had a negative and significant coefficient ($-0.0499$), which means that education was associated with a weaker preference for $\text{ORIGIN}$. Additionally, both $\text{CERT2} \times \text{INCOME}$ ($0.1324$) and $\text{ORIGIN} \times \text{INCOME}$ ($0.1318$) had positive and significant coefficients, suggesting that richer consumers were more likely to prefer $\text{CERT2}$ and $\text{ORIGIN}$. Finally, all attributes interacting with gender had insignificant coefficients, indicating that the preferences for all attributes do not vary with gender. Next, we discuss the results based on the Anhui sample. We observed that $\text{Income}$ played an important role. The coefficients of $\text{CERT1} \times \text{INCOME}$ ($0.0985$), $\text{CERT3} \times \text{INCOME}$ ($0.0900$), and $\text{DRUG-FREE} \times \text{INCOME}$ ($0.1107$) were all significant, suggesting that richer consumers from Anhui preferred $\text{CERT1}$ and $\text{CERT3}$ over no certification and that $\text{DRUG-FREE}$ was preferred to no label. However, $\text{CERT1} \times \text{EDU}$ had a significantly negative coefficient ($-0.0949$), in contrast with the results reported using the Jiangsu data. Again, the attributes interacting with Gender had insignificant coefficients.

5.3. WTP Estimates

Based on the results in Table 6, the willingness to pay for a certain attribute is calculated using the following formula (Lim et al., 2013):

$$WTP_k = -2 \frac{\beta_k}{\beta_{\text{price}}}$$

where $\beta_k$ represents the main effect of the attribute $k$ and $\beta_{\text{price}}$ is the coefficient for $\text{Price}$. Because of the fact that effect coding was used, the formula was multiplied by 2 [42,43]. The 95% confidence interval was calculated by Krinsky and Robb (1986)'s parametric bootstrapping technique [44]. The results on WTP are reported in Table 6.

| Attributes  | Jiangsu       | Anhui         |
|------------|---------------|---------------|
| CERT1      | 8.10 [7.37, 8.73] | 7.21 [6.18, 8.43] |
| CERT2      | 20.22 [20.11, 20.29] | 17.63 [17.62, 17.63] |
| CERT3      | 26.78 [25.94, 27.73] | 18.94 [18.65, 19.18] |
| ORIGIN     | 12.77 [12.12, 13.59] | 10.99 [10.86, 11.08] |
| DRUG-FREE  | 23.18 [23.04, 23.31] | 15.40 [14.28, 16.50] |

In general, consumers from Jiangsu province had higher WTP for all attributes than consumers from Anhui. This is in line with the income gap favoring respondents from Jiangsu. It can also be seen that consumers’ WTP for certification matches the levels of standards. For instance, $\text{CERT3}$ received higher WTP (26.78) than $\text{CERT2}$ (20.22), which in turn received higher WTP than $\text{CERT1}$ (8.10). A similar trend holds for Anhui: $\text{CERT3}$ (18.94), $\text{CERT2}$ (17.63), and $\text{CERT1}$ (7.21). This indicates that consumers had a clear idea about what three certification logos were indicating and the food safety standards behind the certifications. This is in line with the results reported in Liu et al. (2013) [45]. Next, the pork with $\text{DRUG-FREE}$ received an additional WTP of 23.18 (Jiangsu) and 15.40 (Anhui), which is close to the WTP figure for $\text{CERT3}$. This finding is probably because of the food scandals associated with pork happened in China in the past years. Additionally, consumers are willing to pay an extra of 12.77 (Jiangsu) and 10.99 (Anhui) for $\text{ORIGIN}$. 

Table 6. WTP (Yuan) for the three attributes.
5.4. Sub-Group Analysis

Recall that several attributes interacting with income and education had significant coefficients (see Table 5), we now calculate the WTP for each of the attributes by sub-groups categorized by income and education. Following Lim et al. (2013) [46], the WTP for the kth attribute from sub-group g can be calculated as follows:

\[ WTP_{k,g} = -2(\frac{\beta_k + \beta_{k\times g}}{\beta_{price}}), \quad \text{where } g = [EDU, INCOME] \] (9)

where \( \beta_k \) is the main effect, \( \beta_{k\times g} \) is the coefficients of an interaction term between EDU (INCOME) and attribute k, and \( \beta_{price} \) is the coefficient for Price. Krinsky and Robb (1986)'s parametric bootstrapping technique was again used to calculate the 95% confidence intervals of the WTP estimates [47].

Tables 7 and 8 show the WTP for pork attributes among sub-groups in Jiangsu and Anhui, respectively. The high-income group had higher WTP for CERT1 than the middle and low-income groups, among the highly educated and low educated respondents. In contrast, low-income respondents from the middle-educated group had higher WTP for CERT1 than the middle and high-income respondents. For CERT2, high-income respondents from the high-education and middle-education groups had much higher WTP than their middle and low-income counterparts. However, the low-income respondents from the low-education group had much higher WTP than the middle and high-income respondents from the same group. For CERT3, high-income respondents from the high-education group, middle-income respondents from the middle-education group, and low-income respondents from the low-income group had much higher WTP than their counterparts from the corresponding sub-groups, respectively. For ORIGIN, high-income respondents in the middle-education group had the highest WTP (10.78 Yuan). Next, low-income respondents from the low-education group had the highest WTP (20.95 Yuan) for DRUG-FREE among all sub-groups.

### Table 7. WTP (Yuan) for pork attributes among sub-groups (Jiangsu).

| Sub-Groups            | CERT1   | CERT2   | CERT3   | ORIGIN  | DRUG-FREE |
|-----------------------|---------|---------|---------|---------|-----------|
| **Highly-Educated Sub-Group** |         |         |         |         |           |
| High-income           | 10.17   | 14.89   | 25.36   | 9.56    | 17.01     |
|                       | [9.44, 10.80] | [14.78, 14.96] | [24.52, 26.29] | [9.06, 10.19] | [16.87, 17.14] |
| Middle-income         | 8.10    | 3.96    | 16.27   | 5.49    | 10.09     |
|                       | [7.37, 8.73] | [3.86, 4.03] | [15.44, 17.20] | [5.05, 6.06] | [9.97, 10.23] |
| Low-income            | 5.37    | 4.35    | 15.94   | 10.68   | 11.27     |
|                       | [4.65, 6.01] | [4.23, 4.40] | [15.10, 16.88] | [10.22, 11.28] | [11.13, 11.41] |
| **Middle Education Sub-Group** |         |         |         |         |           |
| High-income           | 4.31    | 11.16   | 17.78   | 10.78   | 15.93     |
|                       | [3.59, 4.95] | [11.06, 11.23] | [16.94, 18.70] | [10.30, 11.40] | [15.83, 16.04] |
| Middle-income         | 7.02    | 9.02    | 18.91   | 8.53    | 16.98     |
|                       | [6.29, 7.65] | [8.91, 9.09] | [18.07, 19.83] | [7.98, 9.22] | [16.82, 17.18] |
| Low-income            | 10.33   | 5.24    | 15.93   | 8.61    | 12.57     |
|                       | [9.60, 10.96] | [5.13, 5.31] | [15.09, 16.88] | [8.16, 9.18] | [12.43, 12.71] |
| **Low Education Sub-Group** |         |         |         |         |           |
| High-income           | 4.16    | –1.28   | 8.64    | 4.21    | 9.62      |
|                       | [3.43, 4.79] | [–1.39, –1.21] | [7.95, 9.37] | [3.78, 4.76] | [9.48, 9.75] |
| Middle-income         | 3.64    | 4.05    | 11.84   | 9.73    | 13.76     |
|                       | [2.91, 4.27] | [3.95, 4.13] | [11.14, 12.58] | [9.19, 10.38] | [13.62, 13.90] |
| Low-income            | 4.08    | 14.52   | 19.54   | 2.63    | 20.95     |
|                       | [3.36, 4.72] | [14.42, 14.60] | [18.71, 20.46] | [2.13, 3.25] | [20.81, 21.08] |

Notes: High-income refers to the households whose income was larger than 100,000 Yuan, Middle-income refers to the households whose income was between 50,000 and 80,000, and the Low-income group refers to the households whose income was less than 50,000 Yuan. A respondent is defined to have received high-education if the years of schooling is more than 12 years, Middle-educated if 9–12 years, and Low-educated if less than 9 years.
Table 8. WTP (Yuan) for pork attributes among sub-groups (Anhui).

| Sub-Groups     | CERT1     | CERT2     | CERT3     | ORIGIN     | DRUG-FREE  |
|----------------|-----------|-----------|-----------|------------|------------|
|                | [6.93, 9.02] | [12.50, 12.51] | [14.89, 15.42] | [6.13, 6.35] | [9.34, 11.06] |
| High Education Sub-Group | 7.91 | 12.51 | 15.17 | 6.26 | 10.18 |
| Middle-income | [4.15, 6.40] | [0.40, 0.41] | [7.93, 8.47] | [7.43, 7.61] | [5.24, 7.08] |
| Low-income    | [5.10, 7.34] | [0.21, 0.22] | [7.87, 8.40] | [5.95, 6.16] | [5.12, 6.70] |
| Middle Education Sub-Group | 11.14 | 12.81 | 16.48 | 4.45 | 14.30 |
|                | [10.12, 12.37] | [12.80, 12.81] | [16.19, 16.73] | [4.32, 4.53] | [13.28, 15.22] |
| High-income   | 8.65 | 6.18 | 10.89 | 3.37 | 6.71 |
|                | [7.74, 9.68] | [6.17, 6.18] | [10.60, 11.13] | [3.26, 3.41] | [5.80, 7.75] |
| Low-income    | 7.94 | 13.89 | 13.16 | 5.47 | 5.30 |
|                | [7.11, 8.89] | [13.88, 13.89] | [12.87, 13.41] | [5.34, 5.55] | [4.72, 5.95] |
| Low Education Sub-Group | 10.37 | 2.04 | 3.60 | 4.49 |
|                | [9.43, 11.53] | [−7.33, −7.34] | [1.75, 2.29] | [−3.47, 3.68] | [−5.25, −3.70] |
| High-income   | 11.60 | 6.05 | 11.64 | 5.49 | 2.88 |
|                | [10.61, 12.79] | [6.04, 6.05] | [11.35, 11.88] | [5.37, 5.55] | [1.90, 3.89] |
| Low-income    | 12.59 | 4.10 | 12.11 | 5.41 | 8.39 |
|                | [11.61, 13.79] | [4.09, 4.10] | [11.82, 2.35] | [5.27, 5.49] | [7.49, 9.31] |

Now we discuss the results of the Anhui sample. We observed that the results are much more consistent in a way that high-income respondents from the high-educated respondents had reported consistently higher WTP for all certification attributes than the middle- and low-educated respondents. The same trend holds for the middle-education sub-group where high-income respondents and higher WTP for CERT1 and CERT3 than their middle- and low-income counterparts.

6. Conclusions and Policy Recommendations

Chinese consumers are paying an increasing attention to food safety issues, thus it is important to understand their willingness to pay for safe foods. This paper investigates consumer’s WTP for pork with four attributes, namely government-certification, location-of-origin, “free from veterinary drug residues” label, and price, based on a choice experiment conducted among 844 consumers from Jiangsu and Anhui provinces in China. A Random Parameter Logit model was estimated to elicit consumers’ WTP for the four attributes. The main conclusions are as follows.

Consumers have relatively high WTP for organic pork. In particular, respondents from Jiangsu had the highest WTP for pork with a “Organic Food” logo, followed by a “free from veterinary drug residues” logo, and a “Green Food” logo. Respondents from Anhui were prepared to pay a similar amount for pork with “Organic Food” and “Green Food” logos and a much lower amount for the “Safe Food” logo. We found that respondents from Jiangsu generally were willing to pay more for the four attributes than respondents from Anhui would. We argue that this is a result of the gap in economic development disadvantaging Anhui. Next, we also found that the WTP difference between “Organic Food” and “Green Food” labels among respondents from Jiangsu was much higher than that of respondents from Anhui. This indicates that Jiangsu consumers were aware of the difference between “Organic Food” and “Green Food” whereas Anhui respondents could not tell the difference between the two. The policy implications are that policymakers need to increase public awareness of the different types of verifications (especially in the less economically developed regions) which can be done by the dissemination using social media channels (e.g., Wechat) because of its high reachability to Chinese consumers. The authorization of certification logos should be enforced strictly so that food with certification logos are always reflective of the standard being followed. This is important to build
trust among consumers such that a higher price is always associated with a better quality, i.e., no pesticides residues and organic, etc.

We found that consumers in both provinces were prepared to pay for labels showing location-of-origin and “free from veterinary drug residues”. However, consumers’ WTP for the two attributes are significantly less than that of “Organic Food”. Next, we found that consumers had a small WTP for “Safe Food” in both provinces. The reason is that the standard for obtaining a “Safe Food” is relatively low, causing an impression to consumers that pork with a “Safe Food” logo has little difference with no certification. It could also be that the recent food scandals happened in Hebei where vegetables with “Safe Food” logos were found to have residues of highly-poisonous pesticides. The trust of the public may have been hampered by those events. It was also reported that the two socio-demographic variables associated with a higher WTP are income and education attainment. Labels to reflect “free from veterinary drug residues” and location-of-origin should be used to allow a transparent traceability to how the pork is produced. One possible drawback of the current study is that choice experiment is a stated preference method which might suffer from hypothetical bias. Future research should design incentive-compatible instrument, e.g., actions, to elicit consumers’ willingness to pay estimates in real-life settings.

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