Empirical Study on the Relationship between Highway Construction and Economic Growth Based on Big Data Analysis

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Abstract: Transportation infrastructure including Highway and national economic growth have been widely concerned. Based on the analysis and processing of big data on highway construction and national economic growth, this paper discusses not only the influence of production behavior on economic growth, but also the influence of transportation facility construction and consumption behavior on economic growth. Select the total amount of civilian vehicles as representative data of consumption behavior, and construct the panel data from 2005 to 2018 for regression analysis by analyzing the positive correlation between the highway mileage and the total amount of civilian vehicles to explore the relationship between construction of transportation facilities including its derived consumption behavior and national economic growth.

Keywords: Big Data, Highway Construction, National Economic Growth, Regression Analysis

1. Introduction

Highway and other infrastructure and economic growth have been widely concerned, especially in this year that has been profoundly affected by the epidemic. Whether highway construction can promote economic growth is also an important research direction of China's economic construction.

Road construction belongs to infrastructure construction, which can directly drive investment and increase GDP. The large passenger and freight transportation volume and carrying capacity of highways can also have a long-term impact on the long-term economic development. State and government investment in infrastructure construction including road construction can not only reduce the time distance of transportation between regions, but also bring the economic effects of co-urbanization to the region through transportation integration. Labor transfer, talent flow, and enterprise Configuration and so on will become more and more efficient as the transportation network improves. Understanding the impact of highway traffic facilities construction on economic growth has important practical significance. The construction of transportation facilities
also derives consuming behavior, which will also promote economic growth. Based on the analysis and processing of big data on road traffic construction and economic growth, this paper uses road mileage data, total amount of civilian vehicles and the total domestic GDP to perform analysis to explore the relationship between them, and provide relevant countermeasures and suggestions based on empirical analysis.

2. Literature Review
In the economic theories of mainstream western economists, the construction of transportation infrastructure has always been regarded as one of the important factors that promote economic growth. Economists such as Rodin and Nacks proposed that the classical economic growth theory believes that infrastructure such as transportation is a necessary condition for economic growth. After the 1940s, the famous economist P.N. Rosenstein-rodan put forward the theory of the big push. It is a representative theory in the theory of balanced development. The core of the theory is to simultaneously make large-scale investments in various sectors of the national economy in developing countries or regions, and carry out infrastructure construction including transportation to promote the average growth of these sectors, thereby promoting the rapid growth of the entire national economy and comprehensive development.

Rostow put forward the idea of "economic take-off", which is suitable for developing countries. Lewis, a development economist, points out that the construction of transportation facilities has obviously positive significance for the expansion of market scale, and thinks that the construction of transportation network depends largely on the government. apital and thought that the construction of transportation facilities was an important condition for economic take-off. Domestic related researches have different impacts on transportation facilities and economic growth. Most economic theories regard transportation infrastructure as a factor that affects industrial agglomeration and regional exchanges, while others discuss the relationship between transportation infrastructure investment and economic growth from a macro perspective, such as Wang Xiaodong's Impact of Transportation Infrastructure on Economic Growth, while others discuss the relationship between transportation infrastructure and some specific factors such as residents' consumption behavior and labor transfer from a micro perspective, such as Guo Guangzhen's Economic Growth Model of Transportation Infrastructure Affecting Consumption. According to some literatures, the correlation between transportation infrastructure construction and economic growth is not significant, and some even have a negative relationship. Regarding the relationship between the development of highway construction and economic growth, some scholars believe that after years of large-scale infrastructure construction, the contribution of highway construction to economic growth has declined. In addition, in the relationship between infrastructure and economic growth, domestic scholars focus more on inter-provincial trade, labor transfer, manufacturing development and so on. In addition to production activities, the impact of transportation facilities on stimulating consumption, such as the number of civil vehicles.

3. An Empirical Analysis of Highway Construction and Economic Growth

3.1 Relationship between highway construction and GDP
Highway construction has made outstanding contributions to improving the efficiency of China's economic operation, enhancing the vitality of development, improving the quality of life of the people and ensuring national security. Highway construction has strongly promoted the development of China's transportation industry. Transportation in GDP increased by 683% from 5175.9 in 1999 to 40550.2 in 2018. ileage of China's highways was 135.17 in 1999, and by 2018, the mileage of highways was 484.65, an increase of 258%. Based on the above analysis, it is not difficult to find that highway construction passenger transport has an impact on economic growth in many ways, such as directly stimulating the level of investment activities in countries and regions, and stimulating the economic growth of industries such as steel and cement. Highway construction can improve national and regional infrastructure level, increase passenger traffic and freight volume, and provide an important foundation for long-term economic growth.

In this paper, highway mileage (unit:), gross domestic product (GDP) and the total number of
civil vehicles in China from 2005 to 2018 are selected as the original data. In order to analyze the relationship between variables, single factor analysis is carried out first. Factors such as the number of civilian cars with consumption nature and road infrastructure will have a significant impact on economic development.

Firstly, single factor analysis was carried out. Through that calculation of correlation coefficient formula,

\[
 r = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sqrt{\sum (y - \bar{y})^2}}}
\]

(1)

R is the correlation coefficient, X and Y are the two factors to judge the correlation of variables. In this data, the road mileage and domestic GDP from 1999 to 2018 are respectively. The correlation coefficient is calculated to be 0.896. Through analysis, there is a positive correlation between highway mileage and GDP.

Regarding highway infrastructure, highways include expressways, first-class highways and second-class highways. Expressway is a representative kind of highway traffic. Therefore, we choose the mileage of expressway and analyze its correlation with domestic GDP. According to formula (1), the correlation coefficient is 0.99472, and there is a positive correlation between expressway mileage and GDP, and the correlation is high.

3.2 Relationship between highway growth mileage and GDP

The statistical results are shown Figure 1.

![Figure 1. Highway growth](image)

Excluding the special data of 1999 and 2004. The correlation coefficient is -0.77. It shows that this influencing factor is not suitable as an analysis index. In addition, it can be seen from the chart that since the highway construction mileage reached the maximum in 2009, China has started to slow down the growth rate of the total highway mileage construction.

3.3 The relationship between the total number of civil vehicles and highway mileage and GDP

This paper discusses the relationship between highway construction and economic growth, and through literature analysis, it shows that road construction has a direct impact on consumption. The following carries on the correlation analysis, further discusses the road construction and the total amount of civil vehicles, such as promoting economic growth together. Through the calculation of correlation coefficient formula (1), the correlation coefficient between the total number of civil vehicles and highway mileage is 0.973873. This shows that the variables are positively correlated, and the correlation is high. Highway construction has a positive impact on the increase of the total number of civil vehicles, which in turn will directly affect economic growth.

There is a positive correlation between variables, and the correlation degree is high. Civil vehicles mainly include operating and non-operating vehicles. The increase of highway mileage promotes the increase of the number of more civilian cars. These have a positive impact on
stimulating consumption and promoting economic growth. The increase of highway mileage is more convenient for cross-regional operation. For residents, convenient transportation will also increase the purchase and travel of private cars. Vehicles, while private cars belong to non-operating vehicles. The total number of civil vehicles has been on the rise, and the increment as a whole is also on the rise. In the past three years, the increment began to slow down. The statistical results are shown Figure 2.

Figure 2. Total and Increment of civil vehicle

According to the formula (1) of correlation coefficient, the correlation coefficient between the total number of civil vehicles and GDP is 0.994, which shows that it is positively correlated and the correlation degree is high.

4. An Empirical Study on the Relationship between Highway Construction and Economic Growth in China

4.1 Select indicators GDP (100 million yuan), highway mileage (kilometers), expressway mileage (kilometers), and the number of civil vehicles.

The statistical results are shown Figure 3.

Figure 3. Histogram of GDP, transportation, etc

4.1.1 Drawing the scatter plot of the above variables by software, observing the scatter plot, and combining with the previous single factor analysis conclusion, it can be assumed to be a linear model.
The interpreted variable is the total GDP, and the interpreted variables are the total highway mileage, expressway mileage and the total number of civil vehicles.

Estimated parameters:
The estimated values of related parameters can be obtained by Eviews software calculation. The model expression can be written as:

\[ \hat{Y}_i = \beta_0 + \beta_2 X_1 + \beta_3 X_2 + \beta_4 X_3 + u \]

\[
\begin{align*}
\hat{Y}_i &= -641573.8 + 2361.074 X_1 - 4156.167 X_2 + 18.92699 X_3 \\
\text{s.e.} &= (241866.5) (883.6126) (18063.59) (4.315926) \\
\text{t} &= (-2.660073) (2.672070) (-0.230085) (4.385384) 
\end{align*}
\]

4.1.2 Test the model:

\[ R^2 = 0.997028 \quad \hat{R}^2 = 0.996137 \]

It shows that the overall fit of the model is very good.

Carry out significance test:

Look-up table shows that the critical value \( f \) is 2.49, and the significance level is 1%.

F value is greater than critical value, which accords with F test.

X3 accepts the original hypothesis.

\[ \alpha = 0.1 > p \]

X2 and x4 passed the inspection, while x3 failed the inspection.

The above shows that the mileage of highways and the total number of civil vehicles have a significant impact on GDP growth, but the number of expressways has no significant impact.

4.1.3 Test of economic significance:

\[ \hat{Y}_i = -641573.8 + 2361.074 X_1 - 4156.167 X_2 + 18.92699 X_3 \]

The estimated explanatory variable coefficient can be interpreted as an average increase of 2,361.074 yuan in total GDP for every 1 increase in total highway mileage and 18.927 yuan in total GDP for every 1 increase in total civil vehicles.

Among them, the coefficient of highway mileage as an explanatory variable is much larger than the coefficient of the total number of civil vehicles as an explanatory variable, which shows that highway mileage has a greater impact on GDP, which is also in line with the actual economic significance.

4.2 Revised model

Through the logarithmic linear model of the above variables, it also appears that the variable X3 cannot pass the test. The possible reason is that highway mileage has a positive correlation with GDP, but its influence degree is smaller than other variables. Therefore, the model is further optimized, and the explanatory variables are removed from highway mileage, and then regression analysis is carried out.

The modified model is as follows:

\[ Y_i = \beta_1 + \beta_2 X_2 + \beta_4 X_4 + u \]

The estimated values of related parameters can be obtained by Eviews software calculation. The model expression can be written as:

\[ \hat{Y}_i = -592897.1 + 2174.119 X_2 + 18.13416 X_4 \]
5. Conclusion

The coefficient of highway mileage as an explanatory variable is much larger than the coefficient of the total number of civil vehicles as an explanatory variable, which shows that highway mileage has a greater impact on GDP, which is also in line with the actual economic significance.

Because national comprehensive data is selected for indicators and data, and there is regional imbalance in domestic economic development, the eastern, central and western regions, which are commonly used in domestic economy, are divided into three time periods from 2005 to 2018, and the indicators are regional GDP and regional highway mileage, and the correlation analysis is carried out, showing a positive correlation on the whole. In the early stage of economic development, the correlation coefficient between regional GDP and highway mileage is high, which is generally above 0.9. In the later stage, the correlation coefficient between regional GDP and highway mileage shows a downward trend, such as Jiangsu data of 0.83, while in the central and western regions, especially in the western region, the correlation coefficient shows an upward trend, such as Ningxia data of 0.997.

Through the preliminary research, it is found that the level of highway construction in China is rising, the mileage of highway is increasing rapidly, and the construction of highway network is perfect, which promotes the rapid growth of passenger and freight traffic in China and directly affects the economic growth of China. The empirical analysis of this paper also proves that highway construction can promote economic growth. Combined with the research, the following suggestions are put forward: 1. The government should continue to maintain the construction of transportation infrastructure, including highways, and further improve the construction of China's highway network. In the stage of rapid economic development in China, highway network construction promotes economic development. We should give full play to the leading role of transportation infrastructure such as roads. 2. The construction of transportation infrastructure, such as highways, should be inclined to the economically backward areas in the central and western regions, which should be considered as a whole and analyzed by regions. Long-term economic growth can be achieved by actively developing highway construction, and economic growth can also stimulate the demand of passenger and freight transportation.

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