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A Study on the Relationship between Civil Automobile Consumption and Real Estate in China

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Abstract:

Since the reform and opening up, China's economy has been booming, especially the real estate industry and the automobile industry, which have become the first and second pillar industries of China's economy in recent years. Different scholars have studied the impact of the real estate, residential and automotive sectors on other consumption and have different attitudes. However, few studies have analyzed the relationship between the two, and it is impossible to know the specific relationship between them. Therefore, this paper first puts forward a new theoretical hypothesis for the interaction between the two, then uses Eviews7.2 as the main data processing tool, and uses the cointegration test and the Granger causality test to conduct an empirical analysis of the annual number of new registered civil vehicles and the annual real estate and residential development investment amount in China from 2002 to 2022. The results show a long-term and stable equilibrium relationship between civil automobile consumption and the real estate and residential industry and that civil automobile consumption is a one-way Granger reason for the development of the real estate and residential industry, which is in line with one of the hypotheses. Finally, based on the conclusion, this paper proposes policy suggestions to promote real estate development through automobile consumption.

Keywords: civil automobile consumption;real estate;housing industry;cointegration analysis;Granger causality test.

1. Introduction

Since the reform and opening up, China's economy has developed rapidly, the living conditions of residents have improved significantly, especially the improvement of accommodation conditions, and the real estate industry has become the primary economic pillar industry in China in recent decades. In addition, China's automobile industry, especially the civilian automobile industry, is also rising rapidly and has become the second place in China's economic pillar industry. However, for individual consumers, buying a car and a house are still two major difficulties and goals. In today's society, "having a car and a house" has become an important indicator for people to judge whether to gain a firm foothold in a certain city and develop stably and the goal of living standards pursued by consumers. Luxury cars and mansions have become a status symbol for successful people. According to relevant studies, whether men or women have a property in their name has a significant positive impact on people's mate preference[1].

2. Literature

2.1 The impact of housing prices and housing investment on the household economy

For a long time, residential consumption and real estate investment have had a significant impact on the household economy due to their high prices and the proportion of expenditures, and many scholars have conducted research and analysis on this issue. Some scholars advocate linking high housing prices with low consumption, arguing that rising housing prices force residents to save for house purchases, thus crowding out consumption[2][3], that is, the "house slave effect": the motivation to buy a house and the repayment of housing loans have a crowding out effect on household products and mainly crowd out food, clothing, education, culture and entertainment expenditure, and durable goods, and the faster the expected housing price growth rate, the stronger the crowding out effect on consumption[4]. The "house slave effect" is not only applicable to China but also other countries, and foreign scholars have reached similar conclusions: Coulibaly and Li (2006)

analyzed the impact of the event of paying off home mortgages on household consumption based on the United States Consumer Expenditure Survey (CES) data, and found that non-durable goods spending did not increase significantly after households paid off home mortgages, while durable goods spending increased slightly[5]. For another example, Dynan K (2012) examined the impact of housing mortgage payments on non-housing consumption using data from the United Kingdom Income Dynamics Panel Survey (PSID) and concluded that the heavier the housing mortgage debt service burden or the higher the housing mortgage debt ratio (housing mortgage liability/housing present value) under the premise of controlling for factors such as net wealth and income, the slower the growth rate of non-housing consumption, and the more severe the suppression of non-housing consumption by housing mortgage liabilities in places with higher housing prices[6]. Civil cars are long-term durable goods for families; according to the "house slave effect", the more housing savings of the family, the greater the burden of loan repayment, and the stronger the inhibition effect on the consumption and demand of civil cars, in other words, the more vigorous the development of the real estate and residential industry, the more it can inhibit the development of the civil automobile industry, the more significant the difference between the two. However, relevant data show that the total output value of China's automobile industry will reach 11 trillion yuan in 2023, accounting for nearly 10% of the national GDP (data source: www.autohome.com.cn), surpassing the real estate industry for the first time. In addition, there is another disadvantage of the "house slave effect": the house slave effect is based on the premise that the marginal utility of the affected household consumer goods to consumers is less than the marginal utility of residential inputs. In other words, the products that families buy before buying a house will not be affected by the "house slave effect". Therefore, the establishment of the "house slave effect" is limited by conditions. However, due to the influence of subjectivity, there is no unified measurement index and measurement unit for the marginal utility of products.

Other scholars hold the opposite view of the impact of housing prices and housing demand, arguing that although high housing prices make residents have to increase their savings in order to buy housing, the rise in housing prices also increases the value of household housing wealth, which may produce a "housing wealth" effect and promote consumption [7]. As a result, there has yet to be a consensus on the impact of housing prices and residential investment on household consumption, so it is impossible to continue to cite the relationship between the real estate and residential sectors and the residential and automotive sectors.

2.2 The impact of the automotive industry on the economy

Residential cars and homes have similar characteristics to consumers: they are expensive and demand-rigid, so the results of scholars' research on the impact of the automobile industry on the household economy are pretty similar to those of the real estate industry. Some studies have found that there is a significant difference in other expenses before and after consumers pay off their car loans: other expenses after repayment are significantly higher than before repayment [8]. However, some scholars have found that from a macroeconomic point of view, it is precisely because of the high proportion of automobile consumption, the long industrial chain, and the large number of related industries that it has become the primary driving force for economic growth [9].

2.3 The relationship between the civil automobile industry and the real estate and residential industry

There are few studies on the relationship between the two, and some scholars have studied the combination prediction method of civil automobile ownership and used the Z-score method and the grey correlation analysis method to establish the following correlation coefficient equation:

$$Z\left\{Y_i(k), X_j(k)\right\} = \frac{0.1984}{\triangle_{ij}(k) + 0.1977},$$

where

$$\triangle_{ij} = \left|Y_i(k)' - X_i(k)'\right|, Y_i(k)' = \frac{Y_i(k) - \mu_1}{\sigma_1},$$

$X_i(k)' = \frac{X_i(k) - \mu_2}{\sigma_2}$, Among them, the civil car ownership index is taken as the reference series, that is, $Y_i = \left\{Y_i(k)\right\}$ is the series value of the i index at time k. The indicators of the economic and social system are taken as a comparison series, that is, $X_j = \left\{X_j(k)\right\}$ is the series value of j index at time k, and μ and σ represent the sample mean and standard deviation, respectively. One of the conclusions is that the correlation coefficient between the amount of fixed asset investment and the ownership of civil automobiles is 0.6000 [10], which only indicates that the amount of fixed asset investment with real estate as the main body has a strong correlation with the ownership of civil automobiles. Other literature also shows that the automotive industry and the real estate industry are highly

consistent in their response to the macroeconomic control policies of some countries, but there is a lack of strong evidence to prove that the two industries are directly related [11].

3. Theoretical analysis

According to the theory of consumer behaviour in microeconomics, consumer behaviour aims to maximize utility. In the case of a given budget, rational consumers will always allocate funds to the product or service with the most excellent utility. Although utility is an abstract concept that is difficult to measure in a particular unit, it is still possible to compare the utility level of civil vehicles and residential buildings in combination with Maslow's hierarchy of needs. Combined with Maslow's hierarchy of needs theory, the demand for accommodation is lower than the demand for travel conditions, and because there are many alternatives to civilian automobiles, such as transportation and public transportation facilities, which can meet the travel demand, it can be considered that in general, consumers will give priority to residential demand over vehicles. Since the lower level of demand is more necessary and is the cornerstone of the higher level of demand, the satisfaction of relatively high-level needs means that the relatively low level has reached a better degree of satisfaction. In other words, the development of the real estate industry cannot reveal the consumption of civilian automobiles. However, if the consumption of automobiles is good, it can indicate that the real estate industry must develop well. Therefore, a theoretical hypothesis is proposed:

H1: Civilian automobile consumption is a one-way positive Granger reason for developing the real estate and residential industry.

Combined with the duality of real estate consumption and investment and the related theories of macroeconomics, according to the influence of previous scholars on real estate products on other products, especially household demand goods, it is mainly divided into two schools: the "house slave effect" that squeezes out other consumption and the wealth effect caused by the rise in real estate prices. In reality, the impact of real estate may be a weighted combination of the two effects, and the weight of the two effects is in dynamic change because of the difference in housing prices and the different change trends at each moment, so it is impossible to specifically judge the specific impact of real estate on the automobile industry. The wealth effect may not be obvious because civilian cars are relatively expensive products. In order to further explore which influence is dominant, the following theoretical hypotheses are proposed:

H2: The consumption crowding out effect is dominant; the development of the real estate and residential industry and the consumption of civil automobiles are two-way negative Granger reasons.

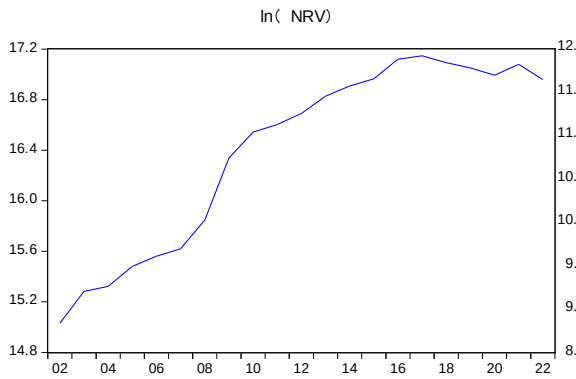
H3: The wealth effect is dominant; the development of the real estate and residential industry is a one-way positive Granger reason for civil automobile consumption.

4. Data selection and empirical analysis

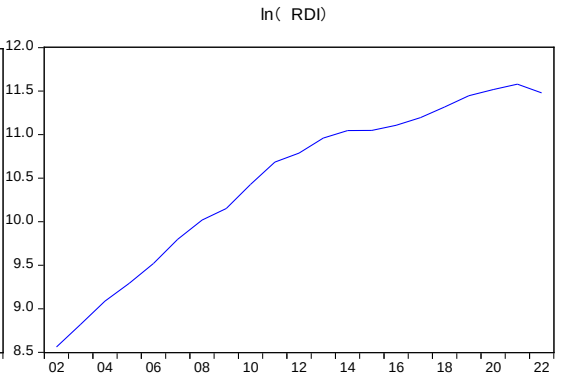
4.1 Data selection and preprocessing

Since China's formal accession to the WTO at the end of 2001 has promoted the rapid development of China's economic growth and foreign trade, which is of great significance, combined with the incompleteness of statistical data, this paper selects China's 21-year annual newly registered civil vehicle ownership from 2002 to 2022 (expressed by NRV: Newly Registered Vehicle, unit: vehicles) to represent the overall consumption of China's civil automobile industry. Therefore, NRV only represents automobile consumption. The annual investment amount in real estate and residential development (expressed by RDI: Residential Development Investment, unit: 100 million yuan) represents the overall investment in China's real estate and residential industry. The RDI data can represent the development of China's real estate industry because the investment amount and the transaction amount must be highly correlated. These two sets of data were used as analysis samples to explore the interaction between civil automobile consumption and real estate and residential industry through the cointegration test and Granger causality test. Considering that the sample data is time series data, it is verified by plotting a line graph based on the data: intuitively, the graph has a clear trend with time (Graph 1, Graph 2). Due to the possibility of heteroskedasticity in the economic time series and the large number of selected data, the selected data are logarithmicized and expressed as ln (NRV) and ln (RDI) respectively, with the first-order difference denoted as dln (NRV) and dln (RDI), respectively, and the second-order difference denoted as ddln (NRV) and ddln (RDI), respectively. The logarithmic processing does not change the dynamic relationship of each sequence and does not have a great impact on the subsequent inspection steps. By using OLS regression analysis and processing, it is easy to conclude that the correlation coefficient between ln (NRV) and ln (RDI) is 0.9784, indicating that there is a strong correlation between the ownership of newly registered civil vehicles and the amount of real estate and residential development investment, which has the significance of further statistics, testing and analysis. The calculations,

data processing, and empirical analysis in this paper were all completed using Eviews7.2.



Graph 1 ln(NRV) linear graph



Graph 2 ln(RDI) linear graph

4.2 Stationarity test

Before doing the cointegration test, the stationarity test of the time series needs to be performed. Since most of the economic time series are stationary, the stationarity test is more important, and the difference method is needed to make the stationary series stationary. Only time series of unitegers of the same order can perform cointegration tests. Otherwise, cointegration tests are meaningless. In this paper, the ADF unit root test is used to verify the stationarity of the sequence, and the stationarity test of the sequence ln (NRV) and ln (RDI) and their differential sequences are carried out, and the results of the ADF unit root test are as follows:

Table 1 ADF unit root test results

sequence	t-value	1% threshold	5% threshold	10% threshold	p-value	Judgment conclusions
ln(NRV)	-2.6322	-3.8085	-3.0207	-2.6504	0.1033	Unsteady
ln(RDI)	0.1777	-2.6924	-1.96	-1.6071	0.7266	Unsteady
dln(NRV)	-2.5019	-3.8315	-3.03	-2.6552	0.1305	Unsteady
dln(RDI)	-3.0936	-4.5326	-3.6736	-3.2774	0.1356	Unsteady
ddln(NRV)	-4.3777	-2.7081	-1.9628	-1.6061	0.0002	Stable at the 1% level
ddln(RDI)	-4.5601	-2.6998	-1.9614	-1.6066	0.0001	Stable at the 1% level

According to Table 1, it can be seen that ln (NRV) and ln (RDI) and their first-order difference sequences are stationary at the significance levels of 1%, 5% and 10%, respectively, and second-order difference sequences ddln (NRV) and ddln (RDI) can reach a stationary state at the significance level of 1%, so ln (NRV) and ln (RDI) are second-order single integer sequences. The homogeneous integer property indicates that the two sequences can be further cointegrated tested.

4.3 Cointegration test

The cointegration relationship refers to the stationary relationship between the linear combinations of some non-stationary time series, and the cointegration relationship of economic time series can show that there is a long-term stable equilibrium relationship between different variables. If a set of nonstationary time series does not have a cointegration relationship, then the variable regression model is pseudo-regression, so the cointegration test is particularly important and provides the necessary conditions for subsequent tests. There are two commonly used cointegration test methods; one is the Johansen cointegration test, which is to establish a VAR model to cointegrate the multiple variables because the core of this paper is to study the interaction between the two variables, the E-G two-step method applicable to the two variables is used, that is, the OLS least squares method is used to establish the regression for the two variables, and the unit root test is performed on the residuals of the regression to judge its stationarity, if the residual series is stationary, it means that there is a cointegration relationship between the two

variables that establish the regression.

Firstly, the OLS regression equation is established by ln(NRV) and ln(RDI):

$$ln(NRV) = C + \beta ln(RDI) + \epsilon$$

The ADF unit root test is performed on the residual ϵ by Eviews, and the test results are as follows:

Table 2 Residual ADF unit root test results

sequence	t-value	1% threshold	1% threshold	1% threshold	p-value	Judgment conclusions
ϵ	-2.6242	-2.6924	-1.9602	-1.6071	0.0117	Stable at the 5% level

According to the results of the ADF test, the residuals are stable at the 5% significance level, indicating that there is a cointegration relationship between ln(NRV) and ln(RDI), that is, there is a cointegration relationship between the ownership of newly registered civil vehicles and the amount of real estate and residential development investment, which further indicates that there is a long-term and stable equilibrium relationship between China's civil automobile consumption and China's real estate and residential industry. Therefore, if the necessary conditions are met, the Granger causality test can be further carried out to explore the relationship between the promotion and the promotion of civil automobile consumption and the real estate and housing industry or the two-way mutual promotion relationship.

4.4 Granger causality test

The Granger causality test is used to test the causal relationship between two variables, and this paper uses the Granger causality test to explore the causal relationship between China's civil automobile consumption and real estate and the housing industry. Based on the above analysis, there is a cointegration relationship between ln (NRV) and ln (RDI), so the causal relationship and direction between the variables of the Granger causality test have practical economic significance. According to the above OLS regression, different lag orders were selected, and it was observed that the Akaike information criterion value was relatively smallest when the lag order was 1 and 2, and the model could effectively balance the complexity and fitting degree, so the Granger test with ln (NRV) and ln (RDI) were selected as 1 and 2 respectively, and the results are as follows:

Table 3 Results of Granger causality test

Null hypothesis	The observed values	F-statistic	p-value
ln(RDI) does not Granger Cause ln(NRV)	20	1.2591	0.2774
ln(NRV) does not Granger Cause ln(RDI)	20	6.0838	0.0246
ln(RDI) does not Granger Cause ln(NRV)	19	0.3323	0.7227
ln(NRV) does not Granger Cause ln(RDI)	19	6.1231	0.0123

From the results in Table 3, it can be seen that no matter whether the lag period is 1 or 2, the following conclusions are concluded. At the significance level of 5%, the rejection of "ln(NRV) does not Granger Cause ln(RDI)" indicates that there is a Granger cause from ln(NRV) to ln(RDI). At the same time, at the significance level of 5%, "ln(RDI) does not Granger Cause ln(NRV)" is not refused, indicating that there is no Granger reason in the direction of ln(RDI) to ln(NRV). Therefore, it can be said that the development of China's civil automobile consumption is the Granger reason for the development of the real estate and residential industry, and this reason is one-way.

4.5 Regression analysis

From the above results, it has been concluded that the development of civil automobile consumption in China is a one-way Granger reason for the development of the real estate and residential industry. Therefore, in order to further explore the impact of civil automobile consumption on the real estate and residential industry, this paper takes ln (RDI) as the explanatory variable, adds time T to eliminate the influence of time on the two, and then takes ln (NRV) as the core explanatory variable to do a regression analysis to establish the regression equation as follows:

$$ln(RDI) = 0.7640 ln(NRV) + 0.0652T - 133.3055$$

T-Statistic (6.8077) (4.9150) (-5.3319)
R-squared=0.9818
Adjusted R-squared=0.9797
The results show that the coefficient of the regression equation has high significance, and the R-squared value of the decidable coefficient is 0.9818, which has a significant goodness of fit. At the same time, it can be determined that there is a long-term economic relationship between ln (NRV) and ln (RDI) variables. Specifically, for every 1% change in the ownership of newly registered cars in China in the first year of t, the amount of investment in real estate and residential development will change by 0.7640% in that year.

5. Conclusions and suggestions

5.1 Conclusions

Through the above empirical analysis of the annual ownership of newly registered civil vehicles and the annual investment amount of real estate residential development, the following conclusions can be obtained: first, through the cointegration test, there is a long-term and stable equilibrium relationship between China's civil automobile consumption and China's real estate investment, which is manifested in the same direction; The second is to conclude that China's civil automobile consumption is a one-way Granger reason for the development of the real estate and residential industry through Granger causality, that is, the hypothesis H1 is valid, but H2 and H3 are not valid; The third is that China's civil automobile consumption can promote the development of the real estate and residential industry, and the elasticity coefficient of the amount of real estate residential development investment on the ownership of newly registered civil cars is 0.7640, so we can consider starting from automobile consumption to drive the development of the real estate and residential industry.

5.2 Policy suggestions

The above research shows that for the automobile industry and the real estate industry, an important entry point can be placed in the former, and the real estate and residential industry can be indirectly stimulated by regulating automobile consumption while regulating the industry itself. If the adjustment direction of the two industries is consistent, it may be possible to achieve twice the result with half the effort, and there will be positive externalities spillover. Therefore, this paper puts forward three policy suggestions for the automotive industry to promote the common development of the two major industries and effectively stimulate the economy.

First, vigorously promote the research development and popularization of new energy vehicles. The promotion of new energy vehicles can reduce the dependence on and demand for non-renewable energy sources such as fossil energy, which can improve the scarcity of these energy resources, reduce the cost of the automobile industry, increase automobile consumption significantly, and optimize the development of the industry itself. At the same time, the promotion of new energy vehicles can solve the problem of air pollution caused by fuel vehicles and effectively improve the air quality in urban and rural areas, thereby improving regional livability and giving it a higher ecological value, which is the embodiment of positive externalities. Higher livability will increase the marginal utility of residential purchases and investments for consumers, thereby increasing consumers' demand for housing and driving the development of the real estate and residential industry through increased demand.

Second, the focus of industry development has shifted to the automotive industry, promoting the upgrading of the automotive industry and giving full play to its driving effect. According to the research and analysis of this paper, the development of the real estate industry does not have a role in promoting the development of the automobile industry; therefore, as far as the two are concerned, the current situation that real estate is the first economic pillar industry and the automobile industry is the second economic pillar industry is not the state of the most significant overall development growth rate of the two. Due to the positive externality of automobile consumption to the real estate industry, the shift of development focus makes it possible to stimulate automobile consumption and give a strong boost to the real estate industry. The upgrading and innovation of the automotive industry, such as the new mode of civilian car sharing, intelligent transportation systems and autonomous driving technology, can maximize its driving effect, further stimulate the development of real estate, and lead the construction of new smart cities.

Third, starting with the automobile industry, we will promote the internal circulation of the economy through the civilian automobile industry. After three years of epidemic turmoil, China's biggest problem in the economic recovery period is weak consumption and insufficient domestic demand. Therefore, China's current macroeconomic policy focuses on promoting economic internal circulation, stimulating consumption, and expanding domestic demand. From the perspective of consumption, the level of consumption directly affects the level of market supply, reflecting market expectations, and the expansion of consumer demand can greatly enhance the enthusiasm of enterprises in production and procurement, thereby effectively promoting the continuous growth of invest-

ment in related fields. Combined with the results of this paper, it is possible to stimulate automobile consumption, increase demand, promote investment with consumption, and feed consumption with good investment, so as to form a virtuous circle of consumption and investment, so as to promote China's economic recovery and growth to the greatest extent in line with the development of China's macroeconomic policies.

The automobile and real estate industries are the two most important economic pillar industries in China, and their common development has made significant contributions and extraordinary significance to China's economic growth and the improvement of people's livelihood and well-being.

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