# Getting Rich and Eating Out: Consumption of Food Away from Home in Urban China

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*The overall goal of this study is to better understand food-away-from-home (FAFH) consumption in urban China. We use national statistical sources and our own data to examine the trends in FAFH during the late reform period and to analyze the determinants of FAFH demand, examining how different groups of consumers have participated in this new area of consumption. Besides the normal Tobit model for total food expenditure away from home, a system of multivariate Tobit equations was estimated simultaneously for three categories of foods consumed outside of the home. The results show that the rapid increase of FAFH demand, a rise that is fueled by higher incomes, is changing consumption patterns in China's post-reform urban economy. We also use our findings to illustrate how omission of accounting for FAFH trends by China's official statisticians has affected the reported trends in national meat supply and demand statistics.*

*La présente étude visait à mieux comprendre le phénomène de la consommation de repas à l'extérieur en Chine urbaine. Nous avons utilisé des données de sources nationales et nos propres données pour étudier le phénomène au cours de la dernière réforme et pour analyser les déterminants de la demande de repas à l'extérieur en examinant la participation de divers groupes de consommateurs à ce nouveau créneau. Outre le modèle Tobit simple pour évaluer les dépenses totales de repas à l'extérieur, nous avons estimé simultanément un système d'équations Tobit à plusieurs variables pour trois catégories d'aliments consommés à l'extérieur du foyer. Les résultats ont montré que la croissance rapide de la demande de repas à l'extérieur, alimentée par une hausse des revenus, est en train de modifier les habitudes de consommation dans l'économie urbaine de la Chine post-réformiste. Nous avons également utilisé nos résultats pour illustrer de quelle façon le fait que les statisticiens officiels de la Chine ne tiennent pas compte des tendances de consommation de repas à l'extérieur a une influence sur l'évaluation des tendances dans les données nationales de l'offre et de la demande de viande.*

## INTRODUCTION

Income growth, consumer preference shifts, and a transitioning economic environment have dramatically changed food consumption patterns in China's cities. While urban per capita expenditure for food on average has been relatively stagnant during the past five

years, the composition of the food basket has evolved. Grain consumption has fallen precipitously in urban areas, while the consumption of animal products has risen (Huang and Rozelle 1998; Rae 1998). A vast array of restaurants has opened in cities since last decade. As a result, the share of food consumed at home has trended downward. At the same time, the share household food expenditures spent on food away from home (FAFH) has increased (CNSB 1992 and 2000).

In some sense, the sudden rise in popularity of eating out is both a cause and a consequence of economic change in China. During the past decade, as incomes of the average urban resident rose, the real urban food expenditure on FAFH trebled from 30.5 billion yuan in 1991 to 98.4 billion yuan in 1999 (HIES 1992 and 2000). Coupled with the rising population base and increased movement of people into urban areas during the 1990s, the total urban food expenditure on FAFH increased even faster. At the same time, rising FAFH demand has stimulated the development of catering and other industries and influenced the way food producers, processors, and retailers that are oriented toward manufacture foods (Mihalopoulos and Demoussis 2001). Hence, it is important to understand these trends in order to be able to anticipate future changes in the economy.

An examination of urban FAFH consumption also may provide answers to a set of questions that has puzzled researchers regarding the slow growing trends of national meat demand and the widening gap between China's livestock production and consumption statistics. Although the quantity of meat consumed by city residents rose rapidly during similar periods of development in other East Asian countries (Garnaut and Ma 1992), demand trends published by China's National Statistical Bureau (CNSB) are almost flat. In fact, the demand has grown too slowly that even after officials used data from National Census of Agriculture in 1997 to revise production trends downward in the late 1990s, official statistical sources still show that pork supply is more than 45% higher than pork demand. While the gap is partly due to over zealous reporting of livestock production (even after the adjustment based on the Agricultural Census) and partly due to systematic flaws in the collection of meat consumption data (Zhong 1997; ERS 1998; Fuller et al 2000), Ma et al (2004a,b) also suggest that meat consumed away from home is not accounted for fully by CNSB enumerators and plays a role in reconciling official supply and demand trends.

Given the rapid rise in FAFH consumption and its increasing importance, there is a high demand for information on the composition and level of current and future urban FAFH consumption. Unfortunately, the existing literature examining food consumption in urban China focuses primarily on China's household food demand in general (Halbrendt et al 1994; Fan et al 1995; Gao et al 1996; Wan 1996; Huang and Rozelle 1998; Gould and Sabates 2001; Gould 2002). And, while previous studies have identified urbanization, market development, and income growth as three important determinants of food consumption growth (Wang and Chern 1992; Huang and David 1993; Huang and Rozelle 1998; Rae 1998; Huang and Bouis 2001), none have directly examined FAFH consumption.

The overall goal of this study is to fill this gap in the literature and increase our understanding of FAFH consumption in urban China. Specifically, our study has three objectives. First, we use national statistical sources and our own data to examine the trends in FAFH during the late reform period. Next, we analyze the determinants of

FAFH demand and examine the nature of the demand of different groups of consumers. Finally, we use our findings to assess whether or not the omission of accounting for FAFH has affected the rising discrepancy in national meat supply and demand statistics.

## DATA

The data used in our study are derived from a survey that was conducted by the authors as part of a research collaboration between the Center for Chinese Agricultural Policy of Chinese Academy of Sciences and the Center for Agricultural Rural Development at Iowa State University. The purpose of the survey was to collect data that could be used to identify and help adjust the discrepancies that exist between officially published production and consumption data series. To keep up with the change of urban food consumption patterns, in general, and FAFH, in particular, the survey contained a section on urban household income and food consumption both away from home and at home. The sample included 250 urban households and 746 individuals in 5 cities—Chengdu (Sichuan Province), Jiangjin (Chongqing Municipality), Changchun (Jilin Province), and Weifang and Feixin (Shandong Province). Since the sample households also were included in CNSB's national household income and expenditure survey (HIES), we can compare our sample statistics with those from the HIES.

In addition to information about the basic characteristics of the household and its members, enumerators asked detailed information about its in-home food expenditures and the consumption of key commodities, such as grain, vegetables, fruit, and meat, on a three-day recall basis. Since our survey was trying to collect accurate information on commodities for the entire year, and since some commodities in China are consumed unequally throughout the year, we also asked households specifically about their expenditures and consumption during major festivals and holidays.

In another section of the survey, enumerators collected information about the consumption of food products when the members of the households were outside the home. Enumerators asked households to report their total expenditures on out-of-home consumption each time in the past three days. To get more detail than is available in the HIES, our survey also asked information about the *composition* of each household member's FAFH consumption. Using this information in conjunction with our estimates of in-home consumption, we were able to create estimates of FAFH consumption of meats, eggs, fish, grain, vegetables, fruit, and other goods on a per capita basis. Our data also allowed us to estimate the percentage of food consumption that was either at home or away from home for each subcategory of food (Table 1).

Comparing the means of key variables that are generated from our sample with those of the urban HIES, we found that most are consistent except those for food expenditures. For example, the difference in per capita household income between our sample and the urban HIES is only 3.5% (5,283 and 5,103 yuan). The difference in household size is only 3.3%. In contrast, there is a divergence in the estimate of food expenditure (2,100 yuan for ours and 1,843 yuan for the HIES, a gap of 257 yuan or 14%). Decomposition analysis demonstrates that this gap is mainly caused by differences in the estimates of expenditures on FAFH. The estimate of average annual expenditure on FAFH from our data is 527 yuan, but the estimate from the HIES is 227 yuan, a gap of 300 yuan. So what accounts for the differences between our estimates of FAFH expenditures and those of

Table 1. Level and source of annual per capita away-from-home and at-home food expenditures and in urban China, 1998

| | Households consuming away from home[a] | | All households | |
|---|---|---|---|---|
| | Total food expenditure away from home | Food expenditure at home | Total food expenditure away from home | Food expenditure at home |
| Total food expenditure (yuan) | 1,539 | 1,846 | 527 | 2,061 |
| Of which (%) | | | | |
| Meats | 35 | 28 | 38 | 28 |
| Eggs | 2 | 8 | 3 | 7 |
| Fish | 8 | 5 | 7 | 5 |
| Grains | 14 | 20 | 12 | 19 |
| Vegetables | 12 | 11 | 12 | 13 |
| Fruits | 3 | 9 | 4 | 11 |
| Others | 25 | 18 | 24 | 17 |
| Sum | 100 | 100 | 100 | 100 |

Note: Expenditure on food is measured in Chinese currency (yuan). Grains include grain products. Vegetables include both fresh and dried. Fruits include tree nuts. Meats include pork, beef, mutton, and poultry. Fish includes shellfish.
Source: Author's 1998 urban household food expenditure survey.
[a]Of 250 surveyed households (746 individual consumers), there are 149 households (264 individual consumers) that consumed away from home during the study period.

CNSB (227 yuan)? There are two possible reasons: (a) in the CNSB survey, the family member who records expenditures in his or her daily diary may be unaware of the daily FAFH consumption by other family members; or (b) there could be a lack of clarity in the question in the CNSB survey, causing the family not to include consumption at one's work unit as FAFH consumption. For these reasons, we believe that the CNSB underestimates FAFH consumption; therefore, Ma (2000) suggests caution when using the consumption data from national sources.

## INCOME GROWTH AND SHIFTING FOOD CONSUMPTION PATTERNS

As income has grown, food consumption patterns in China have changed. Rising income is undoubtedly one of the greatest forces affecting the type of food consumed, although the total quantity may be less affected. From 1995 to 2001, income per capita in urban China rose by 43% (Table 2, column 1). Low-income elasticities, approaching zero in the case of some staples by some accounts (e.g., Fan and Agcaoili-Sombilla 1997), mean that wealthier consumers, on average, did not spend significantly more on food. In fact, after 1995, per capita expenditures on food have grown slowly (column 2). Rising urban population was the major reason why total food consumption in urban areas grew.

Table 2. Income growth and the change of food consumption pattern in urban China

| Year | Per capita income | Per capita food expenditure | | |
|---|---|---|---|---|
| | | Total | Share, at-home | Share, out-of-home |
| 1995 | 4,781 | 1,843 | 0.90 | 0.10 |
| 1996 | 4,965 | 1,846 | 0.90 | 0.10 |
| 1997 | 5,157 | 1,882 | 0.90 | 0.10 |
| 1998 | 5,458 | 1,927 | 0.88 | 0.12 |
| 1999 | 5,966 | 2,021 | 0.87 | 0.13 |
| 2000 | 6,349 | 2,103 | 0.85 | 0.15 |
| 2001 | 6,847 | 2,161 | 0.84 | 0.16 |

Note: Urban per capita income was deflated by urban consumer price indices, and urban per capita food expenditure was deflated by urban food price indices. Both sets of columns are in 1998 real terms. The shares were calculated in terms of both at-home and away-from-home food expenditures.
Source: China Statistical Yearbooks, 1996–2002.

Rising income, however, seems to have a major impact on the structure of China's food economy. Specifically, according to the HIES data, FAFH demand has been one of the main reasons that the composition of urban food expenditures has changed. Between 1995 and 2001, while the share of expenditures spent on food that was consumed at home declined from 90% to 84%, the share of food expenditure on FAFH rose from 10% to 16% (Table 2, columns 3 and 4). Thus, total in-home food expenditure declined by 5% while total FAFH expenditure increased by 63% during this time period.

The same consumption patterns appear in our household data. By comparing the rise in expenditures among households that belong to different income groups, we can see that FAFH demand grows faster than household income (Table 3, row 1). For example, when monthly household income is below 1,000 yuan, individuals on average spend only 164 yuan on FAFH per annum. When monthly household income reaches over 2,500 yuan, annual per capita FAFH demand reaches 1,135 yuan.

Income growth not only plays a role in determining the level of FAFH demand, but it also appears to affect the composition of the expenditures. When households are grouped by monthly income, sharp variations in the composition of the FAFH demand emerge (Table 3). In particular, the proportion of meat in household diets rises with income. For example, for the two lower household income groups, only 21–24% of expenditures were spent on meat products. In contrast, the proportion of expenditures on meat for the two higher household income groups grows to nearly 40% (row 5). A similar pattern can be found for fish demand. In contrast, as income levels rise, the proportions of grain and egg expenditures fall when households eat away from home (rows 2 and 6).

Perhaps the clearest way to show the eating habits that are driving changes in China's food economy is to compare the composition of in-home and away-from-home diets for households that eat away from home (Table 1). According to our data, households spend significantly more on some products when they eat away from home than when they eat at home. When eating out, the average urban resident spends 35% of their food budget

Table 3. Per capita annual food-away-from-home expenditure and expenditure composition by monthly household income

| | Household monthly total income (yuan) | | | |
|---|---|---|---|---|
| | (1) ≤1,000 | (2) 1,000–1,500 | (3) 1,500–2,500 | (4) >2,500 |
| Annual per capita food expenditure away from home (yuan) | 164 | 306 | 656 | 1,135 |
| Of which (%): | | | | |
| Grains | 28 | 22 | 11 | 14 |
| Vegetables | 7 | 10 | 7 | 16 |
| Fruits | 4 | 7 | 5 | 4 |
| Meats | 21 | 24 | 38 | 38 |
| Eggs | 4 | 5 | 2 | 1 |
| Fish | 6 | 2 | 12 | 13 |
| Others | 30 | 30 | 25 | 14 |
| Sum | 100 | 100 | 100 | 100 |

Note: Total expenditure on food away from home is measured in Chinese currency (yuan). Grains include all grain products but do not include soybeans or potatoes or sweet potatoes (as does the definition used by the CNSB 1992 and 2000). Vegetables include both fresh and dried. Fruits include tree nuts. Meats include pork, beef, mutton, and poultry. Fish includes shellfish.
Source: Author's 1998 urban household food expenditure survey.>

on meats versus only 28% when he/she is at home (row 2). A similar pattern is observed for fish consumption (row 4). In the case of grains, fruit, and eggs, however, more is consumed at home than away from home. The same statistics for the entire sample is shown in columns 3 and 4.[1]

## METHODOLOGY

Following the theoretical framework and model specification of McCracken and Brandt (1987), we can define total food expenditure away from home as

$$\mathbf{E}_{hi} = E(\mathbf{Y}_h, \mathbf{Z}_{hi}, \mathbf{Z}_h) \tag{1}$$

where $E_{hi}$ is the total expenditure on FAFH in the $h$th household by the $i$th individual, $Y_h$ is the $h$th household's income, and $Z_{hi}$ are vectors of variables including all other control variables that capture differences in demand among individuals, such as education, age, gender, household head status, and job type. $Z_h$ contains all other variables affecting expenditures that are excluded from $Y_h$ and $Z_{hi}$, such as the location of the sample households. In the rest of the paper, the model in Eq. (1) is called the univariate Tobit selection model (or the demand for total FAFH model).

The variables for our model are mostly measured in ways that make them consistent with those used in other studies of FAFH. The dependent variable, FAFH consumption, is the total amount (in yuan) spent by the individual during the three-day sampling period. Although some studies use total household expenditures in their demand analysis of

FAFH (such as Mihalopoulos and Demoussis 2001), we use our estimates of household income, which, in the context of our urban study, came from the estimates of monthly household income by the respondent. Education is measured as the number of years of schooling that was attained by the individual. A dummy variable equal to one when a person worked in a white-collar job (and zero otherwise) is used to hold constant a person's type of employment and to capture the consumption habits of people who have jobs as government officials, managers in private firms, or other professional positions. The rest of the variables (gender; household head status; location of the city in which the individual lives; and age dummies for three age categories) are measured as 1–0 indicator variables. Descriptive statistics for the variables that we use in the multivariate analysis of FAFH in urban China are summarized in Appendix.

In most demand studies, because household surveys only provide information on consumption at the household level, there is no way that a researcher can investigate individual behavior. The same is true of most studies of FAFH consumption (except Nayga and Capps 1992). Since our sample provides detailed information about each household member's food expenditure on FAFH, we are able to use the individual as the unit of observation. With the greater variability embodied in individual data, we should be able to better match demand with the individual characteristics that proxy for the opportunity cost of time. However, since our important explanatory variable (income) is measured at the household level, we are concerned with the statistical problems that might be associated with the correlations among the common components of error terms of observations that belong to the same household. In other words, we have reason to believe that the behavior of each individual person within the same household may be not independent of each other. To account for this, when we estimate empirically the coefficients, we consider household as clusters and use statistical methods to obtain robust variance estimates.[2]

Since not all individuals in the sample ate a meal away from home during the sample period, the use of OLS to estimate Eq. (1) would result in biased and inconsistent estimates. In fact, only 35% of the respondents reported that they incurred FAFH expenditures during the survey period. This means that 65% of the sample reported that they had made zero expenditure on FAFH. Unfortunately, deleting the nonconsuming individuals and using OLS does not solve the problem of inconsistency and reduces the efficiency of the estimates because of the smaller sample size. Instead, Tobit analysis provides a theoretically consistent technique that uses information from all observations in the estimation of the regression. Using this approach, in cross-sectional analysis there is also the advantage that it is possible to estimate both the effect of increased participation (from the explanatory variables) and the quantity responses. The details of the decomposition of elasticity can be found in McCracken and Brandt (1987).

While the McCracken and Brandt (1987) method provides consistent estimates of FAFH consumption (under the assumptions of the model), more recent work suggests that it may not be an appropriate method for analyses involving disaggregated food groupings (Cornick et al 1994). The main problem, according to Cornick and coauthors, is that households are assumed to purchase all foods outside of home without regard to decisions on individual food groups, many of which are likely to be at their censoring point. In other words, the decision to consume a certain food type away from home is a function of the level of consumption of other types of goods away from home, as well as

a function of the constant factors included in Eq. (1). Empirically, this approach implies that expenditure on FAFH for one good is a function of away-from-home expenditures for other goods.

To better understand the logic of this approach, suppose that there are $p$ foods consumed away from home with $n$ observations (for more details, see Cornick et al 1994; Arias and Cox 2001; Huang 2001; Chavas and Kim 2004). The observable food variables $y_{ij}$ are determined by:

$$y_{ij}^* = x_{ij}'\beta_i + \varepsilon_{ij}, \quad 1 \le i \le p, \quad 1 \le j \le n \tag{2}$$

$$y_{ij} = \begin{cases} y_{ij}^* & \text{if } y_{ij}^* > 0 \\ 0 & \text{if } y_{ij}^* \le 0 \end{cases} \tag{3}$$

where $y_{ij}^*$ is the latent variable and $\varepsilon_j = (\varepsilon_{1j}, \varepsilon_{2j}, \ldots, \varepsilon_{pj})' \sim$ iid $N_p(0, \Omega)$. The dimension of $\beta_i$ is $k_i \times 1$ and $\Omega$ is a $p \times p$ symmetric positive definite matrix. The observed value $y_{ij}$ equals the true value if $y_{ij}^* > 0$; otherwise, the observed value $y_{ij}$ is left censored to be zero. The latent expenditure on the $i$th food of the $j$th consumer is denoted by $y_{ij}^*$ and the observed expenditure by $y_{ij}$, which is either positive or zero. As in Huang (2001), the equations can be expressed as:

$$\begin{bmatrix} y_{1j}^* \\ y_{2j}^* \\ \vdots \\ y_{pj}^* \end{bmatrix} = \begin{bmatrix} x_{1j}' & 0 & \cdots & 0 \\ 0 & x_{2j}' & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & x_{pj}' \end{bmatrix} \otimes \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_p \end{bmatrix} + \begin{bmatrix} \varepsilon_{1j} \\ \varepsilon_{2j} \\ \vdots \\ \varepsilon_{pj} \end{bmatrix} \tag{4}$$

or

$$y_j^* = X_j\beta + \varepsilon_j, \quad j = 1, 2, \ldots, n \tag{5}$$

where $y_j^* = (y_{1j}^*, y_{2j}^*, \ldots, y_{pj}^*)'$, $X_j = \text{diag}(x_{1j}', x_{2j}', \ldots, x_{pj}')$, and $\beta = (\beta_1', \beta_2', \ldots, \beta_p')'$ is a $k \times 1$ vector with $k = \sum_{i=1}^{p} k_i$. One of the main points of this formulation is that consumers will not always buy all the foods outside of home (i.e., a proportion of expenditures on commodities in $y_j$ may be at their censoring points). If there are $p$ foods, there would be $2^p$ possible combinations of foods at their censoring points. We represent the $2^p$ possible combinations by the $2^p \times 1$ vector $S_k, k = 1, 2, \ldots, 2^p$,as

$$\begin{cases} S_1 = (0, 0, \ldots\ldots\ldots\ldots, 0)' \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ S_k = (i_1, i_2, \ldots, i_r, \ldots, i_p)' \quad i_r = \begin{cases} 1 & \text{if } y_{ij}^* > 0 \\ 0 & \text{if } y_{ij}^* \le 0 \end{cases} \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ S_{2^p} = (1, 1, \ldots\ldots\ldots\ldots, 1)' \end{cases} \tag{6}$$

where "1" indicates the observed expenditure is positive and equals the desired expenditure, and "0" means the desired expenditure is nonpositive, meaning that any expenditure on that particular food cannot be observed. Therefore, the likelihood function for the expenditure pattern of the $j$th consumer falling in the $S_k$ combination is given by:

$$L_j^{S_k}(y_j; \beta, \Omega) = \int_{-\infty}^{-x'_{1j}\beta_1} \cdots \int_{-\infty}^{-x'_{rj}\beta_r} L\left(y_j^*; \beta, \Omega\right) dy_{rj}^* \ldots dy_{1j}^* \tag{7}$$

where $L(y_j^*; \beta, \Omega) = (2\pi)^{-0.5p}|\Omega^{-1}|^{0.5} \exp[-0.5(y_j^* - X_j\beta)]' \times \Omega^{-1}(y_j^* - X_j\beta)$, the multivariate normal density function, and $r$ stands for the number of zeros in the possible combination vector. The likelihood function, which accounts for all censoring combinations of all observations, is:

$$L(Y; \beta, \Omega) = \prod_{j=1}^{n} L_j^{S_k}(y_j; \beta, \Omega) \tag{8}$$

where $Y = (y'_1, y'_2, \ldots, y'_n)'$ and $L_j^{S_k}$ gives the likelihood of the combination that the expenditure pattern of consumer $j$ falls into regime $k$. It is clear that Eq. (8) requires an $N$-dimension distribution function, but as long as $p$ is not too large (less or equal to 3), parameter estimates in (8) can be obtained by standard maximum likelihood estimate (Chavas and Kim 2004). The main difference between Eq. (1) and those in Eq. (8) is that the expenditures of other goods appear on the right-hand side of the equation of any individual good. In the rest of this paper, the model in Eq. (8) will be called the multivariate sample-selection model (Yen 2005) or demand for individual commodity expenditure away from home model.

The parameter estimates obtained from both the single- and multivariate approaches can be used to estimate the determinants of the expected expenditures on FAFH. For the univariate Tobit model in Eq. (1), details of the procedure for estimating income elasticities are found in McCracken and Brandt (1987). Likewise, Eqs. (10) and (11) in Cornick et al (1994) describe the process for computing income elasticities from the multivariate sample-selection model in Eq. (8). Following either procedure, estimates of three types of income elasticities of demand can be calculated: (a) the change in total demand that results from a change in income (total or unconditional elasticity); (b) the change in demand that accrues from the advent of food consumption away from home in response to a change in income (participation elasticity); and (c) the change in demand that is attributed to a change in income, given that the consumer already purchases FAFH (quantity or conditional elasticity).

## ESTIMATES AND RESULTS

Maximum likelihood procedures are used to obtain parameters estimates for both the univariate and multivariate sample-selection models. Table 4 presents the parameter estimates for total FAFH for the univariate Tobit model. The base individuals (to which the parameter estimates are compared) are females who are located in Feixian (Shandong Province) who are more than 50 years old. The results show that the univariate Tobit model explaining the determinants of total food expenditure away from home in our sample of individuals performs well. Most of the control variables have the expected

Table 4. Maximization likelihood estimate using a univariate Tobit model for total expenditure of food away from home in urban China

| Independent variables | Estimated coefficients | Standard errors |
|---|---|---|
| Continuous variables | | |
| Monthly household income | 0.018** | 0.00 |
| Individual consumer education | −0.563 | 0.39 |
| Individual attribute variables | | |
| Male individual | 4.882* | 2.04 |
| Head of household | 15.215** | 4.10 |
| White-collar job | 6.341* | 3.12 |
| Individual age groups | | |
| Age ≤ 20 years old | 18.949** | 6.53 |
| Age 21–35 years old | 24.759** | 7.30 |
| Age 36–50 years old | 12.622** | 4.97 |
| Regional dummies | | |
| Changchun (city 1) | −32.839** | −5.82 |
| Chengdu (city 2) | −11.461* | −5.26 |
| Jiangjin (city 4) | −4.640 | −4.00 |
| Weifang (city 5) | 2.742 | 3.81 |
| Constant | −52.788** | 13.68 |
| Sigma | 24.86** | 4.66 |
| Log likelihood function | −1,400.74 | – |
| Wald $\chi^2$ (12) | 48.62** | – |

Note: The base individual is female, non-white-collar occupation, more than 50 years of age, and located in Feixian of Shandong Province.
*Significant at 5% level and **significant at 1% level.

signs and coefficients that are significantly different than zero. For example, the indicator variables that hold constant the effects of gender, household head status, and white-collar worker status demonstrate that these groups of individuals spend more on meals away from home than others (rows 6, 7, and 8). This result is consistent with observations made during the fieldwork. The negative signs on the dummy variables for the individuals that reside in Changchun, Jilin (significant), Chengdu, Sichuan (significant), and Jiangjin, Chongqing (insignificant) show that, all other things equal, FAFH demand is higher in the base city (Feixian). Given the higher relative level of development in coastal cities in Shandong Province, this result might be expected. The positive and significant signs on the coefficients of the dummy variables representing the three age categories (less than <20, 21–35, and 36–50) mean that compared to the base group (those over 50), young people consume more away from home, as well as eat more meat when they are away from home.

The model also demonstrates the strong relationship between income levels and the demand for FAFH (Table 4). The coefficient of the household income variable in the total expenditure equation is positive and highly significant. Our multivariate analysis clearly supports the descriptive findings that rising income during the 1990s was an important impetus for the expansion of the catering industry.

Table 5. Expenditure elasticities with respect to monthly household income for total food expenditure away from home in urban China for various categories

| Independent variables | Total (orunconditional) expenditure elasticity | Participation elasticity | Conditional expenditure elasticity |
|---|---|---|---|
| Monthly household income | 1.74** (0.87)[a] | 1.30*** (0.41) | 0.44*** (0.10) |
| Male individual | 2.13** (0.89) | 1.73*** (0.54) | 0.40*** (0.10) |
| Head of household | 1.82* (0.95) | 1.40*** (0.39) | 0.42* (0.23) |
| White-collar job | 2.07* (1.10) | 1.56*** (0.38) | 0.51 (0.36) |
| Monthly household income groups | | | |
| <1,000 | 1.02 (0.73) | 0.81*** (0.19) | 0.21 (0.12) |
| 1,000–1,500 | 1.49** (0.60) | 1.13** (0.49) | 0.36*** (0.11) |
| 1,500–2,000 | 1.96*** (0.58) | 1.45*** (0.44) | 0.52*** (0.19) |
| ≥2,000 | 2.54* (1.34) | 1.78** (0.71) | 0.77* (0.41) |
| Individual age groups | | | |
| ≤20 years old | 1.71*** (0.50) | 1.31*** (0.27) | 0.39** (0.18) |
| 21–35 years old | 1.64*** (0.51) | 1.14*** (0.28) | 0.50* (0.25) |
| 36–50 years old | 1.68* (0.93) | 1.26** (0.47) | 0.43** (0.17) |
| ≥51 years old | 2.28(1.75) | 1.86* (0.94) | 0.42* (0.23) |

Notes: Column 1 equals column 2 plus column 3 estimated based on the decomposition of McCracken and Brandt (1987). All parameter estimates from Table 4. The total (or unconditional) expenditure elasticity is the sum of participation and conditional expenditure elasticities. The participation elasticity is the elasticity of the probability of consumption with respect to income. The conditional expenditure elasticity is the elasticity of expected consumption of consuming individuals (i.e., for those already participating) with respect to monthly household income. All elasticities are evaluated at the variable means of groups for which the elasticities are reported.

[a]Standard errors are in parentheses. As elasticities are typically nonlinear function of the parameters, one way of dealing with the estimates of their standard errors is to linearly approximate the elasticity formulas in terms of the estimated parameters (Krinsky and Robb 1986, 1990). Approximate formulas for variances and covariances of functions of random variables can be found in Klein (1953, p. 258).

*Significant at 10% level, **significant at 5% level, and ***significant at 1% level.

The elasticities calculated from the estimated parameters in Table 4 also demonstrate clearly that the growth in demand for FAFH is driven by rising incomes (Table 5). The total expenditure elasticity (the effect capturing both the increased participation and higher demand response) with respect to household income is, on average, 1.74, indicating that a 1% rise in income generates an increase in expenditure on FAFH of 1.74%. Moreover, the responsiveness of FAFH demand to increases in income rises for those who are wealthier. For example, for the poorest consumers in the sample, those with household income levels less than 1,000 yuan, the income elasticity of FAFH demand is nearly unitary (1.02). As household incomes rise through the quartiles of our sample, the expenditure elasticity measure rises monotonically. For those that belong to the richest quartile, a 1% rise in income increases FAFH demand by 2.54%. This finding also is consistent with

other studies of FAFH demand. Byrne and Capps (1996), for example, state that Engel's law does not hold at higher incomes for FAFH demand, finding that the expenditure elasticity for FAFH was 1.7 for the highest income households in the United States in the late 1980s. Although Engel's law is not broken by such large income elasticities, since we are studying only one part of the food budget (Engel's law is about total food outlay), the elasticities are large—perhaps larger than one would think when examining a food item. Of course, if we redefine the consumption commodity as more than food, such an interpretation is less convincing (i.e., Engel's law is not broken). In fact, when eating outside of home, consumers are not only consuming food, but also are consuming various other services (e.g., cooking meals, enjoying the atmosphere, and avoiding washing dishes).

The decomposition of the total expenditure elasticity estimate into its participation and conditional expenditure effects shows that it is mainly the increase in participation that is behind the rise in FAFH demand (about 75% of 1.74). Conditioned on participating in FAFH activities, the additional rise in demand that is caused by higher incomes is more modest (only 0.44). Domination of the participation effect over the conditional income effect has also been found in others studies (e.g., McCracken and Brandt 1987).

Age also affects the relationship between income and FAFH demand. The total expenditure elasticities of FAFH demand with respect to household income is 1.71 for individuals who are less than 20 years old, 1.68 for those who are between 36 and 50 years old, but rises to 2.28 for those over 50. Apparently, individuals above the age of 50 are part of the consumer group that is most likely to dine out. Likewise, if the income of those over 50 falls, they are most likely to drop out.

In order to avoid the criticisms of the the univariate Tobit model cited by Cornick et al (1994) and Huang (2001), we repeat the analysis using a multivariate sample-selection model. Since the choice of dependent and independent variables are somewhat different than in the univariate Tobit model, the sample size differs slightly. In particular, we use disaggregated demand for grain, meat, and liquor that were consumed away from home. To the right-hand side of each equation (for each individual food group), we add the expenditures on the other two food categories, since these are assumed to have an independent effect on FAFH consumption in addition to the effects of the traditional determinants of demand. To avoid singularity caused by the adding-up property of demand, we drop expenditures on "other" foods from the system of multivariate Tobit equations. Hence, in our empirical work, we simultaneously estimate the determinants of the FAFH expenditures of grains, meats (including eggs), and liquor (including various beverages).

The results of the multivariate Tobit model are displayed in Table 6. As in the univariate model, the results show that rising household income significantly affects individual food expenditure away from home for both the grains and the meats categories. Interestingly, the coefficient on the income variable in the liquor equation is not significant. But, while income affects FAFH demand overall, there are significant variations in food expenditure across locations—especially in the case of grains and meats. The effect of income growth on grains expenditure away from home was only found in Changchun (Jilin). The effect on meats was found in all sample cities, except for in Jingjin (Chongqing). The multivariate Tobit regressions also suggest that there is a significant complementary relationship between grain and meat consumption away from home. In other words,

Table 6. Maximum likelihood estimates using multivariate Tobit of determinant of food-away-from-home expenditure demand by food categories in urban China

| Independents | Grains | Meats and eggs | Liquor and beverage |
|---|---|---|---|
| Continuous variables | | | |
| Monthly household income | 0.0044* (0.00)[a] | 0.0098* (0.00) | 0.0085 (0.01) |
| Individual education | −0.2425 (0.19) | 0.1123 (0.33) | 0.6606 (0.94) |
| Individual age group | | | |
| Age ≤ 20 | 0.5074* (0.02) | −0.4674 (4.54) | −12.7074 (13.27) |
| Age 21–35 | 7.8399* (3.36) | 7.2613 (4.44) | 13.2721 (12.63) |
| Age 36–50 | 3.6550** (1.66) | 8.1231 (4.20) | 17.9376 (12.47) |
| Household location | | | |
| Changchun (city 1) | −14.0230* (3.03) | −26.6413* (5.67) | −16.8049 (10.77) |
| Chengdu (city 2) | −3.3312 (1.85) | −13.7514* (3.74) | −9.5783 (8.79) |
| Jiangjin (city 4) | 1.2848 (1.68) | −14.0145* (3.67) | 12.6026 (7.33) |
| Weifang (city 5) | 0.2022 (1.67) | 1.0123 (2.76) | 0.1745 (9.01) |
| Individual FAFH expenditure | | | |
| Grains | – | 1.0123** (0.05) | 0.1745 (0.15) |
| Meats and eggs | 0.6970* (0.11) | – | 1.7325 (20.17) |
| Liquor and beverage | −0.3070* (0.08) | 0.7277 (6.39) | – |
| Observations | 125/746 | 73/746 | 29/746 |
| Pseudo $R^2$ | 0.111 | 0.215 | 0.194 |
| Log likelihood | −608.65 | −402.42 | −201.82 |

Note: Intercept terms were dropped from this table.
[a]In parentheses are standard errors.
*Significant at 1% level and **significant at 5% level.

apart from the effect of income and other factors on demand for grain (meat), rising expenditures on meat (grain) away from home increases the demand for grain (meat).

The other "new" variable in the grain equation, expenditure on liquor, suggests that there is a substitution relationship between grain and liquor. Interestingly, the substitution of grain and liquor is consistent with the tradition in China at meal times (mostly in public places, such as restaurants) that does not encourage the consumption of staples (rice, wheat, or any other grain) until have all diners have finished drinking. If this tradition is effective in shaping demand patterns, one would expect that as the consumption of liquor increases, the demand for grain should fall, which is exactly what we find in the grain equation.

The total and conditional expenditure elasticities with respect to household income are estimated and displayed in Table 7. Like Cornick et al (1994), we only provide the elasticities whose estimates of the parameters from the model in Table 6 are significant (except for the liquor group). It was found that the expenditure elasticities of all three individual food categories are less than unitary.

Even if the total expenditure elasticities from the multivariate Tobit model are lower than those from the univariate Tobit models, it needs to be noted that according to the

Table 7. Expenditure elasticities with respect to household income for food-away-from-home consumption on grains, meats, and liquor in urban China using multivariate Tobit model

| | Total (or unconditional) expenditure elasticity | | Conditional expenditure elasticity | |
|---|---|---|---|---|
| Independents | Elasticity | Standard errors[a] | Elasticity | Standard errors |
| Grains | 0.4430 | 0.1045 | 0.0772 | 0.0182 |
| Age groups | | | | |
| Age $\leq$ 20 | 0.4508 | 0.1064 | 0.0798 | 0.0188 |
| Age 21–35 | 0.4324 | 0.1047 | 0.0757 | 0.0183 |
| Age 36–50 | 0.4413 | 0.1071 | 0.0783 | 0.0190 |
| Location | | | | |
| Changchun | 0.4085 | 0.1011 | 0.0719 | 0.0178 |
| Meats | 0.9788 | 0.1987 | 0.1353 | 0.0275 |
| Location | | | | |
| Changchun | 0.9597 | 0.1978 | 0.1406 | 0.0290 |
| Chengdu | 0.6839 | 0.1803 | 0.1077 | 0.0284 |
| Weifang | 0.5913 | 0.1724 | 0.0931 | 0.0272 |
| Liquor | 0.8491 | 0.4588 | 0.0961 | 0.0519 |

Note: The values in the table are the elasticities of food expenditure away from home with respect to household income by various subfood groups and they are estimated based on the parameters in Table 6 and the means of independent variables. Here, we only calculated the expenditure elasticities for those variables that are significant in Table 6 (except for liquor).

[a]See footnote of Table 5 for definition of elasticities and for estimation procedure for standard errors. Participation elasticities can be calculated as column 1 minus column 3.

results in Table 7, FAFH demand is still responsive to income. For example, the unconditional income elasticity for meat consumption expenditure away from home is close to unity (0.98). A 1% rise in income will generate almost the same percentage rise in meat demand away from home. The unconditional elasticity for liquor is also quite high (0.78). That for grain, however, is lower—only 0.44. Although all of these are smaller than the estimates from univariate-based models of total FAFH, the pattern that the participation elasticities are higher than the conditional expenditure elasticities is consistent. The conditional expenditure elasticities, in fact, are fairly small. Hence, according to the multivariate Tobit model, the main impact of rising income on FAFH demand is through its effect in increasing the participation of new restaurant consumers (the participation elasticities—not shown—are implicitly the difference between the unconditional and conditional ones). Once a consumer has started to eat out, as income rises, the rise in expenditure of FAFH consumption is relatively little.

Importantly, although there are differences in the expenditure elasticities with household income that are calculated from both univariate and multivariate Tobit models, the differences are not so great as to make the two sets of estimates inconsistent. There are two explanations for the differences. First, because the overall elasticity should be something around the weighted average of the individual elasticities, it could be that the total

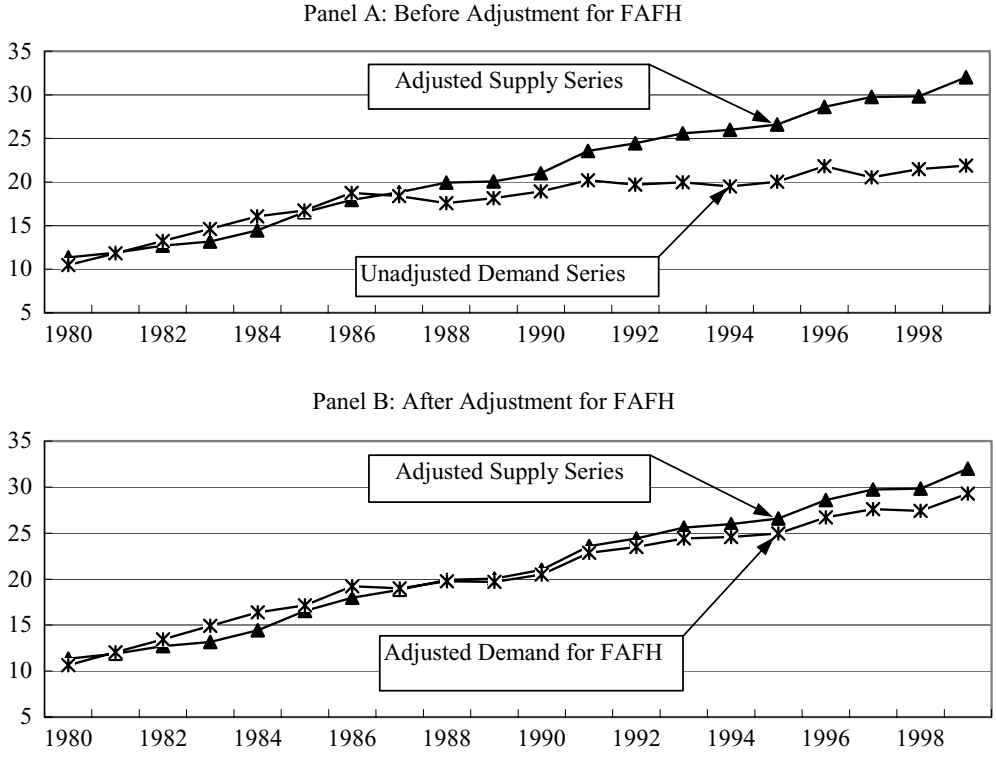
expenditure elasticity of demand for FAFH for the "other foods" category was very high (it would have to be above 3) since expenditure for the "other foods" category accounts for one third of total FAFH expenditure (Appendix). While it is possible that some of the components of other foods, such as the demand for seafood away from home, might have such a high-income elasticity, there also could be a statistical reason. In particular, it could be that another part of the difference between the univariate-based elasticities and the multivariate-based ones is due to bias in the coefficient estimates that are from the univariate Tobit model. The inclusion of expenditures of the food expenditures in the multivariate model (which are not included in the univariate model) may be reducing the size of the coefficient on the income variable (compared to the univariate model) and this may be reducing the size of the elasticity.

Finally, even though the total expenditure elasticities of FAFH with respect to household income are less than one, they are much larger than those for food consumed at home. For example, the total expenditure elasticity of meats consumed away from home (0.98) is much higher than that of meats consumed at home (around 0.6, a number that is the approximate average of those reported in the literature—Huang et al 1999; Cai et al 1998). The 1999–2001 estimates of conditional expenditure elasticities of pork and egg consumption in urban China obtained by Ma et al (2004a,b) using the same data that were used in this study were less than 0.5. The same is true for grain. According to Huang et al (1999), the income elasticity for grain in China is near zero. In contrast, according to our estimates, the total expenditure elasticity for grain consumed away from home is 0.44. This pattern of elasticity, of course, means that the growth of grain and meat consumption will continue to grow as FAFH expenditures continue to rise; at the very least, FAFH will keep food demand from stagnating in a way it would if all consumption was at home.

## RECONCILING CHINA'S LIVESTOCK STATISTICS AND CONCLUSION

In this paper, we have shown the rapid increase of FAFH demand and the factors that appear to be behind the rise. While, during the 1990s, the rapid growth of income has not dramatically increased food consumption in urban China, it generated sharp changes in the patterns of consumption. Specifically, we have seen that both over time and across space, as urban incomes have risen, expenditures on FAFH demand have likewise risen. The multivariate analysis produced consistent results, showing the high response of FAFH demand for meat and liquor to rising incomes. The results also demonstrated that most of the increase in FAFH demand came from the propensity of consumers to begin to eat more frequently in restaurants and other venues as incomes rose.

The highly responsive FAFH demand illustrates the importance of continuing to follow demand patterns and understand consumer behavior. Powerful forces, such as rising income, are not only changing the quantities that consumers demand, but they also change their patterns of consumer diets. The new habits of consumers also have their own effect on the nation's urban environment. The rise of the catering industry has spawned a huge industry and created a highly visible venue in which people are able to meet, entertain themselves, and do business. The industry also provides employment for many poorer workers, many of whom are from rural areas. For leaders wishing to facilitate such changes and other changes that will certainly occur elsewhere in the economy, an understanding of the way that consumers behave is necessary for urban and regional




Note: To see how well FAFH adjustment closes the gap, we compare the adjusted supply series for overstatement with the adjusted demand for FAFH and other errors (e.g., waste) in Panel B.
Source: Reassessing China's Livestock Statistics: Analyzing the Discrepancies and Creating New Data Series (Ma et al 2004b).

Figure 1. Comparisons of adjusted supply, unadjusted demand, and adjusted demand for FAFH statistical series of pork in China, 1980–99 (million metric tons)

planning and long-term decision-making. Our results also should be of interest to food industry analysts who are interested in knowing the socioeconomic factors that define their industry.

The rapid rise of FAFH demand is paralleled by rapidly rising meat demand, and the evidence that we show linking rising income with rapid meat consumption away from home almost certainly helps explain part of the puzzle in China's official statistical series. Since 1990, China's livestock production and meat demand statistics have shown a tendency to being more inconsistent; supply has grown much faster than demand (Figure 1, panel A). In another paper (Ma et al 2004a,b) we demonstrated that the main source of the gap was overstatement of livestock output figures, most likely due to pressures to show rapid economic growth. However, we also argued that part of the problem had to be with demand. One basis for our statement is the fact that demand was fairly stagnant during the 1990s, despite rapid growth of household income. We surmised in the paper that demand also must be understated and suggested that neglect

of the rise in FAFH was one of the main sources of undercounting of meat demand. In this paper, we show that, in fact, meat demand out of the home rose fast during this time, and to the extent that it was not counted (we do not believe it was), the omission of this part of meat demand can explain the statistical anomaly during the 1990s. In fact, when making downward adjustments for supply (see Ma et al 2004a,b) and upward adjustments for demand (adjustments that are consistent with the findings of this paper), the supply and demand series become largely consistent (Figure 1, panel B).

While we have accomplished our original goals in this paper, there are still a number of outstanding questions that deserve further study. It is almost certain that there is a systematic relationship between demand for food at home and demand for FAFH. Our results appear to indirectly show this (hence the adjustments to the data series for meat demand). Further exploration of this relationship is beyond the scope of this paper and would require collection of at home demand by individual. Additional studies are also needed on the supply side of the restaurant industry; knowing the supply is leading the demand or vice versa would be a policy relevant question.

## NOTES

[1]Columns 3 and 4 of Table 1 also imply that increased levels of away-from-home food consumption will increase total food expenditures since the increase of food consumption away from home (1539 − 527 = 1012 yuan) is more than the decrease of at-home food consumption (2061 − 1846 = 215 yuan).

[2]The robust variance estimator is $V = (X'X)^{-1}[\sum_{i=1}^{n_c}[u_i'u_i]](X'X)^{-1}$, where $u_i = \sum(e_{ij}x_{ij})$ is the variance of the $i$th household (or cluster), $j$ indicates individual in the $i$th household, and $n_c$ is the number of households (or clusters). This method, in part, accounts for unobserved household-specific effects that are correlated among individuals within each household.

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Appendix. Descriptive sample statistics for three-day survey period for variables used in regression estimation

| | Full sample | | Consuming | | Nonconsuming | |
|---|---|---|---|---|---|---|
| Variables | Mean | SD | Mean | SD | Mean | SD |
| Continuous variables | | | | | | |
| FAFH expenditure | 4.33 | 13.91 | 12.65 | 21.13 | – | – |
| Grain FAFH (#) | 0.91 | 3.468 | 1.93 | 3.50 | – | – |
| Meat FAFH (#) | 1.22 | 4.28 | 4.40 | 9.50 | – | – |
| Liquor FAFH (#) | 0.96 | 11.22 | 2.85 | 3.92 | – | – |
| Other FAFH (#) | 1.58 | 8.72 | 3.47 | 8.66 | – | – |
| Household income monthly | 1,467 | 627 | 1,594 | 629 | 1,398 | 615 |
| Education (years) | 9.05 | 4.3 | 8.91 | 3.87 | 9.13 | 4.51 |
| Age (years) | 33.2 | 17.2 | 31.5 | 14.8 | 34.1 | 18.3 |
| Dummy variables (yes = 1, no = 0) | | | | | | |
| Age $\leq$ 20 years old | 0.29 | 0.45 | 0.27 | 0.44 | 0.29 | 0.46 |
| Age 21–35 years old | 0.22 | 0.41 | 0.27 | 0.45 | 0.19 | 0.39 |
| Age 36–50 years old | 0.37 | 0.48 | 0.39 | 0.49 | 0.36 | 0.48 |
| Age $\geq$ 51 years old | 0.12 | 0.33 | 0.06 | 0.25 | 0.15 | 0.36 |
| Male individual | 0.49 | 0.50 | 0.55 | 0.50 | 0.46 | 0.50 |
| Head of household | 0.34 | 0.47 | 0.44 | 0.50 | 0.28 | 0.45 |
| White-collar worker | 0.36 | 0.48 | 0.41 | 0.49 | 0.33 | 0.47 |
| Location | | | | | | |
| Changchun | 0.21 | 0.40 | 0.06 | 0.25 | 0.28 | 0.45 |
| Chengdu | 0.22 | 0.41 | 0.16 | 0.37 | 0.24 | 0.43 |
| Feixian | 0.21 | 0.41 | 0.34 | 0.47 | 0.14 | 0.35 |
| Jiangjin | 0.20 | 0.40 | 0.22 | 0.42 | 0.19 | 0.39 |
| Weifang | 0.17 | 0.38 | 0.21 | 0.41 | 0.15 | 0.35 |
| Observation | 746 | | 263 | | 483 | |

Note: FAFH expenditure and income are measured in Chinese currency (yuan).
Source: Compiled from urban food consumption survey conducted by Center for Chinese Agricultural Policy of Chinese academy of Science and Center for Agricultural Rural Development of Iowa State University in 1998.