The role of certificate issuer on consumers' willingness-to-pay for milk traceability in China

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Abstract

In response to increasing concerns about domestic food safety issues, establishing tracking systems in the food industry is mandatorily required under newly launched food safety laws. However, the kinds of monitoring and certification systems that should be set up to ensure practical adoption and the effectiveness of the regulation remain unclear. This study aims to analyze consumers' preferences for milk traceability, with particular interest in investigating how consumers' preferences could be affected by monitoring and certification systems of the regarding system. Survey data from a choice-based conjoint (CBC) experiment are used to achieve this objective. In the experiment, milk is defined by a set of attributes in which we assume that milk traceability can be certified by three entities: the government, an industrial association, and a third party. The CBC data are then analyzed by using the alternative-specific form of a conditional Logit (McFadden's Choice) model. We found that urban Chinese consumers have a strong desire for traceable milk, but their preference for traceable milk is significantly related to the associated certificate issuers. Currently, the highest willingness-to-pay goes to government certificated traceable milk, followed by industrial association certificated and third-party certificated milks. In the future, however, consumers are likely to give more credit to third-party certification with rising income and knowledge.

1. Introduction

Food safety has become a social, economic, and political problem in China following a series of safety scandals. A report on Wikipedia (search "food safety incidents in China") shows that almost in every year in the last decades there has been at least one well-known food safety event disclosed in China. Among them, the melamine contaminated baby formula event is apparently the most severe. In August, 2008, Chinese government officials announced that the industrial chemical melamine had been detected in the milk supply after some illnesses were connected to milk consumption. Eventually, the scandal affected an estimated 60,000 people including over 1,000 hospitalizations and six infant deaths. These events not only caused direct economic and life losses, but also created distrust in the Chinese food system domestically, as well as internationally (Ortega et al., 2011). A census by Pan (2012) indicates that food safety has been ranked as the top social concern in China by 65.8% of 1,019 respondents, even higher than unbearably high price and corruption.

To tackle these headaches and to provide greater safety assurances to consumers, a tracking system, which has been put in force in many EU countries, Australia, and Japan since the breakthrough of BSE (Golan et al., 2004), is required to be established in the food industry under China's new food safety law launched on June 1, 2009 (Xiu and Klein, 2010). According to this new law, food producers, processers, packers, and retailers must implement testing and record keeping systems for all inputs and outputs and must archive the records for at least two years. Food manufacturers and distributors are also required to establish a regime to be able to immediately stop the production of food that does not meet food safety standards, to promptly recall food already in the market place, and to issue notification to related participants. For violations, the new law stipulates associated punishments, including warnings and fines ranging from 2,000 to 20,000 yuan (or from US$320 to US$3,200), and license suspension, according to the degree of seriousness (Zhang et al., 2012).

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While establishing the tracking system is important for food safety, supervision of the operation of the system and endorsement of the credibility of traceable foods is more important (Innes and Hobbs, 2011; Uzea et al., 2011). Food safety issues often arise from asymmetric information between consumers and suppliers with regard to product-specific attributes (Akerlof, 1970). When asymmetric information is present, supervision from the third party becomes critical to ensure food safety by visualizing the information that consumers cannot observe or easily detect (Caswell and Mojduszka, 1996; McCluskey, 2000). Without an independent and reliable inspection system, any quality or safety related requirements or standards could eventually become ineffective. The new food safety law has appointed several governmental entities as authorities to supervise and monitor its execution. It remains an open question as to who should take the leading responsibility for inspecting the tracking system or certification of the traceable foods in order to re-establish confidence in the food system (Zhang et al., 2012).

Now, several questions naturally arise. Who or which organizations can be effective for inspecting the system for food safety? Besides government, can any industrial association or independent third party be issuers certifying food safety? If so, do consumers value alternative certifiers differently or not? As expected, government as a public service provider has been heavily relied for monitoring food safety in many countries. But it is also often criticized that the government lacks efficiency in providing public service. Because of this, many industrial associations and third parties (organizations that are neither government nor producer-controlled) are involved in monitoring and certifying food safety in developed countries. There is also mounting evidence pointing to the inefficiency of government in managing food safety and quality. For example, milk in China is known to carry multiple labels and logos indicating that the product has met various safety-related certifications such as "Green Food," "HACCP," "China Top Brand," etc. (Ortega et al., 2011; Wang et al., 2008). However, these certified logos have had difficulty in earning consumers' trust. According to a study by Zhang et al. (2010), consumers in Beijing are more likely to rely on brand and retailer's reputation as indicators for safe milk than on logos certified and labeled on milk containers.

In this study, we take milk as an example in trying to understand how Chinese consumers value nongovernment organizations in inspecting and certifying traceability. The major purpose of this study is to empirically investigate the potential for nongovernment organizations to become involved in food traceability inspection and certification activities. To do so, we need to not only understand consumers' valuation of different organizations in inspecting and certifying food traceability, we also need to identify the determinants which cause consumers' heterogeneity of valuation. Data of a recent survey collected by interviewing supermarket shoppers in four cities in China through a choice-based conjoint (CBC) experiment will be used in this study.

The article is organized as follows. Section 2 reviews the literature; Section 3 discusses methodology; Section 4 describes data; Section 5 presents empirical results; Section 6 concludes with a summary of the findings and possible future directions for study.

2. Literature review

Consumers' perception of food traceability has received increasing attention due to increasing concern about food safety. For example, Lee et al. (2011) indicated that consumers in Korea are generally willing to pay a 39% premium for traceable imported beef over similar beef without traceability. Ubilava and Foster (2009) also found that consumers in Georgia regard product traceability as a substitute for quality certification. Roosen et al. (2003) surveyed consumers about their preferences for beef from cattle-fed genetically modified corn and found that consumers in France and Germany valued the origin of beef more important than brand, price, or fat content. On the contrary, Loureiro and Umberger (2007) found that American consumers valued both traceability and country-of-origin less than USDA food safety inspection certification. Similarly, Verbeke et al. (2002) found that Belgian consumers expressed more interest in food safety and quality standards than in traceability and origin cues.

Consumers' responses to products with enhanced attributes are often expected to depend on the extent to which the assurance is backed by verification and by whom. For example, Uzea et al. (2011) assessed Canadian consumer attitudes toward animal welfare assurances for pork products and found that consumer preferences for the source of verification are heterogenous among the public sector, private sector, and third-party agents. Innes and Hobbs (2011) examined consumer trust in private, third party, and government organizations to provide credible quality signals for attributes that derive from on-farm production methods. Their results indicated that farmer, third party, and government organizations are similarly trusted to provide accurate information about farming methods, while government standards relating to environmental sustainability were perceived as most effective. Consumer heterogeneities were found too in the study.

Focusing on food traceability, researchers found that information associated can significantly affect consumers' perception of traceable foods. For example, Dickinson and Bailey (2002) suggest that consumers would pay a higher premium for valuable attributes (such as transparency and assurance) attached to traceability than that paid for traceability alone. Hobbs et al. (2005) examined the economic incentives for implementing traceability systems in the meat and livestock sector in Canada, and found that without quality verification traceability is of limited valued to individual consumers. Similar results can also be found in studies by Lee et al. (2011) in Korea and Hobbs (2003) in Saskatchewan and Ontario, Canada.

Studies on Chinese consumers' responses to food traceability mostly focus on measuring consumers' willingness-to-pay (WTP) for the attribute and associated determinants.

Wang et al. (2009) surveyed consumers in Beijing and found that the age of consumers, educational level, the perception safety, and the average price are the main determinants of consumers' WTP for traceable products. Ehmke et al. (2008) measured consumer preferences for country-of-origin (COO) information in China and found that Chinese consumers did not give COO information as much credit as organic production information. Different from the study, Song et al. (2008), Yang and Wu (2009), and Zhang et al. (2012) in separate studies found that Chinese consumers are generally willing to pay a positive premium for food traceability. None of above studies gives attention to the role of traceability verification on consumers' perception of food traceability.

In a recent study, Ortega et al. (2011) measured Chinese consumer preferences for selected food safety attributes in pork through choice experiment models. In the study, consumers' WTPs are compared among several safety attributes, including a government certification program, third-party certification, a traceability system, and a product-specific information label. They found that Chinese consumers have the highest WTP for a government certification program, followed by third-party certification, a traceability system, and a product-specific information label.

This study will empirically analyze consumers' perception of food traceability, but we differ from previous studies in two major aspects. First, we combine traceability and certificate issuers together to measure how consumers value government and nongovernment certification issuers differently. Second, we empirically identify exogenous variables influencing consumers' valuation of different issuers certifying food traceability. By doing so, we try to drive implications for the development of nongovernment certification issuers in the future.

3. Methodology

3.1. Choice-based conjoint analysis

Choice-based conjoint analysis is a stated preference value revelation technique that is based on allowing consumers to make choices from a set of experimentally designed products defined by a bundle of a product's attributes (Louviere, 1988). Conjoint measurement has been widely used in marketing research and health care research (Bryan and Parry, 2002; Kim and Lee, 2005; Lazari and Anderson, 1994; Miguel et al., 2000), and has become an attractive alternative for measuring preference structures, particularly in the marketing research field (Elrod et al., 1992).

Formally, the basic problem of CBC is the estimation of a utility function $U = f(X_1, \ldots, X_k)$, where U denotes utility for the good in question and $(X_1, \ldots, X_k$ represents the k attributes of the good. Consider an individual faced with a set of alternatives from which to choose, each of which consists of a different combination of levels of a set of multiple attributes. Suppose individual i faces J alternatives, indexed $j = 1, 2, \ldots, J$ and

described by vectors of attributes X_j. The individual i has a utility function that can be written in the linear form,

$$U_{ij} = X_j\beta + Z_i\alpha + \varepsilon_{ij}, \tag{1}$$

where X_j is the attribute vector of the jth alternative, the variable Z_i denotes the ith individual characteristics, ε_{ij} is stochastic and reflects the idiosyncrasies of individual i in tastes for the alternative j (McFadden, 1974), α and β are coefficient vectors to be estimated. Then, the probability of an individual i choosing the mth alternative is

$$P_i(m|C, \beta) = P(X_m\beta + Z_i\alpha + \varepsilon_{im} > X_j\beta + Z_i\alpha + \varepsilon_{ij} \forall j \in C \& j \neq m), \tag{2}$$

where C denotes the choice set. In the case of independently and identically distributed extreme value disturbance of ε, the probability of alternative m being chosen can be expressed as follows:

$$P_i(m|C, \beta) = \frac{\exp(X_m\beta + Z_i\alpha)}{\Sigma_{j \in C} \exp(X_j\beta + Z_i\alpha)}. \tag{3}$$

This equation can be estimated from the consumer choice data generally collected in surveys. An existing procedure *asclogit* in Stata 11 is used for parameter estimation.

In this study, we estimated model (3) by using brand as an alternative identifier and controlling consumers' characteristics. We specified the model in two ways. First, each attribute used to define alternatives was included in the model by using either a single variable or a set of dummies to capture main attribute effects on consumers' choices (referred to as model I). Second, in addition to main attribute effects, we also included several interactions between traceability certificate issuers and consumers' characteristics in the model (referred to as model II). In the current study, only three consumers' characteristic variables were included: per capita income, respondent's education level, and whether any friend or relative was involved in food safety event.[1] By including these interactional variables, we can empirically analyze how the effects of certificate issuers on consumer choices vary with consumers' characteristics. In both models, the case-specific variables (i.e.,X_i) are the same, which include respondent's age, gender, education, per capita income, respondent's perception of food safety, and three city dummies. Different from the first model, the second model attempts to understand how consumers' valuation of traceability certification issuers is affected by consumers' characteristics.

3.2. CBC experiment design

In each city, the CBC choice set includes two national milk brands and one local brand. The two nationally known brands are Mengniu, based in Inn Mongolia, and Bright, based in

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[1] For each consumer characteristic variable, three interaction variables need to be included in the model because there are three levels for the traceability certificate issuer. Therefore, it is common for researchers to only include a limited number of variables of consumer characteristics in the model.

Shanghai. According to China's Dairy Development Report, these two companies were ranked in the top and third position, respectively, in terms of total sale in value in 2011 (Mengniu 30.2 billion yuan and Bright 11.7 billion yuan). Besides these two national brands, a local milk brand was also included in the CBC choice set. The local brand was selected by pre-interviewing milk procurement managers and customers in the sampled stores.

Each brand of milk was then defined by three attributes with various levels for each. The first attribute was the type of milk, with two levels, pasteurized and UHT. The second attribute was whether or not the milk is labeled for traceability. The third attribute was the traceability certificate issuer, which is conditional based on the selection of the second attribute. The three types of certification issuers considered were government, industrial association, and third party. The third attribute was not applied if the respondent preferred milk without a traceability label. Apparently, the second and third attributes can be combined together as one attribute. That is, milk with traceability issued by government, or by industrial association, or by independent private firm, or without traceability labeled. The last attribute was price, consisting of three levels: 1.5 yuan, 2.5 yuan, and 3.5 yuan for per 250 g bag of milk.

Among these attributes, price and the traceability labels and issuers were predetermined for the specific purpose of this study, while brand and type of milk were selected based on a pre-test which was conducted by randomly interviewing 50 customers at a supermarket in Beijing. During the pre-test, selected customers were asked to rank the most important five factors of nine determining their purchasing behavior for milk. These nine factors include: date of expiration, brand, type of milk (pasteurized or UHT), packaging material, origin of raw milk, nutrient, taste, quality and safety certification, and price. The two most important factors were then included in our CBC attributes, which in this study are brand and type of milk.

A 36-run (or "profile") fractional factorial design was then used in construction of the CBC experimental questionnaire. Statistically, a full factorial design would have required $3 \times 2 \times 4 \times 3 = 72$ unique combinations of milk attributes. However, asking respondents to select their most preferred attribute combination from 72 possibilities would have given them a difficult, perhaps impossible, task and the resulting decision costs and biases might have compromised the results. The 36 choice scenarios were used to construct 12 choice sets by applying a D-optimal fractional factorial design. More detail information about fractional factorial design and its efficiency can be found in Anderson and Wiley (1992), Lazari and Anderson (1994), and Miguel et al. (2000). To further reduce the difficulties of conducting the CBC experiment in a shopping environment, the constructed choice sets were randomly signed into four groups to form four versions of the CBC questionnaire, with each version including three choice sets. During the survey, each respondent was randomly presented with one of four groups of choice sets. For each choice set, respondents also had a no purchase option to better simulate a milk shopping decision.

Fig. 1. Geographic distribution of sampled cities.

4. Survey and data

The data in this study were collected from in-person interviews. The survey was administered in Xi'an of Shanxi province, Wuhan of Hubei province, Shenyang of Liaoning province, and Xiamen of Fujian province in the summer of 2011. Geographically, Xi'an is in the northwest region of China, Wuhan is in middle-south, Xiamen is a coastal city in east-south, and Shenyang is in Northeast region of China. The geographic distribution of these four cities is presented in Fig. 1.

In each city, the surveys were conducted in three supermarkets. Four or five graduate students from a local university majoring in economics were hired and trained to conduct the survey. The survey took five days to complete in each city, together generating 803 collected questionnaires. Dropping those with missing key information, we ended up with 799 individuals in the sample analyzed.

To avoid potential selection bias from individual sampling, the interviewers were instructed to solicit the third adult consumer (18 years and older) who came into the survey area following completion of the previous interview. Each survey took approximately 10–15 minutes. As a reward for participating in the survey, every respondent was given a gift card (worth 30 yuan, or US$5), redeemable at the participating store. To improve data quality and to minimize disturbances at the survey spots, contracts were signed with the selected food stores, and 1,000 yuan (or about US$160) per day was paid to each store providing the survey area.

To ensure that respondents fully understood the CBC experiment, every respondent was given a demonstration choice before starting the experiment (Table 1). The demonstration is printed in a separated board card, with the statement read as follows:

"Assume that you are now coming here (this supermarket) for purchasing fluid milk for your home consumption. When you stand in front of milk shelf, you see there are only three brands of fluid milk. The first one is Mengniu, which is pasteurized milk,

Table 1
A demonstration example of choice set in CBC experiment

Brand	Mengniu	Bright	Changfu	
Type of milk	Pasteurized	UHT	Pasteurized	I would purchase none of them
Label with traceability	Yes	NO	Yes	
Issuer for traceability certificate	Government	——	Industrial association	
Price (yuan/250 g bag)	2.5	1.5	3.5	
I would like to choose	⬛	⬭	⬭	⬭

Table 2
Summary statistics of sample

Variable	Unit	Mean	Std.
Monthly per capita disposable income	1,000 yuan	1.80	0.88
By city			
Xi'an	1,000 yuan	1.85	0.93
Shenyang	1,000 yuan	1.60	0.76
Wuhan	1,000 yuan	1.79	0.84
Xiamen	1,000 yuan	1.98	0.95
Gender	1 = male; 0 = female	0.31	0.46
Education with college or advance degree	1 = yes; 0 = no	0.28	0.45
Age	Years	41.22	14.61
Food safety accident involvement	1 = yes; 0 = no	0.22	0.42
Xi'an	1 = yes; 0 = no	0.26	0.44
Shenyang	1 = yes; 0 = no	0.26	0.44
Wuhan	1 = yes; 0 = no	0.24	0.43
Xiamen	1 = yes; 0 = no	0.25	0.43

and labeled with traceability certificated by government agent. The price is 2.5 yuan per 250 g bag today. The second brand is ultra-high temperature (UHT) milk, which does not have traceability labeled. Its price is 1.5 yuan per 250 g bag. The third one is Changfu,[2] which is also pasteurized milk and labeled with traceability certificated by industrial association. Its price today is 3.5 yuan per 250 g bag. [Is my explanation clear? If not, I can repeat]. Now, would you please jointly consider these factors, including brand, type of milk, traceability labeling, traceability issuers as well as price, and then carefully think before telling me which one you want to purchase. [Wait and let respondent read the example]; you can also answer 'I would like to choose none of them'."

Following this demonstration, a series of questions about respondents' socio-demographics, their milk consumption, and milk shopping behaviors were presented.

Table 2 reports a summary of statistics for demographic variables that are used in this analysis. Average monthly per capita disposable income is 1,800 yuan (or about US$280). Among four cities, Xiamen has the highest income (1,980 Yuan), followed by Xi'an (1,850 Yuan), Wuhan (1,790 yuan), and Shenyang (1,600 yuan). Of all respondents, nearly 70% are female since they commonly play a major role in the family's food shopping. Also, 28% of survey subjects have a college or advanced degree. The average age of respondents is 41.22 years of age, with a standard deviation of 14.61. Besides, about 22% of respondents have friends or relatives who once were involved in food safety accidents.

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[2] We used different local brand in different city, while keeping two nationally known brands, Mengniu and Bright, unchanged in the CBC choice set. Four local brands are Yingqiao for Xi'an, Huishan for Shenyang, Yangzijiang for Wuhan, and Changfu for Xiamen. These brands were selected by interviewing milk procurement managers of the sampled supermarkets and consumers prior to the survey.

5. Empirical analysis

5.1. Alternative-specific conditional choice model results

To estimate the model (3), we eliminate 60 cases in which respondents chose "I would choose none of them." The literature disagrees on whether or not to include the responses of the no-choice option (or "I would not choose any of them") in the analysis. On one hand, researchers who eliminate the no-choice option argue that these observations do not provide much information in the analysis (Hensher and Bradley, 1993). On the other hand, some recent studies suggest caution in terms of eliminating such options from experiments because they may have significant impacts on the resulting designs (Louviere, 2003). To deal with the concern, a Heckman two-stage approach is often used, in which a binary-choice probit model is used in the first stage to capture the probability of a consumer selecting "no-choice" option, and then estimated information from the first stage is used to adjust the estimation of the second stage model—the conditional logit model or its extended models. Whether it is necessary or not to concern the problem of eliminating "no-choice" observations, however, depends on the occurrence rate of the "no-choice" observations. In the current study, we chose to eliminate these "no-choice" observations because the occurrence rate is less than 3%. This elimination causes the total cases used in this study to reduce to 2,337. The estimated results from Model I and Model II are reported in Table 3. To facilitate the interpretation of results, odds ratios for model I are also computed and reported in the table.

The estimated results indicate consumers in the surveyed cities prefer traceable milk to milk carrying no traceability information. This can be seen from the significant and positive coefficient for the variable "carrying traceability information" in Table 3. The associated odds ratio is 2.22, suggesting that the

Table 3
Estimated results from alterative-specific conditional Logit model

	Model (I)			Model (II)	
	Coef.	S.E.	Odds ratio	Coef.	S.E.
Main effects					
UHT	−0.103	(0.06)*	0.90	−0.108	(0.06)*
Carrying traceability information	0.798	(0.10)***	2.22	0.661	(0.27)**
Government certified	0.459	(0.07)***	1.58	1.011	(0.21)***
Industrial association certified	0.295	(0.08)***	1.34	0.645	(0.24)***
Price	−0.131	(0.04)***	0.88	−0.128	(0.04)***
Interactive effects					
Gov. certificate X income				0.159	(0.11)
Ind. ass. certificate X income				0.189	(0.12)
3rd party certificate X income				0.217	(0.11)**
Gov. certificate X education				0.085	(0.08)
Ind. ass. certificate X education				0.121	(0.08)
3rd party certificate X education				0.200	(0.07)***
Gov. certificate X safety event				0.312	(0.24)
Ind. ass. certificate X safety event				0.430	(0.25)*
3rd party certificate X safety event				0.467	(0.23)**
Mengniu					
Per capita income	0.049	(0.07)	1.05	0.059	(0.07)
Gender	0.231	(0.13)*	1.26	0.226	(0.13)*
Education	0.001	(0.05)	1.00	−0.009	(0.06)
Age	0.003	(0.00)	1.00	0.003	(0.00)
Safety event involvement	0.065	(0.15)	1.07	0.083	(0.15)
Xi'an	−0.511	(0.16)***	0.60	−0.534	(0.16)***
Shenyang	−0.885	(0.17)***	0.41	−0.898	(0.17)***
Wuhan	0.822	(0.18)***	2.28	0.804	(0.18)***
Constant	0.262	(0.32)		0.308	(0.32)
Bright					
Per capita income	−0.045	(0.07)	0.96	−0.069	(0.07)
Gender	0.105	(0.13)	1.11	0.107	(0.13)
Education	0.105	(0.06)*	1.11	0.098	(0.06)*
Age	−0.010	(0.00)**	0.99	−0.010	(0.00)**
Safety event involvement	0.242	(0.14)*	1.27	0.199	(0.15)
Xi'an	−0.168	(0.16)	0.85	−0.170	(0.16)
Shenyang	−0.691	(0.17)***	0.50	−0.703	(0.17)***
Wuhan	1.272	(0.18)***	3.57	1.265	(0.18)***
Constant	−0.410	(0.32)		−0.324	(0.33)
Number of observations	7,011			7,011	
Number of cases	2,337			2,337	
Alternatives per case	3			3	
Log likelihood	−2,009.99			−1,997.22	

Notes: Standard errors in parentheses; *$P < 0.1$, **$P < 0.05$, ***$P < .01$.

probability of choosing milks carrying traceability information is about doubled that for milks carrying no traceability information. Meanwhile, who issues traceability certificates also significantly affects consumers' choices. Government and industrial association certified milks are more likely to be chosen as the preferred selection than those certified by a third party. The odds ratios are 1.58 and 1.34, respectively. This result is consistent with the study by Ortega et al. (2011), in which the government was found to be the most trusted authority for pork safety inspection in China.

Results also indicate that UHT is less likely to be picked as a preferred selection compared to pasteurized milk (odds ratio 0.9). Price, as expected, has a significant and negative effect on consumers' choice. That is, the higher the price the less likelihood that the milk will be chosen as a preferred selection. The likelihood of a type of milk brand to be preferred is also significantly related to consumers' characteristics, but results are mixed between two national brands. Model I suggests that men (gender = 1) are more likely to choose Mengniu milk over a local brand than women (odds ratio 1.26), but that this gender effect is not significantly different between Bright and local brands. Differently, respondents who hold college or advanced degrees are more likely pick Bright over local brand than others, but education effects are indifferent between Mengniu and local branded milks. Age works in the opposite direction, suggesting a positive relationship with the odds ratio of choosing Bright over local brands, but age effect is insignificant between selecting Mengniu and local brands. Respondents who have friends or relatives once being involved in any food safety accident could become more sensitive to milk brand. The results indicate that Bright milk is more preferred to local brands of milk for those whose friends or relatives have had experiences of food safety events. This seems surprising because both Mengniu and Bright have been struggling with milk safety problems in recent years. A likely explanation is that Bright may have no or less safety problems in these surveyed cities. Most city dummies are statistically significant with mixed signs, suggesting that the two national brands in different cities face different competition from local brands.

The relationships between the effects of the certificate issuer on consumers' choices and respondent's characteristics are mixed (Table 3). Estimated results for interactions in model II indicate that consumers tend to give more value to milk with traceability certification issued by a third party as income increases, but their valuations on government and industrial association certificated milks do not change significantly. Highly educated consumers are more likely to value third party and industrial association certificates higher in comparison to low educated persons, while it has no significant effect on consumers' valuation on government certification. Also, those whose friends or relatives once were involved in food safety event, as expected, value third party and industrial association certificates higher than others do. The inclusion of these interactional variables does not affect the significance of the estimates for main attribute effects and case specific variables.

Table 4
Mean WTP and 95% confidence intervals based on model I estimates

Attributes	Mean WTP	95% confidence interval[a]	
		Lower	Upper
UHT	−0.79	−1.53	−0.08
Carrying traceability information	6.09	3.07	9.11
Government certificated	3.50	1.71	5.29
Industrial association certificated	2.25	1.14	3.36

[a]The confidence intervals at 95% level are estimated by applying a 1,000 iterations of bootstrap method.

Jointly considering the main attribute effects and their interactive effects with consumers' socioeconomic factors, it is clear that third certification for milk traceability will become increasingly important in the future, although government issued certification is still currently valued at the highest position. Rising income and education are two driving forces.

5.2. Consumers' willingness-to-pay for certificate issuers

With inclusion of price in the CBC experiment, we are able to calculate the mean WTP for each attribute. The mean WTP can be given by $WTP_k = -\beta_k/\beta_p$, where β_k is the estimated parameter for the kth attribute, and β_p denotes the estimated parameter for price. The mean WTP can be understood as a price change associated with a unit increase in a given attribute, or a premium that the consumer needs to pay for additional increments of a certain attribute to keep utility indifferent. The estimated mean WTPs based on parameters from model I are presented in Table 4. The corresponding confidence intervals at 95% level for mean WTPs are estimated by applying 1,000 iterations of the bootstrap method (Mittelhammer et al., 2000). The reason we choose not to report WTPs for model II is that the mean WTP is a combination of estimated parameters and the included consumer characteristic variables.

Results indicate that consumers are willing to pay a significantly positive premium for milk carrying traceability information. Moreover, it is also significant who is inspecting and certifying the traceability. The mean WTP is 6.09 yuan per $\frac{1}{4}$ kg of cow milk, with 95% confidence intervals lower at 3.07 yuan and upper at 9.11 yuan. It is not clear whether consumers are really willing to pay that much for per $\frac{1}{4}$ kg of milk in reality. But this result is likely reflecting Chinese consumers' overwhelming concern about China's food safety situation, especially milk safety.

Results also indicate that consumers are willing to pay 3.50 yuan more for milks carrying traceability information certificated by the government than for traceable milks certificated by third-party certification providers. For milks certified by industrial associations, the premium is lower than that for government certification, being 2.25 yuan. The independent but private third-party certification provider in China's current economy is quite new, which is a likely explanation for why Chinese consumers value it at the lowest position in certificating milk traceability.

These findings confirm that Chinese consumers have strong desire and demand for milk traceability, suggesting that establishing tracking systems as a mandatory regulation will not face opposition from the consumer side. Concerns for policy makers and the milk industry probably include: (1) how much production cost will be increased by setting up and maintaining the system, and (2) whether the raised cost could be offset by the price premium. To respond to these concerns, however, we need more information on the production side, which is beyond the scope of this study. These findings also suggest that the government and government agents still need to play a critical role in inspecting and certifying milk traceability in China, although its effectiveness in doing so has been proven to be low from past experiences. It is worth noting that nonprofit industrial associations may also be able to play an important role in certifying milk traceability, because consumers are willing to pay a significant premium.

6. Conclusions

In response to increasing concerns about domestic food safety issues, establishing traceability systems in the food industry has been regulated in the new food safety law launched in 2009. Since then, many food companies have started advertising their products as traceable. However, to what degree the traceability regulation can truly be adopted by the food industry remains uncertain. Natural questions include who should monitor the practical adoption of the regulation and ensure the stated traceable foods are truly traceable. A consensus is that an effective monitoring and certification system of regulation is most critical in the establishment of such regulation.

This study aims at analyzing consumers' preferences for milk traceability, with particular interest in investigating how consumers' preferences could be affected by a monitoring system of traceability. We achieve this purpose by employing survey data including a CBC experiment. In the experiment, milk is defined by a set of attributes in which we assume that milk traceability can be certificated by three entities: government, industrial associations, and third parties. The CBC data are then analyzed by using an alternative-specific conditional logit model.

Results indicate that consumers in sampled cities significantly prefer traceable milks to those carrying no traceability information. The associated mean WTP is about 6 yuan per $\frac{1}{4}$ kg cow milk. Although the estimated WTP is likely too high (as with many choice approaches) to be paid in reality, this finding still suggests that Chinese urban consumers have a strong desire for milk traceability following a series of milk safety scandals disclosed in recent years.

Also, a government certificate for traceability is currently valued more highly than certificates issued by a third party, but consumers are expected to give more credit to the latter in the future. Rising income and education are two major driving forces for that future change. This finding suggests that opening certification markets to third parties and providing the necessary policy environment to regulate certification systems for food traceability could be an effective and practical means to promote the establishment of a food traceability system in China.

In the end, we would like to point out a limitation of this study for directing future study. The data used in this study came only from four top- or second-tier cities in China, which limits our ability to generalize the results nationwide. In particular, the results of this study cannot represent the preferences of China's rural population, which still accounts for about half of the nation's total population. Milk consumption in rural China is either "home-produced" in main production areas or very low in the rest, which could cause their preferences for traceability to be different from urban consumers.

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