Rural Household Food Consumption in China: Evidence from the Rural Household Survey

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A two-stage budgeting LES-LA/Aids system is used to estimate rural household demand in China with special emphasis on changes in demand for food commodities across different income groups. The data used in this study are from China's National Rural Household sample survey for 1993. The own-price elasticity for food is more elastic than those for clothing, housing, durable goods, and other items. Within the food group, price elasticities range from -0.18 to -1.24. Wheat and coarse grains are still important staple foods for the average rural household with an expenditure elasticity of almost unity. Meat is the most price elastic among non-staple foods. The education level, the employment structure, and the geographical location significantly effect on food consumption.

Introduction

In recent years, much public attention has been paid to production and its enormous potential for higher efficiencies in China's farming. A few studies have attempted to analyze detailed impact of changes in households' consumption patterns resulting from rapidly rising in household income on food demand(e.g. Kueh,1988; Lewis and Andrews, 1989; Huang and Rozelle, 1990; Halbrendt et al., 1994; Fan et al., 1994; Fan et al., 1995). Information on food demand is essential for production because with stronger linkages to world agricultural product markets, changes in food consumption patterns in China will become more important to world food markets. Accurate estimates of demand elasticities for trade impact analysis are needed because adjusting domestic production to meet rapidly increased non-staple food consumption faces various constraints such as resource and technology availability.

This study will focus on the food consumption patterns of China's rural households across different income groups together with regional effects. The primary goal is to provide price and expenditure elasticities for major food items, and to examine: (1) whether households in different income groups share a common demand structure for food. High, middle, and low income groups were designated by per capita net income. (2) whether expenditures on food increases faster than that of other broad commodity groups such as housing, clothing, durable goods, and others items(fuel, daily household goods, and services) with the increase in income; and (3) which food items are most responsive to food expenditure increases. A two-stage budgeting model is used to estimate demand 1) for food, clothing, housing, durable goods, and others items in the first stage and 2) for subgroup commodities within the food group in the second stage. The subgroup commodities include wheat, rice, coarse grains, meats, poultry, seafood, vegetables, fruits, sweets, stimulants, and cooking oils. The study follows a complete demand system approach which enhances the single-equation-single-commodity approach of past studies on food consumption in China(the World Bank, 1991; FAO, 1991; Peterson et al., 1991).

Consumption Patterns

To forecast changes in China's food demand resulting from a fast increase in disposable income, knowledge of changes on households' food consumption patterns

driven by income growth, especially for rural households, is needed. Economic reforms which transformed a centrally controlled economy to a market economy have dramatically increased rural households' income and their living expenditure. Per capita income and expenditure increased by 13.31% and 14.42% per annum in real terms from 1979 to 1993, respectively. Along with rising income, food consumption expenditures increased from 100.19 Yuan in 1980 to 446.83 Yuan in 1993(in nominal terms). Per capita consumption of meat, eggs, and sweets also increased sharply. Throughout the periods from 1979 to 1993, the proportion of total expenditure devoted to food declined as income rised. The Engel's coefficient for China's rural households was 61.77% in 1979, 58.99% in 1984, and 58.06% in 1993.

Economic development brings changes in both the average level and the distribution of income and food consumption. As China has experienced rapid, albeit uneven growth in national income during the reform period, inequality has increased since the mid-1980s. In 1993, the per capita expenditure for rural household in a high income group was 1027.22 Yuan, 746.78 Yuan in the middle income group, and 600.14 Yuan in the low income group. Per capita net income for the top 10% rural households was five times to that of the bottom 20% of households. However, in 1980, 77.1% of rural households had an average per capita income of 250 Yuan, and 22.9% rural households had an average per capita income of 450 Yuan. Average per capita food consumption of the high income group was as high as 1.85 times of the low income group.

The national Structure of rural household consumption has significantly change: 1) the percentage of purchased commodities for farmers consumption has increased significantly. 2) the greatest expenditure in rural household consumption was for food, followed by clothing and housing before rural reforms. 3) The percentages of staple foods and non-staple foods were 37.30% and 21.70%, with living expenditures for staple foods far higher than that for non-staple foods. The percentages decreased by 1993.

Unlike the gradual increasing pressure on food demand from population growth, the "income effect" as described above, can be a shock to a domestic food system and the world food markets. Given a large populated rural economy with a high rate of income growth, knowledge of food consumption patterns for different income groups with various

demographic characteristics and changing consumption patterns is particularly useful for predicting food consumption changes and evaluating corresponding policy options. Limited availability of micro level data, however, has narrowed previous empirical studies of rural food demand based on aggregate time-series data (e.g. Kueh, 1988; Lewis and Andrews, 1989; Peterson et al., 1991; Fan et al., 1994), time-series with cross-section data at provincial level (e.g. Fan et al., 1995) or household level data within a single province or county (e.g. Halbrendt et al., 1994; Huang and Rozelle, 1990). Aggregate data at best only approximates optimizing behavior by individuals. A regional sample in a province or a few counties is far from being adequate to reflect a large country with widely different socioeconomic conditions across regions. Therefore, it is expected that this study using recent household survey data will provide insights into the consumption behavior of rural households nationwide.

The Model

The two-stage budgeting procedure assumes that the consumer's utility maximization decision can be decomposed into two separate steps. In the first stage, total expenditure is allocated over broad groups of commodities. In the second stage, group expenditures are allocated over individual commodities. Weak separability of the direct utility function over broad groups is both a necessary and sufficient condition for estimating the second stage of the two-stage budgeting procedure. The functional form chosen for the first stage is a linear expenditure system (LES). The advantage of the LES is that it is simple and provides an intuitive economic interpretation, despite its strong separability assumption. The separability assumption is not overly restrictive for such commodities as food, housing, or clothing (Timmer and Aldermand, 1979). The LES functional form is

$$P_I X_I = P_I R_I + \beta_I [Y - \sum_J P_J R_J]$$

with $0<\beta_I<1$, $\Sigma_I \beta_I = 1$ and $X_I > Y$. Where $P_I X_I$ (P_I and X_I are aggregated price and quantity indices for commodities within a group I) is expenditure, and R_I and β_I are parameters. Y is household total expenditure. The uncompensated own-price and cross-

price elasticities associated with equation (1) are:

(2) $\eta_{II} = (1-\beta_I)P_JR_J/(P_IX_I)-1$ and (3) $\eta_{IJ} = -\beta_I(P_JR_J)/(P_IX_I)$

The expenditure elasticities are: (4) $\__I = \beta_I Y/(P_IX_I)$

The Linear Approximation/Almost Ideal Demand System (LA/AIDS), developed by Deaton and Muellbauer(1980), is used for second-stage demand estimation. The model has been applied to micro-level data. The share equation for the LA/AIDS model is:

$$\omega_{i,I} = \alpha_{i,I} + \sum_{,} \gamma_{ii\ ,} \log p_{,\ ,} + \beta_{i\ ,} \log(\frac{Y}{\quad})$$

where $\omega_{i,I}$ is the budget share of good I in a commodity group I, $p_{j,I}$ is the price of commodity j in a group I, Y is the Ith group's total expenditure, and P_I is the Ith group price index. The theoretical restrictions can be written as:

$$\sum_{i,I}^{n} \alpha_{i,I} = 1, \sum_{i,I}^{n} \beta_{i,I} = 0, \sum_{i,I}^{n} \gamma_{ij,I} = 0 (adding up$$

The conditional price elasticity is:

(7) $\eta_{ij,I} = \delta_{ij,I} + \gamma_{ij,I} / \omega_{i,I} - (\beta_{I,\ I}\alpha_{i,I})/$

$$\sum_{,}^{n} \gamma_{i:\ ,} = 0 (homogeneity): \gamma_{i:\ ,} = \gamma_{:i\ ,} (symm$$

$\omega_{i,I} - \beta_{I,I} / \omega_{i,I} \Sigma_{j,\ I} \gamma_{ij,I} \log p_{j,I}$

Where $\delta_{ij,I} = -1$ if I=j, and $\delta_{ij,I} = 0$ otherwise.

The conditional expenditure elasticity is: (8) $\__{i,I} = 1 + (\beta_{I,I})/(\omega_{i,I})$

Unconditional price elasticities within the same group and unconditional expenditure elasticities can be calculated as:

(9) $\eta_{ij} = \eta_{ij,\ I} + \__{i,I}\ \omega_{j,\ I}(1 + \eta_{II})$, and $\__i = \__{i,I}\ \__I$.

Data and Estimation

This study uses China's National Rural Household Survey data of 1993 which recorded all major economic activities for 66,960 participating rural households in the survey year. The sample contains 1401 variables on the rural households' income, expenditure, production, and consumption, as well as their demographic characteristics. Particularly, a subsample of 10 percent of the survey observations is used for this study.

In this analysis, the first stage of budgeting allocates total household expenditure to five board groups of goods: food, clothing, housing, durable goods, and other items. Clothing and durable goods include 10 items and 15 items, respectively. The other items consist of all daily consumption of goods and services other than food, clothing, housing, and durable goods. The second stage of budgeting allocates the food expenditures among following food items: wheat, rice, coarse grains, meat, poultry, seafood, vegetables, stimulants, fruits, sweets, and cooking oils.

Annual expenditure data for durables and housing is calculated differently from the other groups of goods at the first stage since durable goods and housing are not completely consumed within one year. In this study, assumptions are made for the annual consumption values of durable goods and housing. Implicit prices for individual commodities are generated from quantities, expenditures, and sales. The aggregated prices for the grouped goods in the first stage and subgroup in the second stage are computed using the Stone aggregation with their expenditure shares as weights in each group. The study has generated a number of sociodemographic variables, such as household size, age composition, educational level, and other economical characteristics, as well as indicator variables for each province. The implicit assumption is that the regression lines for the different groups differ only in the intercept term but have the same slope coefficients.

For the second stage of budgeting on food consumption, the data sample shows that 9.3% households do not consume wheat; 23.8% households do not consume rice. About 10% households do not consume coarse grain, sweets, fruits, 1% households do not consume meat and stimulants, and 5.4% households do not consume cooking oil. Zero consumption implies a censored dependent variable. To obtain consistent and asymptotically efficient estimates, a two-step estimation procedure is employed in the food consumption system estimation following Heien and Wessells(1990).

To test whether households in different income groups share a common food demand function and to get more precise estimates on rural household food consumption patterns across different income groups, sample households are grouped into three income categories. A non-Linear Seemingly Unrelated Regression was used to estimate a five-equation demand system for the first-stage budgeting. A Linear Seemingly Unrelated

Regression was used to estimate a ten-equation food demand system at the second-stage. Adding up, homogeneity, and symmetry restrictions were imposed for the food group. The same model is estimated for each of the three income groups and their combinations, as well as the whole national sample in order to perform Chow tests for structural changes and for comparison.

Results

1. Parameter Estimates and Elasticities

The estimation results for the first-stage demand for broad groups of goods are presented in Table 1. All parameters, from the regressions for each income group and entire sample, have expected signs and appropriate magnitudes. All parameters are significant at the 1% level. The adjusted R-square is 0.809 for food expenditures, 0.363 for clothing expenditures, 0.616 for housing expenditures, 0.406 for durable goods expenditures, and 0.419 for others. Using the estimated coefficients, uncompensated price and expenditure elasticities are evaluated at the sample means. Own-price elasticity for food is -0.844, which is relatively more elastic than that for other four groups. Own-price elasticities for clothing, durable goods, and others items household goods are similar and range from -0.614 to -0.699. Expenditure elasticities for food(1.026) and other items(1.151) are slightly greater than a unity. This result indicates that demand for food and other daily elastic than demands for the other four groups with respect to both price(-0.210) and expenditures(0.585). This may reflect the fact that no well-behaved rural housing markets exists and house construction is subject to various restrictions. Although own-price and expenditure elasticities for the five commodity groups are similar among the three income groups, demand for food, clothing, and others items are more elastic for higher income households than lower income households. Most of the price coefficients for commodities within the food group are significant at the 1% leve, except for a few cross-price household goods and services increases proportionally with the increase in the households' income. Housing demand is less parameters. All expenditure parameters are significant at the 1% or 5% level. Most of the sociodemographic indicator variables in the model are significant. The implication is that differences in geographical location, topography, household type, and education level lead to differences in household

consumption behavior.

Table 1. Rural Household Demand in China: Parameter Estimates and Comparison of Own Price Elasticities and Expenditure Elasticities Across Income Groups for the First Stage, 1993

	Food	Clothing	Housing	Durable Goods	Others
Parameters					
β_I	0.614(132.81)	0.056(40.72)	0.046(27.69)	0.105(50.61)	0.180 (54.10)
R_I	550.423(30.23)	6.281(30.23)	75.322(70.70)	0.937(28.21)	107.192(19.79)
Price Elasticities					
Nation	-0.844	-0.685	-0.210	-0.613	-0.699
I	-0.870	-0.732	-0.236	-0.554	-0.694
II	-0.850	-0.620	-0.189	-0.636	-0.672
III	-0.858	-0.625	-0.259	-0.675	-0.676
Expenditure Elasticities					
Nation	1.026	0.929	0.585	0.977	1.151
I	1.071	0.978	0.561	0.885	1.082
II	1.064	0.764	0.510	0.918	1.120

	Food	Clothing	Housing	Durable Goods	Others
III	1.051	0.858	0.692	0.818	1.102

Note: (1) I, II, III are high, medium, and low income groups, (2) t-ratio in parentheses.

Conditional price and expenditure elasticities are presented in Table 2. All own-price elasticity estimates have appropriate signs. Own-price elasticities for wheat and rice are similar in a range of -0.45 to -0.46. Non-stable food, including meat, seafood, sweets, and vegetables have similar own-price elasticities in a range of -0.31 to -0.38. The own-price elasticity for fruit is -0.42. Demand for cooking oil is price inelastic (-0.18), and demand for stimulants is much more elastic (-0.78) than any other staple and non-stable foods except for coarse grains (-1.24). Wheat has expenditure elasticity that is near unitary. The expenditure elasticities for rice, vegetables, and fruits are very elastic in a range of 1.27 to 1.29. Conditional expenditure elasticity for rice is very high in this study. In 1993, rice area decreased more than 22 million Mu. Rice production decreased more then 8.5 million tons. Meanwhile, the government rice price increased 13.8%. These reasons are a partial explanation why expenditure elasticity for rice is relatively high in 1993. The expenditure elasticities for meat, poultry, sweets, and cooking oil are inelastic in a range of 0.51 to 0.73.

2. Effect of Household Characteristics on Food Consumption

The effects of the socio-demographic variables on household food consumption are presented in Table 3. This study shows no significant effects of the education level, number of children in the household, and "eating-out" on grain consumption except for the illiterate group, which has a significant and positive relationship with rice consumption. Education level has a negative relationship with protein food consumption. Off-farm employment, working in enterprises, and working in townships have a significant and positive relationship with meat consumption. Education level, number of children per household, and household size have a significant and positive effect on vegetable consumption. The employment structure has no significant effect on vegetable consumption. Education level and geographical location have a significant and negative effect on stimulants consumption.

Table 2. Rural Household Demand in China: Estimated Conditional Price and Expenditure Elasticities within the Food Group, 1993

	Wheat	Rice	Coarse grain	Meat	Poultry	Seafood	Sweets	Vege-tables	Fruits	Stim-ulants	Cooking Oil
Conditional Price Elasticities											
Wheat	-0.45	-0.06	-0.01	-0.02	0.004	-0.03	-0.03	-0.15	-0.06	-0.05	-0.12
Rice	0.02	-0.46	0.20	-0.09	-0.001	0.004	0.05	0.005	0.07	0.02	-0.004
Cgn	-0.03	0.37	-1.24	0.004	0.06	0.01	0.02	-0.23	-0.02	-0.01	0.05
Meat	0.24	-0.003	0.27	-0.38	0.15	0.32	0.25	0.16	0.29	0.35	0.30
Poultry	0.10	-0.21	0.16	-0.19	-0.13	0.07	0.06	0.01	0.08	0.09	-0.06
Seafood	-0.25	-0.64	0.06	0.31	-0.02	-0.31	0.08	-0.08	0.05	0.11	-0.11
Sweets	-0.50	-0.50	0.17	-0.24	-0.11	0.17	-0.31	-0.05	-0.05	-0.07	0.15
Veg	-0.10	-0.03	-0.03	-0.02	0.04	0.05	0.06	-0.38	0.03	0.04	0.03
Fruits	-0.41	-0.01	-0.04	0.13	-0.01	0.04	-0.02	-0.18	-0.42	0.09	-0.03
Stm	-0.12	-0.17	0.01	0.16	0.01	0.04	-0.002	-0.04	0.04	-0.78	-0.02
Oil	-0.23	-0.17	0.15	0.15	-0.03	0.05	0.11	0.02	0.07	0.06	-0.18
Conditional Expenditure Elasticities											
	0.99	1.27	1.08	0.55	0.54	0.73	0.51	1.29	1.29	0.91	0.73

Note: Veg, Stm, and Oil are vegetables, stimulants, and cooking Oil, respectively.

Table 3. Effect of Household Characteristics on Food Consumption in China's Rural Households, 1993

Variables	Wheat	Rice	Cgn	Meat	Pou	Sf	Swt	Veg	Fruits	Stm
Education Level										
Ed1	ns+	+	ns+	-	ns-	ns-	ns-	+	ns-	-
Ed2	ns+	ns+	ns+	-	ns+	ns-	ns-	+	ns+	-
Household Children										
G1	ns-	ns+	ns+	-	ns-	ns+	ns+	+	ns+	ns+
G2	ns-	ns+	ns-	ns-	ns-	ns-	ns+	+	ns-	-
Eating Out	ns-	ns-	ns-	ns-	ns+	ns+	ns-	ns-	ns+	+
Household Size										
<=2	-	+	-	-	ns+	ns+	ns+	+	+	+
3	-	+	-	-	ns-	ns+	ns-	+	+	+
4	-	+	-	-	ns-	ns+	-	+	+	+
5 or 6	-	+	-	-	ns-	ns+	-	+	+	ns+
Off-farm Employment	-	ns+	ns+	+	+	ns+	ns+	ns-	ns+	ns+
Working in Enterprises	-	-	-	+	ns-	ns+	ns+	ns-	-	+
Working in Township	-	+	+	+	-	ns+	+	ns+	-	ns-
Geographical Location										
GEOP	+	-	-	-	+	+	ns+	-	ns-	-
GEOH	+	+	-	-	+	+	+	-	ns+	-
Telephone	-	-	-	ns-	ns-	+	+	+	+	ns+
Road	-	+	+	+	ns+	ns-	-	+	-	ns-
3 Generations	-	-	-	+	ns+	ns+	ns+	ns+	ns+	ns+
MLR	+	+	+	ns-	+	+	-		+	+

Note: 1. + Significant and positive. - Significant and negative. ns+ Nonsignificant but exhibit a positive trend. ns- Nonsignificant but exhibit a negative trend. 2. Ed1: illiterate; Ed2: element-high school; G1: age<7; G2: age>17; GEOP: plane area; GEOH: hill area. 3. Cgn: Coarse grain, Pou: Poultry, Sf: seafood, Swt: Sweets, Veg: Vegetables, and Stm: Stimulants.

3. Food Consumption Patterns Among Income Groups

Results of the Chow tests for stationarily across three income groups fail to reject the null hypothesis that households in different income groups share a common food demand function at any conventional significance level. Comparison of conditional price and expenditure elasticities for major food items among three income groups is presented in Table 4. Demand for most food items is less elastic with respect to price in higher income groups than for lower income groups. Among the three income groups, own-price elasticities for wheat and rice are in a range of -0.34 to -0.66. Non-staple foods, including meat, poultry and vegetables have own-price elasticities in a range of -0.04 to -0.38. Surprisingly, expenditure elasticities for most food items exhibit a non-monotonies

Table 4. Rural Household Consumption in China; Comparison of Major Conditional Own Price Elasticities and Expenditure Elasticities Across Income Groups, 1993

	I	II	III	Nation
Price Elasticities				
Wheat	-0.39	-0.48	-0.62	-0.45
Rice	-0.34	-0.46	-0.66	-0.46
Meat	-0.23	-0.38	-0.37	-0.38
Poultry	-0.19	-0.07	-0.04	-0.13
Vegetables	-0.41	-0.33	-0.31	-0.38
Expenditure Elasticities				
Wheat	1.06	0.97	1.10	0.99
Rice	1.26	1.31	1.21	1.27
Meat	0.49	0.50	0.52	0.55
Poultry	0.49	0.52	0.47	0.54
Vegetable	1.32	1.29	1.38	1.29

Note: I-high, II-medium, III-low income groups.

change across the three income groups. Since provincial and household characteristic dummy variables have captured regional and demographic effects, the pattern of expenditure elasticities across income groups raises a potentially interesting topic on dynamic changes of food demand responses to income changes.

4. Comparison of Elasticities with Previous Studies

The expenditure elasticities from cross-sectional studies are generally larger than those from time-series studies for grain and its components, but the opposite is observed for meat, poultry, and seafood. Our estimated expenditure elasticities for grains are much larger than those of previous studies for grains but relatively smaller for meats. Own-price elasticities are relatively close among different studies with most of them price inelastic. Our own-price elasticities for wheat, rice, meat, vegetables, and fruits range between the estimates from both cross-sectional studies and time-series studies. The own-price elasticity for poultry in our study is inelastic and relatively small (-0.13) in absolute terms but still larger than estimates from previous studies.

Conclusions

Empirical results indicate that China's rural household consumption behavior appears to be consistent with a two-stage budgeting system. The food sector in rural China responds with a proportional demand increase as household income increases. Wheat and coarse grains are still important staple foods for the average rural household. With rapid growth in income, a rapid increase in demand for vegetables and fruits will bring on an increase in production, and consequently, will compete for resources such as arable land and fertilizers from cereal and feed grain production. Non-staple food has similar own-price elasticities in the range of -0.13 to -0.38. Among them, meat is the most price elastic. This study also shows significant effects of the education level, the employment structure, and the geographical location on food consumption. The estimated results provide evidence that the hypothesis that rural households in different income groups share a common demand function for food cannot be statistically rejected. One of the most disconcerting aspects of the study concerned the large variation of the estimates of the key elasticities from previous studies.

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