

The Impact of Urbanization Process on Civil Car Ownership in China

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Keywords: Urbanization, Urban size, Car ownership.

Abstract. The choice of urbanization path has increasingly become a focus problem of our country's urban development. The article choose 161 cities in China above the ground level as samples, studied the 2005-2014 China's urban private car ownership evolution characteristics of space and time, selecting the population density, per capita GDP, urbanization level and per capita road with area of as the four factors that affect the civil car ownership by using the method of combining qualitative analysis with quantitative analysis, using panel data of 2005-2014, panel data model to quantify the contribution rate of various influencing factors, and analysis the mechanism of action of various factors on the urban private car ownership, combined with the relationship between car ownership and the use of oil to explore the different scale of the city civil relationship between car ownership and the choice of urbanization path, and put forward some suggestions on traffic levels for the development of China's urbanization.

Introduction

Urbanization is a process in which the rural population and production factors continue to transfer and gather to the emerging cities and towns, including the increase of urban population and emerging cities as well as the modernization of the social economy. In 2011, China's urban population exceeded the rural population for the first time, and the level of urbanization reached 51.27%. Li et al. (2014) pointed out in the summary of research reports on China's urbanization roads, patterns and policies that the urbanization level of China will remain at about 65% when the population reaches its peak in 2033. However, while great achievements have been made, the urbanization model characterized by high consumption, high emissions, and high expansion has also brought a series of problems. For example, the rapidly increasing number of motor vehicles has brought great pressure to the urban road system, a large amount of energy consumption has increased the resource and environmental constraints on urban development, and extensive urbanization has led to rapid deterioration of the urban ecological environment. The rapid growth of motorization and urbanization, the increasing freedom of resource allocation and mobility have a profound impact on the urban spatial structure, and also bring about the rapid increase of traffic demand, the contradiction between urban traffic demand and traffic supply is increasingly sharp. It is of great academic value and practical significance to study the spatial-temporal characteristics and influencing factors of urban civil automobile development in China and explore the influence law of urbanization process on civil automobile ownership in China.

Since the 1970s, foreign scholars have conducted a large number of studies on the impact of small cars on urban spatial structure, the development characteristics and scale prediction, car traffic and urban environment, car use and land use, etc. (Matas A, Raymond, 2009; Clark, 2009). Domestic scholars put forward their own views from multiple perspectives on the influencing factors of car ownership. Zhou, Ding, and Zheng (2010) argues that gross domestic product (GDP), highway mileage and the total energy consumption of the three main factors that affect car ownership. Huang, Cao, and Li (2012) believe that economic factors are the decisive factors of private car ownership. Sun and Wang (2014) studied panel data of 270 prefectural-level cities in China and found that agglomeration urbanization promotes public transportation and inhibits the development of private cars through intensity, thereby reducing the per capita energy consumption of private cars and thereby

reducing environmental pollution. The research of Li et al. (2015) shows that urbanization has a significant impact on private car ownership in China, among which urban residents' disposable income and urban population are the main influencing factors.

To sum up, the research on the ownership of civilian cars in Chinese focuses on the prediction and the analysis of the problems and countermeasures in the process of their development, mostly in a single city or the country as a whole for analysis and forecast object, discusses the characteristic of the car development and forecast of car ownership, but not in cities across the country as the basic research unit, systematic characteristics of time and space to the development of China's civil car. On the basis of the above literature research, this paper deepens and expands the following works: First, the selected cities are classified according to population size. Next, quantitative analysis is made on the development of urban civil automobile ownership in China from 2005 to 2014 and the influence mechanism of different factors on the urban civil automobile ownership is studied. Finally, the choice of urbanization path in China is discussed.

Research Design

Variable Selection and Data Sources

Index reflecting the process of urbanization mainly includes three aspects: urbanization rate, population density and per capita GDP, in this paper, in addition to using the above three variables, also used the index of "urban per capita road pavement area", which is related to urbanization and civil car ownership, four explanatory variables is used to analyze the impact of China's urbanization on civil car ownership.

In terms of sample selection, cities at the prefectural level and above in China are taken as research objects. By consulting the statistical yearbook of each city, we collected the number of civilian cars in 161 cities above the prefectural level. These 161 cities come from 20 provinces and municipalities in the east, middle and west of China, which have certain representativeness.

In terms of data collection, the data of China's civilian car ownership comes from the national bureau of statistics. In order to establish the influencing factor model of the civil automobile, this paper adopts panel data.

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By searching the statistical yearbook of each city, we collected the civil automobile data of 161 cities from 2005 to 2014, as well as the data of per capita GDP, urbanization rate, population density and per capita road paving area to form the panel data. Based on the above analysis, the following five research hypotheses are proposed:

- H1: the per capita GDP has a significant positive impact on civilian car ownership.
- H2: the urbanization rate has a significant positive impact on civilian car ownership.
- H3: the population density has a significant negative impact on civilian car ownership.
- H4: the per capita road paving area has a significant positive impact on civilian car ownership.
- H5: urbanization plays a greater role in promoting large cities than small and medium-sized cities.

Research Methods

Considering that the log-log form function has clear economic significance and can reduce the non-stationarity of macroeconomic data, this paper uses Stata statistical software to establish the panel data model in the log-log form as follows:

$$\ln Y_{it} = a_{it} + \beta_1 \ln X_{1it} + \beta_2 \ln X_{2it} + \beta_3 \ln X_{3it} + \beta_4 \ln X_{4it} + u_{it} \quad (i=1, 2, \dots, 161; t=1, \dots, 6). \quad (1)$$

where \ln is the natural logarithm; i is the i^{th} city; t is the time interval; Y_{it} are the civilian car ownership in the i^{th} city and the t^{th} year; X_1 is per capita GDP, X_2 is urbanization level, X_3 is population density, X_4 is per capita paving the area, and u_{it} is the random error term.

Data Analysis

The Growth of China's Civil Automobile Ownership

From the growth curve of the civil automobile in figure 1, it can be seen that the evolution of the civil automobile in China presents the following characteristics: the growth trend shows significant exponential growth, and the growth rate increases year by year. According to this trend, the number of civilian cars in China will further increase, breaking through hundreds of millions, and even becoming the country with the largest number of civilian cars in the world.

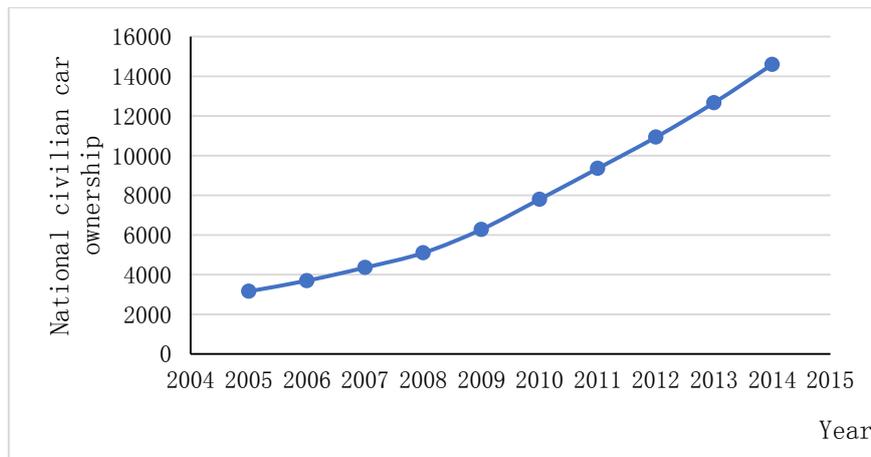


Fig. 1 The change curve of the number of civil automobiles in China from 2005 to 2014

Based on 161 different size cities of civil car ownership data from 2005 to 2014, on the basis of classification standard and the research content, cities with a municipal population of less than 1 million are classified as small cities, cities with a municipal population of between 1 million and 2 million are classified as medium cities, and cities with a municipal population of more than 2 million are classified as big cities, so as to ensure sufficient sample capacity of each city of size. The average annual growth rate of urban civil automobiles of different sizes is calculated. The results are shown in figure 2.

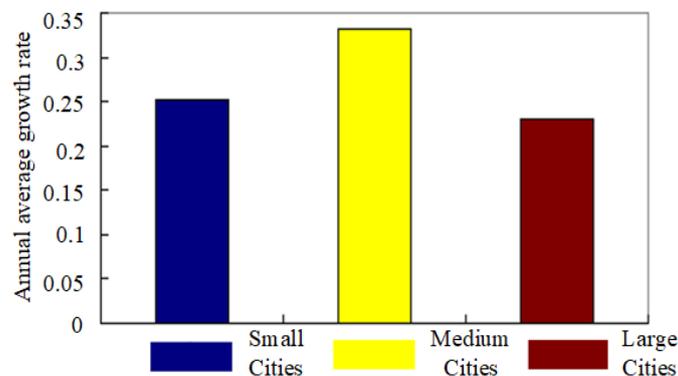


Fig. 2 The average growth rate of civil automobiles in cities of all sizes from 2005 to 2014

According to the results of figure 2, the growth of civil automobiles in cities of different sizes has the following two characteristics.

(1) The growth rate of civilian vehicles is strong. In general, from 2005 to 2014, the growth rate of civil cars in cities of all sizes is still strong, with the growth rate of more than 20%.

(2) The growth rates of cities of different sizes vary significantly. The growth rate of civilian cars in small and medium-sized cities is obviously faster than that in big cities, among which the growth rate of medium-sized cities is the fastest, exceeding 30%, and that of big cities is the slowest, about 22%.

Regression Model Analysis of Urban Car Ownership and Urbanization Process

In order to further analyze the relationship between the growth of civil automobiles and the urbanization process, the regression model is established as equation 1, among which the indicators constituting the urbanization process are shown in table 1:

Table 1. The index of influencing factors of civil automobile ownership

category	Urbanization progress index
X_1	GDP per capita
X_2	Urbanization rate
X_3	The population density
X_4	the per capita road paving area

Next, the overall panel data of 161 cities above the prefecture-level are analyzed by state, and the fixed effect and random effect regression of panel data is conducted according to the size of large, medium and small cities respectively. The regression results are shown in Table 2:

Table 2. Estimation test of fixed and random effects of panel data

Variable	Entirety		Large cities		Medium cities		Small cities	
	Fixed effects	Random effects						
$\ln X_1$	1.0078***	1.0153***	1.168***	1.1394***	1.1701***	1.1482***	0.8859***	0.9144***
$\ln X_2$	0.3541***	0.0935	0.1314	0.0338	0.3585	-0.2809**	0.6099***	-0.0667
$\ln X_3$	0.3073***	0.3404***	1.2002***	0.8746***	0.0961	0.1563	0.3062	0.0924
$\ln X_4$	0.2156***	0.1576***	0.2550	0.1546	0.1185	0.0644	0.2703***	0.2392***
Constant term	-2.1267***	-1.4098***	-8.692***	-5.5999***	-2.3215*	-0.1724	-0.3134	1.2046**
R^2	0.6613	0.6593	0.5981	0.5913	0.6535	0.6248	0.7921	0.7861
F-test	391***	1665.68***	59.89***	221.3***	108.92***	437.78***	381.93***	1422.8***
Hausman	0.0012		0.0000		0.0063		0.0000	
Sample size	161		33		47		81	

Note: *, ** and *** are significant at the levels of 10%, 5% and 1% respectively.

According to the regression results in table 2, the fixed effect is better than the random effect under the four samples. The overall equation has a good fitting degree, and R^2 is basically between 0.6 and 0.8. The regression equation can explain the changes in the number of civil automobiles to a certain extent. According to the regression of each explanatory variable, the four indicators of urbanization process have the following characteristics:

(1) Per capita GDP is the main driving factor for the growth of civilian cars. For big cities, the elasticity coefficient is 1.168, which means that the number of civilian cars will increase by 1.168% if the per capita GDP changes by 1%. For small and medium-sized cities, the promotion effect of per capita GDP is still obvious, so hypothesis H1 is fully supported. It also shows that economic factors are the main factors affecting the number of civil cars at the present stage, so it can be predicted that with the further development of China's economy, the number of civil cars will continue to increase.

(2) The impact of urbanization rate on cities of different sizes is different. Although the elasticity of civil cars in urban samples of different sizes regarding the urbanization rate is positive, there are significant differences in the elasticity. Hypothesis H2 is partially supported. This indicates that the

urbanization rate plays a much smaller role in promoting the number of civilian cars in large cities than in small and medium-sized cities. Therefore, hypothesis H5 is partially supported. According to the result, it can be found that the driving effect of urbanization rate on civil automobiles will weaken with the expansion of urban scale, and when urban scale develops to a certain extent, it may even show a negative elastic relationship.

(3) For large, medium and small cities, the elasticity of civil automobile on population density is all positive, indicating that China's civil automobile is still in the growth stage, and the population density has not played a limiting role, assuming that H3 is not supported.

(4) The per capita road area has little impact on civilian car ownership in cities of different sizes. It can be seen from Table 2 that the influence coefficients of the per capita road area of cities of three sizes on the civilian car ownership are all below 0.3, assuming that H4 is partially supported. Among them, the elasticity of small cities is larger, while the elasticity coefficient of big cities is relatively small; indicating that with the increase of per capita road area, the growth rate of civilian car ownership in small cities is slightly faster than that in big cities.

Summary

Through the above analysis, although the urban car ownership of large cities is still much higher than that of small and medium-sized cities, with the continuous progress of urbanization, the promotion effect of urbanization level on the urban car ownership is more significant than that of big cities. In addition, the growth rate of civilian car ownership in large cities is lower than that in small and medium-sized cities. However, China's limited oil resources, land, transportation, environment, and other factors also restrict the development of urbanization. Therefore, from the perspective of easing traffic pressure, compared with the decentralized urbanization of major developing small and medium-sized cities, the intensive urbanization of major developing large cities can slow down the growth of the number of civilian cars to some extent, and save a lot of oil resources for the country. Therefore, from the perspective of easing traffic pressure, compared with the decentralized urbanization of major developing small and medium-sized cities, the intensive urbanization of major developing large cities can slow down the growth of the number of civilian cars to some extent, and save a lot of oil resources for the country. From the perspective of the growth of civil vehicles and energy consumption, the intensive urbanization road has some advantages that the decentralized urbanization road cannot match. For example, it can alleviate the growing demand for civil vehicles, form a more developed urban public transportation system, and relieve the traffic pressure and energy pressure.

Due to the limitations of data collection, the sample selection in this paper does not involve all Chinese cities, and the selected years are not long enough, which may lead to some deviations in data processing results. In addition, due to the difficulty in collecting some data, factors that may affect the ownership of civil automobiles (such as vehicle purchase cost and residents' consumption habits, etc.) are not considered. If these factors can be included in the model, the development law and influencing mechanism of urban civil automobiles in China will be analyzed more objectively and comprehensively. However, no matter choosing the intensive or decentralized urbanization development path, the purpose is to formulate a plan suitable for China's urbanization development based on China's specific national conditions, so as to make China truly move towards a healthy urban development path.

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