

Study on the Influencing Factors of Private Car Ownership in China under the Background of Aging

Lulu Hao *

Beijing Jiaotong University
Beijing ,China
237593315@qq.com

Xuemeng Guo

Beijing Jiaotong University
Beijing ,China
17113113@bjtu.edu.cn

Abstract—In recent years, with the increasing number of motor vehicles in cities, urban traffic jams, air pollution and other problems have become increasingly prominent. There are a variety of factors affecting road congestion in China, including population, economic factors, urban morphology and policy factors. Among them, the population factor is particularly important, because our country has stepped into the aging society since 1999. In this paper, the factors affecting private car ownership in China are studied, and the aging population in China is taken as the main entry point to find effective ways to control traffic congestion in China. In this paper, it is concluded that aging of population has a significant positive effect on private car ownership in all provinces, however, it is not certain by region. GDP has a significant positive effect on private car ownership in all provinces. The main routes of public transport operation have a significant positive impact on private car ownership in all provinces. Bus routes have a significant positive impact on private car ownership in all provinces. According to the research results, this paper puts forward relevant policy recommendations.

Keywords— private car ownership; ageing; traffic congestion

I. INTRODUCTION

In recent years, with the increasing number of motor vehicles in cities, urban traffic jams, air pollution and other problems have become increasingly prominent. Xie Xuxuan, Shiqiu Zhang, Ru Yi, Dan Wu and Desheng Huang (2011) conducted on-the-spot monitoring of traffic conditions in typical congested sections of Beijing, obtained traffic flow and speed data, and quantitatively assessed the social cost of time delay, fuel consumption and pollutant emission. They estimated that the external cost caused by traffic congestion in Beijing was about 5 to 25 billion in 2008[1]. Wu Qibing, Feng Chen, Yao Huang and Yingyue Hu (2011) analyzed the cost of each sub-item of congestion, according to the critical speed of congestion of all major vehicles, compared the cost of three sub-items, namely, time consumption, energy consumption, establishment time, energy consumption and exhaust gas, and estimated that Beijing's congestion cost was 18.6 billion yuan, accounting for about 1.8% of GDP in 2008[2]. Ke Shanzi and Zheng Tengfei (2015) estimated the impact of traffic density on labor productivity by using the data of prefectural cities in China. The research results showed that during the period from 2003 to 2011, the number of cities with traffic congestion increased from 10 to 130, and the productivity loss increased from 26 to 660 billion [3].

There are a variety of factors affecting road congestion in China, including population, economic factors, urban morphology and policy factors. Among them, the population factor is particularly important because our country has stepped into the aging society since 1999. According to Wang Jiuqing, the aging process in China is obviously accelerating, and the aging of population will bring a series of influences on the spatial and temporal distribution of traffic and the travel structure.

The experience of Japan shows that with the continuous aging of the population, the travel distance, travel mode and travel frequency of the aging population all have certain regular changes, which also puts forward corresponding requirements for transportation infrastructure and transportation policies.

Traffic problem is more and more serious in China, not just large and medium-sized cities, many small cities also have serious congestion problem, which reduces the efficiency of social and economic development, affecting people's quality of life. In China, the research on private car ownership, a very important influencing factor of traffic congestion, is insufficient. This paper studies the influencing factors of private car ownership, and takes China's aging population as the main entry point to find effective ways to control traffic congestion.

At present, domestic studies on motor vehicle ownership and its influencing factors are mostly based on the situation of specific provinces and cities, and lack of systematic empirical studies with a wide range of applications. From the perspective of the aging population in China, this paper studies the private car ownership and its influencing factors with the data from the provincial level in China (Table I). The results thus obtained will be conducive to proposing targeted measures to alleviate urban traffic congestion.

TABLE I. THE AGE STRUCTURE OF CHINA'S POPULATION

YEAR AGE	1953	1964	1982	1990	2000	2010
0-14	36.28	40.69	33.59	27.69	22.89	16.60
15-64	59.31	55.75	61.5	66.74	70.15	70.14
65 and above	4.41	3.56	4.91	5.57	6.96	8.87

II. LITERATURE REVIEW

Although there are many studies on private car ownership, the existing literatures mainly focus on the study of a certain province, or research on the prediction of the overall private car ownership, lacking of general empirical research. FanJie and Yan Guangle (2009) used the system dynamics [4], and Liu Kai (2012) analyzed the influencing factors of private car ownership in Beijing with the multiple regression model, and put forward opinions on future policies [5]. Wan Fang (2015) studied the influencing factors of private car ownership in Chengdu and obtained the correlation between private car ownership and relevant influencing factors through the factor analysis model [6]. Liu Ruijun (2009) took the development of private cars in Wuhan from 1996 to 2007 as the research object, and used time series prediction model, econometric model and gray system model to predict private car ownership in the future [7]. Zhu Kaiyong, Shengwu Zhou, Keyuan Lou, and Chengtong Sun (2008) used the gray prediction model [8], and Zhu Xianghe (2011) used time series analysis to analyze and predict the private car ownership in a certain region [9]. Zhan Xiaoli, Jingya Chen and Kun Wang (2013) used the principle of minimum mean square error to select the exponential smoothing coefficient according to the change of private car ownership in China from 2000 to 2011, established the quadratic and cubic exponential smoothing model, and then used the model to predict the car ownership in China from 2012 to 2016 [10]. Li Yang (2008) use an empirical analysis on the influence of a series of factors such as the change of per capita regional GDP and infrastructure construction on private car ownership in Sichuan province from 1990 to 2005. He found that there was a certain functional relationship between private car ownership and per capita regional GDP, highway mileage and other traffic operation Numbers in Sichuan province [11].

Foreign studies on private car ownership are much more systematic. There are studies on car ownership at the national level, Dargay, J., and d. Gately (1999) analysed car/population ratio and per capita income with 26 countries in 1960-1992 annual data, the relationship between the 26 countries, including the OECD countries and some developing countries (China, India and Pakistan), and automotive growth quantity and total amount of 2015 was forecasted [12]. Dargay, J, d. Gately and m. Sommer (2007) analyzed the relationship between vehicle saturation level and the characteristics of observed countries with the annual data of 45 countries (including 75% of the world population at that time) from 1960 to 2002, and estimated that the total number of automobiles would increase from about 800 million in 2002 to over 2 billion in 2030 [13]. By that time, 56% of the world's vehicles would be in Non-OECD countries, up from 24% in 2002, and China's car inventory would have grown considerably, to 390 million by 2030.

Many other scholars have studied car ownership of different countries and regions. Matas, A, and j. Raymond (2008) analyzed the factors that determined the growth of car ownership in Spain in the past two decades. They used discrete selection model to estimate by select three time points :1980, 1990 and 2000 [14]. The empirical results showed that income elasticity is not a constant, but decreases with the increase of

car ownership. In addition, the income elasticity of families living in urban areas is more sensitive than that living in rural areas, and for those living in big cities, car ownership is also sensitive to the quality of public transportation. Whelan, G. (2007) established a family car ownership of the econometric model, and applied to forecast the number of cars around the country in 2031, he found that the choice to buy a car was related to the saturation of the car market, the availability of licenses, household income and structure, household employment, whether the company provided the car, and the cost of buying and using it [15]. Potoglou, D. and P. S. Kanaroglou(2008) [16], Chingcuanco, F. and E. J. Miller (2014) took the employment rate and the price of natural gas as independent variables and used the multiple logit model to estimate the car ownership of the representative large cities in Ontario from 1971 to 1996 [17].

Overall, the current domestic research mostly focus on the predictions of a car ownership, lack of research on car ownership and its influencing factors, and China has stepped into an aging society in 1999, but the existing research has not studied this influence factor basically, it is necessary to combining with the panel data of provinces, focus on the effects of the aging of population, to discover the intrinsic relationship between population structure and transportation, and put forward the corresponding policy recommendations.

III. THE EMPIRICAL ANALYSIS

A. Model Construction

Since this paper aims to analyze the influence of various factors on private car ownership, it is necessary to establish a multiple linear regression model:

$$CAR = \beta_0 + \beta_1 POPL_t + \beta_2 POP_t + \beta_3 GDP_t + \beta_4 ROAD_t + \beta_5 PUB_t + u_t \quad (1)$$

The dependent variable in this paper is CAR, which is the private CAR ownership in each province. $POPL_t$ is the independent variable, this is the number of people over 65 in each province; GDP_t is the independent variable, which is the GDP of each province. POP_t is the independent variable, this is the population of each province; $ROAD_t$ is the independent variable, which is the road area of each province. PUB_t is the independent variable, and this is the total line of public transportation operation in each province. as shown in the following table.

B. Empirical Results and Analysis

Empirical results of this paper as shown below, in general, aging population has a significant positive impact on private car ownership, and GDP has a significant positive impact on private car ownership. The number of population, road area and bus routes have no significant impact on private car ownership. For eastern, aging population has no significant effect, GDP, road area and bus routes have a significant positive effect on private car ownership, the number of population has no effect on private car ownership. In the middle of China, aging population has no impact on private car ownership, GDP and bus routes have a significant positive impact, but population and road area have no impact on private car ownership. For western China, aging population has no

impact on private car ownership, while GDP and bus routes have a significant positive impact, population and road area have a negative impact on private car ownership.

IV. CONCLUSIONS AND POLICY RECOMMENDATIONS

A. Conclusions

In this paper, it is concluded that aging of population has a significant positive effect on private car ownership in all provinces, however, it is not certain by region. GDP has a significant positive effect on private car ownership in all provinces. The main routes of public transport operation have a significant positive impact on private car ownership in all provinces. Bus routes have a significant positive impact on private car ownership in all provinces. According to the research results, this paper puts forward relevant policy recommendations(Table II&III).

TABLE II. INTRODUCTION OF VARIABLES

	Variable	Meaning
The dependent variable	CAR	Private car ownership in every province
	GDP	GDP of every province
	POP	The population of every province
The independent variables	POPL	The number of people over 65 in each province
	ROAD	Road area in each province
	PUB	The number of public transport operates routes of every province

TABLE III. THE EMPIRICAL RESULTS

	ALL	EAST	MIDDLE	WEST
POPL	8.24 (2.69) ***	0.03 (1.48)	0.02 (0.63)	0.04 (1.53)
GDP	161.15 (8.31) ***	1.63 (8.82) ***	1.89(6.94)** *	2.41 (8.36)***
POP	-109.38 (- 0.95)	-1.40 (- 0.39)	-8.19 (- 3.68) ***	-5.64 (- 3.85) ***
ROAD	-0.25(-0.02)	0.49 (1.69) *	0.13 (0.55)	-0.56 (- 2.17) **
PUB	2.45(0.0194)	0.49 (4.98) ***	0.91(3.33) ***	1.07 (5.83)***
R2	0.84	0.642	0.889	0.713
NUMBER	279	99	72	108

B. Policy Recommendations

This paper studies the factors affecting private car ownership in China, including aging population, and puts forward the following policy suggestions:

1. Improve the public transport coverage. With the development of the society, The education level, income status, health level and social status of the elderly will be improved, and the social activity of the elderly will be greatly enhanced. The scope of the elderly to travel will be broader. If we increase the coverage of public transport, we can reduce the number of private cars.

2. Improve the public transport and waiting conditions, add a new vehicle equipped with lifting device, guide plate, which not only provides convenience for the elderly to get on and off the car, reduce the psychological pressure and psychological burden of the elderly when taking the car, and save the elderly and other passengers time, improve the efficiency of transportation and reduce the number of private cars.

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