Statistical Analysis of the Consumption Structure of Urban Residents in Country

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Abstract: This article conducts a statistical analysis of the consumption structure of urban residents in country, based on the time-series data published by the National Bureau of Statistics. Utilizing the theory of multiple linear regression analysis, the paper performs statistical modeling and empirical research on the consumption expenditure data of urban residents in recent years. This study employs yearbook data to construct statistical models, conduct model testing, heteroscedasticity testing, autocorrelation testing, and multicollinearity diagnosis. The research reveals that China's consumption structure is transitioning from a survival-oriented consumption pattern to a development-oriented and enjoyment-oriented consumption pattern. The consumption structure has undergone significant changes with socio-economic development. The model constructed in this paper can effectively reflect the statistical relationships between variables that affect per capita consumption, providing a quantitative basis for China's economic development research and the formulation of macro strategies.

Keywords: Linear Regression Analysis; Urban Residents; Consumption Structure; Statistical Modeling; Per Capita Consumption

1. Introduction

In recent years, with the rapid development of China's economy, the national economy has entered a new stage where consumption upgrading serves as a driving force for economic growth. The level of consumer spending increasingly reflects the overall level of national economic development. Concurrently, as residents' spending power gradually increases and their living standards gradually improve, the consumption structure also undergoes a transformation. This is reflected in a gradual decrease in the proportion of food expenditure in total consumption expenditure, a reduction in the Engel's coefficient, and a year-on-year increase in the proportion of service-oriented consumption such as education, cultural entertainment, and tourism. To enhance the relevant department understanding of the actual development status of the national economy, effectively perform relevant department functions, facilitate macroeconomic regulation and control, promote economic development, and improve the quality of life of the public, this paper provides a quantitative basis for formulating reasonable strategies and guidelines. By conducting research and analysis on the changes in the consumption structure of urban residents in China, this paper understands the consumption level and development trend of urban residents, employs statistical modeling theory for qualitative and quantitative analysis, explores the relationship between the consumption structure of urban residents, and provides better theoretical support for the transformation, optimization, and upgrading of the consumption structure.

2. Literature Review

In recent years, influenced by the global situation, China's economic development and economic structure have undergone adjustments and changes accordingly. The consumption structure of urban residents is also in a period of development and transformation. From the perspective of development trend characteristics, China's consumption demand has shifted from survival-oriented consumption to development-oriented consumption and enjoyment-oriented consumption, with the proportion of service consumption steadily increasing. From the perspective of industrial development, technological innovation industries and artificial intelligence are important driving forces for

economic development, while population structure, income, and region remain key factors affecting consumption structure.

Zhu Di proposed an analytical framework that integrates macro-social structure and micro-consumption behavior in the study of consumption structure, providing a sociological theoretical perspective for understanding consumption transformation [1]; when studying the structural relationships of residents in the process of China's modernization, he identified characteristics such as the growth of service consumption, the enhancement of developmental consumption, and the narrowing of consumption disparities, with residential and collective consumption expenditures exhibiting a squeezing effect in social development [2].

Tan et al. conducted an empirical research analysis on the statistical relationship between household net asset size and residents' consumption level and consumption structure using data from the China Household Finance Survey [3]. They revealed the reasons behind the consumption differences between urban and rural residents, and proposed that the relevant department should strengthen financial regulation of the real estate market, protect consumers' rights and interests, develop a people-benefiting economy, ensure reasonable and moderate debt for residents, avoid excessive concentration of consumer spending, thereby enhancing residents' consumption capacity and improving consumption structure.

Xie et al. conducted research on the role of digital inclusive finance in enhancing the consumption level of Chinese residents [4]. They conducted an empirical analysis based on provincial panel data from 2011 to 2022 in China, mainly studying the impact of the development of digital inclusive finance in the digital era on Chinese residents' consumption expenditure. They proposed that the development of digital inclusive finance has positively influenced the consumption level of Chinese residents.

Through studying the impact of the network economy on the consumption structure of Chinese residents, Ye Peiru found that the network economy has a significant positive effect on the survival, development, and enjoyment-oriented consumption of Chinese residents. Based on this, she proposed promoting the development of the network economy, enhancing the consumption ability of Chinese residents in the context of the network economy, which can optimize China's consumption structure and promote positive economic development [5].

Zong et al. conducted research on the economic factors and their mechanisms of action that affect the upgrading of residents' consumption structure. They found that the increase in per capita GDP, the proportion of residents' consumption to GDP, and the urbanization rate play a significant role in optimizing the consumption structure. Based on empirical analysis, they proposed suggestions and measures to optimize the consumption structure, such as increasing income and reducing costs to expand the total amount of residents' consumption, enriching consumption scenarios to provide diversified services, and improving structural social security strategies [6].

Zhang et al. conducted research on Chinese-style consumption and proposed that the spatial differences in the modernization of Chinese-style consumption mainly stem from inter-regional disparities. The consumption structure exhibits significant positive spatial autocorrelation characteristics, and the consumption levels in most provinces are relatively stable. They predict that the future development trend will be better [7].

In recent years, Wu Jin has conducted a systematic study on the consumption structure of Chinese residents by utilizing the ELES model and combining dynamic and static analysis methods [8]; Zhao et al. have studied the impact of changes in residents' consumption structure on industrial structure, concluding that optimizing residents' consumption structure can effectively promote industrial transformation [9], Ding Chunjie systematically reviewed the relevant theories of consumption structure optimization, analyzed the optimization of residents' consumption outcomes in the three northeastern provinces using factor analysis, and put forward reasonable suggestions such as increasing residents' income, expanding consumption areas, and enhancing social security [10], Lei et al. proposed constructing a multiple linear regression model to analyze the influencing factors of residents' consumption structure in Cheng zhen, Yibin City, and their research demonstrated suggestions for increasing residents' income, promoting supply-demand balance, and emphasizing education [11].

3. Descriptive Statistical Analysis

According to the relevant data published on the website of the National Bureau of Statistics, we can obtain the expenditure amounts of various items for urban households in China and their proportions in total consumption expenditure, as shown in Table 1. The data in Table 1 reveals that from 2018 to 2024, the per capita consumption expenditure of urban residents in China has shown a yearly upward trend, with per capita consumption expenditure surging from 26112 yuan to 34557 yuan. Over the seven-year period, the average consumption level of urban residents increased by 8445 yuan. This data reflects a steady upward trend in the consumption level of urban residents in China, and also indicates a significant improvement in people's living standards, leading to a happy and fulfilling life of moderate prosperity.

Table 1. Per Capita Expenditure of Urban Household

Annual	2018	2019	2020	2021	2022	2023	2024
Consumption Expenditure	26112	28063	27007	30307	30391	32994	34557
1.Food, Tobacco and Liquor	7239	7733	7881	8678	8958	9495	9957
2.Clothing and Footwear	1808	1832	1645	1843	1735	1880	1913
3.Housing	6255	6780	6958	7405	7644	7822	8008
4.Household Equipment	1629	1689	1640	1820	1800	1910	1903
5.Transport and Communications	3473	3671	3474	3932	3909	4495	4876
6.Education, Culture and Recreation	2974	3328	2592	3322	3050	3589	3928
7.Health Care and Medical Services	2046	2283	2172	2521	2481	2850	2925
8.Miscellaneous Goods and Services	687	747	646	786	814	953	1047

Data source: China Statistical Yearbook

Figures 1 and 2 in this article visually reflect the changes in the consumption structure of urban residents in China regarding food, tobacco, and alcohol consumption from 2018 to 2024. With the gradual improvement of living standards, the per capita expenditure on food, tobacco, and alcohol consumption among urban residents in China has also shown an upward trend. Over the seven years from 2018 to 2024, the per capita consumption expenditure on food, tobacco, and alcohol increased from 7239 yuan to 9957 yuan, an increase of 2718 yuan, reflecting a significant improvement in urban residents' consumption capacity for food, tobacco, and alcohol. However, judging from the changing trends in the steepness of the two broken lines in Figure 2, there is not a definite functional relationship between per capita consumption expenditure and per capita expenditure on food, tobacco, and alcohol. Instead, there is a certain positive correlation. It can be visually observed from the figure that the increase in per capita expenditure on food consumption is less than that in per capita consumption expenditure. The change trend in 2020 was different, largely due to the COVID-19 pandemic in 2020, which caused changes in the consumption structure of urban residents in China. People's income was affected, consumption capacity decreased, and coupled with lockdowns in many places and the closure of scenic spots, individuals reduced consumption and increased savings, leading to a decrease in non-essential consumption materials and an increase in the proportion of per capita expenditure on food consumption to total consumption expenditure.

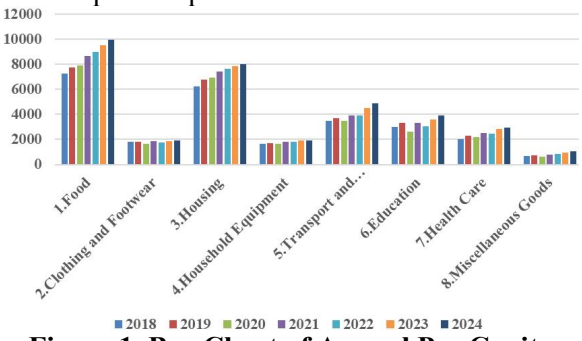

Figure 1. Bar Chart of Annual Per Capita Consumption Level Statistics of Urban Residents

As can be seen from Figure 2, during this period, the consumption expenditure on clothing for urban residents in China remained basically stable. Compared to clothing consumption, the upward trend in housing consumption was more pronounced. Over the seven years from 2018 to 2024, the per capita housing consumption expenditure increased from 6,255 yuan to 8,008 yuan, an increase of 1,753 yuan, which was basically on par with the increase in food, tobacco, and alcohol consumption. Figure 2 in this article also reflects the changes in consumption and proportion of urban residents in China in three areas: transportation and

communication, education, culture, entertainment, and healthcare. From the perspective of changes in consumption expenditure, all three trends showed an upward trend, which is consistent with the overall consumption trend of urban residents in China. This indirectly reflects that the changes in consumption of the aforementioned three types of consumption materials are significantly correlated with the changes in consumption ability of urban residents in China. From the perspective of consumption proportion, the proportion of the aforementioned three types of consumption in the consumption structure of urban residents in China has remained relatively stable. However, it can be observed that the proportion of healthcare has shown an upward trend, indicating that urban residents in China have been attaching increasing importance to healthcare in recent years. Meanwhile, there was a significant decrease in consumption on education, culture, and entertainment in 2020, which was obviously influenced by the COVID-19 pandemic. Due to the requirements of epidemic prevention and control, many offline educational and entertainment activities such as training, performances, exhibitions, and tourism were suspended or postponed, or shifted online, resulting in a greater impact on expenditure on education, culture, and entertainment compared to other types of consumption.

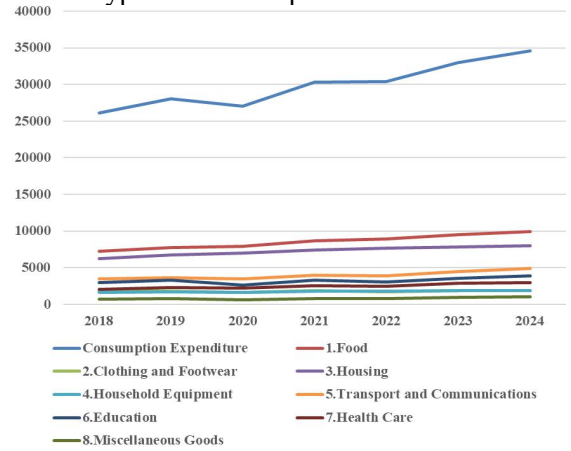

Figure 2. Line Chart of Statistical Data on Annual Per Capita Consumption Level of Urban Residents

4. Empirical Analysis

4.1 Theoretical Model

Regression analysis[12-14] is an important statistical method for studying the statistical relationships between variables. It primarily focuses on exploring the statistical relationships between target factors and multiple variable indicators that affect these target factors in real life, seeking to uncover their inherent statistical patterns. The basic steps involve selecting appropriate indicator variables and dependent variables, initially establishing a statistical model, and then conducting tests such as regression equations, regression coefficients, heteroscedasticity, autocorrelation, and multicollinearity. Once an appropriate statistical model is established, it can be used for prediction and control studies.

Based on the theory of multiple linear regression analysis, this article selects appropriate indicator variables for research. The theoretical model is as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p + \varepsilon \quad (1)$$

In the formula, β_0 is the regression constant, $\beta_1, \beta_2, \cdots, \beta_p$ is the regression coefficient, y is the dependent variable, and $x_1, x_2, \cdots, x_p$ is the independent variable. ε is the random error term, which follows a normal distribution and satisfies the Gaussian-Markov condition.

The regression constants and regression coefficients involved in the model are typically estimated using the method of least squares.

This article selects the explained variable y as the per capita expenditure of urban residents. Due to the many factors that affect the consumption structure of urban residents, combined with yearbook data and relevant literature review, the following indicators are preliminarily selected as independent variables: residents' food expenditure x_1, residents' clothing expenditure x_2, residents' housing expenditure x_3, residents' medical insurance expenditure x_4, residents' cultural, educational x_5, and entertainment expenditure, annual average wage of urban residents x_6, per capita GDP x_7, and consumer price index x_8. This article selects data from the 2024 China Statistical Yearbook for 31 provinces, autonomous regions, and municipalities directly under the central relevant department in 2025, and uses the above data to perform multiple linear regression. The unit of the independent variables $x_1 \sim x_7$ is yuan. According to the theoretical form of the multiple linear regression model, based on the above indicator factors, the

theoretical regression equation constructed in this article is:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 \quad (2)$$

4.2 Result Analysis

Based on the yearbook data [15], R language software was used for programming and running, obtaining the estimated values of the regression coefficients for the corresponding independent variable indicators and the estimated value of the regression constant. The running results are shown in Figure 3, from which the empirical regression equation is derived as follows:

$$y = 31290 + 1.132x_1 + 3.372x_2 + 0.8918x_3 + 1.022x_4 + 2.054x_5 + 0.012x_6 + 0.0067x_7 - 324.7x_8 \quad (3)$$

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.129e+04  1.777e+04   1.761  0.09219 .
x1           1.132e+00  1.606e-01   7.051 4.50e-07 ***
x2           3.372e+00  4.679e-01   7.205 3.21e-07 ***
x3           8.918e-01  1.360e-01   6.559 1.35e-06 ***
x4           1.022e+00  3.275e-01   3.120  0.00499 **
x5           2.054e+00  3.167e-01   6.487 1.59e-06 ***
x6           1.202e-02  3.374e-02   0.356  0.72508
x7           6.596e-03  1.319e-02   0.500  0.62204
x8          -3.247e+02  1.706e+02  -1.903  0.07026 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 785 on 22 degrees of freedom
Multiple R-squared:  0.9926,    Adjusted R-squared:  0.9899
F-statistic: 370.1 on 8 and 22 DF,  p-value: < 2.2e-16
```

Figure 3. Output of Running R Software to Establish a Linear Regression Model

Based on the theory of linear regression analysis, a significance test was conducted on the regression equation. The F value was found to be 370.1, with a corresponding P value 2.2×10^{-16} that is much smaller than the significance level of 0.05, indicating that the model passes the significance test and is statistically significant overall. A significance test was also conducted on the regression coefficients. The P values for the independent variables x_1 to x_5, which correspond to the asterisked indicators in Figure 3, were all less than the significance level of 0.05, indicating that they pass the significance test. However, the P value for variable x_6, x_7, x_8, which corresponds to the t-test, was greater than the significance level of 0.05, indicating that it fails the significance test and may be considered for exclusion. A goodness-of-fit test was conducted on the model, and the coefficient of determination R^2 was found to be 0.9926. The experimental results show that the model can explain 99.8% of the total variation. The adjusted coefficient of determination R^2 is 0.9899, indicating that the model still exhibits high explanatory power after adjusting for degrees of freedom. To further diagnose the feasibility of the model application, further diagnostic modeling is required to ensure that the created model possesses better accuracy and robustness.

Performing a DW test on this model reveals a DW value of 1.7987. Given the sample size n=31, p=8, the degrees of freedom for the regression model are 22. The autocorrelation coefficient is 0.10065, indicating weak autocorrelation. Based on the AIC criterion, the independent variable selection test for the model is as follows, as shown in Figure 4 and Figure 5.

```
Start:  AIC=420.64
y ~ x1 + x2 + x3 + x4 + x5 + x6 + x7 + x8

       Df Sum of Sq      RSS    AIC
- x6    1     78192 13636233 418.82
- x7    1    154066 13712107 418.99
<none>              13558041 420.64
- x8    1   2230919 15788959 423.37
- x4    1   5998063 19556104 430.00
- x5    1  25936477 39494518 451.79
- x3    1  26511487 40069528 452.24
- x1    1  30635077 44193117 455.27
- x2    1  31990853 45548893 456.21
```

Figure 4. Initialization of Independent Variable Selection Based on AIC Criterion

```
Step:  AIC=417.42
y ~ x1 + x2 + x3 + x4 + x5 + x8

       Df Sum of Sq       RSS    AIC
<none>              13904058 417.42
+ x7    1    267825  13636233 418.82
+ x6    1    191951  13712107 418.99
- x8    1   2046519  15950577 419.68
- x4    1   9358435  23262493 431.38
- x5    1  29951747  43855805 451.04
- x2    1  34416478  48320535 454.04
- x1    1  50611772  64515830 463.00
- x3    1 123297173 137201230 486.39
```

Figure 5. Selection of Independent Variables after Iteration Based on the AIC Criterion

The initial AIC value is 420.6. Using the stepwise regression method, the iteration reaches a minimum AIC value of 417.42, and the corresponding model is established. Then, a t-test is conducted, and it is found that the P values for independent variables x_1 to x_5 corresponding to the t-test are all less than the significance level of 0.05, thus still passing the significance test, as shown in Figure 6.

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.853e+04  1.636e+04   1.744 0.093994 .
x1           1.187e+00  1.270e-01   9.347 1.81e-09 ***
x2           3.436e+00  4.458e-01   7.708 6.06e-08 ***
x3           9.795e-01  6.714e-02  14.589 1.99e-13 ***
x4           1.134e+00  2.822e-01   4.019 0.000502 ***
x5           2.017e+00  2.805e-01   7.190 1.98e-07 ***
x8          -2.994e+02  1.593e+02  -1.880 0.072371 .
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 761.1 on 24 degrees of freedom
Multiple R-squared:  0.9924,    Adjusted R-squared:  0.9905
F-statistic: 524.9 on 6 and 24 DF,  p-value: < 2.2e-16
```

Figure 6. Establishing a Linear Regression Model with Selected Independent Variables

For this model, we used the variance inflation factor (VIF) to diagnose multicollinearity. After sequentially removing variables, it can be observed that the VIF of the remaining variables is all less than 10, indicating good elimination of multicollinearity. See Figure 7.

```
> vif(lm2024)
       x1        x2        x3        x4        x5        x6
x7        x8
 4.378797  1.587845 13.047192  2.740944  3.761127 12.458307
15.905607  1.491894
> lm2024_7<-lm(y~x1+x2+x3+x4+x5+x6+x8,data = data2024)
> vif(lm2024_7)
       x1        x2        x3        x4        x5        x6
x8
 4.370684  1.552978  9.029224  2.469120  3.646529 11.034427
1.383920
> lm2024_76<-lm(y~x1+x2+x3+x4+x5+x8,data = data2024)
> vif(lm2024_76)
      x1       x2       x3       x4       x5       x8
2.914875 1.532680 3.383921 2.164793 3.139967 1.383040
```

Figure 7. Diagnosis of Multicollinearity in the Model

Based on the aforementioned tests and analyses, variables x_1 to x_5 are selected to establish a linear regression equation. This equation passes the F-test for regression equations and the t-test for regression coefficients. Additionally, the model successfully passes tests for heteroscedasticity, autocorrelation, and multicollinearity, allowing for the establishment of a theoretically validated model. The theoretical form of the model's regression equation is established as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 \quad (4)$$

Based on the annual data of the aforementioned indicators, the results obtained using R language software are presented in Figure 8.

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -2.137e+03  1.267e+03  -1.686  0.10425
x1           1.231e+00  1.310e-01   9.394 1.11e-09 ***
x2           3.030e+00  4.093e-01   7.403 9.37e-08 ***
x3           1.004e+00  6.911e-02  14.528 1.08e-13 ***
x4           1.087e+00  2.950e-01   3.685  0.00111 **
x5           1.889e+00  2.856e-01   6.615 6.25e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 798.8 on 25 degrees of freedom
Multiple R-squared:  0.9913,    Adjusted R-squared:  0.9896
F-statistic: 571.3 on 5 and 25 DF,  p-value: < 2.2e-16
```

Figure 8. Plot of the Results Obtained from Running the R Software to Establish a Linear Regression Model

It can be concluded that variables x_1 to x_5 have all passed the significance test based on the experimental results, and the empirical regression equation can be derived as follows.

$$y = -2137 + 1.231x_1 + 3.03x_2 + 1.004x_3 + 1.087x_4 + 1.889x_5 \quad (5)$$

Based on the model presented in this paper, it can be observed that residents' housing expenditure and food expenditure still play a dominant role in personal consumption expenditure, with average marginal effects of 1.004 and 1.231, respectively. Meanwhile, clothing consumption tends to fluctuate relatively significantly with social development and changes. Additionally, the level of the consumer price index has a substantial impact on per capita consumption levels.

5. Conclusion

This article conducts research on the consumption structure of urban residents in China based on statistical data from yearbooks,, performs statistical modeling and empirical analysis, and systematically reveals the statistical relationship between per capita consumption levels and important indicators that affect per capita consumption levels. Based on this model, short-term consumption level predictions can be made, and theoretical support can be provided for formulating relevant strategies. In particular, to promote the improvement of per capita consumption distribution, the relevant department should focus on planning in food consumption and housing expenses, thereby contributing to the increase of GDP and the positive development of economic construction.

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