Contribution Analysis of Railway Freight Transportation to Logistics Industry

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Abstract. Railway transportation is the backbone of the transportation system in China; it plays an important role in the development of logistics industry. Based on the index selection, this paper chooses transportation goods turnover index to represent the logistics industry, and chooses railway freight turnover index to represent railway freight. Granger causality test has been used to analyze the relationship between railway freight transportation and logistics industry, the results show: there is a strong two-way causality between railway freight transportation and logistics industry. And variance decomposition technique is used to study the contribution of railway freight to logistics industry; the results show that the short-term contribution of railway freight transportation to the Logistics industry is more than a long-term contribution of that.

Introduction

With the rapid development of China's economy, science and technology, logistics industry takes on a vigorous developing trend, having become a new source of economic growth. The changes of logistics demand market have brought changes to logistics service and supply market, more and more traditional freight enterprise start to transform into logistics enterprise, many transport companies have expanded into logistics service industry and have obtained good benefits[1,2]. On the one hand, the potential of logistics has been recognized by society; On the other hand, more and more logistics service enterprises participate in competition, the competition of logistics industry is increasingly intensified. China railway freight industry as one of main road cargo carrier in China, is facing the unprecedented opportunities and challenges that development of logistics industry brings.

What kind of relationship is between railway freight transportation and logistics industry, and what kind of contribution is railway freight transportation to logistics industry? What aspects should be the future development of railway freight transportation? To solve these problems, based on the related statistical data of railway freight transportation and logistics industry, this paper uses Granger causality test and variance decomposition technique to analyze the contribution of railway freight to logistics industry, and on the basis of the analysis, besides, relevant policy suggestions are put forward to development of railway freight[3].

The Selection of Data and Index

The Selection of Data

The logistics volume of logistics industry is the sum of the activity demand in time and space which includes transportation, packaging, storage, loading and unloading, distribution, circulation processing and information processing of physical objects (such as raw materials, semi-finished products and finished products, goods, etc.) caused by production or consumption in a certain period and certain region space scope[4,5.6]. There are two kinds of measurement index system of logistics: converting system (such as freight, freight turnover, inventory, processing capacity, etc.), and the value system (such as logistics cost, logistics revenue, added supply chain value, etc.). In order to study better on the measurement of the logistics demand, and at the same time based on the

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availability and reliability of the data, freight or freight turnover of converting system is used to characterize the through put in this paper. The two indicators are results of transportation activities, although the traffic is part of the through put, but it cannot represent all the work of logistics service, and transportation is the most basic activities of the logistics process throughout the entire logistics process, its capacity necessarily determines the amount of the related through put, so the volume of transportation freight and transportation of goods turnover can be used to represent the through put. As railway freight, railway freight volume or railway freight turnover can be used to present it. The interval of data sample is: 1985-2012, in it: ten thousand tons of freight is the unit for freight volume, million ton-km is the unit for freight turnover, and data are organized from China statistical yearbook of each year.

The Selection of Index

Logistics industry can be represented by the two index: the volume of transportation freight and freight turnover to represent; Railway freight also can be represented by railway freight volume and railway freight turnover, but which of them is more representative to represent railway freight transportation and logistics industry? Considering logistics industry and rail freight is induced variable, and social economic activities is the basic factor of induced variable, therefore, correlation analysis of the result of the social and economic activities - GDP and the two indexes can be built up to identify which index is more representative. For numerical selection of GDP, considering the comparability of data, this article's GDP are all calculated into 1978's prices, the unit is one hundred million Yuan.

Using ordinary least squares method to establish a simple linear regression equation, to reveal the relationship between the variables by regression analysis method. Under this idea, building up two kinds of monadic linear regression equation: freight volume and GDP regression equation; the freight turnover and GDP regression equation. By analyzing and comparing two regression equation coefficient and statistics, logistics industry and rail freight indexes are representative in the regression equation of high regression analysis effectiveness, and them will be used for railway freight transportation and logistics industry' quantitative indicators.

The Regression Equation of Freight Volume and GDP. Establish regression equation of the transportation freight volume and GDP

$$LH_t = 9.1002 + 0.5038 LGDP_t \quad . \tag{1}$$

$R^2 = 0.9378 \quad F = 346.75 \quad DW = 0.2200$

In where, H and GDP respectively present the t year's transport freight and gross domestic product. Considering the GDP and the transportation freight volume are macro variables, time sequences are volatile, and the data of each sequence after the logarithm will not change the relationship of sequences and can make the data easier to be a stationary sequence, and to eliminate heteroscedasticity phenomena that exists in the time sequence, so log processing has been done to data before analyzing, adding L in front of the letters to represent sequence after logarithm processing. Test result shows that the regression effect of regression equation is good.

Next, establish the regression equation of the railway freight volume and GDP:

$$LTH_t = 8.0892 + 0.4087 LGDP_t . \tag{2}$$

$R^2 = 0.8710 \quad F = 155.29 \quad DW = 0.1439$

In where, TH represents the t year's railway freight volume, adding L in front of the letters to represent sequence after logarithm processing. Test result shows that the regression effect of regression equation is not very well.

The Regression Equation of Freight Turnover and GDP. Establish the regression equation of transport freight turnover and GDP:

$$LZ_t = 2.6383 + 0.8062 LGDP_t \quad . \tag{3}$$

$R^2 = 0.9513 \qquad F = 449.4636 \qquad DW = 0.2164$

In where, Z represents the t year's transport freight turnover, adding L in front of the letters to represent sequence after logarithm processing. Test result shows that the regression effect of regression equation is good.

Next, we establish the regression equation of the railway turnover and GDP:

$$LTZ_t = 4.7353 + 0.4840 LGDP_t \quad . \tag{4}$$

$R^2 = 0.9388 \qquad F = 352.5879 \qquad DW = 0.2405$

In where, TZ represents the t year's railway freight turnover, adding L in front of the letters to represent sequence after logarithm processing. Test result shows that the regression effect of regression equation is good.

Conclusion. 1)By comparing the regression equation (1) and (3), we can find that transportation of goods turnover and GDP as well as freight volume and GDP has good regression effect, compared with the regression equation (1), the related statistics of regression equation (3) increased slightly; and the coefficient of GDP in equation (3) is significantly greater than that of equation (1), showing that transport freight turnover is affected more by GDP.

2)By comparing the regression equation (2) and (4) ,we can find that the improvement of the statistics in regression equation (4) is more obvious than that in regression equation (2) ; From the perspective of the coefficient of regression equation, the coefficient of GDP in equation (4) is greater than that in equation (2), showing that railway freight turnover is affected more by GDP, two aspects of the analysis show that the index of railway freight turnover is more representative in rail freight, we will use the railway freight turnover (LTZ) represent railway freight below.

The Research on Contribution of Railway Freight Transportation to Logistics Industry

Granger Causality Test

In order to review the close degree between variables, at the same time avoid wrong conclusion generated when using correlation coefficient to judge causality, Granger causality test is quoted here to verify the causal relationship between variables. Software EVIEW5.0 is used to calculate the F statistics for inspection and the corresponding acceptance probability, the inspection results of logistics industry, rail freight are shown in table 1.

Table 1 Granger causality of LZ and LTZ

Hypothesis	Observed Value	F statistics	Probability
LZ is not the granger causality of LTZ	18	1.93668	0.18358
LTZ is not the granger causality of LZ	18	3.11842	0.07830

From the result of table 1 shows that null hypothesis accept probability of logistics industry is the granger causality of rail freight is 0.18358, indicating that the logistics industry is the granger causality of rail freight accept is unlikely; The probability of the second test is 0.07830, which indicates that the null hypothesis of rail freight is not granger causality of logistics industry is unacceptable, it also illustrates the rail freight occupies an irreplaceable position in the logistics service. There is a strong two-way causal relationship between logistics industry and rail freight, that is, there is close relationship between the railway freight and the logistics industry.

Variance Decomposition Analysis

Causality test shows that the causal relationship between variables, but cannot explain the

relationship between variables, variance decomposition analysis is used to further analyze the contribution of railway freight to logistics industry. The main idea of variance decomposition is to decompose volatility (k step mean square error) of each endogenous variable in the system (a total of m) according to the causes into m components related to the information of the equation (random error), as to understand the relative importance of the information on the model endogenous variables. Variance decomposition is not only a causality test outside the sample period, but it decomposes the unit increment of each variable into the contribution that comes from a certain percentage of its own and other variables.

For p step vector autoregressive model of m variables:

$$Y_t = B + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \ldots + \varphi_p Y_{t-p} + \varepsilon_t . \tag{5}$$

In where, $Y_t = (y_{1t}, y_{2t}, \ldots, y_{mt})^T$ is m dimensional vector which are made up of endogenous variable, B is constant vector, $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \ldots, \varepsilon_{mt})^T$ is m d random vector, ϕ_i is the coefficient matrix, the covariance matrix of ϕ_i is Ω.If the vector autoregressive model is reversible, then it can be expressed as a vector moving average model (VMA):

$$Y_t = C + \sum_{h=0}^{\infty} \psi_h \varepsilon_{t-h} . \tag{6}$$

In where, ψ_h is the coefficient matrix, C is a constant vector, they can be calculated by the coefficient matrix ϕ_i of equation (5) and constant vector B.

VAR (P) h step prediction error is:

$$\text{var}[Y_{t+h} - E(Y_{t+h} | Y_t, Y_{t-1}, Y_{t-2} \ldots)] = \varepsilon_{t+h} + \psi_1 \varepsilon_{t+h-1} + \psi_2 \varepsilon_{t+h-2} + \ldots + \psi_{h-1} \varepsilon_{t+1} . \tag{7}$$

VAR (P) h step prediction mean square error is:

$$MSE = \Omega + \psi_1 \Omega \psi_1' + \ldots + \psi_{h-1} \Omega \psi_{h-1}' = PP' + \psi_1 PP' \psi_1 + \ldots + \psi_{h-1} PP' \psi_{h-1}$$

$$= \sum_{j=1}^{m} (P_j P_j' + \psi_1 P_j P' \psi_1 + \ldots + \psi_{h-1} P_j P' \psi_{h-1}) \tag{8}$$

In where, P_j is the j column vector matrix P, $P_j P_j' + \psi_1 P_j P' \psi_1 + \ldots + \psi_{h-1} P_j P' \psi_{h-1}$ represents contribution that the orthogonalization impacts (or new) of j on h step prediction mean square error. According to the equation (8), any prediction mean square error of endogenous variable can be decomposed into contribution made by random impacts of each variable in the system, then calculating the importance of each variable impact, namely, the ratio of variable contribution in total contribution.

h step contribution rates of LTZ to LZ are shown in table 2, the results show that in the h step forecast variance decomposition of Logistics industry, the most of Logistics industry is made of its new interpretation, its contribution rate from 100% in the first phase to the tenth of 89.83%; And the contribution rate of railway freight is from the contribution rate of 0% in the first stage, increasing to the contribution rate of 10.22% in the second stage, its impact on logistics industry is

significantly improved; The overall impact of railway freight transportation on logistics industry first increases and then decreases along with the increase of time, contribution rate keeps more than 10%. The short-term impact of railway freight to logistics industry is relatively bigger than the long-term impact, illustrating that due to short-term advantages of railway freight, railway freight plays a major boost for the development of logistics industry, but with the further development and perfection of China's logistics and growing competition between other engaged in the management of logistics industry, railway freight will gradually reduce its influence on logistics industry, the role that railway freight plays in the logistics industry will gradually weaken, data analysis shows that railway freight has a long way to go in the development of logistics industry.

Table 2 h step contribution rates of LTZ to LZ

Predictive Period	SE	LZ	LTZ
1	0.044835	100	0
2	0.072384	89.78209	10.21791
3	0.099921	83.70646	16.29354
4	0.125096	82.44484	17.55516
5	0.14735	83.45847	16.54153
6	0.167192	85.13176	14.86824
7	0.185366	86.74563	13.25437
8	0.202543	88.07292	11.92708
9	0.219264	89.08731	10.91269
10	0.235935	89.8284	10.1716

Conclusions and policy suggestions

1) To speed up the model transformation of railway freight marketing

To actively promote the transformation of rail freight from the traditional way to electronic commerce way, relying on the advantages and unique features of rail freight to extend the chain of railway service, and to realize direct remote services between railway and the customers.

2)To perfect customer service system of railway freight transportation

With the development of logistics industry and the increase of competition, the traditional railway freight already cannot satisfy the needs of the development of logistics industry, under this background, the railway freight must actively satisfy the demand of the market, through perfecting customer service system, to speed up to develop into logistics industry which provides transportation, warehousing, packaging, distribution, circulation, processing, information processing and other services.

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