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Can food ordering apps help combat food fraud through providing food safety information? Consumer responses to gutter-oil-free claim on Koubei

RESEARCH ARTICLE

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Abstract

The illegal use of gutter oil (GO) as cooking oil is a serious food fraud problem in China and has raised widespread concerns. With the popular use of internet, Koubei, a food ordering app, launched a campaign that every restaurant could pledge on the platform that it is GO free. This paper evaluates whether consumers value the GO-free feature reflected on their willingness-to-pay (WTP) to the claim. Results show the GO-free claim receives a positive WTP, and consumers are even more sensitive to the GO-free pledged by small businesses and independent restaurants. For policy implications, results confirm the advantages that the online platforms have in providing food safety information and alleviating the market failure caused by asymmetric information. It will complement the governments' efforts in preventing GO use and other fraud behaviors in food markets.

Keywords: online app, food safety, consumer preference, food fraud, online pledge
JEL code: Q11, Q13

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1. Introduction

Food safety is a broad issue that concerns human health worldwide (Pouliot and Wang, 2018). It mostly refers to unsafe food caused by unintentional production practices, but some unsafe food is intentionally produced through profit-driven illegal behaviors, or food fraud is also considered food safety problem in general such as by the World Health Organization (WHO, 2015). Food fraud threatens the global well-being of consumers, processors, and producers of agri-food businesses (Agnoli *et al.*, 2016; Ehmk *et al*., 2019; Kendall *et al.*, 2019; Ortega *et al.*, 2014).

Food fraud is defined as an act of intentional misrepresentation, substitution, addition, or tampering of food products for economic gains at any stage of the food supply chain (Spink and Moyer, 2011). Food fraud is enabled by informational asymmetries between consumers and producers (Ehmk *et al*., 2019). Furthermore, the lack of governmental enforceability of regulations and the limitation of nongovernmental means of labeling the credibility of food products in the market have led to an increase in the number of cases of food fraud (Ehmk *et al*., 2019; Ritten *et al.*, 2019). Types of food fraud include adulteration, tampering, theft, over-run, counterfeit, simulation and diversion (Charlebois *et al.*, 2016; European Commission, 2020; Spink and Moyer, 2011). Among them, food adulteration fraud through intentional substitution or addition of an inferior substance, including substituting inferior for premium ingredients in processing to earn superior profits (Spink and Moyer, 2011) is the most serious one related to human health and safety. Consumers are generally anxious about their food consumption but feel powerless (Zhu *et al.*, 2017). Many have to rely on informal kinship networks as trusted sources of information regarding food products' authenticity and safety (Kendall *et al.*, 2019).

One current example of food fraud in China is the use of gutter oil (GO) as cooking oil in the food manufacturing and the food service sectors. This has been quite serious and generated wide attention (Li *et al.*, 2017). The GO, refined from discarded kitchen waste, contains toxic substances such as carcinogenic aflatoxins and is illegal to use for cooking. However, such scandals are found in Taiwan (Wu, 2014), Hong Kong (Sam and Boehler, 2014), India (Karmee, 2017), and other Asian countries, raising widespread consumer concerns also. In China particularly, food service is a fast-growing prosperous business. Dining out has become quite common for urban residents as they are getting busier and earning higher income. Small independent mom-and-pop restaurants coexist with regional, national and international chain restaurants. The use of GO as cooking oil in restaurants, especially smaller ones, is a serious food fraud problem (Li *et al.*, 2017). The high profits for producers to make and sell GO as cooking oil and for small restaurants to buy and use it are the driving forces for such a phenomenon. The asymmetric information about food quality preventing consumers from detecting food cooked with GO is causing a market failure. It results in serious consumer welfare loss from consuming the health damaging food, and in turn brings the long-term producer welfare loss from reputation damage for the whole industry.

The Chinese government has made efforts to crack down on the illegal conduct of selling and using GO, including offering cash rewards to informants who report such illegal activities. However, the results are not promising. With the popular use of the internet, the online platform Koubei launched a campaign where restaurants could pledge to be GO-free on the platform. The claim is attached after a restaurant submits the application with the pledge, which then attracts users to support and to monitor the restaurants. The claim will be removed if a restaurant is reported by any app user and confirmed by Koubei for the alleged use of GO. Ordering apps like this are widely used by the Chinese, especially by young people, and they are much more accessible to its users than the government's reporting system. According to QuestMobile, the Koubei app had 21 million monthly active users in 2017 (QuestMobile, 2018).

To develop effective policies combating food fraud, supervision by social media can play an important role. An enormous number of online consumers have relied on online restaurant review websites, discussion forums, personal blogs, et cetera to choose where to dine and where to order meals (Yang *et al.*, 2017).

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Similarly, online reviews help other users to judge whether a restaurant is worth visiting (Cheung and Lee, 2012) or if an online store is a good place to order food (Hu *et al.*, 2010).

Studies about consumers' food safety concerns and preferences in the food service sector exist such as Aksoydan (2007), Alphonce *et al.* (2014), and Medeiros and Salay (2013), and particularly about China also exist such as Bai *et al.* (2019). Food safety is widely recognized by consumers as indicated by price premiums (Jiang *et al.*, 2019; Wang *et al.*, 2021) at online stores as well as when ordering meals from restaurants online (Harris *et al.*, 2017). Online reviews about food safety are assessed by consumers for their future choices (Seo *et al.*, 2015). Extensive research has discovered a positive relationship between reviews of a desirable attributes and restaurant visit intentions (Cheung and Lee, 2012; Parikh *et al.*, 2014; Yang, 2017). There have been many recent studies on food fraud such as Pimentel (2014), Kendall *et al.* (2019), Meerza and Giannakas *et al.* (2019, 2021), and Meerza and Gustafson (2020). However, no attention has been given particularly to food fraud in food service sector, i.e. restaurants. None of these studies have investigated the food safety information delivered through online food ordering apps, and none is specifically about GO. This research is the first attempt to evaluate the market effort of using social media to combat food fraud.

The current aim is to empirically test whether such online social media GO-free claims are valued by consumers. This research is the first attempt to evaluate the market effort of using social media to combat food fraud. The goal of this paper is to evaluate whether this new phenomenon can affect consumers' welfare against the background of food fraud, using GO use as an example. Specific objectives are to: (1) explore Chinese urban consumers' online food ordering behaviors; (2) estimate the values of GO-free claims, consumer reviews, and restaurant branding to consumers in term of their willingness-to-pay (WTPs); and (3) explore factors contributing to the heterogeneity of these WTPs.

2. Methods

2.1 Choice experiment design

To analyze consumer preferences for quality attributes, we utilize a discrete choice experiment (CE) approach. The CE method has been applied to a wide range of food studies to understand individual preferences for food attributes over the last decade (Lai *et al.*, 2018; Ortega *et al.*, 2011). This hypothetical experimental technique enables researchers to easily measure demand for intangible attributes or characteristics such as food safety and animal welfare assurance, which is often not revealed in markets. Once the attributes expected to affect consumers' choices are selected, researchers must carefully design the options in the choice sets to determine the quantitative measurements of consumer preferences. The CE approach also allows for exploration of how attributes are related to each other, i.e. complements or substitutes, even though respondents are not directly asked about these relationships.

We conducted an online survey asking consumers about their restaurant choices as related to the GO-free information. To avoid the confounding effect of restaurant dining environment factors, we used the restaurant food delivery scenario, an extremely fast-growing practice in China. Thanks to the low delivery costs, independent of order size or distance, ordering meals using cell phone apps and having them delivered has become very common for young people in cities. Choosing a restaurant online, customers can see all the information about menu items, prices, vendor GO-free claims, and past evaluations and comments. We conducted choice experiments to find out consumers' WTP for the GO-free claim, combined with other attributes of the composite 'product', a meal ordered online and delivered from particular restaurants.

Relevant quality attributes for ordered meals and their corresponding levels were identified through a detailed literature review and pre-testing of the choice experiment. Out of many characteristics, restaurant brand and satisfaction rate were identified as the most pertinent attributes to be evaluated, as well as the GO-free claim. These are attributes that have been found to influence consumers' purchasing decisions and are of direct relevance to the objective and context of this study. An opt-out option was included to better simulate a real-world decision

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scenario and is consistent with economic theory (Adamowicz *et al.*, 1998; Louviere *et al.*, 2000). A summary of the attributes included in the choice experiment is presented in Table 1. The choice experiment simulates real restaurant selection scenarios; however, the exchange of real food products or money did not occur.

The full-factorial design will involve combinations of any two alternatives out of 3×2×3×3=54 possible distinct ones, totaled to 1,431. A subset of 60 shopping scenarios was created using a D-optimal design out of the full-factorial candidate set. Our design allowed for estimation of main effects and specific two-way interaction effects. To further reduce the probability of respondent fatigue, the choice tasks were blocked into ten groups, with each survey participant evaluating no more than six choice tasks.

The instructions to the survey participants stated, 'Suppose you need an ordered meal (e.g. a particular style stir-fried chicken with vegetables) and there are two restaurant choices on the internet app with the same serving time, quality and service, and so on, except the attributes listed below. Please make a choice between the two options. If you choose neither, it means the meal can't be ordered and there's no third takeaway option. (show picture)'. A sample choice experiment is shown in Figure 1.

2.2 Random utility and econometric model

Choice experiments are rooted in Lancastrian consumer theory (Lancaster, 1966) and random utility theory (Manski, 1977; McFadden, 1974). The Lancastrian approach to consumer theory assumes that utility is derived from the characteristics of goods or service. In our context, each of the attributes of the delivered meal can bring utilities to the consumer. As such, models based on random utility theory assume that consumers select the bundle of attributes that form an alternative among all available alternatives which provides them with the highest utility or value (Cascetta, 2009).

Table 1. Choice experiments and description.

Product attribute	Attribute levels	Description
Price (yuan/dish)	20, 35, 50	Average price including delivery fee.
GO-free	yes, no	Whether there is a claim of GO-free.
Satisfaction rate	80, 90, 100%	The satisfaction rate ranges 0-100%, calculated by the app based on previous customer reviews.
Brand	branded, online popular brand, no brand	The brand for the restaurant has three levels. Branded means reputable offline restaurants including chained brand and some local famous restaurants. Online popular brand means the brand is not well-known offline but is well-known online.

	Choice 1	**Choice 2**	**Neither one**
Price	50	20	
GO-free claim	Yes	No	
Satisfaction rate	80%	90%	
Brand	Online popular	Branded	

Figure 1. A sample ordered food choice task.

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Formally, suppose that individual n faces k alternatives contained in the set ψ. We can define an underlying latent variable $Vnjs^*$ that denotes the indirect utility function associated with individual n choosing option $j \in \psi$ during choice task s. Given a budget constraint, the individual n will choose alternative j so long as $Vnjs^* > Vnks^*$, for $\forall k \neq j$. The researcher does not directly observe $Vnjs^*$, but instead observes the actual choice Vnjs that gives the maximizing utility, where:

$$V_{njs} = \begin{cases} 1 & \text{if } V^*_{njs} = \max(V^*_{n1s}, V^*_{n2s}, \ldots, V^*_{nks}). \\ 0 & \text{Otherwise} \end{cases} \quad (1)$$

This discrete choice model is usually matched by a Logit econometric model. Following standard practice, we assume that indirect utility is linear, which ensures that marginal utility is strictly monotonic in traits and yields corner solutions in which only one good is purchased (Useche *et al.*, 2012). We can write individual n's indirect utility function as:

$$V^*_{njs} = X'_{njs}\beta + \varepsilon_{njs} \quad (2)$$

where X'_{njs} is a vector of attributes for the jth alternative, β is a vector of parameters (i.e. a vector of weights mapping attribute levels into utility) which are the marginal utilities, and ε_{njs} is a stochastic component of utility that is independently and identically distributed across individuals and alternative choices, and takes a known distribution. This stochastic component of utility captures unobserved (to the researcher) variations in preferences and errors in individual's perceptions and optimization.

Because consumers are heterogeneous, their preferences for ordered meal attributes may also be heterogeneous. A common method of evaluating preference heterogeneity is to estimate a random parameter logit (RPL) model. Following the RPL specification in Train (2009), the probability that individual n chooses alternative j in choice task s is given by

$$\text{Prob}(V_{njs} = 1 | X'_{n1s}, X'_{n2s}, \ldots, X'_{nks}, \Lambda) = \int \frac{\exp(X'_{njs}\beta)}{\sum_{k=1}^{k} \exp(X'_{nks}\beta)} f(\beta|\Lambda) d\beta \quad (3)$$

where X_{njs} contains the attribute levels, and the vector Λ refers collectively to the parameters characterizing the distribution of the random coefficients (e.g. mean and covariance of β), and f() is the probability density function which we assume to be multivariate normal. The econometric estimation can give us a set of the mean vector, and a variance-covariance matrix of this random β vector.

The marginal rate of substitution (MRS) of one attribute for another is simply the ratio of the two marginal utilities, i.e. the ratio of the two corresponding elements in β. When one attribute is price and the marginal disutility of the price is β_p, the MRS between any dummy variable k (that k=1 having that attribute and k=0 for not having it) and the price, is the WTP for this attribute. That is, when k increases by 1 unit from 0 to 1, the utility will increase β_k, which can be fully compromised by the taking away β_k/β_p amount of money from the consumer, equivalently to a price increase by the same amount. Therefore, for any attribute represented by a dummy variable k, its WTP is:

$$WTP_k = -\frac{\beta_k}{\beta_p}, \quad (4)$$

or twice of this ratio if we use effects coding instead of dummy coding for some attributes.

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3. Data

Studying the e-commerce, we used an online survey for consumers who have ordered meals online at least once. According to Trustdatada Big Data 2020 takeaway industry analysis report, China's first and second-tier cities are still the main takeaway areas, accounting for nearly 70%. We chose top twenty Chinese cities based on their GDPs including all top tier cities of Beijing, Shanghai, and Guangzhou, and the first seventeen second line cities of Shenzhen, Chengdu, Chongqing, Hangzhou, Suzhou, Tianjin, Wuhan, Nanjing, Qingdao, Changsha, Wuxi, Foshan, Ningbo, Zhengzhou, Shenyang, Yantai and Dalian. We employed a commercial survey company, Dynata, to populate our survey to its national database to collect 460 valid surveys.

We recruit only adults of 18 years or older as participants. We have explained to the participants that the survey is part of a scientific research project to investigate consumer preferences for restaurant food consumption. The survey is anonymous and information will be kept strictly confidential. The survey is about 15 minutes long and participants are told they are totally free to terminate at anytime or not to participate at all without any penalty. However, participants were told they would be paid a cash reward of 25 RMB upon completion as an incentive to encourage the response rate and also the carefulness of their answers. The amount, equivalent to 100 RMB an hour, is a very decent wage rate. The contact person's name, phone number and email are also provided at the beginning of the survey so that they can ask any questions. This information is provided at the beginning of the online survey together with Dynata's routine requirements, and participants' consents were collected online.

In addition to the experiment, we also collected information on consumer characteristics including demographic and socio-economic indicators, and their knowledge of food safety, GO, and online meal ordering behavior. Table 2 lists the summary statistics of demographic and socio-economic variables. In terms of the socioeconomic questions, on average, the sample population was 33-years old, and 52.61% are female. The statistics are reasonably representative of the known population that regularly orders meals online. 6.31% survey respondents have a pregnant woman in their household. Family income is a categorical variable with 'FamincomeL' indicating family income is below 100,000 RMB as the base, 'FamincomeM' between 100,000-200,000 and 'FamincomeH' above 200,000 RMB. It is notable that 80.22% of respondents have at least high school education. The high percentage of educated shoppers in this study indicates that

Table 2. Summary statistics.

Variable	Statistic
Age	Mean 32.97, standard deviation 0.36
Female (%)	52.61%
Pregnants (have a pregnant woman in household)	6.31%
EduH (high school education)	80.22%
Family income (yuan)	
FamincomeH (above 200,000 yuan)	38.05%
FamincomeM (between 100,000 and 200,000 yuan)	46.74%
FamincomeL (below 100,000 yuan)	15.22%
Unable_identify (respondents believing GO[1] is unable to identify vs able to identify)	84.13 vs 15.87%
Unaccept (respondents believing GO is totally unacceptable vs acceptable)	46.74 vs 53.26%
ImpactH (respondents believing GO has bad impact on health conditions vs believe GO has not much impact on health conditions)	39.57 vs 60.43%
ResautF (respondents believing GO is often used in restaurants vs not that often)	54.13 vs 45.87%

[1] GO = gutter oil.

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the majority of them have sufficient knowledge and understanding to evaluate the products in the choice experiment (Antle, 2001; Ubilava and Foster, 2009).

Data shows it is difficult to identify the presence of GO in food because of information asymmetry. As shown in Table 2, 84.13% respondents agree with GO is unable to identify in our research, which is consistent with intuition. 39.57% of the respondents believe that GO has worse impact on their health condition. Out of concern for their health, 46.74% of the respondents think that GO is totally unacceptable. But they are more pessimistic about the reality, with more than half believing that GO is often used in restaurants.

Other than the statistics above, the survey shows that these consumers use online meal order services quite frequently. Data shows 36.14% of them order every other day, 42.05% order at least once a week, 15.15% order at least once a month, and only 6.66% order occasionally. They generally pay good attention to food safety news online; 74.98% of them opened or forwarded food safety news they received from social media at least once in the last six months. They also have a strong concern about the GO's impact on health. 42.05% believe GO is extremely harmful, 47.13% believe it is quite harmful, and less than 11% think the impact is small or trivial.

At the same time, consumers are pessimistic about the usage of GO in their food. Only 3.33% of respondents believe that they have never eaten food with GO, while 53.37% are not sure and feel they may, and 43.30% are quite sure they have. Additionally, 8.41% believe almost the entire the food service sector is using GO. 67.45% of respondents believe that some of the delivered meals are cooked with GO, and only 24.15% believe GO that little to no GO has been used. However, 82.51% of the sample believed there is no way to identify the swill oil. Thus, any mechanism that can differentiate meals free of GO from the counterparts will be welcome.

4. Results

To explore how the GO-free claim and the consumer review affect demand for quality attributes, we estimate main (first order) interaction effects involving these two variables. RPL estimates in preference space using NLOGIT6.0 (Econometric Software, Inc., Plainview, NY, USA) are reported in Table 3.

Table 3. Model results.[1]

	Coefficient[2]		**WTP**
	Mean	**Std. dev**	**Sample mean**
Price	-0.055*** (0.008)	0.085*** (0.010)	NA
Optout	-1.165 (0.951)	6.095 (1.146)	-6.248
GO-free	1.964*** (0.173)	1.964*** (0.179)	18.172
Satisfaction	0.056*** (0.010)	0.051*** (0.005)	0.835
Online popular	-0.118 (0.869)	3.392*** (0.914)	29.904
Branded	4.504*** (1.311)	6.638*** (1.009)	21.812
GO-free×Online popular	-0.645 (0.115)	0.705*** (0.130)	18.309
GO-free×Branded	-0.208*** (0.111)	0.592*** (0.103)	11.171
Satisfaction×Online popular	-0.015 (0.009)	0.040*** (0.010)	-0.093
Satisfaction×Branded	-0.041*** (0.014)	0.072*** (0.011)	-0.070
n	9,234		460
Log-likelihood	-1,819		
Adj. pseudo R-squared	0.462		
AIC/n	1.222		

[1] AIC = Akaike information criterion; GO = gutter oil; Std. dev. = standard deviation; WTP = willingness to pay.

[2] *** denote significant level of 1%.

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All the standard deviation parameters are significant except for the 'optout'. This confirms the heterogeneity of consumer preferences. As expected, the coefficient mean for price is significantly negative because higher price reduces consumers' utility. Among the main effects of the attributes, the estimated mean coefficients for GO-free claim, satisfaction rate, and branded restaurant are all statistically significant. Consumers receive positive utility from reputable brands and the GO-free claim, and positive marginal utility for an increase in satisfaction rate. It implies that consumers are better off when this type of information is provided. The coefficient of branded is larger than that of GO-free claim, which means consumers generally trust well-established restaurants and are willing to pay more, not only for of food safety reasons but also for other qualities. The small coefficient of the satisfaction does not mean it is less valuable than the other two, but it is the marginal value for a small increase in the satisfaction rate. The estimated marginal utility coefficient for the online popular brand is not significant, showing that consumers don't perceive online popular branding as a valuable attribute. This is consistent to the fact that many popular social media influencers and online goods (e.g. fashion) are short lived, and can be created strategically by communication companies with false advertising. They do not gain strong reputation in the long run. Notice, because we have interactions terms, the aforementioned effect of each attribute is for the situation when the dummy variables it interacts with taking value zero. For example, utility of GO-free is 1.964 only for non-branded restaurants.

The marginal utility of each attribute equals the sum of its own value and the interaction value when its interacted dummy variable taking the value of one. For example, the GO-free utility for branded restaurants is 1.964-0.208=1.756. A significantly negative interaction term means the two attributes substitute each other. The two significant coefficient values are both smaller than each of the main effects. For branded restaurants, the GO-free claim is less valuable to consumers than unbranded restaurants. This is because the illegal use of GO is less likely to be found in branded restaurants because they tend to be large and easily supervised, and they would not risk their reputation which can brings them higher profit over the long run. Most GO uses are found for small, independently owned and not so reputable restaurants. Similarly, the interaction between satisfaction and branded is negative. The marginal utility of satisfaction rate is lower for branded restaurants. These two results both show that in emerging economies like China where there exist many small family-owned non-branded restaurants, the online food safety claim and customer evaluation are both useful communication ways to differentiate the good ones from the substandard ones. In contrast for established branded restaurants, their values are smaller.

Because the coefficients are random and jointly distributed, WTPs for each attribute is not a direct division between the two mean coefficients of an attribute and the price. Instead, they are the sample average calculated from the 460 respondents, where the samples are generated by NLogit. The values for the WTPs are reasonable. Consumers are willing to pay about 11 yuan more per order from a non-branded restaurant with a GO-free claim than an order without such a claim. On the other hand, for meals without the GO-free claim, they are willing to pay 31 yuan more for an order from a branded restaurant than a regular one, and 32 yuan more from an online popular restaurant than the regular one. However, both of these high WTPs are reduced for about 6 yuan if the GO-free claim is present. This implies that consumers perceived restaurants with good reputation either online or offline tend to be more trustworthy for not using GO.

Each individual's WTP for each attribute was obtained through the estimation. We attempted to regress these WTPs on their demographic variables and other food safety variables. In Table 4 we report the WTPs for the four main effects and their interactions. However, many variables are insignificant. The female dummy variable is significant for online popular only, showing that the online popular effect is stronger on females.

Recall that 'Unable_identify' is a dummy variable showing whether respondents believe that GO is hard to identify, and 'Unaccept' means that GO is totally unacceptable. Results show the more likely respondents believe that GO is hard to identify, the more they are willing to pay for all attributes except the satisfactory and its interaction with online popular. This means if a consumer consider GO is unidentifiable by consumers, s/he is willing to pay more on all attributes that can indicate GO-free but s/he does not believe other consumers' satisfactory rating implies GO-free. Those who think GO is absolutely unacceptable, s/he is

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Table 4. Willingness to pay regression results.[1]

	GO_Free	Satisf_	Branded_	Online_ Pop	GOFree_ Branded	GOFree_ OnlinePop	Satisf_ OnlinePop	Satisf_ Branded
Female	4.217	-0.128	61.42	37.335*	3.76	2.608	-0.514	-0.755
	-13.028	-0.473	-38.729	-19.732	-13.651	-15.094	-0.645	-0.716
EduH	-19.833	-0.605	-39.557	-1.272	-20.977	-27.514	-0.664	-0.313
	-16.596	-0.603	-49.336	-25.137	-17.39	-19.228	-0.822	-0.912
Agey	0.024	0.017	-2.029	-1.799	0.379	0.456	0.036	0.042
	-0.896	-0.033	-2.665	-1.358	-0.939	-1.039	-0.044	-0.049
FamincomeH	-9.91	-0.416	-49.243	18.285	-7.873	-9.602	-0.449	0.029
	-20.684	-0.751	-61.489	-31.329	-21.674	-23.965	-1.025	-1.136
FamincomeM	-3.195	0.037	-61.274	4.117	-0.343	5.506	0.247	0.724
	-19.681	-0.714	-58.507	-29.809	-20.623	-22.803	-0.975	-1.081
Pregnants	34.659	0.785	124.140*	14.491	26.352	35.371	0.522	-0.412
	-25.403	-0.922	-75.518	-38.477	-26.619	-29.432	-1.259	-1.395
Unable_identify	58.868***	0.652	223.413***	71.682***	43.920**	49.681**	-0.372	-1.705*
	-18.222	-0.662	-54.17	-27.6	-19.094	-21.113	-0.903	-1.001
Unaccept	-5.381	-0.545	23.161	36.898*	-10.549	-13.54	-0.891	-0.88
	-14.174	-0.515	-42.135	-21.468	-14.852	-16.422	-0.702	-0.778
ImpactH	9.383	0.268	27.105	14.9	10.783	12.324	0.147	0.043
	-14.463	-0.525	-42.995	-21.906	-15.155	-16.757	-0.717	-0.794
ResautF	13.578	-0.118	58.727*	15.414	14.44	11.597	-0.386	-0.742
	-13.431	-0.488	-39.928	-20.343	-14.074	-15.561	-0.665	-0.738
_cons	-28.691	0.709	-175.835	-68.563	-33.354	-27.009	1.76	2.686
	-42.627	-1.548	-126.719	-64.564	-44.666	-49.388	-2.112	-2.341
n	460	460	460	460	460	460	460	460
R^2	0.042	0.012	0.078	0.051	0.027	0.03	0.013	0.024

[1] *, **, and *** denote significant levels of 10, 5 and 1%, respectively.

willing to pay more for the GO-free claim but nothing else. Also believing restaurants frequently use GO and having pregnant women in their family are associated with higher WTP for 'Branded'. Overall, although all such attributes may provide additional information for food quality, people with different characters have different perception about their power to represent GO-free. Brand is recognized mostly, even more than the self-claim of GO-free.

5. Conclusions

In this study we used a consumer online survey in 20 cities to explore Chinese consumer preferences and willingness-to-pay for quality information attributes in delivered meals ordered online. Descriptive results show that the average age of the population that is ordering online food delivery is relatively young, with high frequency. We only surveyed those who have online ordering experience to exclude those who stay away from online meal ordering, and we found that over 33% of surveyed consumers order every other day and about 80% order at least once a week. On the other hand, they are quite concerned about the food fraud that can cause health problems and lack the means to identify the GO-contaminated food. Additional information about food safety is needed.

Through the choice experiment conducted online, we found that consumers are willing to pay for a GO-free claim offered by the online order platform and voluntarily adopted by restaurants. We estimated a random parameter model accounting for consumer preference heterogeneity. Results show that displaying the GO-free claim on the meal order app and having a positive restaurant brand image either online or

offline both correlate to a greater WTP. Consumers are found to be even more sensitive to GO-free pledges by small businesses and non-chained restaurants than the branded restaurants. This shows that combining the food safety claim with the online food ordering and delivery system will generate welfare values for consumers. This conclusion will have value within the restaurant industry by indicating that they can enjoy more business and establish higher prices that can ultimately compensate them with greater profits if they give up the illegal use of GO. Restaurants' online popularity can generate a different WTP across genders, higher for women than men, but not across other demographic factors. Restaurants' brand has the highest value, higher than GO-free claim. This is because food safety is only part of the value that a restaurant meal provides, its other food quality also matters which is reflected by brand, although branded restaurant also means high likelihood of GO-free. Brand also means more for those who think restaurants tend to use GO and those have a pregnant woman in household.

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Conflicts of interest

The authors declare no conflict of interest.

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