

The Study of the Effect of Traffic Factors on Economic Development in China

-Econometric Model Based on Data of 20 Provinces

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Abstract: As a basic industry in China, transportation plays an important supporting role in the development of regional economy. Based on the analysis of the mechanism of traffic factors on economic development, this paper selects 20 representative provinces to analyze the relationship between railway, highway, shipping and GDP growth through the econometric model. The results show that different modes of transportation have different effects on economic development in the three regions. Based on this, this paper puts forward some policy suggestions, such as reasonable choice of transportation mode and optimization of transportation layout.

1. Introduction

1.1 Research Background

As one of the basic industries of China's national economy, the transportation industry has developed rapidly in recent years. It has made remarkable achievements in the scale, capacity and quality of transportation infrastructure, effectively promoting the stable economic growth. During the 12th Five Year Plan period, the total mileage of China's transportation network exceeded 5 million kilometers, including 4.57 million kilometers of highway operating mileage (including 123,000 kilometers of expressway), 120,000 kilometers of railway operating mileage (including 19,000 kilometers of high-speed railway), and 126,000 kilometers of inland waterway. By 2018, the total value of China's transportation, storage and postal industry has reached 4055.02 billion yuan, accounting for about 4.50% of GDP. It can be seen that the supporting role of China's traffic factors on economic development cannot be ignored. In the 13th Five Year Plan, the State Council clearly proposed that we should fully realize the necessity of transportation development. We should enhance interregional connection, strengthen the construction of regional transportation integration, actively develop new modes of production, consumption and circulation, improve the capacity of public transport services, and better assist the economic development under the new economic conditions. With the transformation of the economic development mode and the adjustment of economic policies, General Secretary Xi Jinping put forward the important measure of supply-side structural reform. Among them, the policy of "three de-, one reduction and one improvement" lays the foundation for the development of transportation, and also emphasizes the important role of the development of transportation in the change of economic growth mode and the promotion of economic development.

This paper establishes econometric models of 20 provinces to study the role of traffic factors in



China's economic development. On the one hand, it is conducive to improve China's transportation system and give full play to the comparative advantages of transportation; on the other hand, it has great practical significance and application value to make full use of traffic factors to drive China's economic growth and improve people's living standards.

1.2 Literature Review

Taking Ezhou and Xiantao in Hubei Province as examples, Tian Zuhai analyzed that highway transportation plays a positive role in the development of logistics industry, the integration of regional resources and the upgrading of industrial structure [1]. Lian Xinze et al. demonstrated the relationship between the model and the economic development of Wenzhou by constructing the gray system model theory, and studied the internal role of important indicators in the transportation industry in the economic development. The analysis shows that the development of transportation plays an important role in promoting the long-term economic development [2]. Zhang Ruixuan demonstrated the influence of the development of highway transportation on the economic aggregate, industrial structure and layout, as well as the interregional links, etc. by combining qualitative and quantitative methods [3]. Zhai Yize studied the relationship between China's transportation and economic growth from different perspectives, and combined the time dimension and the space dimension to reveal the spatial pattern relationship between transportation development and economic growth [4]. Ran Ruoling established the input-output model to quantitatively analyze the role of air transportation industry in the national economy. The research results show that air transportation plays a direct and indirect role in promoting economic growth in both forward and backward industries [5]. Cui yuan et al. believed that platform economy in transportation has played a huge role in enhancing the supply capacity of transportation and promoting the development of economy and society [6].

2. The Influence Mechanism of Transportation on Economic Growth

2.1 Influence of Transportation on Production Process

Transportation is an important part of the production process, which can change the location and position of objects, so that the production can be carried out orderly. From the perspective of production, raw materials are worthless if they are not transported where they are needed. Production, on the other hand, is usually the assembly of many different objects in proper proportion to form new things. Mass production involves the assembly of parts from different sources, not all parts can arrive at the same time. Moreover, it is also important to keep sufficient reserves to make production proceed in a balanced way, so as to avoid greater delays by using less spare parts storage delays. Scale production depends on two kinds of utility: time utility and space utility, that is, transportation. The accessibility of transportation will inevitably promote the improvement of regional production specialization level, so as to obtain comparative benefits.

2.2 Influence of Transportation on Consumption

Transportation is an important part of sales. If a product produced in a certain place is not transported to the place where it is needed in time, it will not generate much value. Therefore, sufficient transportation conditions are necessary to effectively prevent depreciation caused by overstocking. While the reserve and the delayed use of goods caused by it can make people still get the supply after the actual production has stopped for a long time. For example, adopt the way of ice cellars, refrigerators, etc. to store food, in order to ensure their long-term supply, so changes in time can also create value. Because mass production cannot exist in nothingness, a huge and comprehensive sales system is needed to distribute products.



2.3 Influence of Transportation on Price

Transportation allows other regions to participate in the competition in the local market. In the case of local supply shortage, non-local manufacturers can transport a large number of goods to meet the needs of local people, so the price of the product will not rise too high. Theoretically speaking, due to the regional specialization and the economy nature of labor division, the production cost of the supply area is very low, so the above price is even lower than people expected in the transportation developed areas. Therefore, transportation can keep the price stable and promote the healthy development of market economy.

2.4 Influence of Transportation on Regional Economy

Transportation is the link between regions. The development of means of transportation has greatly improved the transportation between cities and promoted the continuous expansion of cities. In most cities, a concentric development mode around the main railway station or port has been formed. With the continuous expansion of the radiation range, the government or enterprises will increase the investment in transportation, improve the accessibility between regions, and further strengthen the relationship between regions. Moreover, with the increase of transportation investment, the region will form an obvious advantage of transportation location. Combined with natural conditions and resource conditions, it will be transformed into economic advantages, forming a strong attraction, constantly attracting the elements of other regions, optimizing resource allocation in a broader range, and promoting regional economic development.

3. Empirical Study on the Effect of Transportation on Economic Development in China--Econometric Model Based on 20 Province Data

According to domestic geographical location and economic development and other related factors, China is divided into three regions-- Eastern, Central and Western, and 20 representative provinces and municipalities are selected for analysis. The eastern region is divided into six provinces: Beijing, Shanghai, Shandong, Jiangsu, Zhejiang and Hebei. The central region is divided into five provinces: Shanxi, Inner Mongolia, Henan, Hubei and Hunan. The western region is divided into nine provinces: Shanxi, Xinjiang, Chongqing, Guizhou, Yunnan, Sichuan, Ningxia, Qinghai and Gansu. Based on the data of freight volume in 20 provinces of China from 2006 to 2016, the econometric model is established.

3.1 Proposal of Econometric Model

The dependent variable Y of the model selects the total GDP of 20 provinces, and the independent variables are: railway Freight Volume X2, highway freight volume X3, and water freight volume X4, respectively. First, analyze the relationship between the variables and GDP of five provinces in the eastern region, and set up the following econometric model:

$$Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + \beta_4 X_{4t} + \mu_t \tag{1}$$

In the formula, Y_t is the GDP of the tth year (100 million yuan); X2t is the railway freight volume (10,000 tons); X3t is the highway freight volume (10,000 tons); X4t is the water freight volume (10,000 tons).

The relationship between GDP and variables of five provinces in the central region and nine provinces in the western region is also shown in the above formula.

3.2 Model Establishment and Empirical Analysis

By using Eviews software, Y, X2, X3, X4 and other variables are generated, and OLS method is used to estimate model parameters, but the regression results have serious multicollinearity problems. Therefore, it is necessary to make logarithmic transformation for each variable to obtain the following formula:

 $\ln Y_t = \beta_1 + \beta_2 \ln X_{2t} + \beta_3 \ln X_{3t} + \beta_4 \ln X_{4t} + \varepsilon_t$ (2) The following are the regression results of eastern, central and western regions respectively: 3.2.1 Regression analysis results of the eastern region

Dependent Variable: LNY Method: Least Squares Date: 04/16/19 Time: 20:39 Sample (adjusted): 2001 2016 Included observations: 16 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
С	-6.857434	2.051070	-3.343345	0.0059	
LNX2	-0.448852	0.343758	-1.305721	0.2161	
LNX3	0.716251	0.244753	2.926427	0.0127	
LNX4	1.173024	0.171885	6.824486	0.0000	
R-squared	0.989583	Mean dependent var		11.56310	
Adjusted R-squared	0.986979	S.D. dependent var		0.668236	
S.E. of regression	0.076252	Akaike info criterion		-2.097227	
Sum squared resid	0.069772	Schwarz criterion		-1.904080	
Log likelihood	20.77782	Hannan-Quinn criter.		-2.087336	
F-statistic	379.9962	Durbin-Watson stat		1.297717	
Prob(F-statistic)	0.000000				

Fig 1. OLS regression results in the eastern region

The model estimates that

$$\ln \hat{Y} = -6.8574 + 0.4489 \ln X2 + 0.7163 \ln X3 + 1.1730 \ln X4$$
(2.0510) (0.3438) (0.2448) (0.1719)
$$t = (-3.34) (1.31) (2.93) (6.82)$$

$$R^{2} = 0.9896 \quad \bar{R}^{2} = 0.9870 \quad F = 380.00$$

According to the t-test of the above results, given the significance level $\alpha=0.05$, respectively for the original hypothesis: $H_0:\beta_j=0$, check the t distribution table and get the critical value $t\frac{0.05}{2}$ (n-k) =2.16, we can see that except for $\hat{\beta}_2$, the t statistics corresponding to $\hat{\beta}_1, \hat{\beta}_3, \hat{\beta}_4$ are - 3.34, 2.93 and 6.82 respectively, and their absolute values are greater than $t\frac{0.05}{2}$ (n-k)=2.16, so we should reject the original hypothesis: $H_0:\beta_j=0$. It can be concluded that when other explanatory variables remain unchanged, the explanatory variables "highway freight volume" (X3) and "water freight volume" (X4) have significant effects on the explained variables "GDP" (Y), respectively. But "railway freight volume" (X2) has no significant effect.



3.2.2 Regression analysis results of the central region Dependent Variable: LNY Method: Least Squares Date: 04/16/19 Time: 20:56 Sample: 2000 2016 Included observations: 17

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
С	-5.655954	1.101195	-5.136195	0.0002	
LNX2	0.603322	0.097436	6.191988	0.0000	
LNX3	0.271054	0.191268	1.417142	0.1800	
LNX4	0.589269	0.099504	5.922050	0.0001	
R-squared	0.996564	Mean dependent var		10.82914	
Adjusted R-squared	0.995771	S.D. dependent var		0.761773	
S.E. of regression	0.049541	Akaike info criterion		-2.969693	
Sum squared resid	0.031907	Schwarz criterion		-2.773643	
Log likelihood	29.24239	Hannan-Quinn criter.		-2.950205	
F-statistic	1256.665	Durbin-Watson stat		0.956368	
Prob(F-statistic)	0.000000				

Fig 2. OLS regression results in the central region

The model estimates that

$$\begin{split} \ln \hat{Y} &= -5.6560 + 0.6033 \ln X2 + 0.2711 \ln X3 + 0.5893 \ln X4 \\ (1.1012) & (0.0974) & (0.1913) & (0.0995) \\ t &= (-5.14) & (6.19) & (1.42) & (5.92) \\ R^2 &= 0.9966 \quad \bar{R}^2 = 0.9958 \quad F = 1256.67 \end{split}$$

According to the t-test of the above results, it can be concluded that the explanatory variables "railway freight volume" (X2) and "water freight volume" (X4) have significant effects on the explained variables "GDP" (Y), respectively. But "highway freight volume" (X3) has no significant effect.



3.2.3 Regression analysis results of the western region Dependent Variable: LNY Method: Least Squares Date: 04/16/19 Time: 21:03 Sample: 2000 2016 Included observations: 17

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
С	-2.365333	0.974341	-2.427623	0.0305	
LNX2	-0.002270	0.091495	-0.024812	0.9806	
LNX3	0.349982	0.114245	3.063439	0.0091	
LNX4	0.914001	0.112891	8.096342	0.0000	
R-squared	0.998666	Mean dependent var		10.64694	
Adjusted R-squared	0.998358	S.D. dependent var		0.754970	
S.E. of regression	0.030591	Akaike info criterion		-3.933879	
Sum squared resid	0.012166	Schwarz criterion		-3.737828	
Log likelihood	37.43797	Hannan-Quin	n criter.	-3.914391	
F-statistic	3244.013	Durbin-Watson stat		1.293571	
Prob(F-statistic)	0.000000				

Fig 3. OLS regression results in the western region

The model estimates that

$$\begin{split} \ln \hat{Y} &= -2.3653 + 0.0023 \ln X2 + 0.3500 \ln X3 + 0.9140 \ln X4 \\ & (0.9743) & (0.0914) & (0.1142) & (0.1129) \\ & t &= (-2.43) & (0.02) & (3.06) & (8.10) \\ & R^2 &= 0.9987 \quad \bar{R}^2 &= 0.9984 \quad F &= 3244.01 \end{split}$$

According to the t-test of the above results, it can be concluded that the explanatory variables "highway freight volume" (X3) and "water freight volume" (X4) have significant effects on the explained variables "GDP" (Y), respectively. But "railway freight volume" (X2) has no significant effect.

4. Conclusions and Policy Recommendations

4.1 Conclusions

The highway freight volume and water freight volume of six provinces in the eastern region have a significant impact on the GDP. The reason is that the terrain in the eastern region is relatively flat, and the road transport has the characteristics of low cost and easy to carry. Therefore, the transport of goods is mainly road transport. Moreover, the eastern region has developed water system and numerous tributaries. The Grand Canal, the middle and lower reaches of the Yangtze River and the middle and lower reaches of the Yellow River are the main routes to transport coal and other mineral resources, which play an important role in promoting economic development. In the six provinces of the eastern region, railway transportation has no significant impact on promoting economic development, which is related to the rise of new modes of transportation, the advantages of railway transportation as a traditional mode of transportation are gradually not obvious.



The railway freight volume and water freight volume of five provinces in the central region have a significant impact on GDP. It is mainly manifested in the rich coal resources in the central region, the bulk cargo based, railway transportation with the characteristics of fast speed and large capacity, so to a certain extent, it promotes the regional economic development. In the five provinces of central region, highway transportation has no significant impact on economic development, mainly because the cost of highway transportation is higher than that of railway.

The highway freight volume and water freight volume of nine provinces in the western region have a significant impact on GDP. Highway transportation is still the main mode of transportation in the western region. Its low cost, easy to carry and other characteristics meet the psychological expectations of the local people. And after the implementation of the great development strategy, the economic situation of the western region has changed a lot, which makes the productivity development of the western region to a new level, and promotes the development balance between the western region and the eastern and central region. Water transportation plays a very important role in the economic development of the western region. In the nine provinces of western region, railway transportation has no significant impact on economic development, because most of the western provinces are located in the backward and remote areas with rugged terrain and poor soil, and the development of railway network is backward.

4.2 Policy Recommendations

4.2.1 Choose transportation mode reasonably according to the development of the region

China has a vast territory, and the transportation and economic development in the east, central and western regions are quite different. It is necessary to develop the transportation structure in line with the local actual economic situation according to the environmental factors and geomorphic characteristics of different regions, so as to better narrow the gap of the transportation development level between regions. On the basis of maintaining the advantages of highway transportation, the eastern region should vigorously develop and build ports, continuously develop shipping, gradually expand the scale of ports, improve shipping conditions, promote the development level of regional transportation, improve local transportation efficiency, and promote the optimization and upgrading of industrial structure. In the central region, we should promote the development strategy of rising in the central region, speed up the construction of water transportation channels, improve the transportation structure, more closely contact with the eastern region, improve regional transportation infrastructure, and promote sound economic development. The western region should appropriately increase capital investment and infrastructure investment, and continue to vigorously promote the western development strategy, especially the shipping construction in the middle and upper reaches of the Yangtze River Basin, which requires the government to increase support and attract enterprises' investment and development, so as to narrow the differences in the development of transportation between regions and achieve coordinated development.

4.2.2 Adjust transportation structure and optimize transportation layout

To adjust the transportation structure, we need to explore and build in all aspects, especially focusing on the comparative advantages of each mode of transportation, adhering to the local reality, optimizing the layout of the transportation structure, building a distinctive and effective transportation network, meeting the local transportation needs, and better serving the economic development. Therefore, we must break through the traditional transportation modes such as highway and railway, vigorously develop new transportation modes such as high-speed railway, and make contributions to economic development with the help of water transportation. At the same time, give full play to the complementary role of civil aviation passenger transportation, meet the needs of economic development, and share the transportation pressure of railway and highway.



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