Impact of Food Prices and Income Growth on Household Food Consumption

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Abstract: As residents' incomes rise and consumption levels increase, the food consumption structure of China's population is undergoing a gradual optimization process. To forecast future food consumption trends, this study selected indicators including consumption volume, prices, and per capita income from 31 provinces and municipalities across China from 2015 to 2023. Using the multiple linear regression model, a series of price elasticities of demand and income elasticities of demand are obtained. The analysis reveals that income significantly influences demand for various food categories, with varying degrees of impact: aquatic products (1.32%), fresh fruits (0.73%), eggs (0.69%), vegetables (0.56%), poultry (0.52%), grains (0.24%), and meat (0.21%). Regarding price elasticity, food consumption is correlated not only with its own price but also with the prices of other food categories. As residents' incomes rise in the future, it is necessary to care about the development of industries related to aquatic products while accelerating the growth of sectors such as fresh fruits, vegetables, and eggs.

Keywords: Food Consumption Structure; Multiple Linear Regression; Elasticities of Demand

1. Introduction

Food demand is closely linked to factors such as economic development levels, urban-rural population structures, age demographics, and population size. In recent years, China's economy has maintained steady and positive growth. According to data from the National Bureau of Statistics, China's GDP has grown annually over the past five years. Although the growth rate has shown signs of slowing, it has still increased from 103.4 trillion yuan (in 2020) to 134.9 trillion yuan (in 2024). Concurrently, per capita GDP has also risen year by year, climbing from 102.7 yuan per capita (in 2020) to 134.0 yuan per capita (in 2024).

Numerous studies have examined food consumption patterns. Factors influencing food demand include disposable income, population aging, urbanization rates, and population size. Li Shaoting et al. (2025) applied the QUAIDS model to investigate population aging, finding that increased aging significantly reduces urban residents' food demand[1]. Chen Yu (2025) examined the evolution of food consumption demand among Chinese residents, observing that while overall demand grew, consumption patterns gradually diversified. Factors like urbanization rates and aging rates profoundly influenced consumption habits[2]. Ji Peng (2025) studied rural residents' food consumption, noting that while food expenditure showed an overall upward trend, significant regional variations and seasonal fluctuations existed[3].

Some scholars have linked food consumption to environmental emissions. For instance, Qi Huibo et al. (2025) calculated the direct and indirect carbon footprints of rural residents' consumption across 30 Chinese provinces. Using spatial econometric models, they analyzed the spatiotemporal patterns and driving factors. The findings indicate uneven and inadequate development in rural food consumption. Although the carbon footprint decreased overall during the observation period, per capita carbon footprint showed a pattern of initial decline followed by an increase[4]. Wu Xiangqian et al. (2025) examined the carbon and water footprints of urban and rural food consumption. Their findings revealed that while per capita food consumption in both urban and rural areas converged toward the 400 kg level, distinct structural characteristics emerged. Specifically, the per capita carbon footprint of urban residents was significantly higher than that of rural residents[5].

Additionally, scholars have linked food consumption to dietary nutrient composition. For instance, Song Xinzhe et al. (2025) found that in their study on the food consumption structure of urban and rural residents in China that from 2000 to 2020, excessive grain intake and insufficient dairy consumption remain major issues[6]. Both urban and rural residents exhibit a dual-calorie structure dominated by grains and supplemented by vegetable oils, a dual-protein structure centered on grains and supplemented by pork, and a triple-fat structure dominated by vegetable oils with pork and grains providing complementary fats. Rural areas lag behind urban areas by approximately 20 years in plant-based and animal-based dietary nutrition levels. Ji Yiwen and Ma Enpu (2025) employed models such as the food-to-farmland footprint and the ARIMA-GM(1,1) combination to study and forecast factors influencing dietary structure changes[7]. Results indicate that the overall response level of farmland utilization to dietary structure changes is low, hindering the fulfillment of residents' increasingly diversified food demands. Zhu Yanfang (2025) used cosine similarity to measure the alignment between rural residents' food consumption patterns and dietary guideline recommendations. Findings indicate that China's rural consumption structure is transitioning from grain- and tuber-dominated patterns toward diversified plant and animal foods, showing increasing convergence with urban residents' dietary patterns[8]. Zhang Jiguo et al. (2024) employed survey-based retrospective methods to collect food consumption data and utilized weighing methods to record household condiment survey data for analyzing adult residents' food intake. Results indicated that, based on intake levels, the dietary structures of adult residents in ten provinces across China were unreasonable[9].

These studies reveal that amid sustained economic growth and complex challenges, China's food consumption faces new pressures. While scholars have extensively examined staple food consumption issues during economic development, recent research has insufficiently explored the interplay between economic progress, social changes (including expanding urbanization, accelerating aging, and shrinking population), and evolving food demands. Therefore, compared to existing research, this paper will analyze the relationship between income and food consumption from the perspective of food consumption within the context of economic development. By examining the correlation between food consumption and factors such as residents' income, it aims to provide insights for future food consumption patterns under a high-income model.

2. Data Collection and Analysis

2.1 Data Collection

The food consumption data in this study is sourced from the “Per Capita Consumption of Major Food Items Among All Residents” section of the China Statistical Yearbook. It covers food consumption data for residents across China's 31 provinces, municipalities, and autonomous regions, including grains, meat, poultry, aquatic products, eggs, vegetables, and fresh fruits. Food price data were derived through price and price index conversion. Specifically, individual food price data were sourced from the 2015–2024 China Agricultural Product Price Survey Yearbook, while the price index data for various food consumption categories were obtained from the 2016–2024 China Statistical Yearbook regional annual data under “Classified Consumer Price Index.” Per capita disposable income data were sourced from the National Bureau of Statistics. Descriptive statistical analysis was conducted on the data, with results presented in Table 1:

Table 1. Descriptive Statistics of Data

Name of variable	Meaning	Means	Standard Error	Minimum	Maximum
	Comsumption(kg)				
qgrain	Grain	135.3	25.5	75.7	284.5
qmeat	Meat	29.0	8.2	13.3	57.9
qpoultry	Poultry	9.4	5.9	0.9	31.1
qfish	Aquatic products	11.6	8.5	0.4	33.6
qegg	Eggs	10.6	4.6	2.4	25.1
qveg	Vegetables	99.3	19.2	24.7	147.4
qfruit	Fresh fruits	49.3	15.8	4.9	83.5

	Price(yuan/kg)				
pgrain	Grain	135.3	25.5	75.7	284.5
pmeat	Meat	29.0	8.2	13.3	57.9
ppoultry	Poultry	9.4	5.9	0.9	31.1
pfish	Aquatic products	11.6	8.5	0.4	33.6
pegg	Eggs	10.6	4.6	2.4	25.1
pveg	Vegetables	99.3	19.2	24.7	147.4
pfruit	Fresh fruits	49.3	15.8	4.9	83.5
M	Per capita disposable income(yuan)	30317.9	13183.6	12254.0	84834.0

To examine the relationship between income and food consumption, we first applied logarithmic transformations to both income and various food consumption categories. Subsequently, using Stata software, we conducted local polynomial regressions for each food category and plotted their respective graphs, as shown in Figure 1(a) through 1(g) among Figure 1. Subsequently, these seven major food categories were grouped into animal-based foods (meat, poultry, eggs, aquatic products) and plant-based foods (grains, vegetables, fresh fruits). The graphs from Figures 1(a) to 1(g) were processed and categorized onto two separate plots, as shown in Figure 1(h) and 1(i).

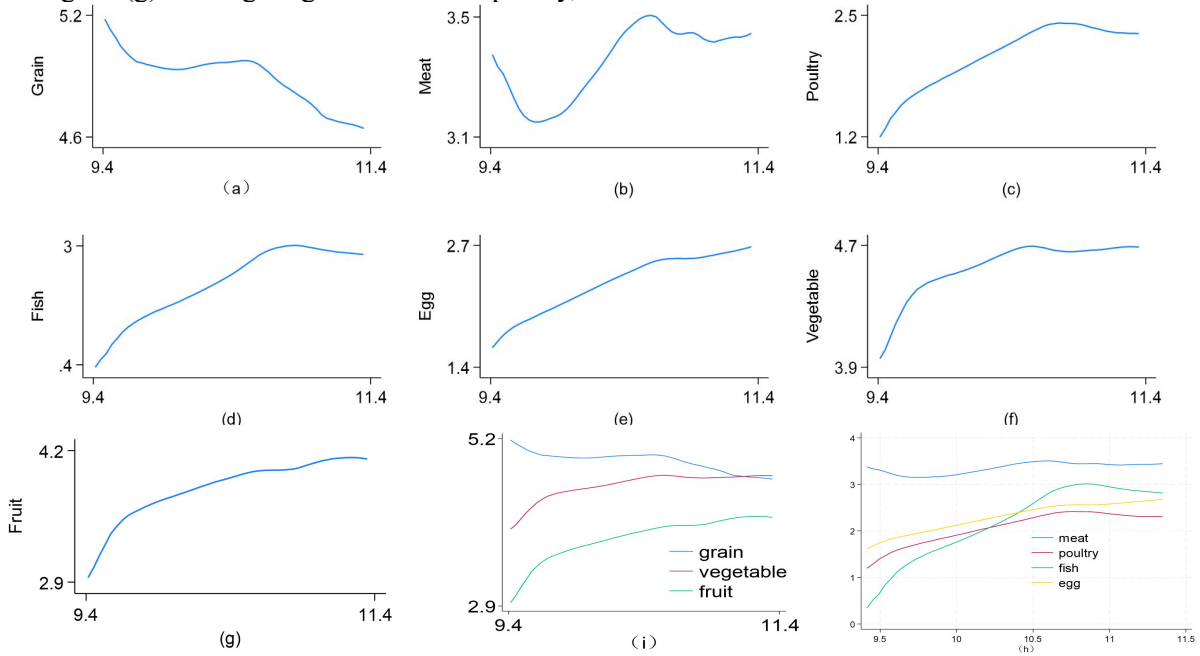

Figure 1. Relationship between Income and Food Consumption (Based on Data from 2015 to 2023)

Note: In Figure 1 (Figure 1(a) to -1(i)), the horizontal axis represents the logarithmic value of income, while the vertical axis represents the logarithmic value of consumption.

As shown in Figure 1, within specific income brackets, the seven food categories exhibit distinct patterns as income increases. However, upon reaching certain income levels, demand for food changes differently compared to the preceding bracket. Therefore, for analytical convenience, this paper divides income into three stages based on the relationship between income and food consumption depicted in Figure 1: The first stage represents the period where lnM is less than 9.8 (income below ¥18,000); Stage 2 represents the period where lnM falls within the range [9.8, 10.6] (income between ¥18,000 and ¥40,000); Stage 3 represents the period where lnM exceeds 10.6 (income above ¥40,000). Results are shown as follows in Table 2:

Table 2. Relationship between Income and Food Consumption (Based on Figure 1)

Level of Income	Below ¥18,000	Between ¥18,000 and ¥40,000	Above ¥40,000
Grain	↘	-	↘
Meat	↘	↗	-
Poultry	↗	↗	-
Aquatic products	↗	↗	↗

Eggs	↗	↗	-
Vegetables	↗	↗	-
Fresh fruits	↗	↗	-

Note: indicates an overall upward trend, "-" indicates an overall stable trend, while "↘"indicates an overall downward trend.

Grain: As shown in Figure 1(a), the overall trend indicates that grain consumption generally declines as per capita income rises. Examining this by stage: In the first stage, grain consumption exhibits a pronounced downward trend alongside increasing income. In the second stage, grain consumption remains relatively stable with little change despite rising income. In the third stage, grain consumption continues to decline as income increases.

Meat: As shown in Figure 1(b), the overall trend indicates that grain consumption exhibits an unstable pattern as per capita income rises. Analyzing by stage: In the first stage, as income increased, meat consumption showed a relatively pronounced downward trend. In the second stage, despite rising income, meat consumption began to rise rapidly instead, eventually stabilizing. In the third stage, with continued income growth, meat consumption continued to decline, though at a much slower rate than in the first stage, ultimately stabilizing.

Poultry: As shown in Figure 1(c), the overall trend indicates that poultry consumption generally increases with rising per capita income. Analyzing by stage: In the first stage, as income increases, poultry consumption exhibits a pronounced upward trend with a relatively rapid growth rate. In the second stage, while income continues to rise, changes in poultry consumption gradually increase but at a significantly slower pace compared to the first stage. In the third stage, despite ongoing income growth, changes in poultry consumption show a slight decline, though the overall magnitude of change remains modest, ultimately stabilizing.

Aquatic products: As shown in Figure 1(d), the overall trend indicates that as per capita income rises, consumption of aquatic products generally increases. Analyzing this by stage: In the first stage, as income increases, aquatic product consumption exhibits a pronounced upward trend with a relatively rapid growth rate. In the second stage, while income continues to rise, changes in aquatic product consumption gradually increase, but the growth rate slows significantly compared to the first stage. In the third stage, despite ongoing income growth, changes in aquatic product consumption show a slight decline, though the overall magnitude of change remains modest, ultimately stabilizing.

Eggs: As shown in Figure 1(e), the overall trend indicates that egg consumption generally increases with rising per capita income. Analyzing by stage: In the first stage, egg consumption exhibits a pronounced upward trend with income growth, rising at a relatively rapid pace. In the second stage, egg consumption continues to increase alongside income growth, though at a slower rate than the first stage, it remains relatively fast. In the third stage, egg consumption continues to rise with income growth, albeit at a slower pace than the previous two stages, yet the upward trend persists.

Vegetables: As shown in Figure 1(f), the overall trend indicates that vegetable consumption generally increases with rising per capita income. Analyzing by stage: In the first stage, vegetable consumption exhibits a pronounced upward trend with increasing income, growing at a relatively rapid pace. In the second stage, while income continues to rise, the rate of change in vegetable consumption gradually increases but slows significantly compared to the first stage. In the third stage, despite further income growth, the rate of change in vegetable consumption slightly declines, though the overall magnitude of change remains modest, ultimately stabilizing.

Fresh fruits: As shown in Figure 1(g), the overall trend indicates that fresh fruits consumption generally increases with rising per capita income. Analyzing by stage: In the first stage, consumption of fresh fruits and melons showed a pronounced upward trend with increasing income, growing at a relatively rapid pace. In the second stage, consumption changes gradually increased alongside income growth, though the growth rate slowed significantly compared to the first stage. In the third stage, consumption changes increased slightly with rising income, but the overall magnitude of change was modest, eventually stabilizing.

Animal-based foods: There are four major food categories including meat, poultry, aquatic products, and eggs, as shown in Figure 1(h). As illustrated in the figure, during Stage 1 and 2, the growth rates of poultry and eggs were relatively similar. Upon entering Stage 3, poultry and aquatic products exhibited comparable stable trends.

Plant-based foods: There are three major food

categories including grains, vegetables, and fresh fruits, as shown in Figure 1(i). The figure reveals that during Stage 1 and 2, the growth rates of grains and vegetables were relatively similar. Upon entering Stage 3, the stable trends of vegetables and fresh fruits became more comparable.

2.2 Data Analysis

The preceding analysis revealed that demand for various food categories correlates with per capita disposable income, exhibiting distinct patterns and trends across different income brackets. However, this conclusion was drawn solely based on per capita disposable income, neglecting another critical factor influencing food demand: food prices. Therefore, this paper posits that food demand is related to the consumption volume of a specific food category, the price of each food category, and per capita disposable income. Based on this hypothesis, the following model is employed for analysis:

$$\ln Q_j = \sum_i \alpha_i \ln P_i + \beta \ln M$$

In the equation, Q represents food demand, P represents food price, M represents per capita disposable income, and i and j represent different food categories. Using the above formula, a multiple linear regression analysis was conducted with the logarithm of food demand as the independent variable and the logarithms of each food category's price and income as the dependent variables. The regression results are shown in Table 3.

Table 3. Estimation of Price Elasticity and Income Elasticity of Food Demand

	Grain		Meat		Poultry		Fish		Eggs		Vegetables		Fresh fruits	
	logarithm	t	logarithm	t	logarithm	t	logarithm	t	logarithm	t	logarithm	t	logarithm	t
$\ln P_1$	0.0286	0.868	0.4625	0.000	1.5449	0.000	2.5355	0.000	0.1373	0.455	0.1012	0.442	0.1870	0.369
$\ln P_2$	0.4883	0.000	-0.3705	0.000	-0.6049	0.000	-2.0859	0.000	-0.0669	0.420	0.0059	0.920	0.2687	0.005
$\ln P_3$	0.3929	0.000	-0.0084	0.891	0.2830	0.084	0.1432	0.492	-0.0865	0.313	0.2105	0.001	-0.0322	0.740
$\ln P_4$	0.1129	0.293	-0.1536	0.061	-1.2756	0.000	-2.0471	0.000	-0.3733	0.001	-0.2858	0.001	-0.3277	0.012
$\ln P_5$	0.0751	0.485	0.6448	0.000	0.8155	0.000	-0.6040	0.031	-0.9785	0.000	0.1079	0.19	-0.4004	0.002
$\ln P_6$	-0.3307	0.052	0.3047	0.019	1.0883	0.002	2.7821	0.000	0.3359	0.064	-0.4082	0.002	-0.5872	0.004
$\ln P_7$	-0.2174	0.141	0.1572	0.162	-1.6950	0.000	-2.1528	0.000	-0.9549	0.000	-0.2706	0.017	-0.5910	0.001
lnM	0.3067	0.000	0.2161	0.000	0.5176	0.000	1.3214	0.000	0.7340	0.000	0.5618	0.000	0.6907	0.000
R^2-adj	0.9972		0.9965		0.9398		0.9147		0.9856		0.9981		0.9934	

(1) Since the constant term was not included, the adjusted R-squared values were highly significant. In fact, if the constant term were included, the adjusted R-squared values would be: 0.2794, 0.5479, 0.5187, 0.6639, 0.6757, 0.3059, 0.4648. It can be seen that compared to models without the constant term, the adjusted R-squared values of models including the constant term do not indicate particularly ideal fitting effects.

Therefore, we should assume here that the regression equation does not contain a constant term.

(2) Analysis of the price elasticity of demand for food: Table 3 shows that the own-price elasticities for grains and poultry are positive. However, at the 5% significance level, their T-values exceed 5%, indicating that the own-price elasticities in the regression results are not statistically significant. This phenomenon suggests that even when grain or poultry prices increase, consumers remain more inclined to purchase these food items. This indicates that grains and poultry are essential goods, making them inelastic commodities. Conversely, the price elasticities of demand for meat, aquatic products, eggs, vegetables, and fresh fruits are negative. At the 5% significance level, their T-statistics are all less than 5%, indicating these five categories are elastic goods—meaning demand for them decreases when prices rise.

(3) Analysis of Cross-Price Elasticities of Demand for Food: At the 5% significance level, the following patterns emerge:

① Grain demand positively correlates with meat and poultry prices. This indicates that when grain prices rise, consumers are more inclined to purchase greater quantities of meat and poultry.

② Meat demand positively correlates with grain, egg, and vegetable prices. This suggests that as meat prices increase, consumers are more inclined to purchase greater quantities of grain, eggs, and vegetables.

③ Demand for poultry is positively correlated with grain, egg, and vegetable prices, and negatively correlated with meat, aquatic products, and fresh fruits prices. This indicates that as poultry prices rise, consumers are more likely to purchase greater quantities of grain, eggs, and vegetables while reducing purchases

of meat, aquatic products, and fresh fruits.

④ Demand for aquatic products is positively correlated with grain and vegetable prices, and negatively correlated with meat, fresh fruits and vegetables, and egg prices. This indicates that as aquatic product prices rise, consumers are more inclined to purchase greater quantities of grains and vegetables while reducing purchases of meat, fresh fruits and vegetables, and eggs;

⑤ Egg demand is negatively correlated with aquatic products and fresh fruits prices, indicating that as aquatic products prices rise, consumers are more inclined to purchase less aquatic products and fresh fruits;

⑥ Vegetable demand is positively correlated with poultry prices and negatively correlated with aquatic products and fresh fruits prices, indicating that as vegetable prices increase, consumers are more inclined to purchase more poultry while purchasing less aquatic products and fresh fruits;

⑦ Demand for fresh fruits and vegetables is positively correlated with meat prices and negatively correlated with prices of aquatic products, eggs, and vegetables. This indicates that as fresh fruits and vegetable prices rise, consumers are more willing to purchase more meat while simultaneously purchasing fewer aquatic products, eggs, and vegetables.

(4) Analysis of Income Elasticity of Demand for Food: Table 3 shows that the income elasticity of demand for each food category is positive. At the 5% significance level, the null hypothesis is rejected for all categories, indicating that income significantly influences demand across the seven major food groups, with varying degrees of impact on different food types. The degree of income's impact on demand decreases in the following order: aquatic products, fresh fruits, eggs, vegetables, poultry, grains, and meat. The table's results indicate that a 1% change in income would cause demand to change in the same direction by 1.32%, 0.73%, 0.69%, 0.56%, 0.52%, 0.24%, and 0.21%, respectively.

3. Discussion and Suggestion

3.1 Discussion

(1) The Bunny Law, which reveals the characteristics of changes in food consumption structure, indicates that as economies develop and incomes rise, food consumption exhibits a trend toward structural upgrading. Specifically, people gradually reduce their consumption of starchy staples like rice and wheat flour, while significantly increasing their consumption of nutrient-rich meats, vegetables, and fruits. However, as analyzed earlier, demand for meat actually increases less with income growth than grain consumption. This may stem from food consumption being a basic life necessity that cannot rise indefinitely alongside income. Consequently, a stable value exists where food consumption converges to a steady state. In the context described in this paper, the demand for meat may have reached this stable convergence state earlier than the other six major food categories. Consequently, in terms of observable patterns, the demand for meat stabilizes at its equilibrium point even faster than that for high-carbohydrate grains. Indeed, Figure 1-1 indicates that grain demand continues to show a downward trend, suggesting it has not yet reached a stable convergence point. This phenomenon indirectly supports the aforementioned conjecture.

(2) In forecasting future food trends, this study does not account for the impact of factors such as urbanization rates, GDP, or population size on food consumption. All projections are based on existing observational data and extrapolated from current trend patterns. Consequently, the conclusions may contain errors, which are unavoidable.

3.2 Suggestion

(1) Appropriately develop the poultry and egg industry while ensuring grain production under food security considerations. As shown in the chart, the egg industry still holds growth potential, indicating continued consumer demand for eggs in the future and warranting appropriate development. Simultaneously, grain demand still has room for reduction, reflecting an ongoing shift in dietary patterns. During this transition, it is imperative to safeguard food security throughout grain production and protect the nation's granaries.

(2) For aquatic products, strengthen monitoring and early warning systems to prevent production fluctuations from causing significant price volatility. First, demand for aquatic products will surge substantially with income growth. Second, aquatic product prices exhibit high elasticity; sharp price swings impact demand more severely than for other commodities. Therefore, stabilizing prices through monitoring and early

warning is indispensable for the industry's development.

(3) Stabilize grain and poultry prices. As essential commodities, consumers tend to continue purchasing grain and poultry even when prices rise. Maintaining price stability for these items is therefore meaningful.

4. Conclusion

From the research above, it is clear that there are conclusion as follows.

(1) The figure illustrating the relationship between income and food consumption shows that as income increases, demand for livestock products, poultry, and aquatic products remains largely stable, while demand for eggs still has room to grow. Demand for vegetables and fresh fruits and melons remains relatively stable, whereas demand for grains still has potential to decline.

(2) As income rises, demand for aquatic products will increase significantly. Among other food categories, demand growth will be seen in eggs, fresh fruits and vegetables, and poultry meat; demand for grains and meat will grow more slowly.

(3) Market responses indicate that grains and poultry meat are necessities; aquatic products exhibit price elasticity, suggesting their demand should be rationally managed according to market needs; other food items fall under the category of normal goods.

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