RESEARCH ON THE RELATIONSHIP BETWEEN FREIGHT TRANSPORT STRUCTURE AND INDUSTRIAL STRUCTURE IN JIANGSU

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ABSTRACT

This article researches the relationship between industrial structure and freight structure of Jiangsu Province by VAR model, then applies the cointegration test and Granger causality. The results show that there is a long-term relationship between the industrial structure and freight structure. Grainger causality analysis shows that the proportion of the first industry is the cause of change of highway and waterway freight volume proportion, Waterway Freight Turnover proportion is the cause of changes in the proportion of the tertiary industry.

1. Introduction

Jiangsu Province is located in the coastal economic belt and the Yangtze River Delta Interchange, the unique geographical location, is one of China's Economically developed provinces. In recent years, Jiangsu's GDP has ranked second in the country, with per capita GDP second only to the three major municipalities, ranking the first among all provinces and autonomous regions. With the continuous promotion of the "One Belt, One Road initiative", Jiangsu Province is facing new development opportunities as well as the competition and challenges of its sister provinces and cities.

In response to the new situation and new challenges the economic development is facing in the new period, Jiangsu Province has actively innovated all economic development policies and increased investment in infrastructure construction. On the one hand, it has actively fostered a new growth point in economic development, On the other hand, take the initiative to guide the industrial restructuring and upgrading, improve quality and grade. Jiangsu Province is increasing the province Transportation infrastructure conditions. Good transport facilities can help to improve the capacity of cargo transport, save transportation time and reduce transportation costs.

This article will study the interaction between the transport structure of goods and the development of local economy in Jiangsu Province, revealing the impact of the freight transport structure and industrial structure. in order to provide a theoretical reference for formulating the transport infrastructure investment policies in Jiangsu Province.

2. LITERATURE REVIEW

The cargo transportation industry belongs to the transportation industry, and is also an important part of the logistics industry. Many scholars on the transportation industry and economic development to make a qualitative and quantitative analysis. Xu Wei, Huang Min-sheng carried out the quantitative analysis of the relationship between transportation and regional economy in Fujian province by the correlation analysis and grey dynamic coordination model and transportation elasticity coefficient [1]. Hu An-gang, Liu Sheng-long, concluded that the development of the transport industry can promote economic growth directly, but also

through its positive externalities indirectly promote the economic growth of economic growth and the spillover effects [2]. Chen Ke-jia, Huang Jian-hui, analyzed the relationship between Fujian province civil aviation transportation and economic growth in the long term, that between the two there is a significant positive correlation, but there is only one-way causal relationship, regional economic growth failed to significantly promote the development of civil aviation transportation by cointegration theory, error correction model and Grainger causality test [3]. Liu Xiao-ming, Dujian studied the relationship between China's regional highway transportation and the development of society and economy by principal component analysis method [4]. Hu Hui analysis of relationship between Jiangxi railway transportation and economic development by the gray relational method [5]. Xu Zhao, Jiang Hui (2015), Jiang Hui-feng (2014), Han Biao, Zhang Zhao-min (2015) researched the relationship between transportation and economic development [6-8]. Cai Wan-hua, Ye Zhong study the interactive relationship between transportation and economic growth and carbon emissions, they conclude that there is a long-term equilibrium relationship between the transportation, economic growth and carbon emissions [9].

3. INDEX SELECTION AND DATA PROCESSING

3.1 Index selection

3.1.1 Freight volume index

Freight transport is the result of social and economic activities, and is closely related to the degree of economic development. The quantity and structure of freight transport can better reflect the economic scale, growth speed and quality of a region. And the transportation data of goods are easy to obtain, and there is no interference of price and political performance factors, and the reliability of the research is higher. According to the statistical data availability and consistency, and considering the rationality of selection index, freight turnover index reflects the total scale of a region of goods transportation, railway freight turnover, road freight, sea freight turnover, aviation freight turnover, pipeline freight turnover proportion of the total volume of freight transportation the goods were selected as reflect the regional transportation structure index, named TLB, GLB, SLB, MHB, GDB.

3.1.2 Economic development index

The most commonly used gross index to measure regional economic development is gross domestic product, while the most commonly used structural indicators are the added value of the primary industry, the second industry added value and the third industry added value. YICHANB, ERCHANB, SANCHANB, respectively. In order to avoid the impact of price factors, the value of the added value data was selected with an index of 100 in 1978.

3.2 Data processing

This data is derived from the Jiangsu Statistical Yearbook (1991~2016), including data on the turnover of goods and economic development data. Because the Yearbook has corrected the statistics in 2015, the data change greatly, and it is not comparable with the 2014 value. In order to keep the consistency of data, we delete the 2015 data. Freight turnover data of civil aviation is not complete, considering that the sum of TLB, GLB, SLB and GDB is 1, and incorporated into the VAR model will lead to multicollinearity, and the volume of railway freight transport capacity is limited, so we eliminate the TLB.

4 EMPIRICAL RESEARCH

4.1 Stability test of time series

Before establishing a model for time series, in order to avoid the emergence of pseudo regression problem, we need to test the stationarity of all variables first. In this paper, we use the ADF test method to test the stationarity. The results of the test are shown in Table 1.

Table 1: Test Results for Stability of Each Variable

variable	ADF Statistic	Test values (5% level)	Prob.	Test results
YICHANB	-3.585874	-3.612199	0.0526	非平稳
DYICHANB	-3.412405	-1.956406	0.0016	平稳**
ERCHANB	-2.070734	-2.998064	0.2572	非平稳
DERCHANB	-1.960915	-1.956406	0.0495	平稳*
SANCHANB	-1.007620	-3.622033	0.9231	非平稳
DSANCHANB	-4.343493	-3.622033	0.0117	平稳*
TLB	-2.403405	-3.622033	0.3682	非平稳
DTLB	-3.265267	-2.998064	0.0289	平稳*
GLB	-1.845817	-2.998064	0.3503	非平稳
DGLB	-3.624062	-1.956406	0.0009	平稳**
SLB	-3.493715	-3.622033	0.0638	非平稳
DSL	-2.532498	-1.956406	0.0138	平稳*
GDB	-2.377263	-3.612199	0.3808	非平稳
DGDB	-4.343171	-3.622033	0.0117	平稳*

notes : **1%、*5% Significant level.

The unit root test results show that the sequence of YICHANB, ERCHANB, ADF test SANCHANB, TLB, GLB, SLB, GDB values were greater than the level of significance for the critical value of 5%, while the probability of P is greater than 0.05, rejected the null hypothesis of unit root does not exist, that all variables are nonstationary sequence; but ADF test of first-order difference sequence DYICHANB, DERCHANB, DSANCHANB, DTLB, DGLB, DSLB, DGDB values were less than the level of significance for the critical value of 5%, while the probability of P value was less than 0.05, should accept the original assumption that there is no unit root, that is the first order difference sequence are stationary series. Belong to I (1).

4.2 Establish VAR model

VAR model is based on the statistical properties of data, and its modeling idea is to construct every model by taking every exogenous variable as a function of lagging values of all endogenous variables, and overcome the bias problem in traditional simultaneous equations. The general expression is:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + \varepsilon_t \quad t=1,2,\dots,T \quad (1)$$

Among them, Y represents the endogenous variable vector of K dimension, A represents the corresponding coefficient matrix, P represents the order of endogenous variable lag, and T is the number of samples. In this paper, YICHANB and GLB, SLB, GDB, ERCHANB and GLB, SLB, GDB; and SANCHANB and GLB, SLB, GDB, respectively.

When the VAR model is established, the selection of the lag order P is very important. Too large or too small will lead to the reduction of the accuracy of the model. Whether the whole model is stable or not depends on the stability condition of the whole system. By comparing the modulus of the

reciprocal of the characteristic root with 1, if the modulus of the reciprocal of the characteristic root is less than 1, it indicates that the VAR model is stable. By experiments, the stability conditions of YICHANB and ERCHANB models are satisfied at the time of 2 order lag, while the SANCHANB model does not fully satisfy the stability conditions. As shown in Figures 1, figure 2, and figure 3, the characteristic roots of Figure 1 and Figure 2 are all within the unit circle, and a characteristic root in Figure 3 is not within the unit circle, slightly greater than 1.

For the YICHANB and ERCHANB models, a stable VAR model can be established, and cointegration test, pulse analysis and variance decomposition are carried out. For the SANCHANB model, because of the small error, the VAR model can be built approximately.

Inverse Roots of AR Characteristic Polynomial

Inverse Roots of AR Characteristic Polynomial

Inverse Roots of AR Characteristic Polynomial

Figure 1: YICHANB、ERCHANB、SANCHANB model's AR Roots Graph

The parameter estimation results of the VAR model are obtained by the EVIEWS9.0 software operation. The expression of each model is as follows:

$$y_t = \begin{bmatrix} 1.44 & 0.67 & -1.49 & -0.019 \\ 0.24 & 1.15 & -2.00 & 0.67 \\ 0.11 & 0.19 & -0.079 & 0.35 \\ 0.05 & 0.55 & -1.03 & 1.01 \end{bmatrix} y_{t-1} + \begin{bmatrix} -0.55 & -0.12 & 0.60 & 0.088 \\ -0.29 & -0.068 & 1.1 & -0.58 \\ -0.15 & 0.054 & 0.49 & -0.23 \\ -0.058 & -0.52 & 1.30 & -0.43 \end{bmatrix} y_{t-2} + \begin{bmatrix} 3.66 \\ -21.50 \\ 61.40 \\ -8.07 \end{bmatrix}$$

at the same time, $y_t = \begin{bmatrix} \text{YICHANB} \\ \text{GLB} \\ \text{SLB} \\ \text{GDB} \end{bmatrix}$ 1.YICHANB model

In the YICHANB model, the estimated coefficients of the four regression functions are 0.987389, 0.902487, 0.979254, 0.753417, respectively, except for fourth, and the other three are all well fitted.

$$y_t = \begin{bmatrix} 1.30 & -0.45 & 1.13 & -0.17 \\ 0.30 & 0.83 & -1.33 & 0.63 \\ 0.23 & -0.090 & 0.42 & 0.34 \\ 0.26 & 0.34 & -0.66 & 1.03 \end{bmatrix} y_{t-1} + \begin{bmatrix} -0.32 & 0.11 & -0.81 & 0.18 \\ -0.06 & -0.32 & 1.23 & -0.58 \\ -0.24 & 0.045 & 0.47 & -0.28 \\ -0.25 & -0.55 & 1.27 & -0.44 \end{bmatrix} y_{t-2} + \begin{bmatrix} -3.47 \\ 30.60 \\ -8.71 \\ -3.92 \end{bmatrix}$$

at the same time, $y_t = \begin{bmatrix} \text{ERCHANB} \\ \text{GLB} \\ \text{SLB} \\ \text{GDB} \end{bmatrix}$ 2.ERCHANB model

In the ERCHANB model, the estimable coefficients of the four regression functions in the estimated results are 0.920154, 0.878629, 0.972669,

0.754569, and the first three are better.

$$y_t = \begin{bmatrix} 1.06 & 0.11 & -0.15 & 0.15 \\ -0.39 & 0.92 & -1.63 & 0.62 \\ -0.26 & -0.14 & 0.39 & 0.35 \\ 0.33 & -0.34 & 0.87 & -0.40 \end{bmatrix} y_{t-1} + \begin{bmatrix} -0.26 & -0.19 & 0.63 & -0.24 \\ 0.35 & -0.14 & 0.77 & -0.46 \\ 0.34 & 0.14 & 0.19 & -0.22 \\ 0.33 & -0.34 & 0.87 & -0.40 \end{bmatrix} y_{t-2} + \begin{bmatrix} 3.82 \\ 6.97 \\ 24.55 \\ -5.94 \end{bmatrix}; \text{ at the same time, } y_t = \begin{bmatrix} \text{SANCHANB} \\ \text{GLB} \\ \text{SLB} \\ \text{GDB} \end{bmatrix} \dots\dots 3.\text{SANCHANB model}$$

The determination coefficients of the four regression functions of the SANCHANB model are 0.983382, 0.836881, 0.966830 and 0.756186 respectively, and the first three general fitting are better.

4.3 Cointegration test

The traditional metric regression estimation requires that the variables involved are stationary sequences. In order to meet this requirement, we need to first transform the non-stationary sequence into stationary sequence by removing trend or difference, and then do regression analysis. But for many non-stationary time series, if their linear combination variables are stationary variables, there is a co integration relationship between them, indicating that there is a long-term relationship between these variables. The previous unit root test shows that all variables are one order single order sequence, which can satisfy the precondition of cointegration test. In this paper, the Johansen method is used for cointegration test. The results of the test are shown in table 2.

Table 2: Johandsan Cointegration test result (model 1)

null hypothesis	eigenvalue	Trace statistics	5% level critical value	Trace test results	eigenvalue	Maximal Eigenvalue Statistic (P value)	5% level critical value	Maximum eigenvalue test results
None *	0.927677	104.8395	47.85613	reject	0.927677	57.78553 (0.0000)	27.58434	reject
At most 1 *	0.654156	47.05398	29.79707	reject	0.654156	23.35890 (0.0239)	21.13162	reject
At most 2 *	0.519025	23.69508	15.49471	reject	0.519025	16.10269 (0.0253)	14.26460	reject
At most 3 *	0.291856	7.592383	3.841466	reject	0.291856	7.592383 (0.0059)	3.841466	reject

Trace statistics test and maximum eigenvalue test show that there are 4 cointegration relationships between YICHANB and GLB, SLB and GDB at 0.05 confidence level, indicating that there is a long-term correlation between YICHANB and GLB, SLB and GDB, and regression analysis can be done. The corresponding normalized cointegration equations are as follows:

$$YICHANB = -1.33GLB + 0.26SLB - 0.14GDB \\ (0.17927) (0.04260) (0.0956)$$

From the above standard cointegration equation can be seen in the long term, every increase in road freight turnover proportion of a unit, will bring the proportion of primary industry decreased by about 1.33 units; each increase of waterway freight volume proportion of a unit, will bring the first industry proportion increase of about 0.26 units; each additional pipeline freight turnover the proportion of a unit, will lead to reduce the proportion of the first industry about 0.14 units. Therefore, in the long run, there is a significant negative directional relationship between the proportion of road freight volume and the proportion of the first industry, while the proportion of waterway freight volume is positively related to the proportion of the first industry, but the impact relationship is not as obvious as that of the highways.

4.4 Grainger causality analysis

The Grainger causality can be used to test whether all the lagging items of a variable have an impact on the current value of another or several variables. If the effect is significant, it shows that the variable has Grainger causality for another variable or several variables. If it is not significant, it indicates that the variable does not exist Grainger causality for another variable or several variables. The following three equations are analyzed by Grainger causality, and the results are shown in table 3 respectively by eviews9.0 software.

Table 3: Grainger causality test (model 1)

Dependent variable: YICHANB			Dependent variable: GLB			Dependent variable: SLB			Dependent variable: GDB		
Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.	Excluded	Chi-sq	Prob.
GLB	2.962831	0.2273	YICHANB	3.703109	0.0078	YICHANB	3.793413	0.0075	YICHANB	0.061920	0.9695
SLB	1.615976	0.4458	SLB	3.991823	0.1359	GLB	9.688910	0.0079	GLB	1.999525	0.3680
GDB	0.151362	0.9271	GDB	3.986646	0.1362	GDB	9.631311	0.0081	SLB	1.028372	0.5980

4.5 Others

In the same ways, we can establish ERCHANB model and SANCHANB model, then Cointegration test and Grainger causality analysis. At last the results are shown in tables by eviews9.0 software.

5 CONCLUSIONS

The cointegration test shows that the proportion of the three industries in Jiangsu province has a long-term and stable cointegration relationship with the proportion of freight traffic volume, the proportion of freight traffic turnover and the turnover volume of pipeline freight.

Grainger indicated that the causal relationship, the three industries of Jiangsu Province, the proportion of the primary industry is the cause of the change of highway and waterway freight volume proportion, the proportion of the second industry is the cause of changes in road freight turnover proportion; on the contrary, only the waterway freight volume proportion is the reason for the change the proportion of the third industry and other freight turnover are not impact on the proportion of three industries.

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