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Demand for Food Quantity and Quality in China

Fred Gale and Kuo Huang

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Abstract

As their incomes rise, Chinese consumers are changing their diets and demanding greater quality, convenience, and safety in food. Food expenditures grow faster than quantities purchased as income rises, suggesting that consumers with higher incomes purchase more expensive foods. The top-earning Chinese households appear to have reached a point where the income elasticity of demand for quantity of most foods is near zero. China's food market is becoming segmented. The demand for quality by high-income households has fueled recent growth in modern food retail and sales of premium-priced food and beverage products. Food expenditures and incomes have grown much more slowly for rural and low-income urban households.

Keywords: China, food, consumption, demand, income, elasticities, Engel curve, households, rural, urban

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Contents

Summary

Rapid income growth is changing the structure of Chinese food expenditure, a development that has important implications for China's agricultural and food sector and for international trade in agricultural products. As household incomes rise, consumers demand not only a greater quantity of food, but also higher quality. The demand for quantity diminishes as income rises, and the top tier of Chinese households appear to have reached a saturation point in quantity consumed of most food items. Most additional food spending high-income consumers is spent on higher quality or processed foods and meals in restaurants.

What Is the Issue?

Past studies have indicated that demand for many foods—especially, meat, poultry, fish, and dairy products—is responsive to income growth. However, there have been many changes in China's food landscape in recent years, including the emergence of a new class of high-income consumers, the rise of supermarkets, restaurants, and other modern retailers, and expanded availability of food products. Most food demand studies were based on data from time periods before these structural changes had taken hold.

Given the responsiveness of food demand to income growth, China's rapid growth of 9-10 percent per year suggests that its demand for food is growing faster than its production capacity. While China has become a major importer of soybeans and vegetable oils, it has remained surprisingly self-sufficient in most food products. Do conventional studies of food demand overstate the potential for demand growth in China? The rapid change in food markets and surprisingly slow growth of food imports warrants a new assessment of food demand in China.

What Did the Study Find?

A disproportionate share of China's income growth accrues to high income households that are purchasing mainly greater value added in food consumption rather than increased quantity. High-income consumers devote expenditures to higher quality food: better cuts of meat, processed and packaged food, meals away from home, and food that is safer, more convenient, or healthier. The demand for quality has been a factor driving the rapid growth in supermarkets, convenience stores, and restaurants—outlets that offer greater convenience and quality in food purchases.

The top tier of urban households in China appear to have reached a saturation point in quantity of food consumed at income levels that would be well below the poverty line in the United States. The top 10 percent of Chinese urban households had average household incomes of just $7,000 in 2003, still poor by developed country standards. For most food items, the quantity consumed by Chinese households is highly responsive to income growth at low income levels.

Rural households (about 60 percent of the population) and low-income urban households (20 percent) are at income levels where they demand increased quantities of many foods as their income rises. Low-income consumers' demand for items like meat, dairy products, and beer is much more responsive to income increases than is demand by consumers with higher income. However, low-income households are experiencing less income growth and their food spending has been sluggish as well. Income for rural and low-income urban households has grown at less than half of China's 10-percent GDP growth rate while income growth for the top 10 percent of urban households has exceeded 15 percent per year.

These food consumption and income growth patterns may explain how China has been able to remain self-sufficient in most food items. A large proportion of China's income growth has been devoted to greater value added in food processing and marketing rather than increased quantity.

There is a growing segmentation of the China market linked to the emerging demand for food quality. Chinese food retailers offer a wide range of food products appealing to demands for safety, quality, and health attributes demanded by high-income urban consumers. However, the majority of Chinese consumers—those with less discretionary income—consume less expensive generic food items.

How Was the Study Conducted?

The study analyzed tabulations of income, food expenditure, and food consumption data from China's national household income and expenditure surveys for 2002 and 2003. National averages by income class were analyzed for both urban and rural households. The analysis included estimation of regression models explaining per capita quantity consumed and expenditure for detail food categories. The study estimated elasticities of food quantity and quality with respect to household income. The study used a model that allows elasticities to vary over different income levels. Quantity data included only food consumed at home. An analysis of expenditures on food away from home indicated that most food is still consumed at home.

Demand for Food Quantity and Quality in China

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Introduction

Studies of food demand in China consistently find that Chinese households tend to consume more meats, poultry, fish, dairy products, and fruit as their incomes rise, while their consumption of traditional staple grains remains stable or declines (Chern, 1997; Gould, 2002; Guo et al., 2000; Xin et al., 2005) The rising demand for meats, in particular, has been cited by many analysts as a factor that would sharply increase China's agricultural imports of meat and/or feed grains. While China has become a major importer of soybeans and vegetable oils, it has remained surprisingly self-sufficient in most other food items and has emerged as an exporter of vegetables, fruits, and aquacultural products (Gale, 2005; Huang and Gale, 2006).

How is it that China's surging income growth has not pushed its demand for food beyond its domestic production capacity? Rapid growth in domestic production of livestock, fruit, and aquaculture is one factor explaining China's surprisingly high degree of food self-sufficiency. However, another possibility is that food demand has grown more slowly than expected. A closer look at food consumption patterns may help analysts to assess China's recent trends in agricultural trade and prospects for future growth.

While there have been many studies of Chinese food demand, many are now dated—based on data from the 1980s and early 1990s—or fragmented, based on data from selected provinces and limited to urban or rural households.[1] Subsequent economic growth and significant changes in food marketing have affected food consumption in China. Chinese consumers are demanding greater quality, convenience, and safety in the food they consume (Gale, 2003; 2006). Chinese consumers are increasingly shopping at supermarkets and convenience stores that carry processed, prepared, packaged, and frozen foods, outlets that did not exist in China until the early 1990s (Gale and Reardon, 2004; Hu et al., 2004; Veeck and Burns, 2005). Publicity about food poisonings and dangerous chemical residues has given rise to nascent demands for "green" and organic foods (Marks and Bean, 2005; Calvin,et al.).

As increasingly affluent consumers increase their spending on food, they may buy not only more but better food. While most Chinese consumers are believed to be very price sensitive in food-buying decisions, an increasing number are willing to pay premium prices for food. Expenditures on restaurant meals, processed foods, products certified as free of harmful chemicals, foods with purported health benefits, or foods with other desirable attributes are increasing. A few recent studies have found that Chinese consumers are willing to pay modest premiums for food with safety-related certifications

[1]Fuller and Dong (2004) found evidence of consumer taste changes in China in the late 1980s and mid-1990s, time periods when major policy changes occurred, including the elimination of food rationing in 1993. (Xin et al. (2005))

(Wang 2003, 2006; Yang, 2005) and Gould and Dong (2004) incorporated the effects of quality in a food demand system for urban China.

This study uses recent Chinese consumption and expenditure statistics for both urban and rural households to examine how food purchases and expenditures vary with income. It assesses the demand for food quantity and quality (Prais and Houthakker, 1971; Hicks and Johnson, 1968; Chung et al., 2005). We find that high-income households have very inelastic demand for quantity of most food types, while rural households and low-income urban households have more income-elastic demand for quantity. Food quality—as measured by the unit value paid for items in a particular class of foods—rises with income at all income levels. Greater quality accounts for most of the increase in food spending by high-income households.

Chinese Household Food Spending and Income

Until the 1980s, Chinese households devoted more than half of their expenditures to food, reflecting both the central importance of food in Chinese culture and the historic vulnerability of the Chinese population to food insecurity. The dominance of food spending in Chinese budgets has diminished as income has grown—following the familiar "Engel's Law"—but food remains the single largest item in household budgets. Food's share of spending has declined to under 40 percent for urban households and about 45 percent for rural households.

Household incomes in China, when converted to U.S. dollars at the official exchange rate, seem low. The average household income of the top 10 percent of urban Chinese households (about 4.5 percent of all households) is just $2,641 per person (about $7,000 per household), still quite low by U.S. standards (table 1).[2] Most Chinese households had per capita incomes less than $1,000 per year in 2003. The middle 20 percent of urban households had incomes averaging $880 per person. The average for the middle 20 percent of rural households was just $275, an amount that included the imputed value of self-produced crops consumed onfarm.

China's Gross Domestic Product (GDP) has grown very rapidly (9-10 percent per year) since China began market reforms in 1978, but income growth has not been uniform across all Chinese households (Khan and Riskin, 2005). Between 2000 and 2003, average per capita income for the

[2]Converted to U.S. dollars at the official exchange rate of 8.28 Chinese yuan per dollar that prevailed during 2003. Bramall (2001) and Khan and Riskin (2005) suggest that these data understate income by excluding the rental value of owned housing, subsidies, and illegal income. See appendix 1, "China Household Survey Data," for more information.

Table 1
Average household income by income percentile, 2003

Household income percentile	Share of all households	Per capita income		Household income[1]	
	Percent	*Yuan*	*Dollars*	*Yuan*	*Dollars*
Urban:					
90-100	4.5	21,837	2,641	58,524	7,077
80-89	4.5	13,123	1,587	36,220	4,380
60-79	8.9	9,763	1,181	28,021	3,388
40-59	8.9	7,279	880	22,055	2,667
20-39	8.9	5,377	650	16,831	2,035
10-19	4.5	3,970	480	13,022	1,575
0-9	4.5	2,590	313	8,807	1,065
Rural:					
80-100	11.1	6,347	767	22,215	2,686
60-79	11.1	3,207	388	12,507	1,512
40-59	11.1	2,273	275	9,319	1,127
20-39	11.1	1,607	194	6,908	835
0-19	11.1	866	105	3,984	482

Note: Data were obtained from separate urban and rural household surveys. Share of all households was calculated based on 2003 national statistics indicating 44.7 percent of 371 million households were urban. Original values converted to dollars at official exchange rate of 8.28 yuan/dollar that prevailed during 2003.

[1]Estimated by multiplying per capita income by average persons per household.

Source: ERS analysis of China National Bureau of Statistics data.

top tier of urban households grew at double-digit rates far exceeding GDP growth (fig. 1). However, income growth for low-income urban and rural households—the majority of China's households—was well below GDP growth. Slow income growth for rural households (55 percent of the population) has become a major policy concern in China, but income growth has been even weaker among low-income urban households. Average income for the lowest decile of urban households actually declined slightly between 2000 and 2003.[3]

Patterns of food expenditure reflect the increase in income inequality. Expenditures by the top tier of households—China's emerging class of professionals and entrepreneurs (Senauer and Goetz, 2003; Gale, 2006)—have grown at double-digit rates. Food expenditures were nearly stagnant for the bottom 20 percent of urban households. Food expenditures by rural households grew 2.6 percent annually.

The uneven distribution of income growth magnifies the importance of understanding how food consumption patterns vary across income classes. Income and food expenditure growth have been disproportionately concentrated at the upper end of the income distribution, so the consumption patterns of high-income households may have been disproportionately influential in driving food demand and market developments.

Food is a necessity that absorbs about half of the income of China's poor households, but food's share of spending and income declines as households gain more income (fig. 2). The wealthiest urban households devoted 30 percent of their expenditures but only 20 percent of their disposable *income* to food. The ratios of food expenditure to income and to total expenditures are both 47 percent for the poorest urban households, about equal to the median rural household's food expenditure share.[4]

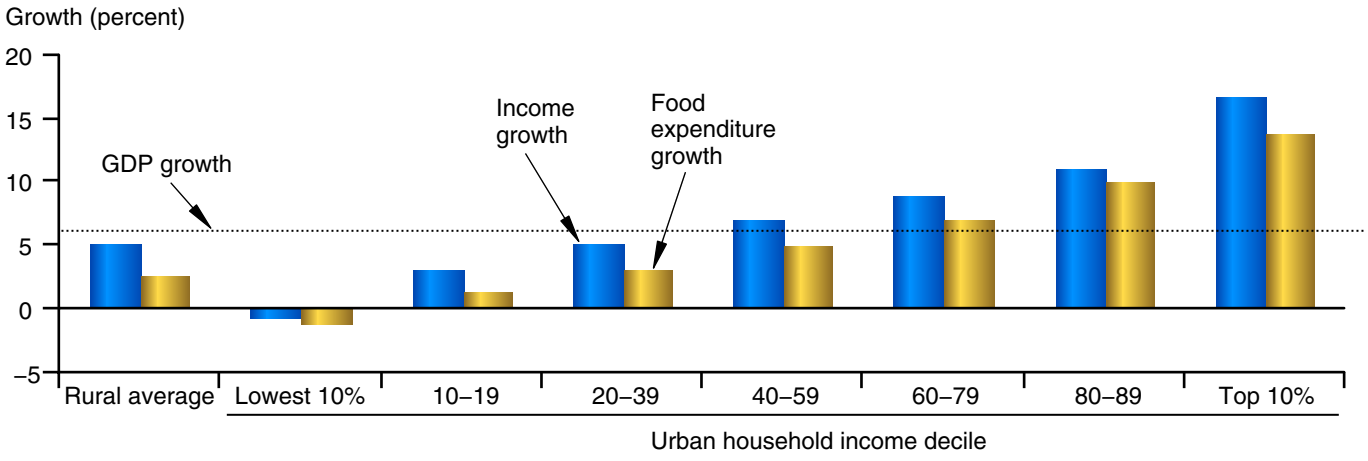
As their incomes rise, Chinese households tend to change the structure of their diets (Gale, 2003; Hsu et al., 2002; Guo et al., 2000; Gould, 2002; Wu, 1999). For low-income urban households, pork and eggs are the dominant

[3]Skilled workers, entrepreneurs, and government officials have experienced rapid income growth, but many industrial and government workers have been laid off or forced into early retirement by downsizing of state-owned enterprises and government bureaucracies. Low productivity in farming keeps farm earnings from rising, and a huge supply of unskilled workers prevents their wages from rising.

[4]By comparison, the 2004 average food share of expenditures for U.S. households was 13 percent. The food share of expenditures exceeds the share of income spent on food because the top 10 percent of Chinese urban households save about one-third of their income.

Figure 1

Average annual growth in household income and food expenditure, 2000–03, by income class



Source: Calculated by ERS from China National Bureau of Statistics data.

sources of animal protein, but purchases of fish and poultry rise more quickly as income increases (fig. 3). Among the lowest income households, pork purchases are more than double fish and seafood purchases. But among China's highest income households, purchases of pork are roughly equal to purchases of fish and seafood. Similarly, low-income households purchase more eggs than poultry, but high-income households' purchases of eggs and poultry are roughly equal.

In contrast, per capita consumption of traditional staple foods (grains and vegetable oils) tends to fall or remain stagnant as income rises. Average rice and wheat flour consumption is lower among households with higher incomes while consumption of grain products (breads, noodles, dumplings) tends to rise slightly as income increases (fig. 4).[5] Consumption of cooking oil is nearly the same for all urban income classes. These consumption patterns reflect the transition from a starch-based to an animal protein-based diet as income rises.

The relationship between consumption and income seemingly weakens as income rises (fig. 3). This is most evident for pork and egg purchases, which rise with income at low income levels but appear to plateau at high income levels. The apparent linear relationships between purchases of poultry, fish, and seafood and the log of income suggest that income elasticity declines as income rises.[6] In other words, the increase in pork and egg consumption in response to a 1-percent increase in income is greater for low-income consumers than for high-income consumers.

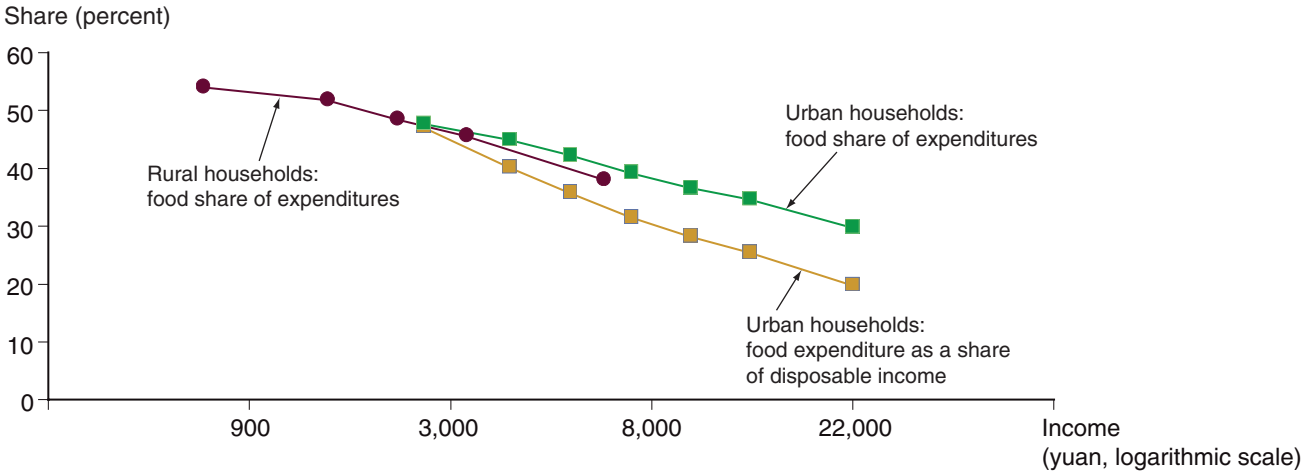
The unit value (expenditures divided by quantity purchased) of foods consumed rises with income. This pattern is most evident for fish and seafood (fig. 5). In 2003, households in the lowest urban income category paid an average of 8.15 yuan per kg for aquacultural food products, less than half the average paid by households in the highest income class. The unit value paid for meat also increases with income, but the unit value paid

[5]The strong negative relationship between flour consumption and income shown in figure 4 largely reflects north-south patterns of income and grain consumption. A disproportionate share of China's high-income households lives in southern China where the population consumes large amounts of rice and little wheat flour (Xin et al.). Conversely, flour consumption is high in northern and western China where incomes tend to be low.

[6]Mathematically, figures 3 and 4 depict the change in the absolute quantity purchased, Q, against the log of income, *lny*. If the slope of the line $(\Delta Q)/(\Delta lny)$ is greater than zero and constant, then the elasticity $(\Delta lnQ)/(\Delta lny)$ declines as y and Q increase.

Figure 2

Importance of food expenditure, urban and rural Chinese households, by income level, 2003

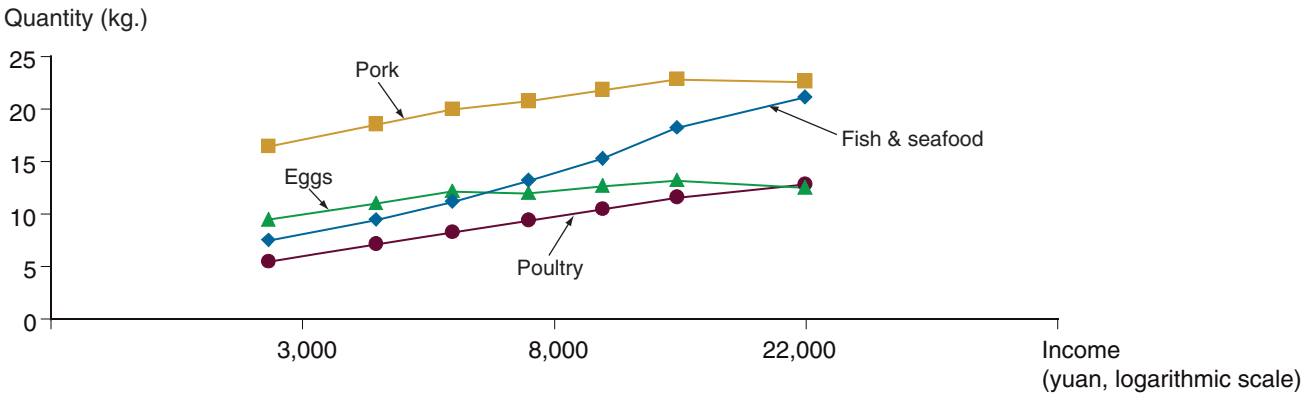


Note: Chart shows average food expenditures as a share of all household expenditures for urban and rural households and the ratio of food expenditures to disposable income for urban households. Averages are shown for household income quintiles for rural households. Averages for the top and bottom two deciles and middle three quintiles are shown for urban households. Income in Chinese yuan is net income for rural households and disposable income for urban households.

Source: ERS analysis of data from China National Bureau of Statistics, urban and rural household surveys.

Figure 3

Annual per capita purchases of livestock products, by income level, urban Chinese households, 2003

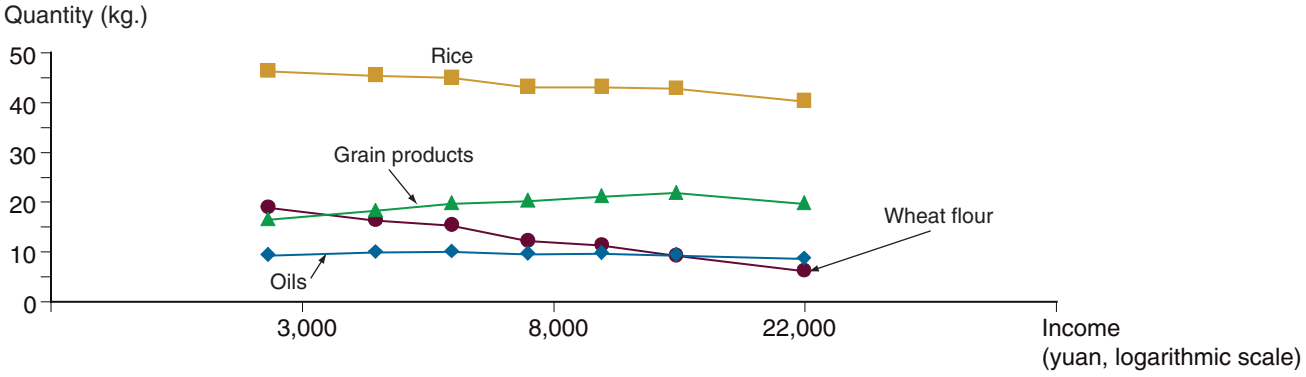


Note: Chart shows average annual per capita purchases by income group.

Source: ERS analysis of China National Bureau of Statistics, urban household survey data.

Figure 4

Annual per capita purchases of grains and oils, by income level, urban Chinese households, 2003

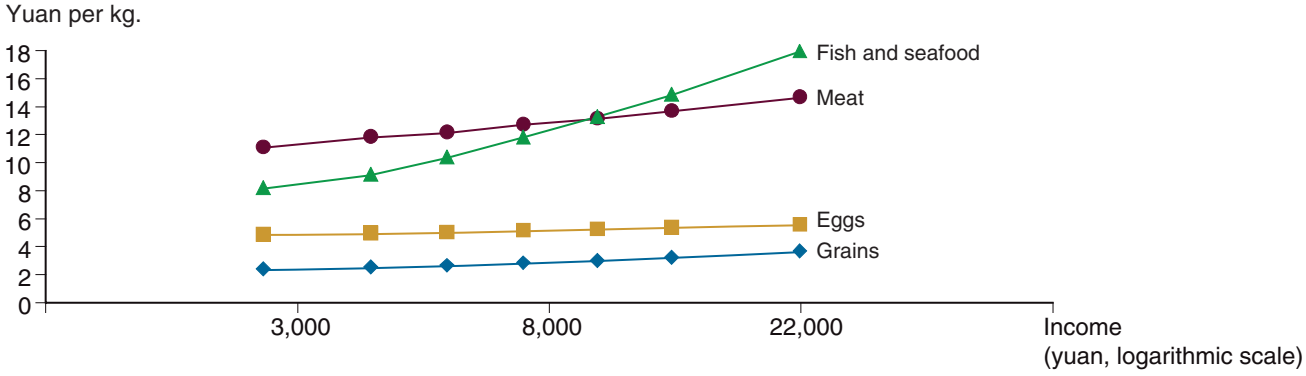


Note: Chart shows average annual per capita purchases by income group.

Source: ERS analysis of China National Bureau of Statistics, urban household survey data.

Figure 5

Average unit value of food purchases, selected food items, by household income, urban Chinese households, 2003



Note: Chart shows average per capita expenditures divided by per capita purchases for each income group.

Source: ERS analysis of China National Bureau of Statistics, urban household survey data.

for eggs—a relatively homogeneous product—increases only slightly with income, from 4.82 to 5.5 yuan per kg. The difference in unit value by income reflects the purchase of processed products, better cuts of meat, branded or packaged products, and more costly products (e.g., shrimp versus fish) by higher income consumers.

Engel Model of Food Consumption and Expenditure

This report estimates Engel curves for a comprehensive, detailed set of food categories using data tabulated from Chinese household surveys. The estimates are intended to capture empirical patterns described in figures 2-5:

1. Rising expenditures for a particular food category can reflect increases in quantity purchased as well as increases in unit value.

2. Engel relationships can be nonlinear.

Income elasticities are estimated for a more detailed breakdown of food categories than has been available from previous studies. The relationship of consumption and expenditure to income is carefully characterized, with no attempt to estimate price effects.[7]

[7]The study uses cross-sectional data from two years of relative price stability, so the data contain relatively little variation in prices.

"Quality" Effects in Engel Relationships

The Engel curve is most commonly expressed as the relationship between household expenditure on item i, e_i, and household income, y. Expenditure is the product of the price, p_i, and quantity purchased, q_i, of item i. In the simplest Engel function, the price is assumed to be independent of y, and the relationship between e and y reflects changes in the quantity purchased in response to a change in y while holding prices fixed:

$$e_i(y) = p_i q_i(y). \qquad (1)$$

The relationship $q_i'(y) > 0$ for a normal good implies $e_i'(y) > 0$. In this simple case, the elasticities of expenditure and quantity with respect to y are equal.

In empirical applications, expenditures on a food category may increase through increases in the "price" as well as quantity purchased. Household survey data used to estimate Engel equations typically consist of household expenditures and quantities for fairly broad categories of food items, such as grain, meats, poultry, fish, vegetables, and fruit. The average "price" for a broad budget category is calculated as the unit value: the ratio of expenditures to quantity purchased. The calculated unit value is actually the average of the prices paid for individual items within the category.

The "quality" component of food expenditures arises from the heterogeneity of food products with varying degrees of quality, processing, marketing services, and safety attributes within a food category. For example, "meat" can include various cuts of meat, processed meat products, organic products, and meats purchased from retail outlets that differ in their convenience or reputation for quality. An increase in expenditures on a particular food category may reflect an increase in quantities purchased (e.g., kilograms of meat) or a shift in the composition of products purchased within that food category (e.g., higher value cuts of meat, branded or processed meat products) or both. The shift in composition toward premium products increases the average unit value (expenditures per kilogram) of products purchased. Thus, the increase in unit value is an indication of food "quality."

Equation 1 can be modified by replacing the price with the unit value of foods in category i, v_i, which may vary with income:

$$e_i(y) = v_i(y)q_i(y). \quad (2)$$

The effect $v'_i(y)$ is the "quality" effect on y. The quality effect is positive if consumers purchase products with higher unit values when their incomes increase.

Taking logs of equation 2 and differentiating with respect to *lny*, the elasticity of expenditures for category i with respect to income has two components:

$$\frac{d \ln e_i}{d \ln y} = \frac{d \ln v_i}{d \ln y} + \frac{d \ln q_i}{d \ln y} \quad (3)$$

The expenditure elasticity, ε_i, is the sum of the "quality" elasticity, θ_i, and the quantity elasticity, η_i:

$$\varepsilon_i = \theta_i + \eta_i \quad (4)$$

These methods are similar to those of Hassan and Johnson (1977), who estimated elasticities of food consumption, expenditure, and quality with respect to household income for Canadian households. This report estimates η_i and ε_i from Chinese household consumption and expenditure statistics. The "quality" elasticity is the difference between the expenditure and quantity elasticies:

$$\theta_i = \varepsilon_i - \eta_i \quad (5)$$

Nonlinear Engel Relationships

Most empirical estimates of Engel curves assume a log-linear relationship between quantity consumed and income, but our exploratory analysis found that the log-linear relationship did not fit the data well. The log-linear relationship assumes a constant income elasticity over all levels of y, but the data indicate that income elasticity falls as income grows, reaching zero at high levels of y for some food items. For example, the consumption of pork and eggs tends to rise with income at low income levels, but plateaus when income reaches a high level.In terms of equation 1, $q_i'(y) > 0, q_i''(y) < 0$, and $q_i'(y)$ approaches zero at high levels of y.[8] Bai and Wahl (2005) found similar nonlinear patterns in nonparametric Engel curves estimated for urban households in Shandong Province. Banks, Blundell, and Lewbel (1999) have emphasized the importance of nonlinearities in Engel curves.

Nonlinear Engel relationships may reflect physical saturation of demand or nonhomothetic consumer preferences. For example, low-income households may have unsatisfied demand for pork, so more income leads to greater pork purchases. At higher income levels, the demand for pork may top out. Or high-income consumers may prefer to spend additional food dollars on a wider variety of meats or seafood.

We use the log-log-inverse (LLI) form of the Engel equation, which allows the income elasticity to vary with income:

$$\mathrm{Inq_{ij}} = \alpha_i + \beta_i(1/y_j) + \gamma_i \mathit{Iny}_j + \mathrm{u_{ij}}, \quad (6)$$

[8] If $q_i'(y)$ approaches zero, the income elasticity, $\eta_i = q_i'(y) \times \left(\frac{y}{q_i}\right)$, also approaches zero as y increases.

where the dependent variable q_{ij} represents the per capita quantity of the *i*th food consumed by the *j*th household.[9] The independent variable y_j represents the per capita income of *j*th household, and u_{ij} is a random disturbance term. The parameters α_i, β_i, γ_i are to be estimated. The LLI functional form does not satisfy the adding-up criterion, but this was not a concern since we did not estimate a complete demand system.[10]

The LLI form has the advantage of being a fairly flexible functional form with only three parameters to estimate. It allows the income elasticity to vary with income and change sign. The LLI has two familiar functional forms nested in it. If $\beta_i = 0$, the LLI simplifies to the familiar "double-log" model. If $\gamma_i = 0$, the LLI model simplifies to the log-inverse model.[11]

The quantity elasticity of the *i*th food category, η_i , is calculated:

$$\eta_i = \beta_i / y_j + \gamma_i . \quad (7)$$

The income elasticity varies with income, y_j, if the estimate of $\beta_i \neq 0$. If $\beta_i < 0$ and $\gamma_i > 0$, then η_i decreases as y increases and may reach zero when $\beta_i / y = \gamma_i$ and become negative if $\beta_i / y > \gamma_i$. If $\beta_i = 0$, the income elasticity is independent of the level of income (the double-log model) and equals γ. If $\gamma_i = 0$ (the log-inverse model), the income elasticity equals $-\beta_i / y$ and also varies with income, but it never reaches zero or changes sign.

An expenditure equation is specified in the LLI functional form as:

$$ln e_{ij} = \alpha_i * + \beta_i * (1/y_j) + \gamma_i * ln y_j + u_{ij} , \quad (8)$$

where the dependent variable e_{ij} represents per capita expenditure on the *i*th food by the *j*th household. The independent variable y_j represents per capita income of the *j*th household, and u_{ij} is a random disturbance term. The estimated expenditure elasticity is calculated from the estimated coefficients and depends on the level of income:

$$\varepsilon_i = -\beta_i * / y + \gamma_i * . \quad (9)$$

Finally, we estimate the quality elasticity as the difference between the estimates of η_i and ε_i.

Data and Estimation

The Engel function is ideally estimated with household-level data, but such data were not available for this study. This study fitted regression equations to group means of per capita quantities, expenditures, and disposable income published by China's National Bureau of Statistics (NBS). NBS annually publishes mean values of income, expenditure, and amount consumed/purchased as calculated from large household surveys (see appendix, "China Household Survey Data"). Rural means for a limited number of food categories are reported for income quintiles. Urban means for detailed food categories are reported for the highest two deciles, the lowest two deciles, and the middle three quintiles. Standard errors are not published, but the means are based on large samples so the standard error is

[9]Hassan and Johnson estimated Engel equations using household totals for consumption and income, but the current study had access only to per capita averages.

[10]The adding up criterion is derived from the consumer's budget constraint that the sum of expenditures on all items equals total expenditure. This condition implies that $\sum_{i=1}^{n} \left(\frac{e_i}{e} \right) \eta_i = 1$.

[11]Hassan and Johnson compare properties of the LLI and several other functional forms used to estimate Engel equations.

likely quite low. Each rural quintile includes 13,600 survey households. Urban deciles include about 4,700 households each, and urban quintiles include about 9,700 households each.

In our regressions, we treated the average per capita values of consumption and income for an income class as an observation of a representative household at the corresponding income level (see box, "Estimating Engel Equations Using Group Means"). The income tabulations gave us seven urban observations and five rural observations for each food category for each year. We pooled the data from these tabulations for 2 years, 2002 and 2003, giving us a total of 14 urban observations and 10 rural observations. Food prices were relatively stable between 2002 and 2003, so the assumption that prices are held constant when we estimated our regressions seemed reasonable.[12]

Engel equations of the form (6) and (8) were estimated for each available food category for urban and rural households using ordinary least squares. A year dummy variable, d_j, equal to 1 for observations from year 2003 and 0 for observations from year 2002, was added to the regression model to capture any shifts in demand between the 2 years due to factors beside income.

The Chinese household survey data are compiled from diaries of income and expenditures kept by sample households. The diaries are kept by a household member year round with assistance from NBS enumerators who visit the household periodically. For urban households, records of food purchases for consumption at home are the primary measure of consumption. This may overstate consumption to the extent that some food purchased is wasted, given away, consumed by guests, or not consumed for other reasons. Expenditures are also recorded, which allows the computation of unit values that approximate the average price paid. (Expenditures on food away from home are recorded, but there is no breakdown on what foods are purchased or consumed away from home.) The quantity for rural households is per capita quantity consumed, and includes both purchased and self-produced food.[13] Quantity data do not include consumption in restaurants, cafeterias, or other foodservice establishments.

The income measure used for urban households was per capita disposable income. This includes income from wages, business earnings, interest, and transfer payments, less tax and social insurance contributions. It excludes proceeds from loans or sale of personal items. Per capita net income for rural households includes net income from farming and other businesses plus interest, transfer payments and remittances. Farming income includes the imputed value of products grown and consumed or used on the household's own farm. We did not deflate income since there was little inflation between the 2 years.

[12]In 2003, China's change in consumer prices for most food commodities ranged from -1 percent to 3 percent. We excluded data from 2004 because large changes in prices occurred between 2003 and 2004. We did not include data from years prior to 2002 because the sampling method of the urban household survey was changed between 2001 and 2002 to include a larger number of households from small cities and towns. Tabulations of rural household data by quintile were not available for years prior to 2002.

[13]About 40 percent of food "expenditures" for rural households are the imputed value of self-produced food (Gale et al., 2005). The tabulations of rural household data used for this study do not report expenditures, so the rural analysis only estimates Engel equations for quantity consumed.

Estimating Engel Equations Using Group Means

Econometric models must often be estimated from aggregated data when values for individual observations are unavailable or too costly to obtain or analyze. Many analyses use grouped data such as means for states, countries, or demographic groups.

Engel models are ideally estimated using household data, but the current analysis fits regression models to group means. This approach provides an accurate estimate of the relationship between household consumption/expenditures and income as long as other factors (besides income) that affect household consumption are not correlated with income.

The group means may be viewed as representative households for each income group. For a quintile A, consisting of N_A households, the mean values for income and quantity consumed of food item i are:

$$\bar{y}_A = \frac{1}{N_A} \sum_{j \in A} y_j \text{ and } \bar{q}_{iA} = \frac{1}{N_A} \sum_{j \in A} q_{ij}.$$

The disturbance for the means for quintile A is the average of disturbances for the households in quintile A:

$$\bar{u}_{iA} = \frac{1}{N_A} \sum_{j \in A} u_{ij}.$$

The means of q and y will have the same relationship as the household level q and y and the model for quintile A is therefore:

$$\text{In } \bar{q}_{iA} = \alpha_i + \beta_i (1/\bar{y}_A) + \gamma_i \text{ In } \bar{y}_A + \bar{u}_{iA},$$

Kmenta (1971) showed that ordinary least squares estimates obtained from group means are unbiased estimates of the parameters, but the variance of the error for each mean is proportional to the number of individual observations in each group. Consequently, errors are heteroskedastic and parameter estimates are inefficient if the groups are of different sizes. In this case, weighted least squares can obtain efficient estimates.

The rural household models are estimated with means for quintiles that contain equal numbers of households, so no corrective action is needed. The urban models are estimated using three quintiles (containing over 9,000 households each) and four deciles (containing over 4,500 households each). Urban models are estimated with weighted least squares using the corresponding number of households in each group as weights.

Compared with other groupings (e.g., provincial means used in other studies), income quantiles are a particularly useful grouping for estimating Engel relationships. Kmenta showed that the difference between the variance of the group-mean estimator and the variance of the estimator obtained from individual observations (the variance of the group-mean estimator is always larger) depends on the ratio of within-group to between-group variation in the explanatory variable. Using a grouping sorted by the explanatory variable (e.g., income quantiles) minimizes the within-group variation in the explanatory variable and maximizes the between-group variation as compared with other possible groupings. The relatively large degree of variation in the explanatory variable improves the efficiency of the group-mean estimator.

Models estimated from grouped means also tend to have high R^2 values (Cramer, 1964). When averaged over N households in quintile A, positive and negative random errors will cancel one another out, and variation in the group means will be much lower (and the R^2 much higher) than the variation in individual household values. We obtain very high R^2 values in our models because most of the variation in q_i due to measurement error, individual effects, and other factors besides y is removed by using group means.

Results

Quantity Elasticities

Regression results for quantity Engel equations are reported in appendix tables 2 and 3. The log-log-inverse model fits the data well, as both the β_i and γ_i parameters are statistically significant in most equations. The year dummy variables are significant in about half of the equations—consumption of yogurt, milk, bottled water, fruit/vegetable juice, and mutton was up sharply in 2003 versus 2002, while consumption of flour, starches and tubers, chicken, and other poultry decreased in 2003. The decline in poultry consumption was probably tied to the outbreak of severe acute respiratory syndrome (SARS) during 2003, which was thought to be linked to poultry consumption. Adjusted R^2 values are very high due to the use of grouped data, which eliminates most of the individual household variation in quantities purchased (Cramer).

Since elasticities may vary with income, they were calculated at three representative income levels for rural households and four representative urban income levels. Elasticities for 15 general food categories are calculated for rural and urban households (table 2) and urban elasticities for 43 detailed food categories (table 3). We calculated rural elasticities at incomes of 900 yuan ($109), 2,500 yuan ($300), and 6,000 yuan ($725), which correspond to the lowest, middle, and highest quintiles of the rural population in 2003 (see table 1). Urban elasticities were calculated at income levels of 2,500 yuan ($300), 7,500 yuan ($900, approximately the median income for urban households), 10,000 yuan ($1,200), and 22,000 yuan ($2,660, the average income for the top income decile of urban households).

The estimate of the β_i parameter was significantly different from zero for 42 of 46 equations estimated for urban households (appendix table 2), indicating that the income elasticity of demand depends on the level of household income. For urban households, the β_i estimate was not significantly different from zero for just a few categories: rice, other grains, starches and tubers, and other poultry.[14] The sign on the estimate of β_i indicated that the elasticity tends to decrease as income rises. For rural households, β_i was significantly different from zero for only 5 of 12 food categories (appendix table 3). The range of incomes for rural households is much lower than for urban households, incomes of most rural households have not reached the threshold income where elasticity begins declining.

Quantity-income elasticities are less than 1 for nearly all food and beverage items, and they decrease in magnitude as income grows. At high income levels, elasticities of demand are close to zero for most food items, suggesting that top income households are approaching saturation levels of quantity consumed.

Quantity elasticities decline as income increases for nearly every food category. For example, the poultry elasticity is relatively high for rural households (0.63-0.74) and for low-income urban households (0.78), but declines to 0.25 for high-income urban households. Income elasticities for grains—

[14]Rice and starches and tubers had small negative elasticities. In the "other grains" equation, none of the parameters were significantly different from zero. We do not report elasticities for "other grains" or tubers and starches in table 3 since the parameters are not statistically reliable.

Table 2

Estimated income elasticities by food item and income level, rural and urban households, 2002-03

Food category		Rural households Income (yuan) 900	2,500	6,000	Urban households Income (yuan) 2,500	7,500	10,000	22,000
					Elasticity			
Grains	}[1]	0.18	0.06	0.02	0.01	-0.09	-0.10	-0.11
Starches and tubers					-.10	-.09	-.08	-.08
Edible oils		.51	.23	.14	.17	-.08	-.11	-.16
Vegetables		.60	.16	.03	.20	.09	.08	.05
Eggs		.72	.46	.38	.50	.10	.05	-.03
Pork		.25	.24	.23	.44	.13	.09	.03
Beef	}[1]	-.76	.39	.71	.93	.19	.10	-.06
Mutton					1.14	.18	.06	-.14
Dairy products		-1.50	.70	1.30	1.74	.64	.50	.28
Poultry		.74	.66	.63	.78	.38	.33	.25
Aquatic products		.91	.93	.94	.72	.52	.49	.45
Fruit	}[1]	.38	.48	.50	.95	.35	.27	.15
Melons					.85	.32	.25	.15
Alcohol		Data not available			.88	.16	.08	-.07
Other beverages					1.69	1.03	.94	.81

Note: Calculated using Engel regression results shown in appendix table 2. Elasticity = $-\beta/y + \gamma$ (see equation 7).
[1]Categories are combined for rural households.

Source: Estimations by ERS from China National Bureau of Statistics data.

which account for most calories consumed by Chinese people—are close to zero at all income levels, although they show a tendency to decrease from slightly positive for the poorest rural households to slightly negative at high incomes. Elasticities for vegetables and edible oils—also important components of the basic Chinese diet—are also close to zero. Vegetable and edible oil elasticities have small positive values at low income levels, but fall to near zero (for vegetables) or negative (for edible oils) at median urban income levels.

Demand for livestock products is strongly related to income at low income levels, but the relationship weakens as income grows. Eggs are an inexpensive source of protein, and their consumption is strongly related to income for rural households and poor urban households, but high-income urban households have very low egg-income elasticities. Pork is the dominant meat consumed in China, and its income elasticity is low compared with poultry, dairy, beef, and mutton. The pork elasticity is about 0.24 for rural households at all income levels, and relatively high (0.44) for poor urban households. However, the pork elasticity is just 0.13 at the urban median income and is near zero for high-income households. Beef, mutton, and dairy elasticities for urban households diminish with income. Each of these items has a high elasticity at an income of 2,500 yuan. The dairy elasticity remains positive even at high income levels, but beef and mutton elasticities diminish more rapidly.

The elasticities for dairy, beef, and mutton show a puzzling pattern for rural households. The estimated income elasticities for dairy and beef/mutton are negative at the lowest income level (900 yuan), become positive at an income of 2,500 yuan, and become even larger at an income of 6,000 yuan. At an income of 6,000 yuan, dairy has the highest income elasticity (1.3) of

Table 3

Estimated quantity-income elasticity by income level, and detailed food category, urban households, 2002-03

	Urban household income (yuan)			
Category	Low 2,500	Median 7,500	High 10,000	Highest 22,000
		Elasticity		
Rice	-0.06	-0.05	-0.05	-0.05
Flour	-.14	-.58	-.63	-.72
Grain products	.42	.07	.02	-.05
Cakes	1.11	.44	.35	.22
Vegetable oils	.22	-.05	-.09	-.14
Animal fats	-.23	-.68	-.73	-.82
Other meats	1.08	.01	-.12	-.34
Meat products	1.29	.50	.40	.24
Chicken	.62	.30	.26	.20
Duck	.77	.31	.26	.17
Other poultry	.95	.82	.80	.78
Poultry products	1.48	.62	.52	.35
Fresh milk	1.75	.64	.50	.28
Milk powder	1.07	.22	.11	-.06
Yogurt	1.94	.75	.59	.35
Fish	.57	.40	.38	.35
Shrimp	1.53	.90	.82	.69
Other aquatic products	1.36	.83	.77	.66
Dried fruit	1.17	.42	.33	.17
Fruit products	1.32	.74	.67	.55
Nuts	.61	.40	.38	.33
Chinese liquor (*bai jiu*)	.46	-.20	-.28	-.41
Beer	1.14	.20	.08	-.11
Wine	.23	.60	.52	.38
Other alcohol	1.64	1.00	.92	.77
Soft drinks	1.23	.64	.56	.44
Fruit/veg juice	1.67	.86	.76	.60
Bottled water	2.02	1.19	1.08	.91
Tea leaf	.58	.29	.26	.20

Note: Calculated using Engel regression results shown in appendix table 2. Elasticity = $-\beta/y + \gamma$ (see equation 7).

Source: Estimations by ERS from China National Bureau of Statistics data.

any food category consumed by rural households. These puzzling patterns are likely a statistical artifact resulting from geographically distinct diets predominant in China's poorest regions. Historically, ruminant products have been the core of the diet for pastoral minority populations—Tibetans, Hui, Uighurs, and Mongolians—in grassland and mountainous areas such as Tibet, Xinjiang, and Inner Mongolia, all regions where animal herding is common. These minority groups are also the poorest people in China and are disproportionately represented in the lowest income quintile of the rural population. Consequently, consumption of milk, beef, and mutton for the lowest quintile of the rural population is much higher than in other quintiles. The result is a spurious negative relationship between consumption and income at very low income levels.

Consumption of ruminant products is strongly associated with access to modern retail outlets and food service. Milk is predominantly marketed

through supermarkets and convenience stores. Consumption of mutton and beef is rising, but it is usually consumed in the form of hamburgers, shish-kebabs, "hot pot," and dishes associated with ethnic minorities served primarily in restaurants or foodstands. The high elasticities for high-income rural households may reflect better access to supermarkets, restaurants, and refrigerator ownership by these households, which tend to live in more developed rural areas near cities and in wealthy coastal provinces. Another implication of these consumption patterns is that our estimates probably understate elasticities for beef and mutton since a large proportion of consumption may not be captured in at-home statistics.

Consumption of aquacultural products—mainly fish and shellfish—is strongly related to income at all income levels. The elasticity is over 0.9 for rural households at all income levels, and declines from 0.72 for poor urban households to 0.45 for high-income urban households. For rural households, aquacultural products are the most income-elastic category (except for dairy products for high-income households). For high-income urban households, aquacultural products have the second-largest elasticity (after other beverages).[15]

[15]Chern (1999) observed that consumption of aquatic products in China was much lower than in Japan and Taiwan.

Elasticities for more detailed food categories can further demonstrate which food items are most sensitive to income. A number of foods and beverages have elasticities exceeding 1 at low income levels that diminish sharply as income rises (table 3). For example, consumption of "other meats" (meats such as rabbit, donkey, dog, and wild animals) is strongly related to income at low income levels, but the elasticity reaches zero at an income of 7,500 yuan and is negative at higher incomes.

Basic staple foods—rice, wheat flour, and animal fats—have negative income elasticities at all income levels, indicating that they are inferior goods. Grain products (noodles, breads, dumplings) have a positive elasticity at low income levels that diminishes to near zero at high income levels. Higher income households likely substitute noodles, breads, and other processed grain products for wheat flour and rice. Vegetable oil has a small positive elasticity at low income levels, turning negative over the range of incomes earned by most urban households.

These subcategories reveal some differences in elasticities within categories. The elasticities for processed poultry and meat products exceed those of fresh meats and poultry. Demand for poultry products is slightly more income-elastic than is demand for meat products at all income levels. Chicken and duck have similar income elasticities. Demand for "other poultry" (such as wild birds, pigeon, turkey) remains strongly related to income at high income levels.[16] Demand for milk powder is less elastic than demand for fresh milk and yogurt. Demand for shrimp and other aquacultural products is more elastic than demand for fish.

[16]The year dummy variable for wild poultry was significant and indicated that consumption was over 20 percent lower in 2003 than 2002. This is likely due to the SARS outbreak in mid-2003, which was associated with wild poultry.

Demand for beer is highly elastic at low incomes, but the elasticity is negative at the highest income level. Traditional Chinese liquor (*bai jiu*) has a negative income elasticity at most income levels. Demand for wine (*putao jiu*) and other alcohol (like brandy and vodka, which are seldom consumed in China) is more elastic. Coffee/cocoa, soft drinks, bottled water, and fruit/vegetable juice have high income elasticities. These beverages were rarely consumed in China until recently, but have now become popular with

urban professionals. Tea, traditionally the predominant beverage in China, has a lower elasticity than any other beverage.

Expenditure Elasticities

Expenditure equations were estimated for 23 food categories for which urban expenditure data were available (appendix table 4). Expenditure data were not available for rural households. The γ_i^* parameter was significant in all but one (eggs) equation. The β_i^* parameter was significant for 16 of the 23 food categories, indicating that the expenditure elasticity varies with income for most foods. The β_i^* parameter is not significant for seven food categories, indicating a constant expenditure elasticity for grain, starches and tubers, beans, aquacultural products, fresh vegetables, vegetable products, and nuts. Constant elasticities are more common for expenditure elasticities than for quantity elasticities. In the quantity equations, β_i was significant in all but 3 of 46 food categories.

Most expenditure elasticities are larger in magnitude than the corresponding quantity elasticities, reflecting a "quality" effect whereby expenditures on most foods rise faster than the quantity purchased when household income grows. Expenditure elasticities for grain range from 0.11 to 0.16, while quantity elasticities for grain were negative for incomes of 7,500 yuan and above. These results indicate that households tend to spend slightly more on grain as their incomes rise, although they reduce the amount of grain they buy. The expenditure elasticity for poultry ranges from 0.96 at an income of 2,500 yuan to 0.42 at an income of 22,000 yuan (table 4), versus quantity elasticities of 0.78 and 0.25. Both expenditures and quantity purchased rise with income, but expenditures rise faster than quantity.

Most expenditure elasticities remain substantially greater than zero at the highest income level (22,000 yuan), while quantity elasticities for most food categories were close to zero or negative at the highest income level. For example, the quantity elasticity for vegetables is only 0.05 at an income of 22,000 yuan, but the expenditure elasticity for fresh vegetables at that income is 0.31. At an income of 22,000 yuan, quantity elasticities for meats ranged from 0.03 for pork to -0.14 for beef, but the expenditure elasticity at that income is 0.19. Thus, the additional food expenditure of high-income households mostly reflects increased unit value, or quality, of foods purchased rather than greater amounts.

Quality Elasticities

Quality-income elasticities were estimated for 17 food categories for which both quantity and expenditure elasticity estimates could be made (table 5). Expenditure and quantity elasticities were evaluated at each of the four urban income levels, and the quality elasticity was calculated as the difference between the expenditure and quantity elasticities. Estimates are presented for urban households only since expenditure data for rural households were not available.

All but one of the food categories have quality elasticities greater than zero, suggesting that Chinese households purchase higher quality food items as

Table 4

Estimated expenditure-income elasticities by income level, by food category, urban households, 2002-03

	Income elasticity at income level (yuan)			
Category	2,500	7,500	10,000	22,000
	Elasticity			
Grain	0.11	0.15	0.15	0.16
Starches and tubers	.11	.16	.17	.18
Beans	.22	.29	.30	.32
Oils	.28	.02	-.01	-.06
Meat	.70	.32	.27	.19
Poultry	.96	.55	.50	.42
Eggs	.53	.17	.13	.05
Aquatic products	1.06	.92	.90	.87
Fresh vegetables	.47	.35	.34	.31
Dried vegetables	1.27	.65	.58	.45
Vegetable products	.65	.57	.56	.54
Flavorings	.44	.33	.32	.30
Alcohol	1.11	.47	.39	.26
Other beverages	1.39	.84	.77	.66
Fresh fruit	1.05	.65	.60	.51
Fresh melon	1.13	.67	.61	.52
Dried fruit	1.35	.71	.62	.49
Fruit and melon products	1.40	1.05	1.00	.93
Nuts	.88	.74	.72	.69
Cakes	1.21	.76	.70	.61
Dairy	1.63	.79	.68	.51
Sugar	.75	.61	.60	.57
Tobacco	1.03	.52	.46	.36

Note: Calculated using Engel regression results shown in appendix table 4. Elasticity = $-\beta^*/y + \gamma^*$ (see equation 9).

Source: Estimations by ERS from China National Bureau of Statistics data.

Table 5

Quality and quantity elasticities by income level, urban households, 2002-03

	Income (yuan)							
	2,500		7,500		10,000		22,000	
Commodity	Quality	Quantity	Quality	Quantity	Quality	Quantity	Quality	Quantity
Grain	0.11	0.00	0.23	-0.09	0.25	-0.10	0.27	-0.11
Starches and tubers	.20	-.10	.25	-.09	.25	-.08	.26	-.08
Oils	.10	.18	.10	-.08	.10	-.11	.10	-.16
Meat	.12	.59	.14	.18	.14	.13	.14	.05
Poultry	.18	.78	.17	.38	.17	.33	.17	.25
Eggs	.03	.50	.07	.10	.07	.05	.08	-.03
Aquatic products	.34	.72	.40	.52	.41	.49	.42	.45
Fresh vegetables	.27	.20	.26	.09	.26	.08	.26	.05
Alcohol	.14	.88	.21	.17	.22	.08	.23	-.07
Nonalcoholic beverages	-.29	1.69	-.19	1.03	-.17	.94	-.15	.81
Fresh fruit	.11	.95	.30	.35	.32	.27	.36	.15
Fresh melon	.28	.85	.35	.32	.36	.26	.37	.15
Dried fruit	.18	1.17	.28	.42	.30	.33	.32	.18
Fruit and melon products	.08	1.32	.31	.74	.33	.67	.38	.55
Nuts	.27	.61	.34	.40	.34	.38	.36	.33
Cakes	.10	1.11	.32	.44	.35	.35	.39	.22
Dairy	-.11	1.74	.15	.64	.18	.50	.23	.28

Note: Quantity elasticities obtained from table 2. Quality elasticities = expenditure elasticity - quantity elasticity. Expenditure elasticities used in the calculation were obtained from estimates in appendix table 4. See equation 5.

Source: Estimated by ERS from China National Bureau of Statistics data.

their incomes rise. While quantities purchased tend to plateau at high income levels, expenditures continue to grow even as households reach high income levels. The quality elasticities reflect a change in the mix of products consumed (more processed products or more high-value products, like shrimp versus fish), as well as consumption of higher grade or branded products by households with higher incomes.

Most quality elasticities are in the range of 0.1 to 0.4. Aquacultural products have the highest quality elasticity. Eggs, edible oils, meat, poultry, and dairy products have elasticities of 0.07 to 0.17. Nonalcoholic beverages are the only category with a negative quality elasticity at all income levels. This reflects the high quantity elasticity for bottled water, an item with low unit-value compared with other nonalcoholic beverages.[17] Dairy products have a surprising negative quality elasticity at low income levels (the quantity elasticity is very high at this income level—1.74), but the quality elasticity is positive at median and higher incomes.

The quality elasticities for grain, starches and tubers, vegetables, and oils are much larger than the quantity elasticities. The quantity of processed products consumed tends to increase with income, while rice and wheat flour purchases decline. Households with higher income also are more likely to buy high-quality items like japonica rice from northeastern China, imported jasmine rice, refined soybean oil, "green food,"[18] or organic food products. The quality elasticities nearly match the quantity elasticities for some of the more income-elastic categories, such as fruit, melons, aquacultural products, nuts, and alcohol. At higher income levels (which have small quantity elasticities for these categories), the quality elasticity often exceeds the quantity elasticity for these categories.

Quality elasticities are modest for livestock products—meat, eggs, poultry, and dairy—ranging from 0.07 for eggs to 0.17 for poultry. This is surprising since our analysis of quantity elasticities showed that purchases of higher valued processed meat and poultry products are highly responsive to income.

Meals Away From Home

Our analysis considered only food consumed at home, but the rising share of spending on food consumed away from home is an important component of the increased demand for quality in Chinese food consumption. Away-from-home spending rose from 8 percent of urban household food expenditures in 1992 to nearly 20 percent in 2004 (fig. 6).[19] Expenditures on meals consumed in restaurants, cafeterias, or food stalls buy not only food, but also service and convenience. Data are not available to measure the unit value of food purchased away from home, but it is likely much higher than the unit value of food purchased for preparation at home.

Our elasticity estimates are based only on food purchased for consumption at home and so may understate the response of food demand to income growth. Estimates did not account for food consumed away from home, an increasingly common occurrence with the explosion of restaurants, cafeterias, and food stands in China. Studies by Ma et al. (2006) and Wang and Yang (2003) have shown that household surveys understate food consumption by failing to account for food consumed away from home.

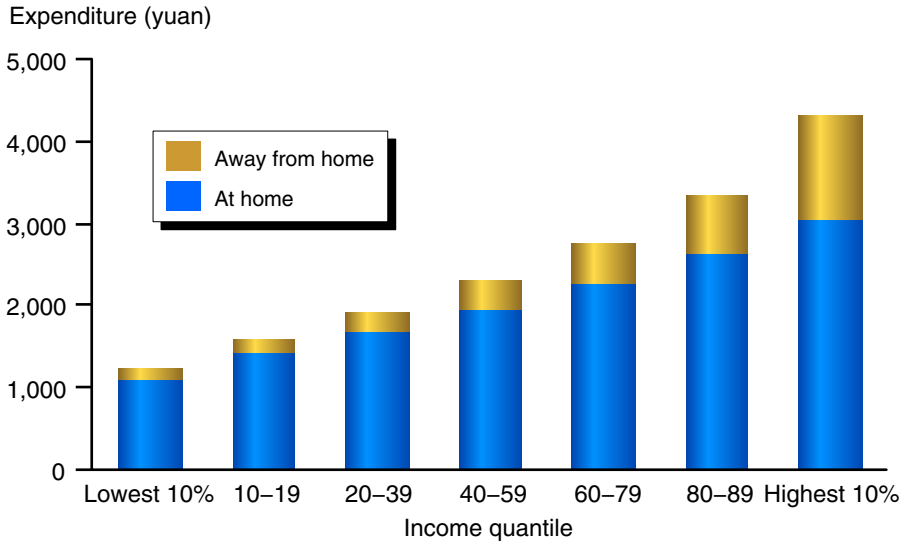
[17]As income rises, bottled water accounts for a greater share of the nonalcoholic beverage category. Since bottled water has a low unit value (it typically sells for 1 yuan or less in supermarkets), its increasing share reduces the average unit value in the category.

[18]"Green food" is a Chinese government standard for products grown to specifications that limit use of chemical inputs and set tolerance levels for pollutants in soil, air, and water in growing areas. These products are viewed as safer and sell at a price premium.

[19]Unpublished rural household survey data obtained by ERS from the China National Bureau of Statistics show that the away-from-home share of food expenditures for rural households rose from 2.4 percent in 1990 to 11.2 percent in 2003.

Figure 6

Per capita food expenditures, by urban household income quantile, 2003



Source: Calculations by ERS based on data from China National Bureau of Statistics.

In 2003, the lowest income decile of urban households devoted 8 percent of their food expenditures to food away from home, but the top 10 percent of urban households spent 30 percent away from home (fig. 6).[20] Thus, considering only food consumed at home also understates the strength of the relationship between food spending and income. Min et al. (2000) found that food away from home in China is a luxury item with an income elasticity of demand much higher than that in the United States. Gale et al. (2005) found that food away from home was the only rural food expenditure category with an expenditure elasticity greater than 1. They also found that the expenditure elasticity for food away from home was greater than elasticities for nonfood expenditures.

The urban household survey reports expenditures on food consumed away from home, but no quantities consumed away from home. Thus, it is possible to estimate an expenditure equation, but not a quantity or unit value elasticity.

In preliminary estimation, we rejected the log-log-inverse model for food-away-from-home expenditure, since the β_i coefficient was not significantly different from zero. This suggests that the double-log model is more appropriate and that the food-away-from home expenditure elasticity is constant across income levels.[21] Our double-log estimate of the Engel equation for food expenditures away from home gives us the following result (standard errors in parentheses):

$$\underset{}{ln e_j} = \underset{(.089)}{-4.72} + \underset{(.010)}{1.20\ ln y_j} - \underset{(.012)}{.048\ d_j} + v_j, \qquad R^2 = .999$$

All coefficients are significantly different from zero. The coefficient 1.2 on the $ln y_j$ term is the estimate of the elasticity of food-away-from-home expenditure with respect to household income. This is the largest expenditure elasticity of any food category. The only other food expenditure elas-

[20]This share is still less than the 42-percent share of food expenditures made away from home in the United States during 2004 (U.S. Bureau of Labor Statistics).

[21]Ma et al. found a food-away-from-home elasticity of 1.7. They also found that the elasticity increased with income, a result also found by Byrne and Capps' analysis of food-away-from-home expenditure in the United States.

ticity exceeding 1 is for processed fruit and vegetable products. The coefficient on the year dummy variable, d_j, is negative. Growth in food-away-from-home expenditure may have been dampened by the SARS crisis during May-June 2003 when most travel in China was halted and many restaurants were idled.

Since the data used for this study do not measure the quantity of food consumed away from home, the quantity elasticity of food away from home cannot be estimated. The food-away-from-home quantity elasticity is likely lower than the expenditure elasticity of 1.2. Food-away-from-home consumption probably has a significant quality elasticity, as do most categories of at-home food consumption. Households with higher income tend to consume food at establishments offering a higher level of service, which translates to a higher unit value of food consumed.[22] If we suppose that the quality elasticity for food away from home is 0.3 (in the range of those estimated for most at-home food categories), then the quantity elasticity for food away from home would be 1.2 - 0.3 = 0.9.

The quantity of food consumed away from home is a major source of uncertainty for analysts calculating food supply and disappearance in China. A sample survey conducted by Wang and Yang found that nearly half of meat was consumed away from home, and Ma et al. also found that a disproportionate amount of meat was consumed away from home. Both studies relied on their findings to reconcile the low per capita meat consumption figures reported from urban household surveys with meat disappearance statistics that suggest much higher consumption levels.

How much food is consumed away from home in China? The share has been growing rapidly, but is still small. While 18 percent of urban food *expenditures* (and 11 percent of rural food expenditures) were made away from home in 2003, the share of the quantity of food consumed away from home is considerably less. Much of the cost of meals consumed in restaurants represents the cost of nonfood services and materials such as labor, rent, equipment, furnishings, utilities, and taxes. If these nonfood costs account for half of restaurant costs, then the cost of food ingredients in restaurant meals may be half of away-from-home food expenditures.[23]

The average per capita expenditure on food away from home in 2003 for urban households was 438 yuan, or 18 percent of food expenditures. If nonfood costs of restaurant meals represent half of expenditures on food away from home, then the cost of food ingredients to prepare restaurant meals would be 219 yuan. Distributing away-from-home expenditure to major food items using shares reported by Ma et al. allows us to estimate expenditures on individual food groups. The expenditures can then be divided by average unit values calculated from urban household survey data to estimate the quantity consumed away from home.[24] This away-from-home quantity is used with the at-home quantity reported by the urban survey to calculate the share of each food item consumed away from home.

Shares of food quantity consumed away from home vary across food categories from 5 percent of fruit to 16 percent of meat (table 6). These shares are modest, and all are less than the 18-percent share of food expenditures made away from home. The 16-percent share of meat consumed away from home is

[22]For example, a low-income person may consume a meal at a roadside stand while a high-income person patronizes luxury restaurants. Both meals may contain the same quantity of food, but differ dramatically in cost. It is conceivable that a high-income person may spend several times the amount spent by a low-income person on food away from home, but only consume a slightly larger quantity of food away from home.

[23]In the United States, our calculations using 2002 Economic Census data (U.S. Bureau of the Census) show that employee payroll alone averages nearly 30 percent of sales by food and drinking establishments. Similar data are not available for China.

[24]Dividing by average unit values assumes that the unit values paid by consumers are similar to the cost of raw food materials procured by restaurants.

much lower than the 50-percent share estimated by Wang and Yang. The 11-percent estimate of grain consumed away from home is also less than the 14.7-percent estimate reported by FAO. However, these estimates are slightly higher than another estimate of 8 percent cited in the FAO study.[25]

These estimates indicate that a significant share of many food items passes through restaurants, cafeterias, food stalls, and other foodservice establishments. Still, roughly 90 percent of urban food is consumed at home. The high expenditure elasticity for food expenditures away from home suggests that the share of food passing through these channels will rise as household incomes grow further.

[25]Estimates are for urban households only. National shares of food consumed away from home would be lower since rural households consume much less food away from home

Table 6
Estimated food expenditures and quantities consumed away from home, Chinese urban households, 2003

Item	Expenditures	Unit value[1]	Away-from-home quantity[2]	At-home quantity[3]	Away-from-home share
	Yuan	*Yuan/kg.*	*Kg.*	*Kg.*	*Percent*
Meat and poultry	83 [4]	12.5	6.7	36.0	16
Eggs	7	5.2	1.3	11.3	10
Fish	15	12.9	1.2	13.2	8
Grain	26	2.7	9.7	79.0	11
Vegetables	26	1.7	15.5	116.5	12
Fruit	9	2.9	3.0	60.5	5
Other foods and beverages	53				

[1] Unit values calculated by dividing expenditure by quantity purchased reported by China urban household survey.
[2] Expenditures divided by unit value.
[3]Per capita quantities reported by China urban household survey.
[4] Cost of food ingredients was apportioned among food categories using shares reported by Ma et al.

Source: ERS estimates based on China National Bureau Statistics and other sources as noted.

Conclusion

Rapid income growth is changing the structure of Chinese food expenditure, a development that has important implications for China's agricultural and food sector and for international trade in agricultural products. As household incomes rise, consumers demand not only a greater quantity of food, but also higher quality. The demand for quantity diminishes as income rises, and the top tier of Chinese households appear to have reached a saturation point in quantity consumed of most food items. Most additional food spending by high-income consumers is spent on higher quality foods and meals in restaurants. This is reflected by increased attention to food safety; demand for processed foods; patronization of restaurants and other foodservice establishments; increased shopping in supermarkets, convenience stores, and other modern retail shops; and consumption of a wider variety of nontraditional foods.

It is surprising that the top tier of Chinese households have reached a saturation point in food consumption at income levels that would be well below the poverty line in the United States. The top 10 percent of Chinese urban households had average household incomes of just $7,000 in 2003 (when converted at the official exchange rate), still poor by developed-country standards.

Rural households (about 60 percent of the population) and low-income urban households (20 percent) are still at income levels where they demand increased quantities of many foods as their income rises. Low-income consumers' demand for items like meat, dairy products, and beer is much more responsive to income increases than is demand by consumers with higher income.

The concentration of income growth in the richest tier of urban households suggests that their spending has been the main driver of development in the retail food sector in recent years. The rapid growth in spending by the top 20 percent of urban households, combined with their preference at this stage for quality over quantity, explains the extremely rapid growth in supermarkets, convenience stores, and restaurants—outlets that offer greater convenience and quality in food purchases. At the same time, the much larger segment of low-income urban and rural residents who have a higher propensity to purchase greater quantities of foods like fish, fruit, dairy products, and poultry have experienced much slower income growth. Growth in food spending by rural households and urban households with incomes below the median has been sluggish.[26]

Taken together, these patterns suggest that the growth in the quantity of food demanded in China has been much slower than would be predicted by China's rapid economic growth. Much of the food expenditure growth accrues to high-income households that are purchasing mainly greater value added in food consumption rather than increased quantity. Low-income households, which have the most elastic demand for food quantity, are experiencing less rapid income growth and their food spending has been sluggish as well. The slow growth in quantity of food demanded may explain how China has been able to remain self-sufficient in most food items.

[26]Rural food expenditure growth understates the commercial importance of rural demand because an increasing share of the rural food supply is passing through formal market channels as rural households move away from subsistence farming (Gale, Tang, Bai, and Xu).

The growing segmentation of the China market is a factor in emerging policy issues. A recent commentary predicted that rural residents would bear the brunt of food safety problems (*China Daily*), noting that rural residents with low incomes are highly price sensitive in food purchase decisions and unlikely to pay a premium for food certified as safe. Food prices are important in agricultural and trade policy as well. China's introduction of subsidies for grain producers in 2004 was driven partly by a sharp increase in retail grain prices that year. Fear of potential social instability from rising food prices has long been a concern for Chinese policymakers. While a growing segment of high-income urban consumers can pay higher prices for food, many low-income urban consumers may be adversely affected by increased food prices.

High-income consumers' willingness to pay for premium foods may boost food imports. In China, imported foods are usually more expensive than domestic foods, and they have had little success penetrating the China market. As consumers gain enough discretionary income to pay premium prices, they may increase their purchases of imported or branded food items. Imported fruit sales have already increased, mainly as the demand for gifts has risen, and freshness and quality are motivating Chinese hotels to procure imported produce.

The increased demand for food quality will continue to be an important driver of food markets in China, creating many new marketing opportunities and contributing to rising awareness of food safety issues. Further investigation is needed in order to better understand these trends and their implications for China's agricultural and food trade.

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Appendix—China Household Survey Data

This study relies on tabulations of data from urban and rural household surveys conducted by China's National Bureau of Statistics. The surveys are conducted annually on a nationwide sample of households to learn about income, consumption, employment, housing, demographics, education, and asset ownership. The surveys are China's primary source of information on its urban and rural residents. The urban and rural surveys are conducted separately.

The urban survey sample includes households registered in an urban area and those who lived there at least ½ year but are registered elsewhere.[1] The rural sample is drawn from all households that have lived in a rural area for at least a year. The samples are drawn in multiple stages. The urban sample is drawn from all large and medium cities and a representative sample of small county-level cities and towns. The sample is chosen by choosing streets, street committees, and households from within the chosen committees. The rural sample is determined by first choosing a sample of counties from each province, then choosing a sample of villages, and finally choosing at least 10 households from each sampled village. One-third of the urban sample and one-fifth of the rural sample is rotated each year.

Improvements in the sample have been made since the surveys were restarted in the 1970s (Bramall, 2001). The underrepresentation of small town's residents in the urban household sample was addressed by expanding the sample to include more households in small cities and towns beginning in 2002. The urban sample now includes over 48,000 households in 146 cities and 80 county towns. The rural sample is now selected from all provinces and includes 68,000 households selected from 9,000 villages in 857 counties nationwide. The surveys do not cover military or institutional populations. It appears that the surveys do not capture the large migrant population of about 150 million who live part of the year at urban work sites, dormitories, or temporary residences and part of the year in their home villages. The sample is believed to also underrepresent extremely low- and high-income households (Bramall, 2001; Khan and Riskin, 2005).

There are some questions about the measurement of income by these surveys (Bramall). Khan and Riskin found that the exclusion of the rental value of owned housing was the largest omitted component of income. This component has become larger as more urban households have become homeowners. Most rural households own their houses and many have been rebuilt or improved during the past decade. Another income source not counted is the value of subsidies from employers, but these subsidies have declined sharply. Illegal income is not counted either, but the size of this component is unknown.

This study makes no attempt to adjust income reported by official statistics. If the true income of households were measured, the main impact would be to further increase the incomes of the highest earning households. The rental value of housing is likely positively correlated with the officially measured income since housing demand tends to be income elastic. Illegal income is

[1]China has a household registration system that requires all households to register at their place of long-term residence. Households cannot move permanently to a different location without gaining permission to change their registration. However, in recent years, restrictions have become looser and many rural migrants have taken up residence in urban areas. A household's registration is specified as "agricultural" or "nonagricultural." Urban areas, especially county towns, can contain large numbers of "agricultural" households, although they may not necessarily be engaged in agriculture. The survey includes both agricultural and nonagricultural households that reside in urban areas. The sample does not include persons living in dormitories.

income is likely to be positively correlated with measured income as well.[2] Consequently, if these components were added to income, the likely result would be that incomes of the top tier of households would be even higher than measured by the official surveys. Quantity elasticities, already small at these income levels, would become slightly smaller.

Unlike most income and expenditure surveys that cover only a short time period, China's survey captures expenditures and consumption via a diary kept by the household over the course of an entire year. China's survey has fewer problems with censored responses than do food surveys that record consumption during a short period of time.

The urban survey collects expenditures and quantities purchased for a wide variety of foods, including grains (rice, wheat, other grains, noodles, and other products), different kinds of edible oils, meats, fish, vegetables, fruits, alcohol, tobacco, beverages, dairy, and other foods (appendix table 1). Expenditures on meals away from home are included. The urban survey also includes the value of food and meals received without cash payment. This study does not include these in-kind gifts and subsidies of food, but preliminary analysis found that they were equivalent to less than 5 percent of food expenditures. The rural survey collects data on quantities consumed, quantities purchased, expenditures, and income. Other living expenditures are also recorded.

Appendix table 1

Food definitions in urban household survey

Category	Description
Food	Various consumption goods needed to obtain nutrition for the body or consumed for enjoyment, including major foods, supplementary foods, cigarettes, alcohol, beverages, fruits and melons, sugar, cakes, and dairy products. These products are purchased in stores, markets, work unit cafeterias, and alternative food retail businesses.
Grain:	
Rice	Including japonica (short and medium grain), indica (long grain), and glutinous rice.
Flour	Wheat flour.
Other grains	Mainly coarse grains like corn, millet, and oats.
Grain products	Processed grain products, including uncooked and cooked products, such as breads, *mantou* (steamed bread), noodles, instant noodles, dumplings, and dumpling skins.
Starch and tubers	Assorted tubers, starch, and starch products, including potatoes and sweet potatoes/yams.
Cakes	Food products using flour and sugar as the major ingredients, and oil, egg, milk, fruit, and nuts as the supplementary ingredients. Include cookies, cakes, frozen rice cakes, and rice sugar candies. Does not include breads. Snack fees collected by kindergartens or elementary schools are counted as cake expenditure if it is not clear what percentage of the collected money goes into which use.
Dry beans and bean products	Including soy beans, other beans, tofu, and other bean products.
Oils:	
Vegetable oils	Edible oils obtained from vegetable products, including peanut, vegetable seed, sesame, bean, tea, and sunflower seed oils. This category also includes salad oils produced by mixing several vegetable oil products.
Animal fats	Cooked and uncooked animal fats and oils, including oils extracted from pork and beef fat. If raw pork fat is bought for edible oil production purposes, the quantity is accounted at 80 percent.
Meat:	
Pork	Fresh or frozen pork, including intestines, heads, feet, skin, bones, and pork blood.
Beef	Fresh or frozen beef, including intestines, heads, and feet.
Lamb	Fresh or frozen lamb, including intestines, heads, and feet.
Other meats	Includes rabbit, donkey, venison, dog, snake, and other wild animal meats.
Meat products	Processed meat products, including cooked pork products, salted and dried meat, sausages, hot dogs, lamb kebabs, fresh meat balls, fried pork skins, and canned meat products.
Poultry:	
Chicken	Edible live, slaughtered chicken, cut chicken legs, chicken wings, frozen chicken, including head, chicken feet, bones, and intestines.
Duck	Edible live, slaughtered, cut duck legs, wings. Include duck head, feet, and intestines.
Other poultry	Poultry other than chicken and duck. Includes wild chicken, wild duck, turkey, pigeon.
Poultry products	Domestic and wild poultry meat preserved, salted, cooked, roasted, cooked or baked. Includes canned poultry meat and processed intestine products.
Eggs:	
Fresh eggs	Fresh chicken and duck eggs, also including other fresh poultry eggs.
Eggs products	Processed poultry egg products. Includes salted, preserved, frozen, and tea eggs.
Aquatic products:	
Fish	Includes fish in sea water and fresh water.
Shrimp	Shrimp and prawns from sea water or fresh water.
Other aquatic products	Aquatic products besides shrimp and fish.
Processed aquatic products	Include dried fish, fish balls, seafood balls, etc.

Continued—

Appendix table 1

Food definitions in urban household survey—Continued

Category	Description
Vegetables:	
Fresh vegetables	Fresh vegetables not processed.
Dried vegetables	Dried vegetable products.
Vegetable products	Processed vegetables, for instance, canned and frozen vegetables.
Fruit and melons:	
Fresh melons	Includes melons, sweet melons, and cantelopes.
Fresh fruits	Includes apples, pears, hawthorn, peach, cherries, kiwi, strawberry, orange, banana, apple, mango, pineapple, lichee, etc. Nuts are not included.
Dry fruits	Fruits dried under the sun or dried over heat sources.
Fruit and melon products	Processed fruit and melons.
Nut and fruit nuts	Includes uncooked and cooked nuts, peanuts, sesame, and other nut or fruit nut products.
Flavorings	Salt, soy sauce, shrimp oil, vinegar, MSG, etc.
Sugar	Sugar products, including white sugar, candies, and other sugar products. Does not include saccharin.
Cigarettes	Includes both cigarettes and tobacco leaves.
Alcoholic beverages:	
Liquor (*bai jiu*)	Liquor distilled from starch or sugar products, mainly sorghum, millet, or rice. Includes packaged and unpackaged. Weight in kilograms is calculated without the bottle.
Fruit wine	Wine made of various fruits and wild fruits, primarily grape, apple, and lichee wine.
Beer	Yeast fermented using barley malt and hops with low alcohol content.
Other alcoholic beverages	Other alcoholic beverages such as rice or millet wine, champagne, sparkling wine. Does not include medicinal alcohol.
Beverages:	
Carbonated drinks	Carbonated non-alcoholic liquid drinks. Includes salted, sweet, and fruit flavored drinks.
Fruit and vegetable drinks	Includes nonalcoholic fruit, vegetable, plant root, and bottled tea drinks.
Bottled water	Includes mineral water, “pure” water, and natural water, including bottled water dispensed by water coolers.
Tea leaves	Products processed from new leaves of tea trees.
Coffee, cocoa	Coffee includes coffee beans, instant coffee, and cocoa powder.
Other drinks	Other non-alcoholic drinks, such as fruit-flavored instant drinks.
Dairy products:	
Fresh milk products	Includes cow, horse, sheep, and goat milk and milk mixtures. Does not include yogurt, milk powder, or soybean milk.
Milk powder	Milk powder dried from fresh milk.
Yogurt	Milk product produced by the introduction of bacteria and fermentation.
Other milk products	Milk products besides fresh milk, milk powder, and yogurt.
Meals away from home	Expenditure outside of home. Includes expenditure in work unit cafeteria, restaurants, and at friends’ houses. Does not include food expenditures paid by work units.

Source: China National Bureau of Statistics, *Urban Household Survey Handbook*.

Appendix table 2

Quantity model estimates for urban households

Commodity	α	Standard error	β	Standard error	Y	Standard error	δ	Standard error	Adjusted R^2
Grain	**5.51**	.24	**-0.304**	0.147	**-0.124**	0.025	0.020	0.010	0.900
Rice	**4.13**	.22	.070	.131	-.042	.022	-.006	.008	.789
Flour	**9.76**	.56	**-1.659**	.334	**-.800**	.057	**-.114**	.021	.985
Other grains	**.09**	.55	-.337	.331	.115	.057	-.033	.021	.869
Grain products	**4.08**	.37	**-1.287**	.219	**-.100**	.037	.006	.015	.895
Starches and tubers	**2.84**	.39	.075	.039	**-.074**	.039	**-.122**	.015	.887
Oils	**4.11**	.24	**-.930**	.141	**-.200**	.024	**.072**	.009	.912
Vegetable oils	**3.96**	.24	**-1.002**	.143	**-.186**	.024	**.080**	.009	.908
Animal fats	**7.22**	.90	**-1.643**	.539	**-.885**	.092	**-.105**	.035	.972
Meat	**3.72**	.24	**-1.509**	.144	-.019	.025	-.001	.010	.986
Pork	**3.41**	.19	**-1.147**	.116	-.023	.020	-.009	.007	.982
Beef	**2.69**	.48	**-2.774**	.284	**-.176**	.049	.004	.018	.967
Mutton	**3.42**	.92	**-3.679**	.551	**-.303**	.094	**.140**	.035	.921
Other meat	**4.09**	1.11	**-3.914**	.667	**-.502**	.114	**.049**	.043	.772
Meat products	**.62**	.59	**-2.931**	.355	.118	.061	.001	.023	.987
Poultry	**.76**	.22	**-1.452**	.130	**.192**	.022	**-.034**	.008	.996
Chicken	**.59**	.20	**-1.155**	.119	**.150**	.020	**-.046**	.008	.995
Duck	-.11	.49	**-1.691**	.290	.093	.050	.006	.019	.977
Other poultry	**-8.23**	.64	-.350	.383	**.784**	.065	**-.237**	.025	.992
Poultry products	-.87	.68	**-3.093**	.405	**.220**	.069	-.001	.026	.988
Eggs	**3.47**	.31	**-1.444**	.183	**-.091**	.031	**.050**	.011	.955
Aquatic products	**-1.12**	.48	**-.706**	.286	**.430**	.049	-.025	.018	.989
Fish	-.60	.39	**-.551**	.236	**.322**	.040	-.003	.015	.987
Shrimp	**-4.56**	.91	**-2.365**	.547	**.585**	.093	**-.104**	.035	.987
Other aquatic products	**-4.01**	.90	**-1.986**	.538	**.575**	.092	**-.087**	.034	.986
Fresh vegetables	**4.45**	.27	**-.375**	.164	.042	.028	.007	.010	.909
Alcohol	**4.19**	.47	**-2.595**	.279	**-.174**	.048	.009	.018	.962
Liquor	**5.91**	.57	**-2.491**	.344	**-.525**	.059	-.030	.022	.875
Wine	**-3.11**	.97	**-2.576**	.575	**.248**	.098	.032	.037	.978
Beer	**4.62**	.55	**-3.438**	.327	**-.256**	.056	.011	.021	.966
Other alcohol	**-6.94**	1.95	**-2.094**	1.169	**.747**	.199	-.081	.075	.955
Other beverages	**-3.60**	.83	**-2.418**	.495	**.713**	.085	**.064**	.032	.992
Soft drinks	**-2.02**	.57	**-2.134**	.341	**.358**	.058	**-.083**	.022	.991
Fruit and veg. juice	**-3.74**	.83	**-3.011**	.499	**.463**	.085	**.179**	.032	.990
Bottled water	**-4.52**	1.08	**-3.097**	.647	**.782**	.110	**.105**	.041	.990
Tea leaf	**-3.02**	1.12	-.884	.668	.190	.114	-.012	.043	.856
Fresh fruit	**3.51**	.19	**-2.204**	.115	**.056**	.020	**-.026**	.007	.997
Fresh melon	**2.67**	.44	**-1.927**	.265	.066	.045	**-.045**	.017	.982
Dried fruit	-.34	.65	**-2.769**	.388	.058	.066	.008	.025	.978
Fruit and melon products	**-4.81**	1.59	**-2.071**	.956	**.487**	.163	-.088	.061	.948
Nuts	-1.71	.59	**-.687**	.351	**.319**	.060	**-.048**	.022	.974
Cakes	.78	.38	**-2.495**	.228	**.109**	.039	**.051**	.015	.993
Dairy	**2.65**	.65	**-4.096**	.386	.099	.066	**.141**	.025	.991
Milk	**2.56**	.73	**-4.147**	.440	.094	.075	.132	.028	.988
Milk powder	**2.05**	.77	**-3.307**	.462	**-.235**	.079	-.019	.030	.933
Yogurt	-.08	.54	**-4.468**	.325	**.154**	.055	**.259**	.021	.995

Note: The quantity model is $lnq_{ij} = \alpha_i + \beta_i (1/y_j) + \gamma_i \ lny_j + \delta_i d + u_{ij}$. Variables q_{ij}, y_j and d are quantity, income, and year dummy variables. Estimated with weighted least squares. Coefficients in bold typeface are statistically significant at 5 percent.

Source: Estimated by ERS from China National Bureau of Statistics data.

Appendix table 3

Quantity model estimates for rural households

Commodity	α	Standard error	β	Standard error	Y	Standard error	δ	Standard error	R^2
Grain	**5.568**	0.158	-0.150	0.035	-0.003	0.018	**-0.053**	0.007	0.976
Vegetables	**5.403**	0.217	**-0.524**	0.048	-0.053	0.025	**-0.036**	0.010	0.993
Beef and mutton	**-7.794**	1.087	**1.358**	0.238	**0.934**	0.125	0.064	0.050	0.931
Pork	**0.854**	0.275	-0.014	0.060	**0.230**	0.032	-0.005	0.013	0.990
Aquatic products	-5.935	0.382	0.028	0.083	**0.944**	0.044	0.020	0.017	0.999
Poultry	-3.692	0.399	-0.101	0.087	**0.618**	0.046	**0.071**	0.018	0.997
Eggs	-0.898	0.474	**-0.308**	0.104	**0.336**	0.054	0.016	0.022	0.993
Milk	-14.602	1.408	**2.578**	0.308	**1.727**	0.162	**0.344**	0.064	0.969
Fruit	-1.158	0.997	0.109	0.408	**0.521**	0.089	**-0.517**	0.047	0.997
Edible oils	1.507	0.737	**-0.336**	0.161	0.091	0.085	**-0.201**	0.034	0.958
Tobacco	0.296	0.099	-0.002	0.022	**0.367**	0.011	**-0.048**	0.005	0.999
Sugar	-2.652	0.502	0.111	0.110	**0.400**	0.058	**-0.311**	0.023	0.989

Note: Quantity model is $lnq_{ij} = \alpha_i + \beta_i (1/y_j) + \gamma_i \ lny_j + \delta_i d + u_{ij}$. Variables q_{ij} , y_j and d are quantity, income, and year dummy variables, respectively. Estimated with weighted least squares. Coefficients in bold typeface are statistically significant at 5 percent.

Source: Estimated by ERS from China National Bureau of Statistics data.

Appendix table 4

Expenditure model estimates for urban households

Commodity	α	Standard error	β	Standard error	Y	Standard error	δ	Standard error	R^2
Grain	**3.74**	0.27	0.164	0.162	**0.168**	0.028	0.008	0.010	0.950
Starches and tubers	**.93**	.37	.256	.221	**.197**	.038	**.113**	.014	.948
Beans	**.29**	.42	.336	.249	**.343**	.043	**.049**	.016	.972
Oils	**5.25**	.15	**-.954**	.090	**-.105**	.015	**.193**	.005	.991
Meat	**4.91**	.22	**-1.425**	.135	**.129**	.023	**.022**	.009	.995
Poultry	**1.81**	.32	**-1.465**	.190	**.361**	.032	**-.036**	.012	.996
Eggs	**4.33**	.30	**-1.294**	.182	-.003	.030	.014	.012	.973
Aquatic products	**-2.47**	.73	-.496	.439	**.858**	.075	-.055	.028	.991
Fresh vegetables	**2.75**	.66	-.417	.397	**.300**	.068	.010	.025	.954
Dried vegetables	-.40	.60	**-2.270**	.358	**.355**	.060	**.112**	.023	.991
Vegetable products	**-2.73**	.59	-.250	.352	**.542**	.060	**.053**	.023	.986
Flavorings	**1.00**	.30	**-.350**	.181	**.290**	.031	.019	.011	.989
Alcohol	**3.06**	.53	**-2.345**	.321	**.165**	.055	.012	.021	.987
Other beverages	-.99	.51	**-1.993**	.303	**.582**	.052	-.012	.019	.995
Fresh fruit	**.93**	.17	**-1.484**	.100	**.450**	.017	**-.033**	.006	.999
Fresh melon	-.75	.40	**-1.632**	.238	**.457**	.040	.011	.015	.996
Dried fruit	-.99	.77	**-2.374**	.462	**.395**	.079	-.032	.030	.986
Fruit and melon products	**-6.19**	.81	**-1.224**	.485	**.891**	.083	-.048	.031	.992
Nuts	**-2.88**	.59	-.455	.355	**.685**	.061	.033	.023	.991
Cakes	-.65	.46	**-1.638**	.277	**.540**	.047	.006	.020	.996
Dairy	**1.84**	.50	**-3.148**	.299	**.370**	.051	**.114**	.019	.996
Tobacco	**2.60**	.55	**-1.903**	.331	**.275**	.057	.021	.021	.987
Sugar	**-1.47**	.27	**-.547**	.163	**.538**	.028	-.006	.010	.997
Food away from home	**-4.47**	.30	-.152	.182	**1.171**	.031	-.048	.011	.999

Note: Quantity model is $lnq_{ij} = \alpha_i + \beta_i (1/y_j) + \gamma_i \ lny_j + \delta_i d + u_{ij}$. Variables q_{ij} , y_j and d are quantity, income, and year dummy variables. Coefficients in bold typeface are statistically significant at 5 percent.

Source: Estimated by ERS from China National Bureau of Statistics data.