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An Empirical Analysis of the Relationship Between Transportation and Economic Growth in Jiangmen City

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ABSTRACT

Based on the data of economic survey, this paper studies the quantitative relationship between transportation industry and economic growth in Jiangmen City. Firstly, the index system is constructed from the two levels of transportation and economic development, and then the quantitative relationship between them is deeply analyzed by using the co integration method through three links: Stationarity test, Cointegration test and Granger causality test. The results show that: Jiangmen's GDP growth and freight turnover is the most closely related, followed by fixed assets investment in transportation, and the third is passenger turnover. Finally, according to the results of the data analysis, some countermeasures and suggestions are put forward.
***Keywords**: Transportation, GDP, co-integration method, empirical analysis*

1. INTRODUCTION

As the basic industry of the national economy, transportation industry links the social production, distribution, exchange and consumption, maintains the normal operation of economic activities, and provides important support and guarantee for the development of economy and social undertakings. By continuously improving the transportation capacity and service quality, we can strengthen the economic ties between different regions, promote the optimal allocation of industries, maximize the demand of social and economic development for transportation, improve the distribution of productivity, and promote the sustainable development of social economy. It can be said that transportation not only ensures the healthy development of social production and regional economy, but also constitutes a material production department of regional economic system, which has an important impact on regional development. Therefore, it is of great theoretical and practical significance to study the interaction between transportation and economic development[1-4].

2. ANALYSIS OF RESEARCH STATUS

At present, many scholars have explored the relationship between transportation and regional economic development. The research contents are mainly concentrated in three aspects. The first is the mechanism of transportation promoting economic growth[5-9], which mainly analyzes the relationship between transportation and economic growth from the perspective of division of labor and transportation cost, and discusses the mechanism of transportation promoting economic growth, And put forward relevant policy recommendations; the second is about the impact of transportation investment on economic growth[10-14], through the improved Cobb Douglas production function and auto-regressive model, this paper analyzes the impact of transportation infrastructure investment, labor input, industry capital, land investment and other factors on regional economic development; The third is the research on the relationship between the development status of transportation and regional economic development[15-20], mainly from the freight volume, passenger volume, highway mileage and other factors on economic development, and puts forward the relevant optimization countermeasures.

Based on the data of Jiangmen economic survey and the data of Guangdong and Jiangmen statistical yearbooks, this paper analyzes the present situation of Jiangmen transportation industry, studies the promotion of transportation industry to Jiangmen's overall economic development from qualitative and quantitative aspects, and puts forward relevant policy suggestions according to the results of data analysis.

3. RESEARCH METHODOLOGY

Because most of the time series of macroeconomic variables are non-stationary, the traditional system modeling technology may fall into the dilemma of "pseudo regression", leading to the deviation of subsequent statistical inference. In order to solve the above-mentioned problems, a method of processing non-stationary data-cointegration method has been developed in the past two decades. Cointegration was initially proposed by Granger, then Engle and Granger put forward the famous "Granger Cointegration theorem" based on the concept of Cointegration. The purpose is to solve the relationship between Cointegration theory and error correction model. The significance of the theorem lies in its proof of the

inevitable relationship between the Cointegration theory and the error correction model, and puts forward a rigorous theorem proof and specific operational framework for the Cointegration relationship between time series, thus opening up a new branch of contemporary econometrics. Since then, the Cointegration theory and error correction model have become more and more mature after the development and improvement of Hendry, Granger, Johansen, Philips and Philips Perron. In recent years, Cointegration theory and error correction model have not only aroused widespread interest in academia, but also been widely used in various fields of economic research [21-22].

4. EMPIRICAL ANALYSIS

4.1. Indicator Selection

Based on the existing research results and the principle of selecting index data, this paper comprehensively considers the scientificity, practicality, availability, comparability, and validity of statistical data and other influencing factors. The evaluation indexes are selected from two aspects: traffic volume index and economic index.

(1)Traffic volume index.

From the point of view of transportation scale, there are four key indicators of transportation volume: passenger volume, passenger turnover, freight volume, freight turnover, in which passenger turnover and freight turnover can comprehensively reflect the total results of transportation production, including quantity and distance.

(2)Economic indicators.

From the point of view of regional economic development, regional gross domestic product (GDP) is the most direct indicator of its development, and investment in fixed assets of transportation is the most closely related index to the construction of transport infrastructure. Therefore, choose both as economic indicators.

Above all, the final independent variable index is passenger turnover, freight turnover, traffic fixed assets investment, and the dependent variable is Jiangmen GDP.

4.2. Data Collection and Collation

Combined with the above selected indicators, the original data shown in Table 1 are collected and sorted from the fourth Economic Census and the Statistical Yearbook of the past years, with a time span of 2005-2018.

4.3. Data Preprocessing

In order to fit the regression model by linear model, the original data can be logarithmic first. On the one hand, it can eliminate the trend of exponential growth and facilitate the use of linear model to fit the curve. On the other hand, the heteroscedasticity problem of model fitting residual can be alleviated. After logarithmic processing of the data of the four indexes, the drawing is shown in Figure 1. It can be seen that the two graphs basically show a linear trend, and a linear regression model can be established.

Table 1 Data on Transport and Economic Development in Jiangmen City

Time	GDP(Billions)	Investment in transport fixed assets (10,000 yuan)	Passenger turnover (10,000 km)	Cargo turnover (10,000 ton km)
2005	801.7	228932	570892	462846
2006	943.79	175282	999383	695295
2007	1098.82	169281	920114	713269
2008	1272.33	157881	929078	754101
2009	1341.82	413278	540945	756934
2010	1581.52	515057	589934	1125467
2011	1846.2	299641	605515	1071885
2012	1899.14	424077	644636	1152885
2013	2020.13	767672	673124	1350682
2014	2104.8	736441	596095	1682398
2015	2264.19	1390232	573605	1584857
2016	2444.09	1571664	606477	1694403
2017	2690.25	1626949	611027	1866187
2018	3001.24	1519570	613436	1683582

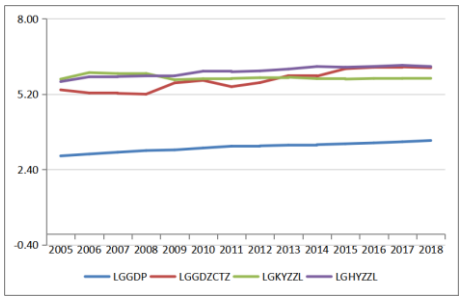

Figure 1 change trend of indicators from 2005 to 2018

4.4. Stationary Test

The stationarity of time series is an important index in time series analysis and plays a directional role in subsequent tests. If the statistical characteristics of a sequence (mean, variance, self-covariance function, etc.) do not change with time, it is called stationary time series. Conversely, if the characteristics of a sequence change with time, it is called a nonstationary time series. This paper uses ADF test with strong practicability. The full name of the ADF test is Augmented Dickey-Fuller test, the result of the upgrade of the DF test by Dickey and Fuller in 1980. The biggest difference between it and the regression test is that the difference lag term which can control the correlation of higher order sequence is added to the right of the regression equation.

According to the calculation results, it is shown that the first-order difference of the four indicators does not meet the requirements of stationarity, while the model 3 of the second-order difference all meets the requirements of stationarity. Therefore, these four time series must pass the second-order difference to achieve the stationarity of the significance level above 95%. Therefore, we can conclude that GDP, LGGDZCTZ, LGKYZZL and LGHYZZL are the unit root processes of I (2).

4.5. Cointegration Test

The economic significance of Cointegration analysis is that there is a long-term equilibrium relationship between two variables with their own long-term fluctuation law if they are Cointegration. Conversely, if the two variables are not co-integrated, there is no long-term equilibrium relationship between them. The common methods of Cointegration test are E-G (Engle-Granger) two-step test and Johnson (Johansen) test. Engle-Granger test is usually used to test the cointegration relationship between two variables, but for the cointegration relationship between multivariables, Johnson test based on vector auto-regressive model can be used.

As this paper examines the cointegration relationship between GDP and fixed assets investment, passenger turnover and freight turnover in Jiangmen City, Johnson test is adopted. From the previous unit root test results, we can see that the time series of the four indexes are all second order stationary, therefore, our cointegration test can be carried out in two steps.

The first step is to establish the cointegration equation, assuming that the cointegration equation between GDP and LGGDZCTZ、LGKYZZL and LGHYZZL is as follows:

$$LGGDP = \alpha + \beta_1 * LGGDZCTZC + \beta_2 * LGHYZZL + \beta_3 * LGKYZZL + \varepsilon$$

Where α is the constant term, and ε is the interference term. Johansen maximum characteristic root test and trace test are used to test the cointegration relationship of variables. The test results are shown in Table 2. At the significant level of 0.05, there are four groups of cointegration relationship in the model, indicating that there is a long-term stable relationship between GDP and LGGDZCTZ,LGKYZZL and LGHYZZL.

The second step is to carry out the residual test. According to the data in Table 1, the expression of residual error is obtained as follows:

$$\hat{e}_t = LGGDP + 2.231 - 0.184 * LGGDZCTZC - 0.596 * LGHYZZL - 0.138 * LGKYZZL$$

Check the singleness of e_t to see if the residuals are stationary sequences. According to the unit root test, it is found that when the lag order is 2, the model without constant term and intercept term is the most suitable, and the result of ADF test is shown in Table 3.

It can be seen that the absolute value of ADF is 3.8183, which is greater than the absolute value of the critical value of 5% significance level of 1.9740. It can be considered that the residual sequence Q is a stable sequence. In other words, there is a long-term stable equilibrium relationship between GDP and fixed asset investment, passenger turnover and freight turnover. The linear regression equation is as follows:

$$LGGDP = -2.231 + 0.184 * LGGDZCTZC + 0.596 * LGHYZZL + 0.138 * LGKYZZL$$

Table 2 Johansen Findings

Original hypothesis	eigenvalues	Trace statistics			eigenvalue statistics		
		Trace tatistics	Critical value (5 per cent)	P value	eigenvalue statistics	Critical value (5 per cent)	P value
None *	0.9470	126.8481	47.8561	0	52.8820	27.5843	0
At most 1*	0.9172	73.9661	29.7971	0	44.8342	21.1316	0
At most 2*	0.5930	29.1320	15.4947	0.0003	16.1803	14.2646	0.0246
At most 3*	0.5130	12.9517	3.8415	0.0003	12.9517	3.8415	0.0003

Trace test indicates 4cointegrating eqn (s) at the 0.05 level
denotes rejection of the hypothesis at the 0.05level

Table 3 Unit Root Test e Residual Sequence

Model	ADF	Critical value		
		a=1	a=5 per cent	a=10per cent
Model 3	-3.8183	-2.7719	-1.9740	-1.6029

4.6. Granger Causality Test.

Through the previous cointegration test analysis, it shows that there is a cointegration relationship between GDP and fixed asset investment, freight turnover and passenger transport turnover. However, whether this long-term equilibrium relationship is the result of the change of dependent variable caused by independent variable, or the result of independent variable change caused by dependent variable, or between the two, Granger causality should be carried out Inspection. We take the lag period as 2 and conduct Granger causality test on the above four indicators. The results are shown in Table 4.

From Table 4, we can see that the P values of hypothesis 1, hypothesis 2 and hypothesis 4 are all less than 0.05, so all three assumptions are not valid, which means that GDP and traffic fixed assets investment are Granger causality, GDP is Granger causality of freight turnover, otherwise, it is not established. And the P value of the other hypothesis tests is greater than 0.05, so the original hypothesis condition is accepted.

The above test results show that: in the case of economic growth, in order to better attract foreign investment and meet the needs of industrial cluster development, local governments increase investment in transportation industry and improve regional transportation conditions to create a better enterprise operation environment; conversely, the increase of transportation fixed assets investment has laid a solid foundation for regional economic development,

which directly or indirectly promotes the development of regional economy.

Second, according to the GDP contribution ratio of the three major industries in Jiangmen City, the cumulative contribution of the secondary industry and the tertiary industry is 93.3%, while the main object of freight turnover is the transportation demand generated by the development of the secondary industry and the tertiary industry. The rapid growth of GDP also means an increase in freight turnover.

Table 4 Granger Causality Test Results

Serial number	Original hypothesis	F statistics	P value
1	LGGDZCTZ does not Granger Cause LGGDP	6.8166	0.0227
2	LGGDP does not Granger Cause LGGDZCTZ	5.9511	0.0309
3	LGHYZZL does not Granger Cause LGGDP	0.5611	0.5943
4	LGGDP does not Granger Cause LGHYZZL	5.2883	0.0399
5	LGKYZZL does not Granger Cause LGGDP	1.1030	0.3833
6	LGGDP does not Granger Cause LGKYZZL	0.6410	0.5551

5. CONCLUSION

In summary, first of all, from the coefficients of the regression equation, we can see that the GDP growth of Jiangmen City has the closest relationship with the change in freight turnover, followed by investment in fixed assets in transportation, and finally passenger turnover. This data shows that freight turnover has the greatest pulling effect on Jiangmen's GDP. For every unit increase in freight turnover, GDP will increase by 0.596 units, because most of the increase in cargo flow is due to industrial manufacturing and household consumption. These two aspects are closely related to economic development.

The data in Table 1 above shows that in the past 10 years, while the economy of Jiangmen City has been developing rapidly, it has also invested a lot of money in the construction of transportation infrastructure, effectively promoting the development of the transportation industry, attracting investment and leading the industry in the region. The formation of clusters creates more favorable conditions, and at the same time has a direct impact on reducing the logistics cost of enterprises. The improvement of the above factors is closely related to the economic growth of Jiangmen City. The coefficient of the regression equation also reflects the impact of transportation infrastructure investment on economic growth. At the same time, the results of Granger causality test also show that investment in transportation infrastructure is the cause of economic growth. Therefore, it can be said that investment in transportation fixed assets promotes GDP growth.

The coefficient of the regression equation reflects the positive effect of passenger turnover on GDP. For every unit of passenger turnover, Jiangmen's GDP will increase by 0.138 units. The Granger causality test shows that there is no two-way causal relationship between passenger turnover and GDP. In fact, passenger turnover mainly reflects the degree of passenger flow in the region, and it cannot directly create economic value. However, they can indirectly contribute to regional economic development through the jobs of migrant workers in Jiangmen area. The data in Table 1 above shows that after experiencing rapid growth from 2009 to 2013, the growth rate of passenger turnover in Jiangmen City has begun to drop significantly. At the same time, due to the rapid increase in the number of private cars, many residents travel by self-drive. The contribution of passenger turnover to Jiangmen's GDP has remained at a relatively stable level.

6. COUNTERMEASURES

According to the results of the above data analysis, it can be found that the relationship between the transportation situation and economic development of Jiangmen City is very close. In order to ensure the rapid economic development of Jiangmen City, first of all, lay a solid foundation at the level of transportation foundation. Therefore, we can do a good job in the following aspects: (1) continue to speed up the transportation infrastructure with the awareness of "moderate advance" Construction; (2) adjusting the transportation structure to promote the coordinated development of various modes of transportation; (3) broadening the channels of fund-raising and innovating the investment mechanism of transportation fixed assets; (4) vigorously developing regional economy. The growth of economic aggregate requires the expansion of transportation scale, the transformation of economic growth mode requires the improvement of transportation quality and efficiency, and economic development is the lasting and internal driving force of transportation development.

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