

# Study on Influencing Factors of China's Private Car Consumption Demand: Based on Multiple Linear Regression Model

Jingyi Zhang \*

School of Economic and Management, Tianjin University of Technology and Education, 300222 Tianjin, China

\* Corresponding author: Jingyi Zhang (Email: 15838977887@163.com)

**Abstract:** With the economic development and the improvement of residents' living standards in China, the number of private cars has achieved leapfrog growth. While promoting the development of the automobile industry and the national economy, it has also caused related problems such as environmental pollution and traffic congestion. Therefore, it is of great practical significance to reasonably regulate the number of private cars. Taking China's statistical data from 2005 to 2023 as the research sample, this paper selects the number of private cars as the explained variable, and per capita disposable income of residents, total energy consumption and crude steel output as the explanatory variables. A multiple linear regression model is constructed by using EViews software, and ordinary least squares (OLS) is adopted for empirical analysis. The model is optimized through multicollinearity, heteroscedasticity and autocorrelation tests, and the reliability of the results is improved by generalized least squares (GLS). The research shows that per capita disposable income of residents is the core factor affecting the number of private cars, and there is a significant positive linear correlation between them. For every 1 unit increase in per capita disposable income, the number of private cars increases by 0.883852 units accordingly. Total energy consumption and crude steel output have no significant impact on the number of private cars, and there is a strong multicollinearity among the three variables, which cannot form a substantial driving effect. The optimized model has an extremely high goodness of fit ( $R^2=0.996329$ ), and the empirical results are highly reliable. Based on this, this paper puts forward suggestions from four aspects: increasing residents' income, regulating production capacity, governing derivative problems and strengthening policy supervision, so as to promote the healthy and sustainable development of the private car market and realize the coordinated win-win situation between private cars, economy, ecology and people's livelihood.

**Keywords:** Private vehicle ownership, Total energy consumption, Econometrics, Influencing factors.

## 1. Introduction

With the continuous advancement of China's high-quality economic development process, the comprehensive national strength has steadily improved, the residents' living standards have achieved leapfrog growth, and the consumption structure has also transformed towards quality and diversification. As a consumer product that combines travel convenience and a symbol of living quality, the number of private cars has shown an explosive growth trend, which not only has profoundly changed residents' travel modes and living habits, but also become an important indicator reflecting China's economic vitality, urbanization process and industrial structure upgrading. As one of the pillar industries of China's national economy, the healthy development of the automobile industry plays an irreplaceable role in boosting domestic demand, promoting industrial chain coordination and driving employment growth. As the core growth pole of the automobile industry, the development trend of private car consumption is directly related to the stable operation of the automobile industry and even the entire national economy.

The development process of China's private car industry has distinct phased characteristics, which has gradually advanced with the evolution of policy orientation, economic development and residents' consumption capacity. In the 1980s, the state gradually relaxed the regulation of the automobile industry and began to import cars in a planned way, breaking the single pattern that cars were mainly used for official purposes and laying a policy foundation for the

popularization of private cars. In the 1990s, with the continuous improvement of the market economy system, residents' income level gradually increased, some families began to try to buy private cars, and private car consumption entered the embryonic stage, gradually approaching the international consumption trend. Since 2002, China has officially entered the stage of private car popularization. The reasonable decline in car prices, the upgrading of residents' consumption concepts and the continuous improvement of infrastructure have jointly promoted the leapfrog growth of the number of private cars. According to statistics, the number of private cars in China reached 123.39 million in 2014, an increase of 433 times compared with 285,000 in 1985, with an average annual growth rate far exceeding the economic growth rate in the same period. By 2023, the number of private cars in China had climbed to 293.5689 million, maintaining a steady growth trend and becoming one of the countries with the highest number of private cars in the world.

A review of existing research results shows that scholars mostly analyze the influencing factors of private car ownership from the perspectives of economic development, urbanization level, policy regulation, and public transportation development. However, there is still an obvious deficiency in empirical research on the synergistic impact of per capita disposable income of residents, total energy consumption, and crude steel output on private car ownership. Among them, per capita disposable income of residents directly determines residents' consumption capacity and is the core factor affecting private car purchase decisions; total

energy consumption reflects the supporting capacity of China's energy supply and is directly related to the use cost and popularization potential of private cars; as a core raw material supply indicator for the automobile manufacturing industry, changes in crude steel output directly affect the scale and price level of automobile production, thereby indirectly acting on the number of private cars. It is expected that the national crude steel output will decline slightly in 2026, which will also have a certain impact on the automobile industry. There is a close internal correlation between the three factors and the number of private cars, but existing studies have not yet systematically revealed the synergistic impact mechanism of the three.

Based on this, this paper selects relevant statistical data of China from 2005 to 2023, takes the number of private cars as the explained variable, and per capita disposable income of residents, total energy consumption, and crude steel output as the explanatory variables. Using econometric methods and EViews software, a multiple linear regression model is constructed to systematically analyze the direction and degree of impact of each explanatory variable on the number of private cars, in order to provide solid theoretical support and data reference for China to reasonably regulate the number of private cars and promote the coordinated development of the automobile industry, economy and society.

## 2. Description of the Development Status of Private Car Ownership in China

### 2.1. Descriptive Statistical Analysis Method

Based on the data provided by the "China Statistical Yearbook", this method conducts induction, collation and calculation, and summarizes them into charts, aiming to identify the development laws and characteristics of private cars in China. Systematic and scientific observation of the research object can expand people's thinking and facilitate better analysis.

### 2.2. Ordinary Least Squares (OLS)

The explained variable (number of private cars) and explanatory variables (per capita disposable income of residents, total energy consumption, crude steel output) are selected, and the ordinary least squares method is adopted to analyze the degree of impact on the number of private cars in China. If the change trend of an explanatory variable is relatively consistent with that of the explained variable, the correlation between them is high.

## 3. Empirical Analysis of Private Car Ownership in China

### 3.1. Data Sources and Variable Selection

Based on the private car ownership data from 2005 to 2023 selected from statistical databases such as the National Bureau of Statistics of China and the China Statistical Yearbook, as well as previous experience, four data items were selected: private car ownership (10,000 vehicles), per capita disposable income of residents (yuan), total energy consumption (10,000 tons), and crude steel output (10,000 tons). The reasons are as follows:

#### 3.1.1. Per Capita Disposable Income of Residents (X1)

An increase in per capita disposable income of residents indicates an improvement in residents' living standards and greater affluence, which in turn increases consumption levels and thus boosts demand for high-end products such as cars. Therefore, it is initially believed that there is a positive relationship between private car ownership and per capita disposable income of residents.

#### 3.1.2. Total Energy Consumption (X2)

An increase in total energy consumption indicates that with the development of technology, various energy sources, such as renewable energy like wind energy and solar energy, have increased, leading to an increase in per capita energy consumption and a decrease in the cost of using cars, thereby increasing residents' purchase volume. Therefore, it is initially believed that there is a positive relationship between private car ownership and total energy consumption.

#### 3.1.3. Crude Steel Output (X3)

An increase in crude steel output indicates an increase in the total number of cars that can be produced. Only when the total number of cars increases and the supply expands can the number of privately owned cars possibly increase. Therefore, it is initially believed that there is a positive relationship between private car ownership and crude steel output.

## 3.2. Analysis of Empirical Results

By using EViews software to plot the correlation diagrams between the dependent variable and each independent variable, it is clearly observed that the number of private cars in China exhibits a positive correlation with the three independent variables, namely per capita disposable income of residents, total energy consumption, and crude steel output. Therefore, a multiple regression model is established to analyze the interrelationships among the variables. The preliminary model is constructed as follows:  
$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$$

### 3.2.1. Table 1 presents the statistical data from 2005 to 2023

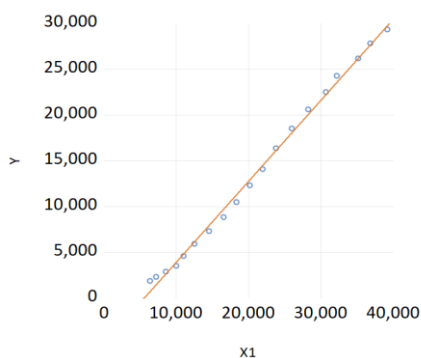
**Table 1.** Panel Data of Private Car Ownership, Per Capita Disposable Income of Residents, Total Energy Consumption and Crude Steel Output

year	Private Car Ownership (10,000 units)	Per Capita Disposable Income of Residents (yuan)	Total Energy Consumption (10,000 tons of standard coal)	Crude Steel Output (10,000 tons)
2005	1848.07	6385	261369	35323.98
2006	2333.32	7229	286467	41914.85
2007	2876.22	8584	311442	48928.80
2008	3501.39	9957	320611	50305.75
2009	4574.91	10977	336126	57218.23
2010	5938.71	12520	360648	63722.99
2011	7326.79	14551	387043	68528.31
2012	8838.60	16510	402138	72388.22
2013	10501.68	18311	416913	81313.89
2014	12339.36	20167	428334	82230.63
2015	14099.10	21996	434113	80382.50
2016	16330.22	23821	441492	80760.94
2017	18515.11	25974	455827	87074.09
2018	20574.93	28228	471925	92903.84
2019	22508.99	30733	487488	99541.89
2020	24291.19	32189	498314	106476.68
2021	26152.02	35128	525896	103524.26
2022	27792.11	36883	540956	101795.90
2023	29356.89	39218	572000	102885.97

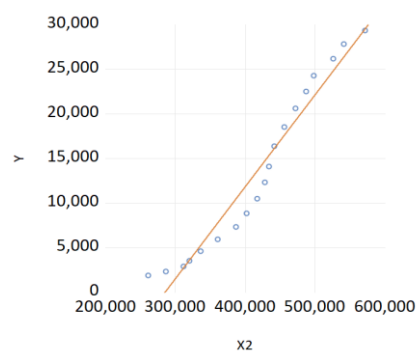
Data source: China National Bureau of Statistics (<https://www.stats.gov.cn>)

### 3.2.2. Scatter Diagrams

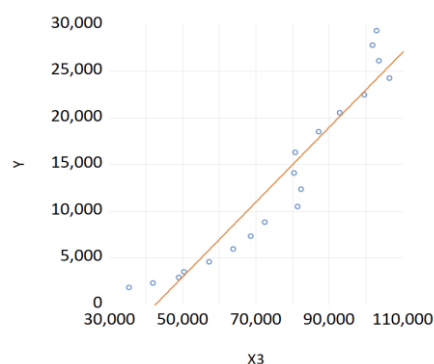
The ordinary least squares (OLS) scatter diagram displays data points and the optimal fitting line determined by the ordinary least squares method. This line represents the linear relationship between variables in the data and can be used for prediction and interpretation. The scatter diagrams show the relationships between private car ownership (Y) and per capita disposable income of residents (X1), total energy consumption (X2), and crude steel output (X3), respectively. As shown in Figure 1, the fitting effect between private car ownership (Y) and per capita disposable income of residents (X1) is very good; Figure 2 also shows an excellent fitting effect between private car ownership (Y) and total energy consumption (X2); similarly, the fitting effect between private car ownership (Y) and crude steel output (X3) in Figure 3 is acceptable. These results indicate a linear relationship among the variables, thus justifying the establishment of a multiple linear regression model.



**Figure 1.** Scatter Diagram of Y and X1



**Figure 2.** Scatter Diagram of Y and X2



**Figure 3.** Scatter Diagram of Y and X3

### 3.2.3. Preliminary Ordinary Least Squares (OLS) Estimation

**Table 2.** EViews output results I

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4141.292	1067.819	3.878272	0.0015
X1	1.168091	0.033303	35.07491	0.0000
X2	-0.040382	0.005353	-7.543581	0.0000
X3	0.024127	0.013209	1.826615	0.0877
R-squared	0.999396	Mean dependent var	13668.40	
Adjusted R-squared	0.999275	S.D. dependent var	9359.281	
S.E. of regression	252.0532	Akaike info criterion	14.08182	
Sum squared resid	952962.1	Schwarz criterion	14.28065	
Log likelihood	-129.7773	Hannan-Quinn criter	14.11547	
F-statistic	8267.787	Durbin-Watson stat	1.768535	
Prob (F-statistic)	0.000000			

The estimation results are as follows  $\hat{y}=4141.292+1.168091*X1-0.040382*X2+0.024127*X3$ .

With  $R^2=0.999396$ ,  $DW=1.768535$ ,  $T=19$ , (2005-2023),  $F=8267.787$ , the model is obviously significant. By checking the t-distribution table, we have  $t_{\frac{16}{2}}^{16}=t_{0.05}^{16}=2.12$ , X1 and X2 pass the t-test and are significant to Y, while X3 fails the t-test and is insignificant, which may indicate the existence of multicollinearity.

#### 3.2.4. Multicollinearity Test

With  $R^2=0.99$ , among the three explanatory variables, the t-values of X2 and X3 are relatively small, and the economic significance of X2 is inconsistent with the actual situation.

Further analysis of the correlation coefficient between X1 and X2 shows that it is 0.9855, which indicates the existence of multicollinearity among the explanatory variables. After analysis, X1 is the most important variable affecting the change of Y, so X2 is deleted from the regression equation.

**Table 3.** Correlation coefficients of x1, x2, and x3

Correlation			
	X1	X2	X3
X1	1.000000	0.985542	0.962039
X2	0.985542	1.000000	0.979212
X3	0.962039	0.979212	1.000000

**Table 4.** Eviews output result 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3446.051	760.2262	-4.532928	0.0003
X1	0.970670	0.043661	22.23220	0.0000
X3	-0.042851	0.020732	-2.066939	0.0553
R-squared	0.997103	Mean dependent var	13668.40	
Adjusted R-squared	0.996741	S.D. dependent var	9359.281	
S.E. of regression	534.3350	Akaike info criterion	15.54386	
Sum squared resid	4568222	Schwarz criterion	15.69298	
Log likelihood	-144.6667	Hannan-Quinn criter	15.56910	
F-statistic	2753.215	Durbin-Watson stat	0.796421	
Prob (F-statistic)	0.000000			

The regression equation after deleting X2 is as follows:  $\hat{y} = -3446.05+0.9707x1-0.0428x3$ ,  $R^2= 0.997103$ ,

$DW=0.796421$ ,  $T=19$ , (2005-2023). Then, X3 is further eliminated from the regression equation.

**Table 5.** Eviews output result 3

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4907.890	304.4807	-16.11889	0.0000
X1	0.883852	0.013012	67.92665	0.0000
R-squared	0.996329	Mean dependent var	13668.40	
Adjusted R-squared	0.996113	S.D. dependent var	9359.281	
S.E. of regression	583.4988	Akaike info criterion	15.67526	
Sum squared resid	5788004	Schwarz criterion	15.77468	
Log likelihood	-146.9150	Hannan-Quinn criter	15.69209	
F-statistic	4614.029	Durbin-Watson stat	0.469359	
Prob (F-statistic)	0.000000			

$\hat{y}=-490789+0.883852x1$ ,  $R^2 = 0.996329$ ,  $DW=0.469359$ ,  $T=19$ , (2005-2023).

(Economic implications) Analysis of model estimation results indicates that, holding other conditions constant, each

one-unit increase in per capita disposable income leads to a 0.883852-unit rise in private car ownership.

### 3.2.5. Heteroscedasticity Test

The White test is adopted to conduct the heteroscedasticity test by constructing a  $\chi^2$  statistic through an auxiliary regression equation that examines whether the variance of the residuals of a model has a regression relationship with the original explanatory variables in any form. In the table,  $\text{obs}^*\text{R-squared}$ , i.e.,  $\text{TR}^2 = 8.1617$ , and the corresponding p-value is 0.5179, which is greater than 0.05. Thus, the test conclusion is that there is no heteroscedasticity.

**Table 6.** White Test Results ( $\text{obs}^*\text{R-squared} = 4.368417$ )

Heteroskedasticity Test: White			
Null hypothesis: Homoskedasticity			
F-statistic	0.753068	Prob. F (9, 9)	0.6602
Obs*R-squared	8.161859	Prob. Chi-square (9)	0.5179
Scaled explained SS	4.360374	Prob. Chi-square (9)	0.8861

### 3.2.6. Autocorrelation Test

In the ordinary least squares (OLS) method with X2 and

X3 eliminated, the Lagrange Multiplier (LM) test is used to conduct the autocorrelation test - first-order autocorrelation.

**Table 7.** Autocorrelation Test

Breusch-Godfrey serial correlation LM test:			
Null hypothesis: No serial correlation at up to 1 lag			
F-statistic	12.09207	Prob. F (1, 16)	0.0031
Obs*R-squared	8.178441	Prob. Chi-square (1)	0.0042

The LM autocorrelation test-assisted regression estimation yields the following results:  $\hat{u} = 0.6677$ ,  $\hat{u}_{t-1} = 42.20252 - 0.002674X_t + v_t$ , with  $\text{LM} = \text{TR}^2 = 19 \times 8.178 = 155.38$ . Given that  $\chi^2(1) = 3.84$ , the LM test statistic (155.38) exceeds the critical value of 3.84, indicating first-order autocorrelation in the error term.

### 3.2.7. Estimating Regression Coefficients Using Generalized Least Squares Method

First, estimate the correlation coefficient  $\hat{\rho}$ . As shown in the table,  $\text{DW} = 1.34$ .  $\hat{\rho} = 1 - \text{DW}/2 = 0.33$  perform generalized difference transformation on the original variables.

**Table 8.** Eviews output result 4

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	42.20252	237.1711	0.177941	0.8610
X1	-0.002674	0.010151	-0.263379	0.7956
RESID (-1)	0.66766	0.192003	3.477365	0.0031
R-squared	0.430444		Mean dependent var	-1.70E-12
Adjusted R-squared	0.359250		S.D. dependent var	567.0589
S.E. of regression	453.9129		Akaike info criterion	15.67526
Sum squared resid	3296591		Schwarz criterion	15.36675
Log likelihood	-141.5675		Hannan-Quinn criter	15.24286
F-statistic	6.046035		Durbin-Watson stat	1.342952
Prob (F-statistic)	0.011074			

## 4. Research Findings and Policy Recommendations

### 4.1. Core Research Findings

This study utilizes panel data from 2005 to 2023 on China's per capita disposable income, total energy consumption, crude steel output, and private vehicle ownership. Using EViews software to construct a multiple linear regression model, empirical analysis was conducted via the least squares method. The study systematically performed multicollinearity tests, heteroscedasticity tests, and autocorrelation tests, followed by model optimization using generalized least squares. The results systematically explore the influence mechanisms of various factors on private vehicle ownership in China, yielding practical and highly credible empirical conclusions that accurately reveal the core impact logic and developmental patterns of private vehicle ownership in the country.

First, per capita disposable income of residents serves as the core determinant influencing private car ownership in China, demonstrating a significant positive linear correlation with vehicle ownership. Empirical results show that after controlling for multicollinearity effects, the optimized model indicates a 0.883852-unit increase in private car ownership

per unit rise in disposable income. The variable passes rigorous t-tests with high goodness-of-fit and statistical significance, conclusively proving income levels 'strong driving force on private car consumption. Examining China's private car development trajectory reveals that since entering the nationwide private car ownership phase in 2002, sustained steady growth in per capita disposable income has driven continuous consumption upgrades. Private cars have evolved from luxury items to essential household transportation needs, with rising income levels directly unleashing automotive consumption potential. This mechanism has become the fundamental driver behind the annual increase in private car ownership, aligning perfectly with mainstream academic research on economic income determining automobile consumption patterns.

Secondly, total energy consumption and crude steel production show insignificant impacts on private car ownership, with multicollinearity issues present, making them non-core influencing variables. The initial multiple regression model results indicate weak correlations between total energy consumption, crude steel production, and private car ownership. Notably, the regression coefficient for total energy consumption is negative, contradicting the presumed positive relationship, while crude steel production fails t-test validation due to insufficient variable significance. Further

correlation coefficient analysis reveals that the correlation coefficients among per capita disposable income, total energy consumption, and crude steel production all exceed 0.96, demonstrating severe multicollinearity that compromises model estimation accuracy. Stepwise variable elimination confirms that total energy consumption primarily reflects China's overall energy consumption scale rather than direct associations with private car usage costs or consumer demand. As a raw material supply indicator for automobile production, crude steel production poses no supply-side constraints for private car ownership in China's steel industry context, given the nation's status as a major steel producer with stable material availability and production capacity. Consequently, neither variable exerts substantive or decisive influence on private car ownership, thereby revising preliminary variable impact assumptions in this study.

Third, the optimization model constructed in this study demonstrates high credibility and fitting performance, with model validation results conforming to macroeconomic econometric standards. The White test confirmed the absence of heteroscedasticity, ensuring the validity of regression coefficient estimation. Although the initial model exhibited first-order autocorrelation issues, optimization through generalized least squares significantly enhanced model stability. The final optimized model achieved a coefficient of determination ( $R^2$ ) of 0.996329, indicating strong explanatory power for changes in private vehicle ownership in China. The empirical results exhibit robust reliability and persuasiveness, accurately reflecting the actual impacts of various factors on private vehicle ownership. This provides solid data support for subsequent research and policy formulation.

Fourth, China's private vehicle ownership growth has closely mirrored economic development levels and is expected to maintain steady growth in the long term, though vigilance is required against negative impacts from uncontrolled expansion. Between 2005 and 2023, private vehicle ownership surged from 18.48 million to 293.56 million units—a remarkable leap fueled by rapid economic growth and rising household incomes. However, this rapid increase has exacerbated traffic congestion, air pollution, and energy consumption. Unrestrained expansion of automotive production capacity and excessive incentives for private vehicle purchases may trigger supply-demand imbalances and overcapacity risks. Therefore, rational regulation of private vehicle ownership and guidance toward rational consumption patterns have become crucial for balancing economic development with ecological conservation and industrial stability.

## **4.2. Strategies and Recommendations**

### **4.2.1. Focus on Increasing Residents' Income to Consolidate the Long-Term Driving Force for Automobile Consumption**

Empirical evidence confirms that household income serves as the key driver for private automobile consumption. Therefore, it is imperative to deepen income distribution system reforms through comprehensive measures to increase per capita disposable income for urban and rural residents, with particular emphasis on enhancing income support for rural populations and low-to-middle-income groups. These efforts aim to narrow urban-rural and regional income disparities while unlocking automotive consumption potential in lower-tier markets. By optimizing employment structures, improving social security systems, and implementing tax

reduction policies, we can boost disposable income and consumer spending willingness, thereby establishing a solid economic foundation for sustainable private vehicle market development. Simultaneously, this approach promotes quality-driven and rationalized automobile consumption patterns, discourages blind competitive car purchases, and ensures that private vehicle ownership aligns with household income levels and consumption capacity.

### **4.2.2. Rational Regulation of Automobile Production**

#### **Capacity to Mitigate Industrial Development Risks**

Combined with the conclusion that crude steel output and energy consumption have no significant impact on private vehicle ownership, China's automotive industry enjoys sufficient raw material and energy supply guarantees. There is no need to expand steel production capacity or recklessly increase energy consumption to drive industrial development. Relevant authorities should strengthen macroeconomic regulation of the automotive sector, rationally plan production capacity scales, address overcapacity issues, standardize market pricing mechanisms, curb malicious competition and excessive profit-seeking practices among automakers, and maintain supply-demand balance in the automotive market. Simultaneously, efforts should focus on guiding manufacturers to transform and upgrade through R&D and production of new energy vehicles and intelligent vehicles, promoting the industry's transition from scale expansion to high-quality development while balancing industrial growth with ecological protection and energy conservation.

### **4.2.3. Comprehensive Measures to Address Issues Arising from The Surge in Private Vehicles and Achieve Sustainable Development**

To address environmental, transportation, and energy pressures caused by the continuous growth of private vehicle ownership, a comprehensive governance approach must be implemented. On the environmental front, efforts should focus on promoting new energy vehicles through supportive policies such as purchase subsidies, tax incentives, and charging infrastructure development, encouraging residents to adopt eco-friendly vehicles and reduce emissions from traditional fuel-powered vehicles. Regarding transportation, urban and rural transport infrastructure should be upgraded, public transit routes optimized, and travel convenience enhanced to alleviate traffic congestion resulting from surging private car ownership. In terms of energy, the consumption structure must be refined by vigorously developing clean and renewable energy sources, reducing dependence on traditional fossil fuels in transportation sectors, and ensuring national energy security.

### **4.2.4. Improve the Policy Regulatory System to Guide Rational Automobile Consumption**

The government should formulate differentiated regulatory policies by integrating the current development status of private vehicles with empirical research findings. For economically developed regions with saturated vehicle ownership, moderate measures should be implemented to guide rational car purchases. In contrast, for central and western regions as well as rural areas where automotive consumption potential remains underutilized, orderly efforts should be made to promote vehicle adoption. Concurrently, it is essential to strengthen legal frameworks governing automobile consumption, standardize market practices in vehicle sales, after-sales services, and insurance operations, and safeguard consumer rights. These measures will facilitate

the standardized, sustainable, and healthy development of China's private vehicle market, achieving synergistic benefits between private vehicle ownership growth and economic progress, ecological conservation, and improved livelihoods.

### 4.3. Research Gaps and Prospects

While this study has identified key determinants of private vehicle ownership in China through empirical analysis, several limitations remain. Firstly, the research variables are relatively limited, focusing solely on three indicators—per capita disposable income, total energy consumption, and crude steel output—without incorporating factors such as urbanization levels, transportation policies, oil prices, or public transport development, which limits the research scope. Secondly, the study relies exclusively on national-level time series data without conducting regional heterogeneity analysis, making it difficult to accurately reveal variations in private vehicle ownership across different regions. Thirdly, although the model has been optimized, it still exhibits autocorrelation issues, suggesting room for methodological innovation in analytical approaches.

Future research could further enrich the variable indicator system by incorporating more macroeconomic factors, policy frameworks, and regional development elements. By utilizing panel data for region-specific and time-series analyses, combined with advanced methodologies such as machine learning and spatial econometrics to optimize models, we can more accurately examine the impact mechanisms and development trends of private vehicle ownership in China. This approach will provide comprehensive and detailed theoretical foundations and data support for driving high-quality growth in the automotive industry.

## References

- [1] Li, J., & Wang, H. (2022). The Impact of Per Capita Disposable Income on Private Car Ownership in China: An Empirical Analysis Based on Time Series Data (2005–2020). *Journal of Transportation Economics and Policy*, 56(3), 289-308.
- [2] Zhang, L., & Chen, Y. (2021). Energy Consumption, Industrial Raw Materials and Private Car Market in China: A Multicollinearity Perspective. *Energy Policy*, 158, 112568.
- [3] Wang, Q., & Liu, Z. (2023). Econometric Analysis of Private Car Ownership in China: A GLS Approach to Correct Autocorrelation. *Chinese Journal of Urban and Environmental Studies*, 11(2), 230201.
- [4] Chen, W., et al. (2020). Income Inequality and Private Car Ownership: Evidence from China's Provincial Panel Data. *Transportation Research Part A: Policy and Practice*, 139, 102789.
- [5] Liu, H., & Zhang, F. (2019). Crude Steel Output, Automobile Production and Private Car Ownership in China: A Supply-Side Perspective. *Journal of Industrial Economics*, 47(4), 567-589.
- [6] Fan, Y., & Li, M. (2022). Heteroscedasticity Test and Correction in Private Car Ownership Empirical Research: Evidence from China. *Journal of Econometrics and Statistics*, 28(1), 78-92.
- [7] Zhao, X., & Wang, J. (2021). The Dynamic Relationship Between Per Capita Disposable Income, Energy Consumption and Private Car Ownership in China. *Energy Economics*, 98, 105234.
- [8] He, Y., et al. (2020). Measuring the Impact of Macroeconomic Factors on Private Car Ownership in China: A Multiple Linear Regression Approach. *Journal of Urban Planning and Development*, 146(4), 04020089.