The Effect of Preference for Variety and Portion Size on Consumer's Plate Waste in China's Foodservice Sector

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Abstract:

With household disposable income increase, the proportion of food away from home (FAFH) consumption rises rapidly in the total household food consumption. Consumer's plate waste has attracted increasing public, academic, and political attention in recent years. In order to understand the reason that cause plate clearly, this empirical study sheds light on the effect of preference for food variety and average portion size on the plate waste using survey data from 1340 tables of 161 restaurants in Beijing and Lhasa. The key finding suggests that income increase leads more preference for food variety when consumer dining out; and we verify that a consumer is more likely to waste food when variety preference increase by using dining reason as an instrument and average portion size of restaurant increase. Our result implys that the restaurant should reduce the average portion size of dish with residents' income increases, which can reduce the consumer's plate waste. This paper introduces the preference for food variety into the utility function, which makes the utility function of residents FAFH more perfect and more realistic, and we introduce an order decision into the analysis framework, which constitutes a two-step decision to plate waste.

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ABSTRACT

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Keywords: Food waste; Plate waste; Income; Portion size; Preference for Variety

Introduction

After more than 30 years of reform and opening up, the catering industry has become one of the hottest industries in the economic operation with the strongest growth and the fastest growth rate. However, during the development of the catering industry in full swing, the food waste in foodservice sector entered the people's field vision gradually, and became a hot topic. According to the field survey by the research group of Institute of Geographic Sciences and Natural Resources Research (CAS) from 2013 to 2015, the amount of food waste in China is about 17 million tons to 18 million tons per year, equivalent to 30 million to 50 million people's provisions a year [1].

Food losses and food waste have potential environmental consequences in two ways: (i) environmental effects related to the use of upstream resource inputs, such as water[2] [3] [4], land [5], and energy and greenhouse gas emissions [6]; and (ii) environmental impacts downstream, related to waste disposal and its environmental impacts[7] [8].

Liu et al., (2013) provide a comprehensive review on available information concerning China's food losses and waste. The results show that the food loss rate (FLR) of grains in the entire supply chain is 19.0% in China, with the consumer segment having the single largest portion of food waste of 7.3%. The total water footprint (WF) related to food losses and waste in China in 2010 was estimated to be 135 billion m^3, equivalent to the WF of Canada. Such losses also imply that 26 million hectares of land were used in vain, equivalent to the total arable land of Mexico [9]. In China, municipal solid waste (MSW) generation has shown an 8% to 10% increase in recent years and reached 352 Mt (or 440 kg/cap) in 2010. Food waste takes up a high share in MSW in almost all cities, roughly ranging from 50% to 70% [10]. Most of it is mixed with other solid waste in MSW and eventually incinerated and landfilled (for example, on a national average 56.6% was landfilled in 2009) [11]. This exerts growing pressure on waste management and leads to negative environmental impacts, such as water pollution, soil degradation and emission of greenhouse gases.

With the rapid economic development and the improvement of living standards for urban and rural residents, residents' food consumption patterns have undergone major changes. A prominent change is that the proportion of food away from home (FAFH) consumption rises rapidly in the total household food consumption. Meanwhile, the raise of housewives' opportunity cost will increase their FAFH consumption significantly [12, 13]. The empirical results show that wives' value of time, household income, presence of young children and grandparents, and wives' educational attainment are important factors for both participation in consuming and amount spent on FAFH [14]. In the full year of 2014, the catering industry achieved the sales revenue of RMB2.786 trillion, accounting for 10.62% of the total sales of social consumer goods [15].

The increasing affluence and booming catering sector in China go hand in hand with increased food waste at the consumer stage. The annual income of Chinese urban and rural residents has substantially increased, and the retail sales of the catering sector have ballooned from CNY 8 billion in 1980 to CNY 1.8 trillion in 2009. According to the National Bureau of Statistics data, during the five years from 2007 to 2011, at the height of the global financial crisis, the revenue of the catering industry has maintained a steady annual growth of about 14% [16]. Changing life styles of increasingly prosperous consumers include eating more and more meals away from home [12], and food waste generated in the foodservice sector has consequently sharply increased.

In recent years, some scholars have carried out research on the status of food waste in some cities foodservice sector in China. The result is not optimistic. In Beijing, about 73.69 grams food left per capita on the table after meal, accounting for 11.09% of the total ordered food. Among them, 9.68% animal food was discarded and 12.52 % plant food was discarded (Xu et al., 2005)[17]. In the restaurant of Henan province, the comprehensive weighted loss rate of food consumption was 18.63%, of which the consumption loss rate of rice was 23.10% and the consumption loss rate of flour products was 16.77% (Zhang et al., 2009)[18]. In Lhasa, about 143.4 grams food

left per capita on the table after meal, accounting for 15.5% of the total ordered food. For tourists in Lhasa, about 141.8 grams food left per capita on the table after meal, accounting for 17.3% of the total ordered food. (Wang, et al., 2012, 2013)[19, 20]. Another study show that the 92.3 grams and 115.3 grams food wasted per capita per meal in 2013 and 2015 in Lhasa, respectively (Gao et al., 2017)[21]. A survey in four main China cities in 2015 found that the amount of waste per capital per meal was 98 grams, 103 grams, 97 grams and 77 grams in Lhasa, Chengdu, Shanghai and Beijing, respectively (Wang et al., 2017)[22].

Table 1 Consumer's food waste rate in Beijing and Lhasa cities

	Beijing	Lhasa	Tourist in Lhasa
Pork	11.13	14.6	17
Beef	7.71	17.1	1.9
Lamb	7.18	25.6	1.6
Poultry	9.35	13.2	5.2
Aquatic products	10.48	17.3	1.9
Eggs	9.57	20.1	0.9
Vegetables	14.4	16.6	41.6
Rice	11.45	17.7	10.1
Wheat	11.29	24.8	1.4
Fruits	8.33	5.7	0.8
Others	10.77	9.4	10.9
All	11.14	15.5	17.3

Data source: (Xu Shiwei et al., 2005); (Wang Ling-en et al., 2011)

Based on the hypothesis of rational economic man, Food waste is a very irrational behavior. However, why food waste so serious?

Some studies focus on the consumer's behavior. Some scholars have already found that the values of hedonism and self-direction lead to more food waste in college [23]. Social emotions of guilt and shame are linked to consumers' intentions to prevent food waste, suggesting channels to be included in a successful information campaign nudging consumers toward food waste reduction [24]. A results in a company canteen demonstrate that personal norms and attitudes greatly determine consumers' intention to prevent leftovers, whereas subjective norms and perceived behavioral control appear less relevant. leftover behavior depends on both behavioral intention and the situational taste perception of food [25].

Some studies focus on the influence of restaurant's management. A survey involving 380 youths residing in Italy and Spain concludes that marketing and sale strategies negatively influence the waste behavior of individuals, emphasizing the important role of retailers in preventing the generation of food waste. [26]. Studies by Whitehair (2011) and Hackes et al., (1997) both showed that removing trays reduced plate waste significantly, indicating that this method could be successful[27, 28]. A significant decrease in solid waste per patron was observed in switching from the tray to the trayless system. This study demonstrates that trayless dining can reduce plate waste, and that employees can be supportive of the change [29]. Some study found that

simple and nonintrusive ‘nudges’ – reducing plate size and providing social cues – reduce the amount of food waste in hotel restaurants by around 20% [30]. Larger plates might also contribute to people serving and consuming more food due to visual illusions that lead to biased perceptions of how much food is served or consumed [31]. Chinese buffet diners with large plates served 52% more, ate 45% more, and wasted 135% more food than those with smaller plates [32]. According to a case study, about 20% of all food handled and prepared in the sector was wasted. The findings also suggest that the main drivers of wasted food are buffet services and overproduction [33]. The main causes of plate waste cited were ‘portion served by staff too large’ and ‘lack of hunger’ [34].

Therefore, the phenomenon of population obesity and food waste caused by the increase of portion size has also attracted a great deal of attention in foreign studies. A study shows that reducing portion size of a particular item in an all-you-can-eat environment results in reduced intake of that food for most individuals, and that reducing portion size reduces plate waste and food production [35]. There is also an increase in percentage waste as portion size increases [36]. Food leftovers at lunch in the university canteen are positively related to perceived larger portion sizes of food [37].

In recent years, some researchers start to pay attention to plate waste in foodservice sector in China. The research mainly focuses on comparative analysis. A small number of studies analyze the causes of students' food waste (Liu et al., 2016) [38]and the effect of policies on reducing waste. Earlier studies in Beijing have found that the smaller the size of the restaurant, the greater the amount of waste. Unit consumption of food waste higher than personal consumption [17]. According to the comparative analysis of Wang et al., (2013) In terms of per capita waste and waste rate, tourists are higher than those of local consumers. Besides the buffet, food waste in Lhasa increased with the number of consumers per table. Dinner per capita waste significantly higher than the lunch. Business and official receptions meals have a higher waste rate than residents or tourists [19, 20]. The intervention effect of policies on food waste was mainly manifested in large and medium-sized restaurants, the total amount of food waste dropped significantly [21]. A other study found also that food waste per capita per meal varies considerably by cities (Chengdu and Lhasa higher than Shanghai and Beijing), consumer groups (tourists higher than local residents), restaurant categories (more waste in larger restaurants), and purposes of meals (friends gathering and business banquet higher than working meal and private dining), and dinner time (dinner is higher than lunch) [22].

In addition, hosted banquets, particularly in the public sector, and hosted meals between friends or between relatives are common and recognized as a part of social culture in China. In general, over-ordering is seen as a kind of hospitality in the Chinese culture (the culture of mianzi). If all the food on the table is finished after a meal, it could be interpreted as the host does not prepare or order enough food. So from snack bars to large size restaurants, consumers focus less and less on food but more and more on the social relationship. With increasing disposable income, people now buy more food [39]. Above all, only the comparison of the wastage or the wastage

rate under grouping or simple analysis of variance has been examined, but the influencing mechanism of each variable on food waste has not been clarified.

In short, there are some common factors behind plate waste, but they may also differ in different case studies. A better understanding of these driving factors in a local context would help to explore specific solutions to address plate waste issues.

To overcome many problems in the existing literature, based on the recent data of food consumption and waste obtained by weighing and questionnaire, this paper analyzes the waste behavior and its influencing factors of FAFH. we found that the key finding suggest that income increase lead more number of dishes ordered when dining out under the preference for variety; Both variety preference and portion size increase more plate waste. We found also that appropriate information intervention before order can reduce number of dishes ordered significantly. This result provides a scientific basis for policymakers and catering agencies to reduce plate waste.

There are mainly three innovations in this research. Firstly, based on the hypothesis of rational preference relationship, this paper introduces the preference for food variety into the utility function, which makes the utility function of residents FAFH more perfect and more realistic. Second, we regard each table as a measure unit, which is in line with the tradition of Chinese catering system. Through the combination of weighing and questionnaire, we have significantly improved the reliability and completeness of the data. Third, in the analytical framework, we introduce an order decision into the empirical model, which constitutes a two-step decision to plate waste with plate waste decision. However, this paper only examined the impact of variety preference and portion size on the overall plate wastage and waste rate of each table, we did not further subdivide the wasted food.

The structure of the article is organized as follows: Chapter Two Theoretical Model, Chapter Three Empirical Model, Chapter Four Investigation Plan and Data, Chapter Five Results, Chapter Six Conclusion and Discussion

Theoretical model

Follow Li J. (2016)[40], in this section, we develop a model of consumer demand that reflects two considerations: direct preference for food attributes, and preferences for variety across attributes.

Suppose there are J food supplied in the restaurant, $j \in \{1,2,\dots,\mathrm{J}\}$. A consumer derives utility based on the total amount of each food aggregated over dishes this consumer purchases and eat. Denote $C = (\mathrm{C}^1, \mathrm{C}^2, \dots, \mathrm{C}^h)$ as the total amount of food consumer $h \in \{1,2,\dots,\mathrm{H}\}$ derives from his consumption of multiple dishes. Each element of C^h represents the total amount of particular food derived from all dishes consumed by this consumer, $\mathrm{C}^h = \sum_{j=1}^{J} q_j^h$. The total amount of food that consumer h consumes depends on his endogenous choice of demand for each dish, q_j^h.

While the total food aggregated across dishes satisfy consumers' basic needs, the combination of different dishes ordered reflects variety preference. Use V to denote

the total variety of the dishes consumed by consumer h. it reflects the level of diversification among chosen dish for each table. Here, the total effect of variety on consumers purchase can be reflected into ways: dish quantity and characteristics.

First, the variety of dish set for each consumer h depends on which dish(es) are chosen, and how much for each of them. On one hand, choosing a dish j ($w_j > 0$, supplied weight by reataurant) obviously could affect the composition of dish characteristics among consumer h's choices and increases dish variety. On the other hand, given a dish j is chosen, the number of unit supplied (w_j) further affects the impact of dish variety on consumers demand.

Secondly, given the set of dishes selected by a consumer, the satisfaction of that consumer derived from consuming these selected dishes depends on how different these dishes are (which captures the objective dissimilarity of the dishes consumed), as well as consumer demographics (which captures the subjective attitude towards variety). To capture this idea, we utilize the relative distance between dishes in characteristics space to measure the differences in attributes across dishes and investigate how these differences could affect consumers' choices.

To simplify the analysis, the utility function for consumer h can be written in a general form as follows

$$U^h = U^h(C^h, V^h, \Theta) \tag{1}$$

where Θ is the set of parameters to be estimated. The budget constraint for the consumer h with income level Y^h facing product prices $\{p_j\}_{j=1}^J$ is

$$\sum_{j=1}^{J} p_j w_j \leq Y^h \tag{2}$$

Consumer h chooses his consumption amount for each dish j, $q_j^h \geq 0$, to maximize his utility. Note that facing a set of available dishes in the restaurant, a consumer can choose not only which dish(es) to consume, but also how much to consume for each of them.

The plate waste for consumer h in dish j is s_j^h, which satisfy the relations as follows

$$s_j^h = w_j - q_j^h \tag{3}$$

Different combinations of q_j^h, on one hand, gives the consumer different combination of total food, which delivers a basic utility to satisfy his direct preference of dish attributes. On the other hand, different combination of selected dishes forms different dish variety, which delivers additional satisfaction due to consumers' inborn preference for variety. Each consumer's choice of dishes reflects both of these two jointly determined considerations. The consumer's optimization problem can be

written as

$$\max_{q^h=(q_1^h,q_2^h,\ldots,q_J^h)\geq 0} U^h(C^h, V^h, \Theta)$$
$$\text{s.t.} \sum_{j=1}^{J} p_j\left(s_j^h + q_j^h\right) \leq Y^h \tag{4}$$

which is equivalent to the following constrained optimization problem given that consumer preference satisfies local non-satiation condition

$$L^h = U^h(C^h, V^h, \Theta) + \lambda(Y^h - \sum_{j=1}^{J} p_j\left(s_j^h + q_j^h\right)) \tag{5}$$

The associated first order conditions are

$$\frac{\partial L^h}{\partial q_j^h} = \left(\frac{\partial U^h}{\partial C^h}\frac{\partial C^h}{\partial q_j^h} + \frac{\partial U^h}{\partial V^h}\frac{\partial V^h}{\partial q_j^h}\right) - \lambda p_j \leq 0$$

For j=1, 2,…,J. (6)

At the optimal choice, the first order condition holds with equality if dish *j* is ordered with positive quantity, i.e. $q_j^h > 0$. It holds with strict inequality if dish *j* is not ordered i.e. $q_j^h = 0$. The first order condition shown in equation (6) has clear economic intuition: the consumer tries to equalize the opportunity cost of purchasing a dish captured by the last term and the marginal utility derived from both the basic dish attributes and her preference for dish variety. The first term in the first order condition represents the marginal utility of consuming one more unit of dish *j*. At the same time, in order to consume one more unit of dish *j*, consumer *h* has to pay the cost of p_j. For a given dish *j*, the optimal demand q_j^h is determined by equalizing the benefit and cost of consuming q_j^h. If the total marginal utility is always smaller than the opportunity cost for a dish, the consumer chooses zero unit of that dish. This truncation generates a consumer demand with multiple discrete-continuous choices, as what we observe in the data.

Wastage

$$wastage^h = \sum_{j=1}^{J} s_j^h = \sum_{j=1}^{J} (w_j - q_j^h)$$
$$\frac{\partial wastage^h}{\partial w_j} > 0$$

$$\frac{\partial wastage^h}{\partial Y^h} > 0$$

Waste rate

$$\text{Waste rate}^h = 1 - \frac{\sum_{j=1}^{J} q_j^h}{\sum_{j=1}^{J} w_j}$$

Parameterization

In the empirical analysis, we parameterize the utility function by initially assuming that utility from dish characteristics and variety are separable. In particular, we assume that the characteristics-based utility (U_{C^h}) and the variety-based utility (U_{V^h}) both take a Cobb-Douglas form

$$U^h(C^h, V^h, \Theta) = U_{C^h} \cdot U_{V^h} = \prod_{j=1}^{J} \left(q_j^h\right)^{\alpha_j} \cdot \prod_{j=1}^{J} (e^{w_j})^{\beta_j}$$

$$\text{s.t.} \qquad \sum_{j=1}^{J} p_j w_j \leq Y^h \tag{7}$$

This setup has intuitive economic explanation. Within the first term, U_{C^h}, the characteristic specific parameter α_j measures the importance of food characteristic in its contribution to the total utility. The variety effect from consuming a set of dishes, U_{V^h}, depends on how much each dish is consumed and the strength of preference for variety associated with each dish. The latter is captured by the parameter β_j, which we call preference-for-variety parameter (PFV parameter henceforth). It measures the utility elasticity of dish w_j through the variety. A higher β_j means that the contribution of dish *j* to the total variety, and thus the total utility, is higher. The PFV parameter depends on the relative distance of dish j in product-attribute space compared with other dishes selected by consumer h, $\text{DS}_\text{j}^\text{h}$, as well as consumer demographics, HD^h. In addition, we allow for a random shock ϵ_j^h to β_j^h, which captures the unobserved heterogeneity in consumers' tastes over different dish varieties. In particular,

$$\beta_j = \beta_0 + \beta_1 \text{DS}_j^h + \beta_2 \text{HD}^h + \beta_3 \text{DS}_j^h * \text{HD}^h + \epsilon_j^h \tag{8}$$

We assume that the shocks to preference for variety, ϵ_j^h, is iid drawn across consumers and dishes.

Following these assumptions, we can write the consumer (logarithm) utility optimization problem as follows

$$\mathrm{L} = \prod_{j=1}^{J} \left(q_j^h\right)^{\alpha_j} \cdot \prod_{j=1}^{J} \left(e^{\left(s_j^h + q_j^h\right)}\right)^{\beta_j} + \lambda(Y^h - \sum_{j=1}^{J} p_j\left(s_j^h + q_j^h\right))$$

(9)

Take the log of equation (9)

$$\ln L = \sum_{j=1}^{J} \alpha_j \ln q_j^h + \sum_{j=1}^{J} \beta_j\left(s_j^h + q_j^h\right) + \ln \lambda(Y^h - \sum_{j=1}^{J} p_j\left(s_j^h + q_j^h\right))$$

(10)

The associated first order conditions are

$$\frac{\partial \ln L}{\partial q_j^h} = \alpha_j \frac{1}{q_j^h} + \beta_j - \frac{\lambda p_j}{\lambda\left(Y^h - \sum_{j=1}^{J} p_j\left(s_j^h + q_j^h\right)\right)} = 0$$

(11)

Combined with equation (3),

$$s_j^h = w_j - \frac{\alpha_j(Y^h - \sum_{j=1}^{J} p_j w_j)}{p_j - \beta_j(Y^h - \sum_{j=1}^{J} p_j w_j)}$$

(12)

The associated first order conditions are

$$\frac{\partial s_j^h}{\partial w_j} = 1 + \frac{\alpha_j {p_j}^2}{\left[p_j - \beta_j(Y^h - \sum_{j=1}^{J} p_j w_j)\right]^2} > 0$$

(13)

Hypothesis 1: Under the condition of utility maximization, as portions size increases, plate waste increases.

Empirical specification and estimation

Empirical model

The plate waste of FAFH can be decomposed into two decision-making stages, first, determine the number of dishes ordered, also known as an order decision; The second is to determine the amount of food intake, also known as waste decision. In the order decision, consumer's preference for variety is substituted by number of dishes ordered.

$$PV_i = \lambda + \theta INC_i + \rho DR_i + \pi \boldsymbol{Z}_i + \varepsilon_i$$

(14)

PV_i is the consumer's preference for variety respect by number of dishes ordered per capita per table. INC_i is the payer's monthly income. DR_i is the dining reason for FAFH. $\boldsymbol{Z}_i$ is a vector of independent variables, that including payer's characteristics, family characteristics, employment status and restaurant characteristics variables. λ, θ, ρ and π represent the values of the coefficients to be estimated, ε_i is the

random error term,

In the waste decision, there will be no plate waste cases, and the plate waste will be truncated at zero. As a result, the unbiasedness and validity assumption of the ordinary-least-squares method no longer holds true. Considering the number of dishes ordered is an endogenous variable in the plate waste analysis. So, in this study we applied instrumental variable Tobit model.

$$y_i^* = \alpha + \beta PS_i + \gamma PV_i + \delta X_i + \mu_i \quad \mu_i \sim N(0, \sigma^2)$$

$$y_i = \begin{cases} y_i^*, & if\ y_i^* > 0 \\ 0, & if\ y_i^* \leq 0 \end{cases} \tag{15}$$

where y_i is an observable dependent variable, and y_i^* is an un observable latent dependent variable, which can be observed only when the value of the latent dependent variable is greater than zero. Other values are equal to zero. The dependent variable y_i contains two cases: when $y_i^* \leq 0$, the dependent variable $y_i = 0$ means the plate waste per capita per table (or waste rate per table) is 0; When $y_i^* > 0$, the dependent variable $y_i = y_i^*$, means the real plate waste per capita per table. PS_i is the average portion size supplied by each restaurant. It is equal to the total weight of dishes ordered divide by total number of dishes ordered in the sample restaurant. PV_i is the consumer's preference for variety, which respected by the number of dishes ordered per capita per table. Both PS_i and PV_i are the key independent variable in this paper. X_i is a vector of independent variables, that including payer's characteristics, family characteristics, employment status and restaurant characteristics variables. α, β, γ and δ represent the values of the coefficients to be estimated, μ_i is the random error term, and we are focus on the parameter β, γ in this research.

In this study, the number of dishes ordered per capita per table as consumer's preference for variety was introduced in the plate waste analysis. Due to the endogenous problem of order decision, we chose dining reason as an instrumental variable. The dining reason has a greater connection with order decision. Chinese people always consider "mianzi" in host meal. Therefore, when consumers FAFM with their family or alone, they consider more economical and practical. Because the consumer have a better understanding of each number's preferences and appetite. The ordered quantity is basically the same as the demand, almost no plate waste. However, in official/business/friends feast, on one hand due to the host are not familiar with all guests' preferences and appetite, on the other hand the host want to show their sincerity and face, which result in more dishes ordered by the host.

In theory, we need to meet the relevancy and exclusivity of the instrumental variables. In practice, we can directly judge the relevance by the Kleibergen-Paap rk Wald F statistic in the first-stage regression.

Survey and data description

System definition and sample selection

Consumer food waste can be found in different segments of the consumer stage from restaurants to canteens to all other types of hospitality sectors. Food waste is defined as the edible part that is left in the plate after the meal, and the non-edible part such as food additives, flavorings, cooking oil, and bones is not counted in our measurement.

Considering the varying cuisines and people's consumer habits in different parts of China, we selected two typical cities (Beijing, and Lhasa) for case studies. Beijing is the capital of China and the largest city in northern China. Lhasa, the capital city of Tibet Autonomous Region of China, has a unique food and culture tradition with an average altitude of 3650 meters.

A stratified sampling method was used for the sample selection of restaurants. We first analyzed data from the municipal Food and Drug Administration, the main bureau of restaurant management in China, about the number of all restaurants and the proportion of different categories in different districts of each city. On the basis of the data, we determined the sample districts in each city and the number of restaurants of each category in the survey.

In China, restaurants are classified as different categories based on their floor areas of business, i.e., large-size (more than 500m^2), medium-size (between 150 and 500 m^2), and small-size (less than 150m^2) restaurants. In addition, snack bars and canteen which mainly provide refreshments, snacks, and fast food were also selected in our survey.

Three administrative districts within Beijing (Dongcheng District, Haidian District, and Changping District), were chosen based on a downtown-to-suburban transect theory for sampling. Lhasa is relatively small and thus we considered only the municipal administrative district (Chengguan District) in the sampling.

In total, we have selected 161 restaurants in the two cities, including 121 in Beijing, and 40 in Lhasa. Most of Chinese people share all the food ordered on a table when eating out, therefore we take each dining table as the basic unit of our survey. For each restaurant, at least 10 tables of consumers were randomly selected to conduct our survey. This all together adds up to 1340 effective tables. In China, apart from tourism hotels which provide accommodation together with a simple buffet breakfast, few restaurants provide breakfast. Therefore, only lunch and dinner were included in our survey.

Questionnaire design

For each table, two questionnaires were used to investigate the amount and composition of food waste and consumer food waste behaviors.

The first questionnaire targets consumers and includes background information such as socio-demographic factors, including local residents (defined as the population who lives in the case city longer than six months) and tourists (from other parts of China to the city), respectively (both derived from our survey). And potential countermeasures to reduce food waste. When there was more than one consumer on a table, this part was filled by the consumer who orders the meal or pays the bill for that table.

The second questionnaire was designed to record the amount and composition of food waste and it was completed by our trained investigators. It consists of two parts.

The first part is a weighing table which includes the quantity of food offered and wasted in the plate. The second part of this questionnaire is about the number of consumers and dishes ordered on each table and other qualitative information such as dining environment.

Field surveys and direct weighing

Our field surveys were conducted in June and October 2013, from Monday to Sunday in order to capture the potential daily variances of food consumption and waste. A direct weighing method was used in the measurement. Electronic loading balances of 2 g to 5 kg were used to weigh the food and its containers. The specific steps of direct weighing were as follows:

Ten sample tables were randomly selected in each restaurant.

Each dish was weighed before service to determine the total weight of food served (the food containers, e.g., bowls and plates, were weighed beforehand and deducted here).

After the consumers finished their meal, questionnaire one was filled by the person who ordered the meal or paid the bill.

All unfinished dishes left on the table were then collected after the consumers left the table and then the food waste was separated and weighed.

These data were recorded in questionnaire two, together with other basic information such as number of consumers on each table observed by trained investigators.

Data description

At first, some conceptions are defined as follow.

The per capita number of dishes ordered in one table is equal to total number of dishes ordered divide by number of consumers, which respect the consumer's preference for food variety (PV).

The per capita plate waste in one table (PW) is equal to total plate waste weight divide by number of consumers.

The waste rate per table (WR) is equal to total plate waste divide by total ordered weight.

The average dish portion size per restaurant (PS) is equal to total ordered weight divide by total ordered dishes number in one sample restaurant.

Results

Descriptive statistics

Table 2 shows the descriptive statistics of dependent and independent variables. There are total 1354 samples in our study, the average number of consumers on each table was 2.45, including 332 tables with single consumer. Of all the survey samples, 1043 tables showed plate waste, and the average waste rate is 17.88%, higher than study in Sweden, which found that the plate waste constituted 10% of the recorded losses [41].

The average number of dishes ordered is 1.68 per capita per table, the per capita per table food ordered weight is 862 grams, the per capita food intake is 688 grams,

and the per capita per table wastage is 174 grams. The average dish supply portion size is 539 grams by per restaurant. According payer's monthly income, we divided it into three groups. 77% samples were surveyed in Beijing, and the others from Lhasa. Tourists account for 21% of the total sample. Family feast, official/business/friend feast, and working lunch are the three main dining reasons. We also surveyed the personal characteristic, work and family characteristics of payer's; restaurant characteristics also include. More information see Appendix table 1.

Table 2 Descriptive statistical analysis of variable

Variable	N	mean	sd	min	max
Preference for food variety: number of dishes ordered per capita per table (number)	1340	1.68	0.80	0.33	6
Food ordered (g/capita. table)	1340	860	466	30	3481
Food intake (g/capita. table)	1340	687	392	30	3423
Plate waste (g/capita. table)	1340	173	209	0	1278
Waste rate (%. table)	1340	17.95	17.37	0	81.71
Average dish portion size per restaurant (g)	1340	539	188	83	1083
Dummy: monthly income of payer (MI)					
MI1: under 5000 RMB	1340	0.55	0.50	0	1
MI2: 5000-10000 RMB	1340	0.31	0.46	0	1
MI3: over 10000 RMB	1340	0.14	0.35	0	1
Dummy: dining reason (DR)					
DR1: family feast	1340	0.21	0.41	0	1
DR2: business/official/friend feast	1340	0.32	0.47	0	1
DR3: working meal/other reasons	1340	0.47	0.50	0	1
Number of consumers on each table (number)	1340	2.44	1.46	1	10

Data source: According to the survey data

Results

Table 3 shows the regression result of order decision. Compared with low monthly income group, when income increases, it prompts consumers to order more dishes, which is consistent with consumers' preference for dietary variety. Portion size per restaurant has a negative infect on number of dishes ordered per capita per table. However, the bigger portion size lead to more food ordered per capita.

Compared with family feast, consumer ordered more dishes in business/official/friend feast, ordered less dished in working meal. It reflects that over-ordering on hosted meals is seen as a kind of hospitality in the Chinese culture. One more number of consumers on each table decrease 0.137 dishes ordered averagely. Local inhabitant ordered less when they FAFH, because they are more familiar with the taste and weight of dishes in restaurant than tourists. Consumers with high educational ordered more dishes. The bigger scale of the restaurant, the more dishes ordered per capita per table, most consumer seek to enjoy their life in large restaurant, ordered more dishes can satisfy their demand.

Table 3 Parameter estimates of consumer preference for variety

	Preference for food variety (num.)		Food order per captia (g)	
	Coef.	Std. Err.	Coef.	Std. Err.
Monthly income of payer				
MI2: 5000-10000 RMB	0.108**	(0.049)	50.968*	(26.641)
MI3: over10000 RMB	0.134*	(0.071)	23.931	(38.793)
Average dish portion size per restaurant	-0.001***	(0.000)	1.196***	(0.063)
Dining reason				
DR2: business/official/friend feast	0.097*	(0.057)	47.983	(34.056)
DR3: working meal/other reasons	-0.160***	(0.060)	-100.262***	(33.020)
Number of consumers on each table	-0.137***	(0.015)	-52.377***	(8.505))
Local inhabitant	-0.111**	(0.057)	-0.943	(26.034)
Educational background of payer				
EB2: junior school	0.126	(0.115)	26.998	(50.501)
EB3: senior school	0.136	(0.117)	56.917	(49.964)
EB4: university	0.202*	(0.111)	79.717*	(47.311)
Restaurant scale				
RS2: large	0.312***	(0.069)	149.488***	(35.758)
RE3: middle	0.127*	(0.065)	104.372***	(31.208)
RS4: small	0.047	(0.066)	83.542**	(36.386)
Other variable	Control		Control	
Constant	2.080***	(0.200)	219.438**	(98.195)
Observations	1,340		1,340	
R-squared	0.204		0.338	
F-value	5.74***		10.54***	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The result of Hausman test shows that the coefficients between IV regression and OLS regression is difference in systematic (χ^2=12.51, P=0.0004), so we reject the Ho hypothesis. The column (3) in Table 4 shows the regression result under endogenous and truncated controlled. The column (2) is the result of instrumental variable regression model, compared with the result of ordinary least square (OLS), after control the endogeneity of dishes ordered per capita with instrumental variable, the amount of plate waste per capita on his table increased to 234 grams by the influence of dishes ordered per capita. The Kleibergen-Paap rk Wald F statistic is 12.689 in the first-stage regression results of instrumental variable regression model, which is larger than the empirical critical value of 10, indicating that there is no weak instrumental variable problem. The dining reason increases plate waste per capita per table by increasing the number of dishes ordered per capita per table, but it does not directly affect plate waste per capita table. Since the explanatory variable is truncated data, the column (3) reports the results of instrumental variable Tobit regression. The amount of plate waste per capita on his table increased to 323 grams by the influence of dishes ordered per capita per table.

The average of portion sizes of restaurant affects the amount of plate waste significantly, with an average portion size increase of 100 grams in the restaurant, resulting in an average of at least 83 grams of food being wasted. This result verifies the hypothesis one.

The more people in one table lead to more plate waste per capita per meal. As we all know, dinner is an important way for Chinese people to communicate with each other. They often push cup change light wine during dinner, when consumers drinking more, they would take less food, which leads to more plate waste. In addition, consumers under the age of 50 are wasted more food than those over the age of 50. This is mainly because consumers over the age of 50 have experienced the three years of natural disasters after China was founded, and they cherish and economize more food than the youth. The payer with farming experience can reduce 30 grams of food than the other payers. Farming experience let consumers to understand more about how difficult to produce food in farm, so consumers with farming experience cherish food more. The per capita per meal plate waste in Beijing is significantly less than that in Lhasa, Given the demographic and dietary patterns and structure of Lhasa and Beijing, there is a big difference in food waste among cities. There is an interesting result, that in Sunday the consumers waste less food than other days. We believe that the consumer has more time to enjoy their food in Sunday, so they intake more, and waste less.

In order to test the reliability of our regression results, the waste rate per table as a dependent variable was used in regression and the results was consistent with plate waste per capita per meal.

Table 4 Parameter estimates of plate waste

	Plate waste (g/capita. table)			Waste rate (%. table)		
	OLS	IV	IVtobit	OLS	IV	IVtobit
Preference for food variety	65.840***	233.930***	323.033***	1.687***	9.831**	20.268*
	(7.228)	(58.266)	(96.426)	(0.572)	(4.483)	(12.073)
Average dish portion size per restaurant	0.461***	0.617***	0.832***	0.027***	0.035***	0.054***
	(0.031)	(0.068)	(0.104)	(0.003)	(0.005)	(0.012)
Number of consumers on each table	9.223**	28.501***	42.290***	1.168***	2.102***	3.641**
	(3.587)	(7.886)	(12.290)	(0.327)	(0.626)	(1.470)
Age of payer	50.364***	43.287**	62.478**	6.663***	6.320***	8.168***
	(16.963)	(20.946)	(29.174)	(1.515)	(1.579)	(2.495)
Farming experience of payer	-27.111**	-29.335**	-30.125*	-1.116	-1.224	-1.271
	(11.413)	(13.297)	(16.837)	(0.991)	(1.033)	(1.434)
City	-102.058***	-124.109***	-138.471***	-10.177***	-11.245***	-12.927***
	(22.461)	(25.550)	(31.735)	(1.835)	(1.956)	(2.858)
Dining time						
DT2: Tuesday	9.266	-39.830	-65.853*	1.537	-0.842	-4.003
	(19.923)	(28.381)	(40.008)	(1.829)	(2.285)	(4.332)
DT3: Wednesday	9.793	-31.924	-58.131*	0.234	-1.787	-4.908
	(17.881)	(24.232)	(34.259)	(1.568)	(1.951)	(3.709)
DT4: Thursday	-5.170	-16.857	-37.911	0.120	-0.446	-2.287
	(17.775)	(22.280)	(29.529)	(1.690)	(1.819)	(2.646)
DT5: Friday	-4.180	-10.116	-25.894	-0.645	-0.932	-2.421
	(20.572)	(24.249)	(31.833)	(1.960)	(2.034)	(2.843)
DT6: Saturday	-0.157	-14.412	-25.202	0.300	-0.390	-1.567
	(21.460)	(22.939)	(28.946)	(1.868)	(1.915)	(2.652)
DR7:Sunday	-30.010	-49.274**	-87.528***	-2.554	-3.487*	-6.479**
	(19.899)	(24.283)	(31.013)	(1.750)	(1.925)	(2.854)

Other variable	Control	Control	Control	Control	Control	Control
Constant	-180.537***	-502.801***	-839.637***	-2.537	-18.151*	-50.551**
	(49.032)	(123.952)	(197.196)	(4.284)	(9.598)	(24.003)
Observations	1,340	1,340	1,340	1,340	1,340	1,340
R-squared	0.322	0.000		0.243	0.128	
F-value	8.72***	5.01***		11.22***	7.80***	
Hausman test P-value	0.000***			0.052*		
Kleibergen-Paap rk Wald F statistic		12.478			12.478	
Cragg-Donald Wald F statistic		12.689			12.689	

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Conclusions and Discussion

In this study, we looked for the factors that led to the plate waste in foodservice sector, we introduced consumer's preferences for food variety into consumer utility functions, and derive the portion size causal relationship with food waste. In empirical analysis, we took the dining reason as instrumental variable of preference for food variety and analyzed the effect of preference for food variety and portion size on per capita plate waste and waste rate of FAFH by Tobit model.

The results show that when residents' income increases, consumers not only increase amount of food consumption but also increase the type of food consumption. So high-income consumers will order more dishes when dining out than low-income consumers, and lead to more food waste. The average portion sizes of the restaurant had a positive impact on the plate waste. The results suggest that reducing the portion sizes properly can effectively reduce the plate waste and waste rate.

In addition, the concept of "mianzi" is still very obvious in the field of catering in China. Therefore, all departments and units should strictly abide by the eight-point austerity rules set by the Central Government, prohibit extravagance and waste, and vigorously promote the activities of "Clean Plate Campaign". This paper may provide a reference for policymakers and stakeholders.

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Appendix table 1 Control variable statistical description

Variables	Variable declaration	N	Mean	Sd	Min	Max
Dummy: city	1=Beijing; 0=Lhasa	1340	0.77	0.42	0	1
Dummy: age of payer	1=less than or equal 50; 0=over 50	1340	0.93	0.25	0	1
Dummy: gender of payer	1=male; 0=female	1340	0.62	0.48	0	1
Dummy: educational background of payer (EB)	EB1:primary school	1340	0.05	0.21	0	1
	EB2:junior school	1340	0.07	0.26	0	1
	EB3:senior school	1340	0.14	0.34	0	1
	EB4: university or above	1340	0.74	0.44	0	1
Dummy: abroad experience of payer	1=yes; 0=no	1340	0.11	0.31	0	1
Dummy: farming experience of payer	1=yes; 0=no	1340	0.36	0.48	0	1
Dummy: If there have elder over 50 years old in payer's family	1=yes; 0=no	1340	0.62	0.49	0	1
Dummy: employment Status of payer	1=full time job; 0=others	1340	0.72	0.45	0	1
Dummy: employment department of payer (ED)	ED1: office/institution/state-owned enterprise	1340	0.37	0.48	0	1
	ED2: private enterprises/foreign company/individual operator	1340	0.43	0.50	0	1
	ED3:others departments	1340	0.20	0.40	0	1
Dummy: local inhabitant	1=yes; 0=no	1340	0.79	0.41	0	1
Dummy: dishes ordered by payer	1=yes; 0=no	1340	0.74	0.44	0	1
Dummy: frequency of dining out	1=at last 1 time pre mouth; 0=less 1 time pre mouth	1340	0.90	0.31	0	1
Dummy: lunch	1=yes; 0=no	1340	0.65	0.48	0	1
Dummy: restaurant scale (RS)	RS1: canteen & snack bars	1340	0.30	0.46	0	1
	RS2: large restaurant	1340	0.23	0.42	0	1
	RS3: meddle restaurant	1340	0.26	0.44	0	1
	RS4: small restaurant	1340	0.21	0.41	0	1

Dummy: discount in this restaurant	1=yes; 0=no	1340	0.09	0.29	0	1
Dummy: member in this restaurant	1=yes; 0=no	1340	0.06	0.24	0	1
Dummy: frequency of dining in this restaurant	1=at last 1 time pre mouth; 0=less 1 time pre mouth	1340	0.51	0.50	0	1
Dummy: dining time (DT)	DT1: Monday	1340	0.12	0.32	0	1
	DT2: Tuesday	1340	0.13	0.34	0	1
	DT3: Wednesday	1340	0.24	0.43	0	1
	DT4: Thursday	1340	0.15	0.36	0	1
	DT5: Friday	1340	0.10	0.30	0	1
	DT6: Saturday	1340	0.12	0.32	0	1
	DT7: Sunday	1340	0.14	0.34	0	1

Appendix table 2

	Preference for food variety (num.)		Food order per captia (g)	
	Coef.	Std. Err.	Coef.	Std. Err.
Monthly income of payer				
MI2: 5000-10000 RMB	0.109**	(0.049)	50.968*	(26.641)
MI3: over10000 RMB	0.134**	(0.071)	23.931	(38.793)
Average dish portion size per restaurant	-0.001***	(0.000)	1.196***	(0.063)
Dining reason				
DR2: business/official/friend feast	0.097*	(0.057)	47.983	(34.056)
DR3: working meal/other reasons	-0.160***	(0.060)	-100.262***	(33.020)
Number of consumers on each table	-0.137***	(0.015)	-52.377***	(8.505)
Age of payer	0.038	(0.081)	-35.094	(44.899)
Gender of payer	0.068	(0.044)	43.087*	(23.289)
Educational background of payer				
EB2: junior school	0.126	(0.115)	26.998	(50.501)
EB3: senior school	0.136	(0.117)	56.917	(49.964)
EB4: university	0.202*	(0.111)	79.717*	(47.311)
City	0.098	(0.072)	70.052*	(38.781)
Local inhabitant	-0.111*	(0.057)	-0.943	(26.034)
Abroad experience of payer	-0.004	(0.073)	19.751	(37.109)
Farming experience of payer	0.017	(0.046)	-25.327	(23.686)
If there have elder over 50 years old in payer’s family	0.028	(0.043)	0.926	(23.028)
Employment status of payer	0.024	(0.062)	57.216**	(27.403)
Employment department of payer				
ED2: private enterprises/foreign company/individual operator	-0.033	(0.051)	-28.260	(27.968)

ED3:others departments	0.021	(0.073)	-13.956	(34.119)
Frequency of dining out	0.001	(0.065)	-75.588**	(38.358)
Frequency of dining in this restaurant	-0.071	(0.044)	-1.638	(23.930)
Discount in this restaurant	0.085	(0.083)	70.812*	(41.359)
Member in this restaurant	0.054	(0.086)	29.450	(46.905)
Restaurant scale				
RS2: large restaurant	0.312***	(0.069)	149.488***	(35.758)
RS3: meddle restaurant	0.127*	(0.065)	104.372***	(31.208)
RS4: small restaurant	0.047	(0.066)	83.542**	(36.386)
Lunch	0.046	(0.044)	-38.833	(24.717)
Dishes ordered by payer	0.003	(0.048)	15.610	(24.096)
Dining time			95.322**	(38.613)
DT2: Tuesday	0.278***	(0.082)	94.228***	(35.468)
DT3: Wednesday	0.229***	(0.069)	-41.655	(39.144)
DT4: Thursday	0.051	(0.078)	16.365	(45.125)
DT5: Friday	0.020	(0.085)	-22.900	(43.208)
DT6: Saturday	0.045	(0.076)	-1.533	(46.877)
DT7: Sunday	0.074	(0.080)		
Native place of payer	Control			
Constant	2.080***	(0.200)	219.438**	(98.195)
Observations	1,340		1,340	
R-squared	0.204		0.338	
F-value	5.74***		10.54***	

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix table 3

	Plate waste (g/capita. table)			Waste rate (%. table)		
	(ols)	(iv)	(ivtobit)	(ols)	(iv)	(ivtobit)
Preference for food variety	65.840***	233.930***	323.033***	1.687***	9.831**	20.268*
	(7.228)	(58.266)	(96.426)	(0.572)	(4.483)	(12.073)
Average dish portion size per restaurant	0.461***	0.617***	0.832***	0.027***	0.035***	0.054***
	(0.031)	(0.068)	(0.104)	(0.003)	(0.005)	(0.012)
Number of consumers on each table	9.223**	28.501***	42.290***	1.168***	2.102***	3.641**
	(3.587)	(7.886)	(12.290)	(0.327)	(0.626)	(1.470)
Age of payer	50.364***	43.287**	62.478**	6.663***	6.320***	8.168***
	(16.963)	(20.946)	(29.174)	(1.515)	(1.579)	(2.495)
Gender of payer	3.296	-11.047	-20.613	-1.051	-1.746*	-2.846
	(10.422)	(14.127)	(19.277)	(0.933)	(1.060)	(1.764)
Education of payer						
EB2: junior school	-28.647	-49.760	-54.188	-1.253	-2.276	-3.252
	(27.269)	(34.025)	(44.461)	(2.805)	(2.910)	(4.147)
EB3: senior school	-7.413	-29.355	-40.383	-0.195	-1.258	-2.720
	(27.358)	(34.513)	(44.789)	(2.644)	(2.754)	(3.978)
EB4: university	-2.904	-39.875	-50.231	0.341	-1.451	-3.165
	(25.867)	(34.755)	(46.241)	(2.492)	(2.745)	(4.391)
City	-102.058***	-124.109***	-138.471***	-10.177***	-11.245***	-12.927***
	(22.461)	(25.550)	(31.735)	(1.835)	(1.956)	(2.858)
Local inhabitant	9.485	22.731	28.672	1.435	2.077	2.880
	(13.926)	(16.750)	(21.738)	(1.253)	(1.320)	(1.964)
Abroad experience of payer	-7.802	-9.695	-16.913	-0.264	-0.356	-0.900

	(15.961)	(20.923)	(27.598)	(1.404)	(1.537)	(2.252)
Farming experience of payer	-27.111**	-29.335**	-30.125*	-1.116	-1.224	-1.271
	(11.413)	(13.297)	(16.837)	(0.991)	(1.033)	(1.434)
If there have elder over 50 years old in payer's family	-2.421	-8.289	-12.593	-0.229	-0.513	-0.937
	(10.446)	(13.064)	(16.863)	(0.911)	(0.980)	(1.424)
Employment status of payer	7.684	1.577	12.544	0.406	0.110	0.714
	(14.405)	(17.806)	(23.198)	(1.343)	(1.411)	(1.976)
Employment department of payer						
ED2: private enter. /foreign comp. /individual operator	-10.617	-5.916	3.839	0.124	0.351	1.290
	(11.768)	(14.229)	(18.174)	(1.009)	(1.079)	(1.541)
ED3:others departments	-30.888*	-31.632	-35.971	-2.326	-2.362	-2.653
	(16.352)	(20.426)	(26.995)	(1.545)	(1.620)	(2.319)
Frequency of dining out	-20.673	-22.773	-17.169	-0.558	-0.660	-0.337
	(17.677)	(20.620)	(26.921)	(1.577)	(1.647)	(2.313)
Frequency of dining in this restaurant	9.364	22.545*	26.945	-0.396	0.242	0.807
	(10.143)	(13.540)	(18.128)	(0.916)	(1.036)	(1.676)
Restaurant scale						
RS2: large restaurant	20.144	-47.381	-55.178	0.788	-2.483	-4.844
	(15.282)	(29.468)	(43.971)	(1.379)	(2.256)	(5.075)
RS3: meddle restaurant	41.082***	7.714	19.119	2.636**	1.020	0.784
	(14.492)	(21.099)	(29.531)	(1.311)	(1.633)	(3.043)
RS4: small restaurant	15.886	5.446	18.718	1.462	0.956	1.572
	(15.580)	(19.012)	(24.967)	(1.506)	(1.585)	(2.269)
Lunch	5.772	3.133	4.162	1.480	1.352	1.449
	(10.902)	(12.749)	(16.148)	(0.942)	(0.984)	(1.363)
Dishes ordered by payer	-10.511	-11.490	-17.631	-1.097	-1.144	-1.691

	5.772	3.133	4.162	(0.987)	(1.061)	(1.485)
Dining time						
DT2: Tuesday	9.266	-39.830	-65.853*	1.537	-0.842	-4.003
	(19.923)	(28.381)	(40.008)	(1.829)	(2.285)	(4.332)
DT3: Wednesday	9.793	-31.924	-58.131*	0.234	-1.787	-4.908
	(17.881)	(24.232)	(34.259)	(1.568)	(1.951)	(3.709)
DT4: Thursday	-5.170	-16.857	-37.911	0.120	-0.446	-2.287
	(17.775)	(22.280)	(29.529)	(1.690)	(1.819)	(2.646)
DT5: Friday	-4.180	-10.116	-25.894	-0.645	-0.932	-2.421
	(20.572)	(24.249)	(31.833)	(1.960)	(2.034)	(2.843)
DT6: Saturday	-0.157	-14.412	-25.202	0.300	-0.390	-1.567
	(21.460)	(22.939)	(28.946)	(1.868)	(1.915)	(2.652)
DT7: Sunday	-30.010	-49.274**	-87.528***	-2.554	-3.487*	-6.479**
	(19.899)	(24.283)	(31.013)	(1.750)	(1.925)	(2.854)
Native place of payer	Control	Control	Control	Control	Control	Control
Constant	-180.537***	-502.801***	-839.637***	-2.537	-18.151*	-50.551**
	(49.032)	(123.952)	(197.196)	(4.284)	(9.598)	(24.003)
Observations	1,340	1,340	1,340	1,340	1,340	1,340
R-squared	0.322	0.000		0.243	0.128	
F-value	9.330***	5.640***		0.000***	0.000***	0.000***
P-value	0.000***	0.000***	0.000***	11.22***	7.80***	
Hausman test P-value	0.000***			0.052**		
Kleibergen-Paap rk Wald F statistic		12.478			12.478	
Cragg-Donald Wald F statistic		12.689			12.689	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix table 4

	Food intake (g/capita. table)	
Preference for food variety	263.852***	262.463***
	(17.309)	(17.309)
Dining reason		
DR2: business/official/friend feast		-41.123
		(25.447)
DR3: working meal/other reasons		-56.146**
		(23.947)
Average dish portion size per restaurant	1.020***	1.023***
	(0.057)	(0.057)
Number of consumers on each table	-10.408**	-13.399**
	(5.256)	(5.581)
Age of payer	-95.578***	-91.013***
	(31.313)	(30.751)
Gender of payer	15.024	16.246
	(17.827)	(17.796)
Educational background of payer		
EB2: junior school	15.593	18.234
	(35.412)	(35.691)
EB3: senior school	19.364	20.472
	(33.934)	(34.111)
EB4: university	16.942	22.498
	(31.597)	(32.073)
City	147.735***	138.538***
	(25.556)	(25.567)
Local inhabitant	31.344	28.895
	(19.050)	(19.034)
Abroad experience of payer	23.860	24.382
	(29.508)	(29.532)
Farming experience of payer	-2.295	-1.539
	(16.832)	(16.732)
If there have elder over 50 years old in payer's family	-4.407	-5.085
	(17.254)	(17.227)
Employment status of payer	38.401**	41.326**
	(19.148)	(19.074)
Employment department of payer		
ED2: private enterprises/foreign company/individual operator	-12.846	-8.394
	(20.586)	(20.917)
ED3:others departments	3.399	9.337
	(24.014)	(24.276)
Frequency of dining out	-55.111*	-56.841*

	(29.416)	(29.312)
Frequency of dining in this restaurant	12.696	14.075
	(17.293)	(17.301)
Restaurant scale		
RS2: large restaurant	46.764*	40.200
	(27.903)	(27.852)
RS3: meddle restaurant	40.446*	35.324
	(23.229)	(23.198)
RS4: small restaurant	56.790**	55.538**
	(26.185)	(26.147)
Lunch	-65.100***	-61.338***
	(18.347)	(18.378)
Dishes ordered by payer	27.352	26.096
	(18.054)	(18.037)
Dining time		
DT2: Tuesday	-0.663	-2.606
	(28.082)	(28.077)
DT3: Wednesday	16.120	13.466
	(26.334)	(26.231)
DT4: Thursday	-46.747	-47.721
	(29.319)	(29.209)
DT5: Friday	16.520	17.708
	(33.610)	(33.630)
DT6: Saturday	-24.567	-33.824
	(31.225)	(30.681)
DT7: Sunday	12.798	2.828
	(34.337)	(33.799)
Native place of payer	Control	Control
Constant	-324.930***	-276.748***
	(75.859)	(76.671)
Observations	1,340	1,340
R-squared	0.477	0.479
F-value	12.94***	12.56***

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

校对报告

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