Supermarket Revolution and Food Demand in China

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Abstract

This paper aims at examining the impact of supermarkets on the Chinese dietary structure. Using the China Health and Nutrition Survey data, the effects of the distance to the nearest supermarket on individual food consumption are estimated. While the existing research focuses mostly on demand-side factors during the dietary transition, this study takes up a new angle by studying the influence of supermarkets, a supply-side factor. A few findings emerge. First, the distance to a modern supermarket exhibits different effects on various food consumption. The proximity of supermarkets is associated with a higher consumption level of animal foods, fruit, and dairy products, but a lower consumption level of cereal and vegetables. Second, individuals with high income appear to consume more of all food categories except for cereal. Third, better educated, urban individuals consume a much higher level of animal foods, fruit, and dairy products than their less educated, rural counterparts.

1 Introduction

An extensive literature studies the contributing factors to dietary structures in different countries. Researchers find nutrient consumption patterns vary in response to economic factors such as income, as well as socioeconomic and demographic factors such as race, education, knowledge of health, and residing location (Basiotis et al., 1983; Tippett et al. 1993; Block and Subar, 1993; Swanson et al., 1993; Gould and Lin, 1994; Nayga, 1994; Variyam et al., 1996; Adelaja et al., 1997; Variyam, 2003). In the context of China, existing research focuses on the changing dietary habits and related policy implications during the 1990s (Guo and Zhai, 2000; Guo, Popkin, Mroz, and Zhai, 1999; Du, Lu, Zhai, Popkin, 2002).

Above studies take a demand-side approach, by estimating the effects of socioeconomic variables or calculating demand elasticities of food prices. The supply-side factors are rarely examined, even though the availability of food, facilitated largely by middlemen, is crucial for food consumption.

Supermarkets are one type of middlemen between consumers and food producers. A "supermarket revolution" has occurred in Asia in the past two decades (Reardon, et al., 2010). In China, the concept of supermarkets was introduced in the late 1990s. Funded by domestic and foreign capital, supermarkets expanded quickly nationwide after 2000. Even though foreign supermarkets had a head start, domestic competitors caught up swiftly with growing efficiency. In 2012, three of the top five supermarkets were Chinese brands (Gaoxin, Huarun, and Bailian), accounting for 17.7% of total market share. The two largest foreign players, Wal-Mart and Carrefour, took up 11.7% (Kantar Worldpanel China, 2013). Majority of supermarkets are sited in cities, targeting the rising middle-class families. Fewer supermarkets have business in townships and villages, where individuals often need to travel more than 30 minutes to access a modern supermarket. This is even more inconvenient considering the fact that many lower-income families do not own any vehicles.

The rise of supermarket challenges the position of traditional community markets (Caichang). Compared to supermarkets, community markets are smaller, more scattered, and closer to residential areas. Similar to farmers' markets in the West, villagers from nearby rural areas travel to community markets every morning to sell produce, meat, and other agricultural products from local farms. They work as private vendors at a cost of monthly rent paid to the organizer. Prior to the supermarket revolution, most Chinese relied on community markets for grocery shopping. Over time, supermarkets have attracted more customers by offering a better shopping environment, more choices of goods, and food safety guarantee. Nevertheless, community markets are still an important part of citizens' life, thanks to its unique ties to the neighborhood.

This paper aims at examining the impact of supermarkets on the Chinese dietary structure by investigating whether the availability of supermarkets is associated with certain consumption patterns of different foods. Using the most recent China Health and Nutrition Survey data, this study estimates how the distance to the nearest supermarket is related to consumption levels of five food groups. A few findings emerge. First, the distance to a modern supermarket has a strong significant effect on food demand, even after controlling for family income, location, and food prices. Distance exhibits opposite effects on the consumption of different foods. Individuals living in close proximity of supermarkets consume more animal foods, fruit, and dairy products, while those far away from supermarkets consume more cereal and vegetables. Second, higher-income

Table I: Recommended vs. Observed Food Consumption

FOOD CONSUMPTION

	Recommended[a] Daily Intake	Actual intake from data, 2009						Mean
		Percentile						
		p10	p25	p50	p75	p90	p95	
Cereal (g)	(250, 400)	230	300	383.3	493.3	620	713.3	408.7
Animal foods (g)	(100, 175)	33.3	76.7	146.7	228.3	316.7	383.3	163.9
Vegetables (g)	(300, 500)	183.3	266.7	376.7	500	633.3	733.3	397.5
Fruit (g)	(200, 400)	0	0	0	74.7	200	283.3	57.1
Dairy products (g)	300	0	0	0	0	0	83.3	11.7

(a) Chinese Nutrition Society

individuals consume more of all foods except for cereal. Third, better educated urban individuals consume a much higher level of animal foods, fruit, and dairy products.

# 2   Data and Summary Statistics

The data set is collected by the China Health and Nutrition Survey (CHNS), an ongoing longitudinal survey conducted by the University of North Carolina. This survey covers nine provinces (Heilongjiang, Liaoning, Shandong, Henan, Jiangsu, Hubei, Hunan, Guizhou, and Guangxi), with considerable variations in locations, levels of economic development and health status. A multistage random cluster process was adopted to draw the sample. Within each of the nine provinces, counties were stratified by income and a weighted sampling method was used to randomly choose four counties (one low-, two middle-, and one high-income). Additionally, two cities (the capital city and a lower-income city) were randomly selected. In the next stage, villages and townships within the four counties and urban/suburban areas within the two cities were randomly selected as primary sampling units (PSU). Lastly, twenty households were surveyed within each primary sampling units and all individuals within the households were interviewed (Monda, Adair, Zhai, and Popkin, 2008; Guo, Popkin, Mroz, and Zhai, 1999). The CHNS database contains information based on a three-day dietary recall in each survey, providing first-hand records on individual food consumption. The survey also tracks socioeconomic and demographic information at the household and individual level, such as region, height/weight, education, marriage, and income.

This paper makes use of data for adults aged 20-69 surveyed in 2004, 2006, and 2009. Data prior to 2004 are not used because earlier surveys didn't collect information of supermarkets. Over time, some households were lost to follow-up and others were recruited and/or returned to the survey (Guo, Popkin, Mroz, and Zhai, 1999). As a result, the data set is an unbalanced panel, with 78.9% of individuals participating in only one wave, 18.29% in two waves, and only 3% in all three waves.

The consumption patterns of main food groups are shown in Figure (1). Over time, people consumed less cereal but more animal foods, fruit, and dairy products. The average daily consumption of cereal decreased by 26.3%, while that of animal foods, fruit and dairy grew by 91%, 216% and 328%, respectively. Large variations exist between rural and urban diets. In particular, rural individuals consume more cereal but less animal foods, fruit and dairy.

Table I reports the mean and several percentiles of major food intakes by Chinese adults surveyed in 2009. The observed distribution is compared to the daily recommended intakes by the Chinese Nutrition Society. This comparison reveals several characteristics of Chinese diets. The average consumption of cereal, animal foods and vegetables are all

Figure 1: Per Capita Food Consumption in China, Rural vs. Urban, 1989-2009
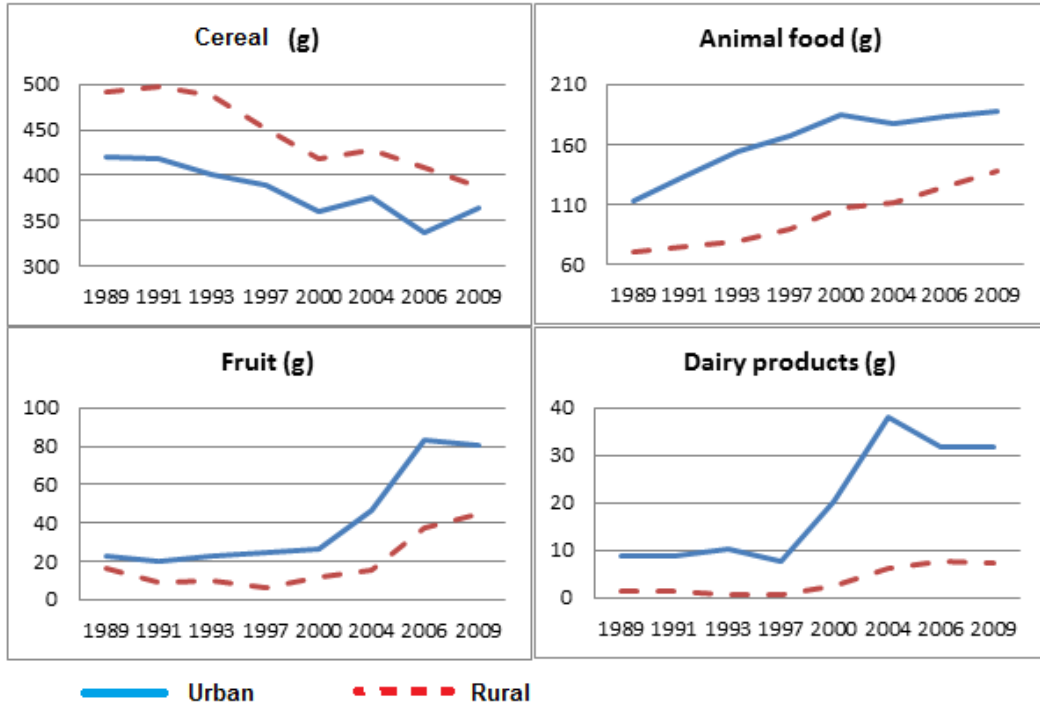
around the upper bound of the recommended range. On the contrary, the consumption of fruit and dairy products are well below adequacy. It is recommended that an adult should have 200-400 grams of fruit everyday, but the survey shows a mean of 57.1 grams and a median of 0. The consumption of dairy products is even more skewed – even the 90th percentile reports zero. The mean intake of 11.7 grams is far below the recommended 300 grams. Professor Fan from China Agriculture University pointed out that, while people in large cities may drink one cup of milk every day, the nationwide average is about one spoon (Renmin Net, 2007). An imported good originally, cheese is largely excluded from traditional Chinese cuisine, and its nutrition facts remain unrecognized by ordinary consumers.

The summary statistics of socioeconomic and demographic variables are presented in Table II. On average, the closest supermarket is about 4.8 kilometers away (about 3 miles). The distance from a supermarket is 3.5 kilometers for urban dwellers, compared to 5.7 kilometers for their rural counterparts. Moreover, individuals in rural areas are less likely to own vehicles, and the public transportation system there is not well established, both of which make traveling to supermarkets difficult.

Table II: Summary Statistics of Socioeconomic and Demographic Variables

Variable	Definition	Mean	S.D.
Distance	Distance (in KM) to the nearest supermarket	4.8	8.1
Income per capita	Family net income per capita (Yuan)	8785	11886
Education	Length of education completed (Years)	8.5	4.1
Urban	Dummy variable, = 1 if residing in urban areas	0.41	0.49
HH Size	Number of people in a family	3.4	1.4
Weight	Weight in kilograms	61.06	10.9
Height	Height in centimeters	161.65	8.4
Age	Age in years	47.44	11.9
Male	Dummy variable, = 1 if male	0.49	0.49
South	Dummy variable, = 1 if residing in a southern province	0.64	0.48
Married	Dummy variable, = 1 if married	0.87	0.34

3   Empirical model

The consumption model is motivated by Nayga (1994) and Nayga and Capps (1994), in which the intake of a particular food or nutrient is specified as:

$$C_i = F(p, y_i, S_i), \tag{3.1}$$

where C_i corresponds to the consumption of a certain food by individual i; p represents food price; y_i is per capita income; and S_i is a vector of various socioeconomic and demographic factors.

As noted above, the CHNS data set is an unbalanced panel. If the reason for individuals dropping out of the sample is uncorrelated to the unobserved individual characteristics, then the traditional panel regression can be applied; otherwise, it yields biased estimates (Cameron and Trivedi, 2008). Unfortunately, CHNS surveys do not record the reasons for dropping out, thus the existence of attrition bias cannot be tested and a panel regression cannot guarantee unbiased estimation results. Therefore, a pooled OLS model with year dummies is estimated (Eq. 3.2), controlling for data clustering[1].

$$\begin{aligned}
log(C_i^j) = & \alpha_0 log(Distance) + \alpha_1 log(Income) + \alpha_2 Education + \alpha_3 Urban + \alpha_4 HHSize + \alpha_5 Weight \\
& + \alpha_6 Height + \alpha_7 Age + \alpha_8 Age^2 + \alpha_9 Male + \alpha_{10} South + \alpha_{11} Married \\
& + \beta_1 log(P.rice) + \beta_2 log(P.wheat) + \beta_3 log(P.vege) + \beta_4 log(P.pork) \\
& + \beta_5 log(P.beef) + \beta_6 log(P.chicken) + \beta_7 log(P.fish) + \beta_8 log(P.lamb) \\
& + \beta_9 log(P.eggs) + \beta_{10} log(P.milk) + \gamma_1 d_{2006} + \gamma_2 d_{2009} + Constant
\end{aligned} \tag{3.2}$$

where C_i^j represents the 3-day average daily consumption (grams) of food group j by individual i. This paper considers five food groups: cereal, animal foods, vegetables, fruit, and dairy products. *Distance* controls for the proximity of a supermarket. *Income* is per capita annual income in 2009 RMB. *Education* measures the years of schooling. *Urban* $= 1$ if the person is an urban resident and 0 otherwise, *Weight* and *Height* are in the units of kilograms and centimeters, respectively. *South* $= 1$ if the person lives in a southern province and 0 otherwise. *Married* $= 1$ if the individual is married and 0 otherwise. Dummies $d_t = 1$ if $Year = t$ and 0 otherwise.

4   Results

Table III presents the regression results. First of all, the coefficient of distance from the nearest supermarket is positive for cereal and vegetables, but negative for animal food, fruit, and dairy products. In other words, individuals with convenient access to supermarkets appear to consume more meat, fruit, and dairy, but less cereal and vegetables. The coefficient estimates are statistically significant.

The results suggest that the availability of neighborhood supermarkets has certain influence over the Chinese dietary structure. Although the supermarket revolution had adversely impacted the business of traditional community markets, they were never completely replaced by supermarkets. In fact, supermarkets and community markets have their respective advantages. Thanks to economies of scale, supermarkets are able to reduce transportation costs per unit and supply products from distant regions (e.g., tropical fruit). Supermarkets also provide better storage for perishable goods (e.g., meat,

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[1]The model is estimated with robust standard errors allowing individual clustering.

Table III: Regression Results

	Cereal	Vegetables	Animal foods	Fruit	Dairy products
(log) Distance	0.055***	0.059***	-0.067***	-0.133***	-0.099***
	(0.006)	(0.007)	(0.019)	(0.025)	(0.015)
(log) Income	-0.014**	0.014	0.18***	0.13***	0.12***
	(0.005)	(0.009)	(0.018)	(0.019)	(0.012)
Education	-0.021***	-0.01***	0.04***	0.068***	0.058***
	(0.002)	(0.002)	(0.005)	(0.008)	(0.012)
Urban	0.042***	0.09***	0.39***	0.76***	0.59***
	(0.015)	(0.017)	(0.036)	(0.065)	(0.045)
HH size	0.007	-0.012*	0.008	-0.065***	-0.040**
	(0.005)	(0.006)	(0.712)	(0.019)	(0.012)
Weight	0.002**	0.002**	0.008***	-0.004	-0.005*
	(0.0007)	(0.0009)	(0.002)	(0.175)	(0.002)
Height	0.000	-0.001	0.016***	0.006	0.012***
	(0.982)	(0.502)	(0.003)	(0.240)	(0.000)
Age	0.019***	0.017***	0.03***	-0.011	-0.030*
	(0.004)	(0.004)	(0.01)	(0.647)	(0.013)
Age^2	-0.0002***	-0.0001***	-0.0004**	0.000	0.0004***
	(0.000)	(0.000)	(0.000)	(0.308)	(0.0001)
Male	0.190***	0.079***	-0.14**	-0.478***	-0.301***
	(0.017)	(0.020)	(0.05)	(0.074)	(0.052)
South	-0.340***	-0.160	0.17***	-0.792***	-0.175**
	(0.019)	(0.022)	(0.053)	(0.076)	(0.057)
Married	-0.021	0.022	0.11*	0.195**	0.04
	(0.227)	(0.344)	(0.05)	(0.08)	(0.061)
N	6134	6134	6134	6134	6134

***:p<0.001; **:0.001<p<0.01; *:0.01<p<0.05; standard errors are in parentheses

milk, and eggs). For these reasons, the proximity of supermarkets helps facilitate the consumption of animal foods, fruit, and dairy products. On the other hand, community markets maintain an unique appeal to customers. First, they offer delivery services for large quantities of foods, such as bags of rice and wheat powder. In China, people purchase rice in bags ranging from 10 to 50 kilograms (about 22-110 pounds). Absent delivery services, households with no vehicles find it inconvenient to buy rice and other cereals from supermarkets. Second, fresh vegetables delivered daily from local farms to community markets are popular among families preferring fresh produce. Third, unlike in supermarkets, vegetables in community markets are often loosely presented with no packaging or pre-washing, and thus less expensive. For these reasons, when supermarkets are unavailable, individuals tend to rely on community markets, which specialize in selling cereal and vegetables.

The coefficient estimates for other covariates are consistent with economic theory and the literature. The coefficient of income is negative for the consumption of cereal, but positive for the intakes of animal foods, fruit, and dairy. An 1% increase of income is associated with a 0.016% decrease of cereal, but 0.18%, 0.13%, and 0.12% increase of meat, fruit, and dairy.

Education is negatively correlated to the consumption of cereal and vegetables, but positively correlated to that of animal foods, fruit, and dairy. There is a clear rural-urban divide in consumption patterns. Compared to their rural counterparts, urban individuals consume 41% more meat, 114% more fruit, and 80% more dairy products[2]. This means the food basket of urban Chinese is more diversified whereas the habitual diet of their rural counterparts consists of more cereals. Studies have found that globalization has a stronger impact on urban diets in developing countries due to the proliferating consumer food industry and imported processed foods (Vepa, 2003). In addition, urban residents

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[2]Notice that *Urban* is a dummy variable, and dependent variable is logarithmic. The marginal effect of *Urban* is $(e^{\beta_{urban}} - 1) \times 100\%$.

Table IV: Robustness

	Cereal	Vegetables	Animal foods	Fruit	Dairy products
Pooled OLS w/ year dummies	0.055***	0.059***	-0.067***	-0.133***	-0.099***
Panel regression	0.044***	0.054***	-0.071***	-0.123***	-0.099***
Pooled OLS w/ fewer control variables	0.069***	0.047***	-0.123***	-0.118***	-0.126***
Panel regression w/ fewer control variables	0.065***	0.048***	-0.109***	-0.096***	-0.122***

***:p<0.001; **:0.001<p<0.01; *:0.01<p<0.05; standard errors are in parentheses
Complete estimation results are available upon request.

may have better access to the health and nutrition related information, which helps them maintain a more balanced diet.

The main estimation strategy is pooled OLS with year dummies for reasons explained above. As a robust check, panel regression techniques were applied. No significant difference was found between results from the two estimation strategies (Table IV). Additionally, estimation was conducted using only distance, income, education, and food prices. The results appear to be robust.

5   Conclusion

Existing studies explain the transition of dietary habit in China by income growth, food inflation, and the changing appetite under the influence of western cuisine. This paper introduces a supply-side factor, the availability of supermarkets, which has been largely overlooked in the literature.

The results show that individuals living in close proximity of supermarkets consume more animal foods, fruit, and dairy products, but less cereal and vegetables. Even though the western-style supermarkets challenge the business of the traditional community markets, the latter continues to play an important role where supermarkets are rare. In addition, higher income, better education, and urban residency are found to be associated with higher consumption levels of animal food, fruit, and dairy products.

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