Prediction of China's Household Consumption and Its Effects on China’s GDP

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Keywords: Household consumption, Population age structure, Housing loan, Online payment, Forecast.

Abstract. Based on the change trend and the main impacting factors analysis of China’s urban and rural household consumption, considering not only household disposable income and population age structure, but also housing loans, online payment and other factors, this study applied multiple linear regression model and ARIMA to forecast China’s urban and rural household consumption in 2019-2035. The results are as follows. Household income is the main factor affecting urban and rural household consumption. Aging and the increase of household debt have seriously inhibited urban residents' consumption, e-commerce in village has promoted rural residents' consumption. In the future, China's household consumption will still show an upward trend, but the urban and rural household consumption growth rate will slow down to 4.7% and 5.4% in 2035, respectively. Household consumption will continue leading economic growth. Based on the input-output model, it is estimated that GDP will increase by 3831 billion yuan in 2019 as household consumption rises and the driving effect of household consumption on GDP is 3.6%. Some suggestions are put forward to expand household consumption in China.

Introduction

Under the new normal state of economic, China has entered into an important phase of sustained growth in consumption demand, accelerated upgrade in consumption structure and obvious enhancement of consumption-driven economy. According to the National Bureau of Statistics, the contribution rate of final consumption to GDP growth reached 64.6% in 2016 and 58.8% in 2017, which ranked first continually among final consumption expenditures, gross capital formation and net exports of goods and services. As a part of final consumption, household consumption has always maintained the characteristics of large quantity and fast growth. The household consumption increased from 4.7 trillion yuan in 2000 to 31.8 trillion yuan in 2017, increasing by 6.8 times in 17 years. Moreover, household consumption accounted for 39% of GDP in 2017.

The impacting factors of the household consumption have been widely studied by scholars. First, as China entered an aging society in 2001 and the demographic dividend is gradually disappearing from 2010, the structure of population is undergoing significant changes. Varlamova and Larionova [1] confirmed that population is an important factor affecting consumption. Foster, Biljana and Petar [2,3] used micro-survey data to analyze expenditure of different age groups in the United States and Serbia respectively. Secondly, the residents' concept of consumption has changed from "fear of debt" to "high debt", and household debt has become a new impacting factor of Chinese household consumption in the new era. Based on US household data, Yun et al. [4] thought household borrowing and household indebtedness affected current consumption. Fan and Yavas [5] found out the crowding out effect of mortgage payments on household consumption. Browning et al. and Viven [6, 7] also explored the impact of household housing debt on household consumption from the perspective of housing prices. Finally, the rapid development of e-commerce and mobile payment in China has changed the way that residents consume. Because mobile payment is just emerging and the
annual data of online payment are less, there are few related literatures about the relationship between online payment and household consumption. However, the latest data showed that the popularity of rural e-commerce has promoted rural residents' consumption. Rural online retail sales increased from 180 billion yuan in 2014 to 1244.9 billion yuan in 2017. Literatures mainly used the following methods to predict household consumption: (1) AIDS model [8]. However, the prediction of AIDS model needs to provide price index and other prediction information. The accuracy of price index prediction will affect the prediction accuracy of dependent variables. (2) Multivariate linear regression model and extended linear expenditure model [9]. But the relevant literature used multivariate linear regression model in the prediction of household expenditure considered few factors. They mainly considered the disposable income of residents and ignored the population age structure, debt and other related factors. (3) Grey model [10]. Unfortunately, the grey model is usually not suitable for the medium and long-term prediction. (4) ARIMA model [11]. However, it cannot conduct quantitative analysis on the key influencing factors of dependent variables.

Through literature review, we found that although a large number of articles have analyzed and predicted household consumption, they often concentrated on single factor, lacked multiple factors analysis and prediction on household consumption. In this paper, we considered not only household disposable income, the age structure of the population, but also some new factors, such as housing loans and online payment coverage, in order to reveal the impact of new consumption mode and concept on household consumption. And then we forecasted the household consumption of urban and rural residents respectively and analyze the impact of household consumption on China’s GDP. Finally, relevant opinions are put forward.

Model Establishment

According to Income Hypotheses [12, 13, 14], Ratcheting Effect and Precautionary Saving Theory, we regarded urban and rural disposable income (inc$_i$), pre-consumption of residents (cons$_{i-1}$) and inflation rate (ir$_i$) as explanatory variables of the urban and rural household consumption (cons$_i$) respectively. Based on Life Cycle Hypothesis of Modigliani and Brumberg [15], children population ratio (cdr$_i$) and elderly population ratio (odr$_i$) describing the population structure may also be the key factors affecting household consumption. Ogawa and Wan [16] illustrated with a theoretical model and made empirical analysis to reveal that housing-related debt affected consumption. Loan for personal house purchase (loan) is considered as an explanatory variable that may mainly affect urban household consumption. Finally, considering the popularity of online payment in China, the coverage of online payment (opr$_i$) also becomes an important factor affecting consumption.

The household consumption data is from the annual data of 1993-2017. Urban and rural online payment population is from “China Development of Rural E-Commerce Report” and “China Internet Development Report”. The individual housing loan is from the “Financial Institutions Loan Investment Statistics Report”. The data of the other variables are calculated and sorted out from “China Statistical Yearbook” from 1994 to 2018. This paper uses the population structure prediction results of China under the complete two-child policy from Liu and Liu [17].

Descriptive and correlational analyses are conducted so as to distinguish whether each explanatory variable is related to household consumption. In order to reduce the heteroscedasticity of data, eliminate the sequence correlation and reduce the fluctuation of data, logarithms are taken for cons$_i$, inc$_i$ and loan. According to the correlation analysis, lncons$_i$ is closely related to lninc$_{i-1}$, lncons$_{i-1}$, cdr$_i$, odr$_i$, opr$_i$, and lnloan. However, there are obvious linear relationships among some explanatory variables. In order to prevent multiple collinearities in multivariate linear models, we first regarded lninc$_i$, odr$_i$, opr$_i$, lnloan as the main factors influencing lncons$_i$. After model-parameter estimation, we will use the variance expansion factor (VIF) to verify whether the models have multiple collinearities problems. In the analysis of the relationship between lnloan and lncons$_{i-1}$, as well as opr$_i$ and lncons$_i$, the time dummy variables (D$_1$ and D$_2$) are introduced to compare the changes of consumption behavior caused by the rise of loan and online payment. Therefore, we get urban and rural household consumption model, respectively.
\[
\ln \text{cons}_1 = \alpha_0 + \alpha_1 \ln \text{inc}_1 + \alpha_2 \text{odr}_1 + \alpha_3 D_1 \times \ln \text{loan} + \alpha_4 D_2 \times \text{opr}_1 + \varepsilon_1
\]

\[
\ln \text{cons}_2 = \beta_0 + \beta_1 \ln \text{inc}_2 + \beta_2 \text{odr}_2 + \beta_3 D_2 \times \text{opr}_2 + \varepsilon_2
\]

\( \varepsilon_i \) is a random perturbation term. \( D_1 = 0 \) denotes the year before 2000, \( D_1 = 1 \) denotes the year after 2000. \( D_2 = 0 \) denotes the year before 2008, \( D_2 = 1 \) denotes the year after 2008.

Model Test and Estimation

This paper uses ADF unit root test to test the stability of household consumption and related explanatory variables. The results show that \( \ln \text{cons}_i, \ln \text{inc}_i, \text{odr}_i, \text{opr}_i, \ln \text{loan} \) are all non-stationary time series, but their second difference series are stationary time series, i.e. I (2) process, which meets the precondition of cointegration test, so Johansen cointegration test can be used for multiple variables.

From Johansen cointegration test there are co-integration relationships between variables, so regression analysis can be carried out. We used Granger causality test to analyze the causality between variables. The test results show that \( \ln \text{cons}_i \) is not the Granger cause of \( \ln \text{inc}_i, \text{odr}_i, \ln \text{loan} \) and \( \text{opr}_i \), so there is no endogenous problem.

Based on the weighted least square method, the annual data from 1993 to 2017 are used to estimate the parameters of Chinese household consumption expenditure model. In this paper, the stepwise regression method is utilized in order to ensure that only significant variables are included in the final regression equation and F-test is the highest. Finally, we got the consumption model of urban and rural areas.

\[
R^2 = 0.9998 \quad R_/2 = 0.9997 \quad F = 259862
\]

\[
R^2 = 0.9994 \quad R_/2 = 0.9993 \quad F = 17828
\]

The t-statistics for each estimated parameter are shown in parentheses. We calculated the variance expansion factor (VIF) of two sets of explanatory variables and the maximum values of them are within the acceptable range.

The results of model estimation show that China’s household consumption can be fitted well by using multiple linear model. The household disposable income plays a positive role in promoting the consumption of urban and rural residents. The proportion of urban elderly population increased by one percentage point, and the consumption of urban residents decreased by 2.38 percent. After 2000, the consumption of urban residents decreased by 1.23 percent for every 1 percent increase in housing loans. The development of rural e-commerce has greatly promoted rural household consumption. After 2008, rural household consumption will increase by 0.64 percent for every 1 percentage point increase in the penetration rate of online payment in rural areas.

Household Consumption Forecast

Through the above analysis, we concluded that the model of urban and rural household consumption. We used the population forecast results of Liu and Liu [18] and ARIMA to predict other explanatory variables from 2018 to 2035. After predicting the consumption of urban and rural residents in 2018-2035 by two models, we calculated the nominal growth rate of urban and rural consumption, as shown in Fig. 1. With the continuous improvement of residents' disposable income, the China’s urban and rural household consumption both maintain a sustained growth trend. However, the nominal growth rates of urban and rural household consumption show a downward trend. The consumption of urban residents is mainly affected by the negative impact of the increase of family debt and the elderly population, and the consumption of rural residents is mainly affected by the increase of rural residents’ income and the popularity of rural e-commerce, so the growth rate of urban residents decreases more than that of rural residents. By 2035, the nominal growth rate of urban consumption may be lower than that of rural consumption, which is 4.7% and 5.4%, respectively.
Figure 1. The nominal growth rates of China’s household consumption.

As the contribution of household consumption to economic growth continues to strengthen, we further used input-output model to explore the role of household consumption in driving China’s GDP in 2019. However, households earn incomes (at least in part) in payment for their labor inputs to production processes, and consumers spend their income in rather well patterned ways. Thus, we placed the household consumption column and labor input row inside the technically interrelated table, making it one of the endogenous sectors, finally we could get matrix $A^*$. The expression of the extended Leontief inverse matrix $L^*$ is

$$L^* = (I - A^*)^{-1} = \begin{bmatrix} L_{11}^* & L_{12}^* \\ L_{21}^* & L_{22}^* \end{bmatrix}.$$  \hspace{1cm} (3)

Then the driving effect of household consumption on GDP is calculated based on the input-output model.

$$\Delta GDP = \mu^T * \hat{A}_v * L_{11}^* * \Delta f^{CH} = \mu^T * \hat{A}_v * L_{11}^* * S^{CH} * \Delta f^{CH},$$  \hspace{1cm} (4)

where $\hat{A}_v$ is a value-added coefficient matrix, $S^{CH} = \left[ f_{CH}^{1}, f_{CH}^{2}, \ldots, f_{CH}^{n} \right]'$ is the sectoral structure of household consumption ($f^{CH}$) and $\mu$ represents a column vector whose elements are all 1. We used 2015 input-output table from the National Statistical Bureau of China and assumed $A^*$, $\hat{A}_v$, $S^{CH}$ is constant from 2015 to 2019. With Eq. 4, we got that an increase of 3056 billion yuan in household consumption could pull GDP up by 3831 billion yuan in 2019 and the driving effect of household consumption on GDP was 3.6%.

**Conclusions and Suggestions**

This paper constructs two consumption functions related to urban and rural household consumption with disposable income, population age structure, housing loan and online payment rate. We forecasted China’s household consumption from 2018 to 2035 and analyze the consumption function and forecast results. The results show that: (1) The disposable income of residents is the main factor affecting household consumption in China. With the increase of income, the consumption of urban and rural residents will continue increasing in the future. (2) Aging population and increase of household debt will restrain the consumption of urban residents and make the motive force of urban household consumption growth insufficient. (3) The rapid development of e-commerce and the rapid popularization of mobile payment in China have made consumers pay more and more convenient. Especially, rural e-commerce has significantly promoted rural household consumption. (4) In the future, China household consumption will continue to rise, but the growth rate has slowed down. It is estimated that the nominal growth rate of urban and rural resident consumption will be 4.7% and 5.4% by 2035, respectively. (5) Consumption continues to play an increasing role in stimulating the economy. It is estimated that China’s GDP will increase by 3831billion yuan and the driving effect of household consumption on GDP will be 3.6% in 2019 due to the increase in the proportion of household consumption to final demand.
Therefore, in order to promote the sustained growth of consumption and ultimately achieve the goal of promoting economic growth, we put forward the following suggestions. First, we should steadily raise the disposable income of residents and rationally adjust the social minimum wage. Second, we should expand the elderly consumer market. Third, we should maintain the stable regulation of the real estate market, including stabilizing house prices, controlling rents, reducing leverage and preventing risks in order to limit the amount of loans. Finally, we should continue to implement the rural e-commerce policy, raise the awareness of e-commerce of rural residents and enhance the rate of online payment, so as to promote rural household consumption.

Acknowledgements
This work was supported by the National Natural Science Foundation of China (Grants No.71874184).

References