Dietary Diversity in Urban and Rural China: An Endogenous Variety Approach

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Abstract. In the canonical consumer demand problem, an agent makes a decision about quantities to consume, under the assumption that all possible varieties are available and can be accessed at zero cost. Quantities of each budget item are adjusted to achieve maximum utility subject to the budget constraint. As a result, utility and expenditure reflect aggregations of quantity and, implicitly, variety. In reality, the cost of accessing variety may not be zero. In this paper we study the consumer's choice problem using an endogenous variety approach, allowing variety access cost to influence consumption. We develop a conceptual framework for the problem and test its predictions empirically by comparing patterns of dietary diversity over time among a large sample of urban and rural Chinese consumers. We find that access costs, reflecting differences in infrastructure and household storage technologies, influence dietary diversity.
Keywords: dietary diversity, rural-urban difference, variety access cost
JEL Codes: D12, D13, I10, Q18, R22

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1. Introduction

Standard consumer theory regards quantities as choice variables. Utility maximization produces the consumer's optimal choice of quantity as a function of prices and income. Expenditure allocation assures equalized price-weighted marginal utilities, which are implicitly quantity-based measurements. More correctly, however, both utility and expenditure should be thought of as aggregations of quantities and varieties. Consumers gain satisfaction not only because "more is better," but also because "variety is the spice of life." When variety is costless, the consumer's budget implicitly constrains not only the quantity of goods consumed, but also the diversity of goods consumed.

Our interest in this paper is the demand for variety, in particular the diversification of diet. Understanding variety in food consumption is important in several respects. First, higher dietary diversity is correlated with improved nutritional adequacy and a lower risk of mortality (Kant et al., 1993). Second, apart from these health consequences, research has shown that consumers have a preference for variety, and are willing to pay extra for the potential welfare-enhancing aspects of variety (Kahn, 1995; Drescher et al., 2008). Third, from a macroeconomic point of view, expanding the consumption set may have far-reaching effects on the process of long-run growth and development (Feenstra 1994; Broda and Weinstein, 2006, 2010). And finally, understanding diversification in food demand can be particularly important to understanding the evolution and structure of food marketing systems (Reardon et al., 2003; Pingali, 2007).

To examine demand for variety we construct a model in which a representative agent maximizes the utility of her consumption by selecting the optimal level of variety as a function of preference and the cost of variety-seeking. To test the predictions of the model we use individual, household and community data, including dietary data, provided by several rounds of the China Health and Nutrition Survey (CHNS). A descriptive analysis of dietary diversification in rural and urban sub-samples of the CHNS suggests two stylized patterns. First, individual food baskets are more diverse, on average, among urban consumers than among their rural cohorts, regardless of whether one measures diversity in terms of the total number of food items or in terms of consumption shares. Second, individual diets among the sample respondents have tended to become more diverse over time, in both urban and rural areas. This diversification coincides with rising household income during the period covered by the data. However, regression analysis shows that, even after controlling for income, urban residents on average consume more diverse diets than do their rural counterparts, which suggests that some force other than income is driving this pattern. Our findings provide insights into regional differences in dietary diversity, and why these might exist. Results suggest that a higher cost of access, driven by lower availability, higher transaction costs of seeking and obtaining variety, and limited access to improved food storage, adds a marginal cost to the market price of variety and creates friction in the individual's ability to diversify her diet.

2. Consumer demand for variety

Traditional modeling of consumer choice, based on strict convexity, implies an inherent preference for variety, as reflected by the indifference contours that are asymptotic to the axes and bowed toward the origin (Lancaster, 1990). The variety of the feasible consumption bundle is taken as exogenous. Consumers can access all available varieties at no cost beyond the price of the good (Deaton and Muellbauer, 1980). In the traditional model, the quantity of each good, rather than the composition of varieties, is adjusted to achieve maximum utility. Despite the popularity of this approach, however, the assumption that variety is costless is at odds with evidence (Bell et al., 1998). The u-shaped relationship between marginal cost (MC) and variety consumed reflects limits on time and resources, while the inverted u-shaped relationship between marginal benefit (MB) and variety reflects the diminishing marginal utility of variety. As a result, equilibrium occurs where the upward sloping MC curve for variety intersects the downward sloping MB curve. At the optimum, the consumer ends up with some but not all varieties.

In an attempt to address issues of variety, Jackson (1984) formally introduced the concept of hierarchical demand. He demonstrates how only a subset of all goods available is actually consumed and how the variety of goods purchased increases with income. A series of country-specific studies confirm Jackson's finding, and further identify the principal determinants of dietary diversity in addition to food expenditure. Thiele and Weiss (2003) show that in Germany diversity in food purchases is significantly related to characteristics of the household. Several other studies confirm the importance of household characteristics and extend analysis to other influencing factors. For example, Torheim et al. (2004) report an association between isolation and less varied diets in Mali. Thorne-Lyman et al. (2010) use data from Bangladesh to show that a dietary diversity score is positively correlated with land ownership. In a different study from Bangladesh, Rashid et al. (2011) identify food price and agricultural cycle as crucial determinants of dietary diversity. And for India, Bhagowalia et al. (2012) examine the nexus of agricultural production, diets, and nutrition in children. They find that production conditions – including irrigation, livestock ownership, and crop diversification – substantially influence household dietary diversity. A recent study by Drescher and Goddard (2011), however, emphasizes the variable effects of social-economic characteristics at other points of the distribution of dietary diversity than at the mean. And another study considering the asymmetric response of eating behavior to economic status finds that dietary knowledge affects mainly the quantity of diet when the expected food availability (EFA) is increasing, while the quality is affected when the EFA is decreasing (Shimokawa, 2013) .

Most of these studies share a common interest in the role of particular household socio-economic characteristics such as income, household size, age, sex composition, employment status, education level of the household head and agricultural productivity, but do not directly explore the idea that the cost of access to variety and the technology-related cost of seeking and accessing additional variety may be determined by the setting in which consumers make choices. These costs are not normally independent of household characteristics and, as a result, their omission may bias conclusions regarding the determinants of dietary decisions. As for the geographical scope of investigations, studies of Chinese consumers are somewhat rare. Exceptions include Kim et al. (2003) who construct a Diet Quality Index-International (DQI-I) to assess diet quality (including variety) but do not account for regional distinctions, and Li et al. (2009) who compare rural-urban DQI-I but focus on differences among families with and without youth. Liu et al. (2012) investigate urban–rural nutritional disparities, but do not include all food categories of food and study the status of children only.

A second branch of the literature focuses on why consumers might exhibit a taste for variety. Early discussions of consumer behavior (e.g. Howard and Sheth, 1969) suggest that individuals transit through a pattern of search among goods until a suitable good is found, and repeat the purchase until some exogenous shock breaks the routine and leads to a return to search behavior. Consumers may seek variety because of intrinsic stimuli, such as a self-generated desire for change, as in McAlister and Pessemier (1982), or because of inherent uncertainty regarding current or future preferences, as in Walsh (1995). On the other hand, extrinsic stimuli such as environmental change, promotion, word-of-mouth and external constraints also contribute to patterns in which consumers may be willing to try out new things (Howard and Sheth, 1969; McAlister and Pessemier, 1982). In such models the degree of variety-seeking is associated with characteristics or categories of goods (Adamowicz and Swait, 2012). Goods that are characterized by less concentrated market share distribution, more frequent replenishment rates and lower unit prices (implying smaller consequences of misjudgments) are more likely to expand the set of available and revealed choices. In addition, how variety is purchased – the "variety cycle" – matters. Those who make fewer trips to satisfy their demand for variety than to complete their quantity demand are less variety-seeking than those who contemplate two demands at the same time (Berne and Mugica, 2010).

3. Conceptual Model

Our conceptual model arises from a standard utility maximization problem. A representative consumer has constant elasticity of substitution (CES) preferences, and chooses the optimal consumption bundle {q} given a budget constraint *Y*:

$$\max_{q_i}\left(\int_0^N q_i^{\frac{\sigma-1}{\sigma}}\,di\right)^{\frac{\sigma}{\sigma-1}} \tag{1}$$

$$s.t.\int_0^N p_i q_i\,di \le Y$$

(1)

where $\sigma > 1$ is the elasticity of substitution. p_i and q_i are the price and quantity of consumed variety i, defined over [0, N], the range of the entire continuum variety set. Solving this maximization problem yields a set of Marshallian demands:

$$q_i = \frac{Y}{p_i}\left(\frac{p_i}{P}\right)^{1-\sigma} \tag{2}$$

where $P(\{p_i \mid i \in N\}) \equiv \left(\int_{i\in N} p_i^{1-\sigma} di\right)^{\frac{1}{1-\sigma}}$ is the CES price aggregator. The expenditure required to reach the maximized utility U^* can be written as:

$$Y(U^*, \{p_i \mid i \in N\}) = U^* P(\{p_i \mid i \in N\}). \tag{3}$$

We modify the model to incorporate the cost of accessing variety and solve for optimal variety (instead of optimal quantity). As defined, access cost (*A*), which is composed of fixed and variable cost, is a function of varieties, but not necessarily quantities. Li (2011) expresses *A* as an exponential function of the number of varieties actually consumed (*n*) scaled by the factor *F*:

$$A(n) = Fn^{\varepsilon}. \tag{4}$$

This specification implies the simplified assumption that *F* affects all consumers symmetrically. However, it seems reasonable to assume that consuming variety involves an increase in cost due to search, matching, substitution, storage and preparation. Such costs may vary widely across consumers for many reasons, including household-specific characteristics (such as productivity) or location-specific factors. Accordingly, we relax the restriction on *F* and allow it to be influenced by household and community characteristics, represented by *Z*:

$$A(n) = F(Z)n^{\varepsilon}. \tag{5}$$

We can then write the new budget constraint as:

$$s.t. \int_{i \in N} p_i q_i di + F(Z) n^{\varepsilon} \leq Y \,. \qquad (6)$$

If one further assumes that prices follow an exponential distribution given by $p_i = p \left\{ [\psi(\sigma - 1)]^{\frac{1}{1-\sigma}} \right\} i^{\frac{1}{\theta}}$,

the CES price aggregator simplifies to:

$$P(n) = pn^{-\psi}, \quad \psi \equiv \frac{1}{\sigma - 1} - \frac{1}{\theta} \,. \qquad (7)$$

One can think of p as the level determinant of prices, and $\frac{1}{\theta}$ as a relative price shifter for marginal varieties. Closely following Li (2011), equations (5), (6) and (7) can be used to rewrite the utility maximization problem as:

$$\max_n \left(\frac{Y - F(Z) n^{\varepsilon}}{pn^{-\psi}} \right), \qquad (8)$$

where the budget constraint is implicitly embedded in equation (8). Analogous to equation (4) in Li (2011), our first-order condition with respect to variety n implies an equating of marginal benefit and marginal cost:

$$\underbrace{\log(\frac{Y}{p}) + \log(\psi) + (\psi - 1)\log n}_{MB} = \underbrace{\log(\frac{F(Z)}{p}) + \log(\psi + \varepsilon) + (\psi + \varepsilon - 1)\log n}_{MC} \,. \qquad (9)$$

The second-order condition for an interior solution is satisfied for a positive ε by:

$$\frac{1}{n}\left[(\psi - 1) - (\psi + \varepsilon - 1)\right] = -\frac{\varepsilon}{n} < 0, \forall \varepsilon > 0 \,. \qquad (10)$$

It follows that the optimal choice of variety n^* is:

$$n^* = \left[\frac{Y\psi}{F(Z)(\psi + \varepsilon)} \right]^{\frac{1}{\varepsilon}} . \qquad (11)$$

This solution suggests two testable hypotheses. First, since $\partial n^*/\partial Y > 0$, one would expect to find wealthier people consuming more varieties than their poorer cohorts, other things equal. Second, because $\partial n^*/\partial F(Z) < 0$, higher costs of access generate friction in a consumer's ability to consume variety. We now turn to an empirical investigation of these conjectures in the context of our sample.

4. Empirical Strategy

4.1 Method

Following equation (11), we parameterize the empirical model to test the extent to which variety is correlated with income and cost of access, while controlling for potential confounders. Our main regression equation is:

$$V = \gamma_0 + Y\gamma_1 + Y^2\gamma_2 + A\gamma_3 + X\gamma_4 + \Phi\gamma_5 + u_1 . \tag{12}$$

In this cross-sectional study, the dependent variable V is a measurement of variety. To measure variety, we use both the count of varieties and a set of three indices derived from a three-day average of the number of items consumed by an individual. Y represents observed annual household income in thousand CNY. A is the cost of accessing variety, which we assume to be a linear function of the distance to the nearest market, community population density, the number of restaurants per capita in a community, and a set of dichotomous variables indicating the presence of a bus stop in the neighborhood, refrigerator ownership, and household transportation ownership. X is a set of demographic variables including covariates that specify the timing of the survey; Φ is a set of binary indicators for province of household residence.

4.2 Measurement of dietary diversity

In the nutritional literature, count measures are frequently applied, whereby the number of consumed food items and food groups is recorded (Kant et al. 1991, 1993; Drewnowski et al. 1997; Krebs-Smith et al. 1987). These indices, although handy for interpretation, have several important disadvantages: they do not account for the distribution of individual food quantities, and they cannot distinguish whether observed variety results from the addition of healthy or unhealthy products to the diet (Drescher et al., 2007).

Moving beyond this simple indicator of quantity, dietary diversity can be measured by the composition of food consumption. Three indices have been used as standard measurements of diversity in the literature (Lee and Brown, 1989; Theil and Finke, 1983; Jekanowski and Binkley, 2000). These are Entropy (E), the Simpson Index (SI) and the Cumulative Share (CS). The basic idea behind each of these measurements is that maximum diversity occurs when consumption shares are equally distributed among varieties. Entropy is defined as a function of the consumption share w_i :

$$E = \sum_{i=1}^{n} w_i \log(\frac{1}{w_i}), \tag{13}$$

where high diet diversity corresponds to a large index value of *E*. A maximum of $\log n$ is reached when consumption is evenly distribution across all varieties. *SI* is computed as one minus the Herfindahl index, a commonly used measure for market concentration:

$$SI = 1 - \sum_{i=1}^{n} w_i^2 \,. \tag{14}$$

SI varies from zero (when a single item is consumed) to a maximum of $1-\frac{1}{n}$ (when all shares equal $\frac{1}{n}$). *CS* provides an indirect indicator of diversity derived from the shape of the cumulative distribution of consumption shares. If consumption is sufficiently diverse, shares follow a uniform distribution. At the other extreme, if consumption is highly concentrated, the cumulative distribution of consumption shares, based on a ranking of shares from highest to lowest, is highly skewed to the left.

4.3 Data

Our data come from the China Health and Nutrition Survey (CHNS), an ongoing open cohort study designed to measure how the social and economic transformation of Chinese society is affecting the health and nutritional status of its population. The study population is drawn from nine provinces of China. [1] A multistage, random cluster process is used to draw the sample in each province.[2] Eight survey waves were conducted over the period 1989-2009.[3] During each wave, nutrition intake data were collected via three consecutive 24-hour dietary recalls. For this analysis, each food code is treated as an individual food variety. The unit of analysis is an adult household member[4]. All variables are described in Table 1.

We first use the longitudinal data to examine the overall average number of items eaten by rural and urban consumers. As illustrated in the left-hand panel of Figure 1, urban residents, on average, always reported consuming a more diverse diet than their rural cohorts. Moreover, daily consumption exhibits increasing diversity over time. This is consistent with evidence reported by Hovhannisyan and Gould

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[1] They are Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Liaoning, and Shandong.

[2] Counties in the nine provinces were stratified by income (low, middle, and high). A weighted sampling scheme was used to randomly select four counties from each province. Villages and townships within counties and urban/suburban neighborhoods within the cities were selected randomly. See http://www.cpc.unc.edu/projects/china/about/design/survey for details of the survey design and sampling methods.

[3] Survey years were 1989, 1991, 1993, 1997, 2000, 2004, 2006 and 2009.

[4] A household may be represented multiple times in the dataset depending on the number of adults residing in the household. Table 1 reports the mean, minimum and maximum household size. Our regression results are invariant in sign, magnitude and significance to whether we conduct the analysis using all household members or a random draw of one member from each household. We report results for the full sample.

(2013), who argue that Chinese food preferences have undergone a structural change. These patterns coincide with the observation that annual household incomes were higher, on average, in urban areas and that household income gradually increased over the past two decades in both regions (middle panel of Figure 1). The pattern is consistent with previous findings about the role of income in variety consumption. Interestingly, if we regress an indicator of each individual's dietary variety on household income, while controlling for time period, location (urban/rural) and their interaction, we find that the variety gap between urban and rural diets grows larger over time. This suggests that outcomes are being driven by forces other than income. This estimated urban effect is plotted in the right-hand panel of Figure 1.[5] Such an observation reinforces findings of Hovhannisyan and Gould (2013) who argue that urban Chinese consumption has been becoming more expenditure-elastic due both to increased availability of food (in greater variety) and to consumers' gradual switch to higher quality food.

In Figure 2 we use diet data observed for individuals in 1989 (at the start of the CHNS survey) and 2009 (the most recent round available to us) to illustrate the overall pattern of changing consumption at the individual level. Figure 2 displays the bivariate kernel density contours of the number of items consumed daily for this panel of individuals, separated into urban and rural samples. In both plots, the majority of observations lie above the 45 degree line, indicating that most people were consuming more items per day in 2009 than in 1989. In addition, the tighter density of contour lines in the rural sample corresponds to the steeper slope of the rural density function, suggesting that dietary diversity is more homogeneous and has been evolving more slowly in rural areas.

Next we use cross-sectional CHNS data from 2006 to compare the composition of rural and urban diets. Figure 3 plots the distribution of food consumption, organized by USDA food pyramid categories. Compared to urban diets, rural diets are more concentrated on grains and vegetables, and exhibit less consumption of fruit, meat and dairy products. These latter commodities are predominantly subject to

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[5] The regression equation is $n = \alpha_0 + \alpha_1 Income + \alpha_2 Year + \alpha_3 Urban + \alpha_4 Year \cdot Urban + u$. The right-hand panel in Figure 1 is a scatter plot of $\hat{\alpha}_3 + \hat{\alpha}_4$.

spoilage and characterized by higher prices, higher storage costs, or both. To obtain a quantitative evaluation of the degree of dietary diversity, we measure dietary diversity using the three methods outlined above in section 4.2. The share w_i is calculated in two different ways, based on weight[6] and based on category.[7] We use the shares to compute the overall average level of three indices – *E, SI* and *CS* – for the rural and urban sub-samples, respectively.[8] These index values are reported in in Table 2, where a larger number indicates a higher level of diversity. Urban diets exhibit greater diversity, regardless of the metric used.

5. Results

In tables 3-5 we report separate regression results for rural and urban sub-samples. To check the robustness of results to differences in samples, we run regressions separately for the 2004 and 2006 samples. In all instances we correct for heteroskedasticity using the heteroskedastic-consistent-covariance matrix estimator (HCCME). Model 1 is a parsimonious regression in which we consider only demographic and survey timing effects. Models 2 and 3 add to this basic regression sets of control variables for household and environment characteristics.

Comparing results from Model 1, we see that men consume greater variety than women in rural areas but not in urban areas, perhaps reflecting greater calorie consumption in conjunction with labor-

[6] For example, if two items weighing exactly the same amount were consumed, their shares will be 1/2 each.

[7] Seven categories are defined by the USDA food pyramid. These are grains, vegetables, fruits, meat/poultry/seafood, dairy, snacks, beans/eggs/nuts. If the consumer consumes one item from each category, each category share will be 1/7.

[8] We first rank the two types of shares in descending order, and compute the sum of shares at a level representing approximately 75% of total consumption. We then count the number of items that contribute to this cumulative share of 75%. A larger number of counts indicates a higher degree of diversity.

intensive farm work in rural areas.[9] Education is positively correlated with diet diversity, not only because education improves one's knowledge regarding health and nutrition, but also because education lowers the cognitive cost associated with consuming variety (Gronau and Hamermesh, 2008; Adamowicz and Swait, 2012). Married people tend to consume greater variety, perhaps because responsibility for other family members leads to a wider variety of diet items in the household. We find that reported diversity is sensitive to the recall period. If the relevant diet recall period included a weekend, more items were consumed among urban residents. When surveys took place during the months of August, September and October, greater diversity was reported by rural residents, most likely because these months correspond to harvest periods.[10]

Moving to Model 2, we find that richer people consume more items. The relation between income and variety is not linear, however, because consumption is subject not only to expenditure constraints, but also to calorie constraints. Even though greater levels of expenditure can substantially diversify diet at low levels of expenditure, at higher levels of expenditure a marginal expenditure can adjust variety only slightly, if at all, once a satisfactory level of diversity has been reached. Not surprisingly, larger household tends to consume more items per day. Refrigerator ownership is positively correlated with indicators of dietary variety, probably because consumers who own a refrigerator can buy a large quantity and/or variety, smooth out consumption, and reduce shopping frequency. Owning some form of transportation tends to facilitate shopping by reducing the per-trip cost of shopping (both in terms of time and in terms of monetary cost). Transportation also increases the maximum number of groceries the buyer can carry. Both of these features contribute to greater variety in consumption. Finally, some households, especially those in rural areas own farms where they can grow vegetables and raise livestock to replace or

[9] Also, in some rural areas it is traditional to give males highest priority at meal times.

[10] The survey period includes August (wave 1), September (wave 2), October (wave 3), November and December (wave 4). We combine the last two months into one wave, because very few interviews were done in December. Wave 4 serves as the base case in the regressions.

supplement purchased food with self-produced food. This "farm" effect is likely to be negative because variety is limited by farm size, season, and agronomic constraints. Self-sufficient households do not benefit from the wide variety of items provided by the market.

Model 3 adds community characteristics to Model 2. All have the expected signs and most point estimates are individually significant at standard test levels.[11] Not surprisingly, dietary diversity is linked to population density: cities may provide a word-of-mouth effect (external stimulus), lower prices for consumer goods after controlling for store amenities, and larger differences in the number of varieties available (Handbury and Weinstein, 2011). All allow individuals to more cheaply substitute among travel destinations. Restaurant dining usually involves a larger number of items due to the options provided by a restaurant menu (Binkley, 2008). At higher densities, travel distance to a restaurant is shortened, increasing the frequency of dining out. Greater variety choice also allows consumers to choose the particular one they like from a larger set. The presence of public transportation and local markets are both positively correlated with diet variety, in reflection of the improved access they provide.[12]

6. Concluding remarks

In this article, we examined how dietary diversity differs between rural and urban consumers, and identified a set of factors associated with observed differences. Given that access to more varieties is not costless, high access cost prevents consumers from accessing more varieties. We test this hypothesis

[11] Adding community characteristics improves model fitting less than the inclusion of household characteristics. Furthermore, results from an F-test suggest rejecting at standard test levels the hypothesis that the community variables are jointly insignificant.

[12] We use distance to the nearest farmer's market as our proxy in the urban sample, and distance to the nearest supermarket in the rural sample. The logic in so doing is that because super markets are more commonly seen in cities, proximity to a different type of market (not a redundant option) should provide more consumption opportunities. The opposite argument applies in a rural setting.

empirically using individual food diary data from China and find that variety consumed is positively correlated with household and community characteristics that lower the cost of accessing different food items. We show that dietary diversity has been evolving in both rural and urban China, in line with growth in income and food availability.

Since the beginning of this century, the Chinese government has launched a series of policies aimed at accelerating rural development. These include promotion of township and village enterprises to raise income and boost infrastructure development (especially roads and rural electrictrification). Our findings suggest that these development policies, although not explicitly targeted at improving eating behavior, may affect not only food security but also diet quality. Over time, consumers in rural areas may face difficulties keeping pace with their urban cohorts with respect to diet diversification, in part due to differences in access to food storage technologies and infrastructure. Nevertheless, a growing wedge between diversity of rural and urban diets need not translate directly into larger welfare or nutritional gains among urban consumers, since marginal welfare changes depend on underlying nutritional profiles and needs, as well as the nutritional quality of food items being added to individuals' diets. Further progress demands a precise definition and measurement of *healthy* food diversity, which considers not only number and distribution of food items, but also the health and nutrition value of consumed varieties. Such an investigation is the subject of ongoing research.

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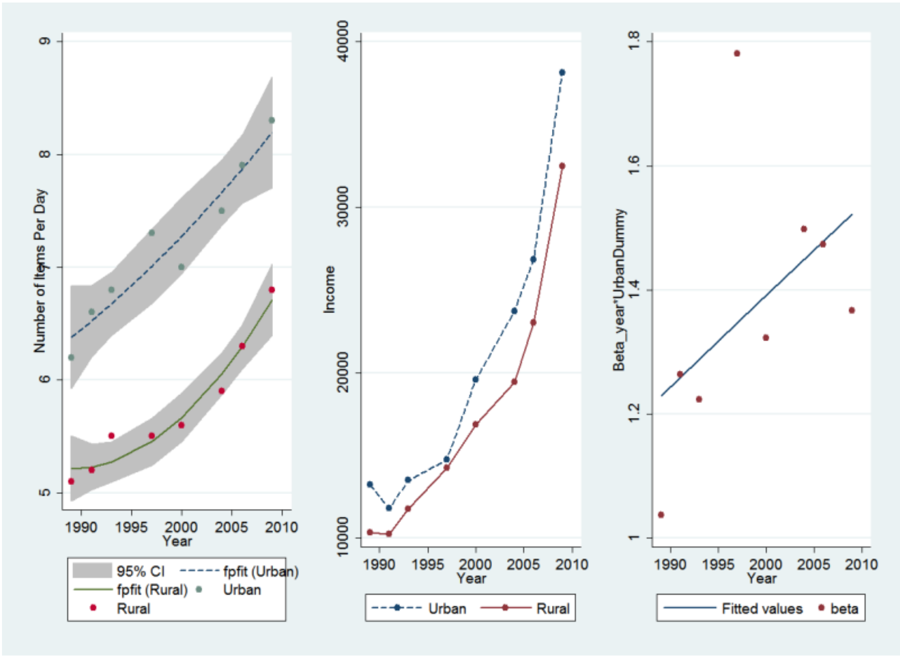

Figure 1. Trend of dietary diversity and household income, 1989-2009.

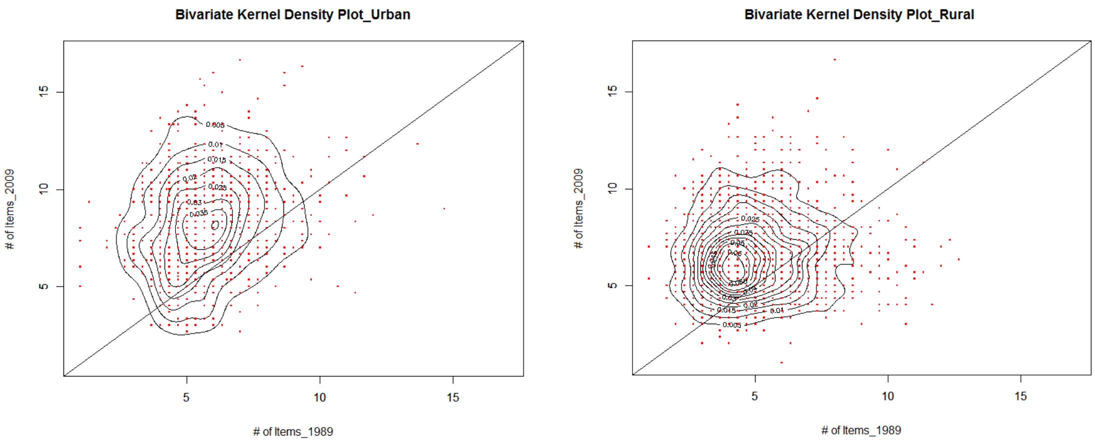

Figure 2. Bivariate kernel density contours of daily items consumed

Figure 3. Distribution of consumption by food category

Table 1: Summary statistics (2006)

	Urban				Rural			
	Mean	Std	Min	Max	Mean	Std	Min	Max
Number of Item Consumed/Day	10.413	2.699	1.667	19.667	9.019	2.352	3.333	19.333
Age	49.383	15.835	18	95	48.679	14.719	18	96
Female	0.528	0.499	0	1	0.524	0.499	0	1
High School	0.341	0.474	0	1	0.157	0.364	0	1
Married	0.806	0.396	0	1	0.858	0.349	0	1
HHINC (thousand CNY)	33.944	33.869	0.005	251.093	24.993	30.495	0.103	460.617
$HHINC^2$	2298.76	5973.742	0	63047.523	1554.268	8366.334	0.011	212167.594
HHSIZE	3.444	1.382	1	10	3.878	1.712	1	14
Refrigerator	0.694	0.461	0	1	0.396	0.489	0	1
Transportation Tool	0.699	0.459	0	1	0.784	0.412	0	1
Population Density ($1000/km^2$)	4.836	6.208	0.001	24.213	1.388	2.074	0.016	14.317
Restaurants (per 1000 people)	3.932	5.834	0	30.075	5.028	7.902	0	48.157
Bus Stop	0.811	0.392	0	1	0.662	0.473	0	1
Distance to Market (km)	0.776	1.238	0	6	10.372	12.863	0	60.5
Weekend	0.562	0.496	0	1	0.570	0.495	0	1
Survey Wave 1	0.082	0.275	0	1	0.065	0.246	0	1
Survey Wave 2	0.45	0.498	0	1	0.393	0.489	0	1
Survey Wave 3	0.387	0.487	0	1	0.377	0.485	0	1
Home Farming	0.228	0.42	0	1	0.691	0.462	0	1

Table 2: Alternative measurement of dietary diversity (2006)

Region		Entropy	Simpson	Cumulative Share
Rural	Weight share	2.00	0.81	6.87
	Category share	1.22	0.66	1.77
Urban	Weight share	2.33	0.86	10.45
	Category share	1.38	0.71	2.28

Table 3: Number of items as dependent variable (left: 2004, right: 2006)

	Urban			Rural		
	(1)	(2)	(3)	(1)	(2)	(3)
Age	-0.0049	0.00025	0.00067	-0.0021	0.0022	0.00076
	(-1.45)	(0.07)	(0.19)	(-0.81)	(0.83)	(0.29)
Female	-0.030	-0.044	-0.040	-0.15	-0.20**	-0.21**
	(-0.30)	(-0.45)	(-0.41)	(-1.95)	(-2.71)	(-2.87)
High School	0.95***	0.69***	0.69***	0.93***	0.44***	0.38***
	(8.60)	(5.87)	(5.82)	(8.29)	(3.95)	(3.39)
Married	0.53***	0.39**	0.39**	0.42***	0.34***	0.35***
	(4.02)	(3.03)	(3.01)	(4.13)	(3.44)	(3.59)
Weekend	0.25*	0.26*	0.32**	0.020	0.23**	0.32***
	(2.27)	(2.44)	(2.68)	(0.24)	(2.85)	(3.95)
Survey Wave 1	-2.27***	-1.47***	-1.25***	2.21***	2.06***	3.83***
	(-6.04)	(-4.59)	(-3.65)	(8.12)	(7.85)	(8.23)
Survey Wave 2	-0.50***	-0.22	-0.048	0.54***	0.79***	0.72***
	(-3.30)	(-1.47)	(-0.31)	(3.31)	(4.75)	(4.21)
Survey Wave 3	-0.72***	-0.53***	-0.38*	0.49***	0.58***	0.64***
	(-4.95)	(-3.72)	(-2.19)	(3.84)	(4.29)	(4.76)
HHINC (thousand CNY)		0.018***	0.015**		0.019***	0.019***
		(3.62)	(3.14)		(3.90)	(3.82)
HHINC2		-0.00010***	-0.000089**		-0.000072	-0.000064
		(-3.34)	(-2.94)		(-1.78)	(-1.59)
HHSIZE		0.18***	0.19***		0.10***	0.11***
		(3.97)	(4.33)		(3.32)	(3.75)
Refrigerator		0.83***	0.80***		0.42***	0.24**
		(6.66)	(6.48)		(4.80)	(2.66)
Transportation Tool		0.30*	0.27*		0.28**	0.27**
		(2.46)	(2.20)		(2.91)	(2.82)
Home Farming		-0.39*	-0.016		-0.70***	-0.29**
		(-2.49)	(-0.09)		(-8.00)	(-3.09)
Population Density (1000/km^2)			0.00041			0.024***
			(0.18)			(3.40)
Restaurants (per 1000 people)			0.0066			0.014**
			(1.17)			(3.16)
Bus Stop			0.21			0.29**
			(1.47)			(3.02)
Distance to Market (km)			-0.019***			-0.030***
			(-4.57)			(-7.18)
Constant	8.29***	6.64***	6.46***	4.76***	4.28***	4.18***
	(29.30)	(19.23)	(17.39)	(17.89)	(14.58)	(14.48)
Observations	2485	2485	2485	2887	2887	2887
Adjusted R^2	0.287	0.322	0.328	0.157	0.220	0.254

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Urban			Rural		
	(1)	(2)	(3)	(1)	(2)	(3)
Age	0.0031	0.0067	0.0042	-0.012***	-0.0040	-0.0032
	(0.85)	(1.80)	(1.15)	(-4.06)	(-1.29)	(-1.03)
Female	-0.027	-0.027	-0.039	-0.31***	-0.32***	-0.32***
	(-0.25)	(-0.26)	(-0.39)	(-3.68)	(-3.95)	(-4.00)
High School	0.69***	0.36**	0.27*	0.52***	0.22	0.21
	(5.76)	(2.87)	(2.16)	(4.06)	(1.70)	(1.63)
Married	0.62***	0.46***	0.48***	0.33**	0.16	0.14
	(4.64)	(3.50)	(3.71)	(2.60)	(1.31)	(1.16)
Weekend	0.58***	0.58***	0.42**	-0.24**	-0.050	0.046
	(4.37)	(4.42)	(3.07)	(-2.65)	(-0.54)	(0.50)
Survey Wave 1	-0.67*	-0.57	-0.44	-0.33	-0.23	-0.069
	(-2.08)	(-1.78)	(-1.23)	(-0.99)	(-0.66)	(-0.20)
Survey Wave 2	0.17	0.19	0.18	1.12***	0.99***	0.93***
	(0.65)	(0.76)	(0.59)	(7.20)	(5.94)	(5.50)
Survey Wave 3	-0.20	-0.32	-0.20	1.54***	1.43***	1.48***
	(-0.84)	(-1.34)	(-0.72)	(8.71)	(7.67)	(7.76)
HHINC (thousand CNY)		0.016***	0.016***		0.0096***	0.0098***
		(4.05)	(4.12)		(3.88)	(3.92)
HHINC2		-0.000074***	-0.000075***		-0.000030***	-0.000031***
		(-3.59)	(-3.68)		(-4.71)	(-4.75)
HHSIZE		-0.0051	0.0051		0.15***	0.14***
		(-0.12)	(0.13)		(4.87)	(4.88)
Refrigerator		0.90***	0.81***		0.45***	0.43***
		(7.05)	(6.36)		(4.47)	(4.28)
Transportation Tool		0.67***	0.69***		0.42***	0.42***
		(4.91)	(5.10)		(3.84)	(3.87)
Home Farming		-0.23	0.33		-0.43***	-0.14
		(-1.32)	(1.78)		(-4.07)	(-1.20)
Population Density (1000/km^2)			0.059***			0.052*
			(5.20)			(2.10)
Restaurants (per 1000 people)			0.081***			0.021***
			(7.24)			(4.05)
Bus Stop			0.77***			0.24*
			(3.54)			(2.40)
Distance to Market (km)			-0.14**			-0.014***
			(-2.81)			(-4.07)
Constant	8.11***	7.19***	6.32***	6.78***	5.80***	5.82***
	(20.33)	(16.18)	(10.22)	(21.16)	(16.19)	(14.75)
Observations	2222	2222	2222	2664	2664	2664
Adjusted R^2	0.157	0.198	0.225	0.205	0.243	0.255

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Entropy (based on weight share) as dependent variable (left: 2004, right: 2006)

	Urban			Rural		
	(1)	(2)	(3)	(1)	(2)	(3)
Age	-0.00088	-0.0015**	-0.0016**	-0.00071	-0.00040	-0.00052
	(-1.76)	(-2.97)	(-3.19)	(-1.58)	(-0.91)	(-1.19)
Female	0.028	0.020	0.020	0.017	0.0050	0.0041
	(1.95)	(1.46)	(1.52)	(1.32)	(0.42)	(0.34)
High School	0.18***	0.077***	0.076***	0.21***	0.082***	0.076***
	(12.15)	(5.07)	(5.00)	(11.22)	(4.56)	(4.23)
Married	0.060**	0.048**	0.051**	0.077***	0.070***	0.072***
	(3.03)	(2.60)	(2.83)	(4.27)	(4.18)	(4.32)
Weekend	0.062***	0.065***	0.088***	-0.032*	0.0088	0.015
	(3.77)	(4.27)	(5.29)	(-2.22)	(0.64)	(1.07)
Survey Wave 1	-0.48***	-0.18*	-0.085	0.053	0.028	0.29***
	(-5.62)	(-2.48)	(-1.06)	(0.99)	(0.51)	(3.90)
Survey Wave 2	-0.098***	-0.022	0.018	-0.070**	-0.028	-0.034
	(-4.15)	(-0.98)	(0.82)	(-2.77)	(-1.16)	(-1.40)
Survey Wave 3	-0.084***	-0.058**	0.013	-0.073***	-0.062**	-0.054**
	(-3.62)	(-2.59)	(0.52)	(-3.48)	(-3.12)	(-2.72)
HHINC (thousand CNY)		0.0031***	0.0028***		0.0063***	0.0062***
		(4.86)	(4.43)		(8.22)	(8.04)
HHINC2		-0.000015***	-0.000013***		-0.000026***	-0.000025***
		(-3.92)	(-3.51)		(-4.63)	(-4.38)
HHSIZE		-0.0018	0.00095		-0.0035	-0.0033
		(-0.28)	(0.15)		(-0.66)	(-0.63)
Refrigerator		0.16***	0.15***		0.10***	0.084***
		(8.17)	(8.03)		(7.09)	(5.80)
Transportation Tool		0.018	0.022		0.026	0.027
		(1.04)	(1.29)		(1.67)	(1.73)
Home Farming		-0.23***	-0.15***		-0.16***	-0.13***
		(-9.68)	(-5.88)		(-10.87)	(-7.97)
Population Density (1000/km^2)			-0.0010**			0.00018
			(-3.28)			(0.15)
Restaurants (per 1000 people)			-0.00065			0.0016**
			(-0.81)			(2.62)
Bus Stop			-0.029			-0.020
			(-1.42)			(-1.17)
Distance to Market (km)			-0.0054***			-0.0038***
			(-7.54)			(-5.91)
Constant	2.12***	2.08***	2.13***	1.77***	1.77***	1.79***
	(50.64)	(40.19)	(39.39)	(36.56)	(33.07)	(32.32)
Observations	2485	2485	2485	2887	2887	2887
Adjusted R^2	0.244	0.346	0.367	0.217	0.330	0.338

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Urban			Rural		
	(1)	(2)	(3)	(1)	(2)	(3)
Age	-0.0010*	-0.0016**	-0.0016**	-0.0017***	-0.0010*	-0.00094*
	(-2.03)	(-3.10)	(-3.19)	(-3.68)	(-2.22)	(-2.03)
Female	0.028	0.026	0.025	-0.0032	-0.0092	-0.0100
	(1.89)	(1.81)	(1.79)	(-0.25)	(-0.75)	(-0.83)
High School	0.13***	0.045**	0.037*	0.13***	0.036*	0.034
	(8.15)	(2.67)	(2.25)	(6.70)	(1.96)	(1.89)
Married	0.046*	0.032	0.033	0.083***	0.063***	0.057**
	(2.31)	(1.70)	(1.75)	(4.35)	(3.45)	(3.13)
Weekend	0.098***	0.091***	0.069***	-0.027	0.026	0.041**
	(5.03)	(4.84)	(3.58)	(-1.80)	(1.72)	(2.76)
Survey Wave 1	-0.077	-0.016	0.019	-0.043	0.0086	0.0038
	(-1.58)	(-0.34)	(0.36)	(-0.86)	(0.18)	(0.08)
Survey Wave 2	0.090*	0.13***	0.14**	0.14***	0.12***	0.10***
	(2.33)	(3.60)	(3.21)	(4.26)	(3.86)	(3.52)
Survey Wave 3	0.13***	0.10**	0.12**	0.15***	0.11***	0.10**
	(3.53)	(2.92)	(3.12)	(4.11)	(3.42)	(3.19)
HHINC (thousand CNY)		0.0038***	0.0035***		0.0024***	0.0026***
		(7.19)	(6.78)		(6.62)	(7.07)
HHINC2		-0.000014***	-0.000014***		-0.0000044***	-0.0000050***
		(-5.25)	(-5.38)		(-4.63)	(-5.26)
HHSIZE		-0.019**	-0.018**		0.0063	0.0061
		(-3.20)	(-3.09)		(1.44)	(1.46)
Refrigerator		0.14***	0.11***		0.12***	0.11***
		(7.62)	(6.38)		(7.92)	(7.24)
Transportation Tool		0.026	0.031		0.029	0.038*
		(1.42)	(1.71)		(1.76)	(2.25)
Home Farming		-0.13***	-0.062*		-0.14***	-0.091***
		(-5.32)	(-2.43)		(-8.69)	(-5.28)
Population Density (1000/km^2)			0.00070			0.023***
			(0.47)			(6.54)
Restaurants (per 1000 people)			0.014***			0.000015
			(9.88)			(0.02)
Bus Stop			0.062*			0.046**
			(2.14)			(3.13)
Distance to Market (km)			-0.047***			-0.0016**
			(-5.94)			(-2.70)
Constant	2.02***	2.05***	2.09***	1.99***	1.93***	1.90***
	(36.31)	(33.11)	(24.04)	(31.67)	(30.66)	(28.22)
Observations	2222	2222	2222	2664	2664	2664
Adjusted R^2	0.204	0.278	0.309	0.229	0.308	0.324

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Simpson Index (based on weight share) as dependent variable (left: 2004, right: 2006)

	Urban			Rural		
	(1)	(2)	(3)	(1)	(2)	(3)
Age	0.000050	-0.00012	-0.00013	-0.000073	-0.000094	-0.000099
	(0.51)	(-1.26)	(-1.34)	(-0.74)	(-0.95)	(-0.99)
Female	0.0076**	0.0060*	0.0060*	0.0058*	0.0038	0.0037
	(2.76)	(2.27)	(2.32)	(2.09)	(1.41)	(1.38)
High School	0.029***	0.010***	0.010***	0.035***	0.013**	0.013**
	(10.38)	(3.71)	(3.66)	(8.49)	(3.16)	(3.04)
Married	0.0066	0.0057	0.0064	0.014***	0.014***	0.014***
	(1.75)	(1.60)	(1.82)	(3.51)	(3.70)	(3.70)
Weekend	0.0089**	0.0095**	0.015***	-0.0036	0.0031	0.0037
	(2.76)	(3.12)	(4.39)	(-1.12)	(1.02)	(1.19)
Survey Wave 1	-0.10***	-0.051**	-0.032	0.019	0.017	0.039*
	(-3.98)	(-2.68)	(-1.65)	(1.61)	(1.39)	(2.33)
Survey Wave 2	-0.015***	-0.0024	0.0052	-0.017**	-0.011*	-0.013*
	(-3.47)	(-0.59)	(1.29)	(-3.04)	(-2.10)	(-2.37)
Survey Wave 3	-0.013**	-0.0098*	0.0048	-0.020***	-0.019***	-0.018***
	(-2.96)	(-2.26)	(1.01)	(-4.03)	(-4.07)	(-3.94)
HHINC (thousand CNY)		0.00026*	0.00021		0.0010***	0.0010***
		(2.13)	(1.71)		(5.92)	(5.88)
HHINC2		-0.0000011	-0.00000075		-0.0000040***	-0.0000040**
		(-1.52)	(-1.05)		(-3.33)	(-3.24)
HHSIZE		-0.0020	-0.0015		-0.0026	-0.0027*
		(-1.56)	(-1.19)		(-1.95)	(-1.99)
Refrigerator		0.024***	0.022***		0.015***	0.013***
		(6.06)	(5.65)		(4.56)	(3.95)
Transportation Tool		0.0038	0.0050		0.0025	0.0023
		(1.06)	(1.44)		(0.71)	(0.65)
Home Farming		-0.046***	-0.032***		-0.031***	-0.027***
		(-9.09)	(-5.74)		(-9.31)	(-7.51)
Population Density (1000/km^2)			-0.00015*			-0.000085
			(-2.18)			(-0.35)
Restaurants (per 1000 people)			0.000069			0.00030**
			(0.46)			(2.64)
Bus Stop			-0.011**			0.00095
			(-2.69)			(0.25)
Distance to Market (km)			-0.00097***			-0.00036*
			(-5.66)			(-2.45)
Constant	0.83***	0.84***	0.85***	0.78***	0.80***	0.80***
	(101.29)	(83.67)	(79.77)	(64.96)	(59.98)	(58.67)
Observations	2485	2485	2485	2887	2887	2887
Adjusted R^2	0.205	0.293	0.312	0.165	0.238	0.240

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

	Urban			Rural		
	(1)	(2)	(3)	(1)	(2)	(3)
Age	-0.0000081	-0.00016	-0.00017	-0.00019*	-0.00011	-0.000090
	(-0.09)	(-1.70)	(-1.85)	(-2.01)	(-1.16)	(-0.95)
Female	0.0083**	0.0078**	0.0076**	0.0031	0.0021	0.0020
	(2.94)	(2.83)	(2.83)	(1.17)	(0.80)	(0.77)
High School	0.018***	0.0048	0.0028	0.022***	0.0070	0.0067
	(5.83)	(1.53)	(0.89)	(6.04)	(1.90)	(1.84)
Married	0.0049	0.0042	0.0043	0.012**	0.0091*	0.0083*
	(1.30)	(1.14)	(1.21)	(3.02)	(2.36)	(2.17)
Weekend	0.017***	0.015***	0.0090*	-0.0037	0.0048	0.0075*
	(4.42)	(4.13)	(2.39)	(-1.24)	(1.57)	(2.40)
Survey Wave 1	-0.013	-0.0024	0.0051	-0.020*	-0.012	-0.010
	(-1.37)	(-0.24)	(0.50)	(-2.03)	(-1.22)	(-1.08)
Survey Wave 2	0.021**	0.028***	0.031***	0.0052	0.0015	-0.00078
	(3.04)	(4.22)	(4.17)	(0.82)	(0.25)	(-0.13)
Survey Wave 3	0.028***	0.025***	0.030***	0.011	0.0046	0.0038
	(4.35)	(3.83)	(4.23)	(1.55)	(0.71)	(0.58)
HHINC (thousand CNY)		0.00053***	0.00047***		0.00045***	0.00046***
		(5.57)	(5.13)		(6.18)	(6.30)
HHINC2		-0.0000021***	-0.0000019***		-0.00000087***	-0.00000093***
		(-4.36)	(-4.29)		(-4.42)	(-4.68)
HHSIZE		-0.0044***	-0.0041***		0.00050	0.00045
		(-3.72)	(-3.59)		(0.58)	(0.54)
Refrigerator		0.017***	0.013***		0.020***	0.019***
		(5.23)	(3.98)		(6.81)	(6.37)
Transportation Tool		0.0010	0.0016		-0.00032	0.0012
		(0.29)	(0.49)		(-0.09)	(0.35)
Home Farming		-0.022***	-0.0061		-0.021***	-0.014***
		(-4.48)	(-1.28)		(-6.56)	(-3.79)
Population Density (1000/km^2)			0.00011			0.0023***
			(0.40)			(3.69)
Restaurants (per 1000 people)			0.0024***			0.000011
			(10.07)			(0.07)
Bus Stop			0.013**			0.0077**
			(2.76)			(2.59)
Distance to Market (km)			-0.013***			-0.00040**
			(-6.53)			(-3.05)
Constant	0.79***	0.81***	0.82***	0.83***	0.82***	0.82***
	(73.59)	(66.59)	(49.30)	(65.76)	(65.32)	(63.91)
Observations	2222	2222	2222	2664	2664	2664
Adjusted R^2	0.163	0.208	0.248	0.161	0.218	0.224

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$