Co-integration Analysis of the Relationship between Logistics Transportation and Economic Growth of Agriculture in Zhejiang Province

WANG Dong-hui *

Yiwu Industrial and Commercial College, Yiwu 322000, China

Abstract The thesis selects freight volume and passenger capacity from 1978 to 2008 in Zhejiang Province and the total output value of the primary industry as the object of research, uses quantitative method of co-integration analysis to analyze the freight volume and passenger capacity, and the total output value of the primary industry in Zhejiang Province. After the stationary test of the time sequence, I conduct the regression analysis of the relationship between freight volume and the total output value of agriculture, and the relationship between passenger capacity and the total output value of agriculture. In addition, I conduct Granger causality test of the relationship between freight volume and passenger capacity, and the total output value of agriculture. The results show that the transportation of Zhejiang Province has promoted the development of agricultural economy prominently, and the development of agricultural economy plays indistinctive role in promoting the transportation volume in Zhejiang Province.

Key words Logistics transportation, Agricultural economy, Co-integration, Granger causality test, China

The transportation is the basis of national economy, which can guarantee and support other industries. The development of transportation plays an important role in promoting rural economy and increasing farmers' income. There are different conclusions concerning research of the relationship between transportation and economic growth[1-4]. This may be related with the difference of role of transportation on different regions in different developing periods. The government report of China in 2010 emphasized on reinforcing degree of coordinating development between city and village, and strengthening the basis of rural agricultural development. Based on this, researching the relationship between logistics transportation and agricultural economic growth is significant in terms of theory and reality. I select the freight volume, the passenger capacity and the total output value of the primary industry as objectives of research from 1978 to 2008 in Zhejiang Province, conduct co-integration analysis of the relationship between logistics transportation and agricultural economic growth, and finally conduct Granger causality test on the relationship between freight volume and agricultural total output value, the relationship between passenger capacity and agricultural total output value respectively.

1 Indices selection, data sources and research methods

1.1 Indices selection I select freight volume, passenger capacity and the total output value of the primary industry as the analytical indices. There are 3 aspects concerning indices selection as follows.

Firstly, the research does not take the factor of inflation, namely the problem of goods price into consideration. Having referred to the viewpoint of Sun Chu-ren[5] and the like, I adopt the way of including the factor of goods price. There are two reasons as follows: firstly, according to the theory of behavior economy, people's economic behavior only takes the historical account digits into consideration, and might distort the relevant information when dealing with the factor of goods price; secondly, the national statistical goods price index differs in different departments and trading, lacking one comprehensive goods price index.

Secondly, the relevant documents mostly select the distance of transportation route or the density of road network as the index reflecting transportation amount. In my opinion, the construction of infrastructure only reflects the ability of designing transportation. Considering the use rate, there is might difference between practical transportation amount and designing transportation amount, so the research selects the practical freight volume and passenger capacity as research objectives. Because the needed proportion of transportation of all industries is fixated in a certain period, so such selection method is available in theoretical research.

Thirdly, I select the practical freight volume and passenger capacity as research objectives, not transportation turnover. The main consideration factor is that although the transportation turnover can realize the conversion between freight volume and passenger capacity, the factor of transportation mileage which is included in transportation turnover generates a certain difference between data expression and reality.

1.2 Data sources The used sample for analysis is from the annual data of Zhejiang Province from 1978 to 2008, and the data are from *The Statistical Yearbook* in 2009[6]. I put the time

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* Corresponding author. E-mail: c5c5c5@126.com

sequence of total value of agricultural production (*GDPNY*) as the level of agricultural economic growth, the freight volume (*HY*) and passenger capacity (*KY*) as logistics transportation amount.

1.3 Research method I conduct co-integration analysis and Granger causality test on the selected variables in order to explain their relationship.

2 Results and analysis

In order to eliminate the phenomenon of heteroscedasticity existing in the time sequence, I conduct logarithmic transformation on variables and the co-integration relationship of sequence after transformation. The logarithmic forms of variables are ln*GDPNY*, ln*HY* and ln*KY*. By analyzing the tendency figure of all variables (Fig. 1), the variables of ln*GDPNY*、ln*HY*、ln*KY* tend to increase incessantly, and the variation direction and pace are identical, so there might exist the related relationship among the variables.

I use *d*ln*GDPNY*, *d*ln*HY*, *d*ln*KY* to represent the first order difference of ln*GDPNY*, ln*HY*, ln*KY* respectively. By analyzing the first order difference figure of the three variables, it shows strong stability. I conduct variable inspection on the stability of sequence as follows.

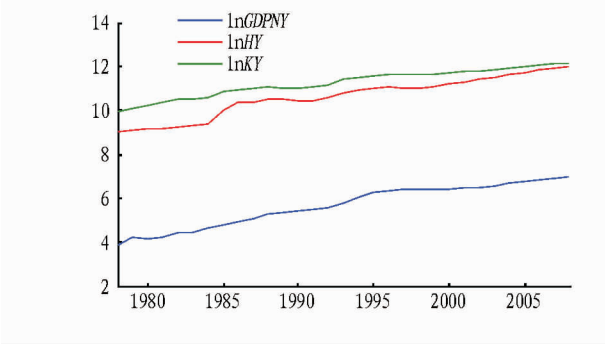

Fig.1 Trend of three variables

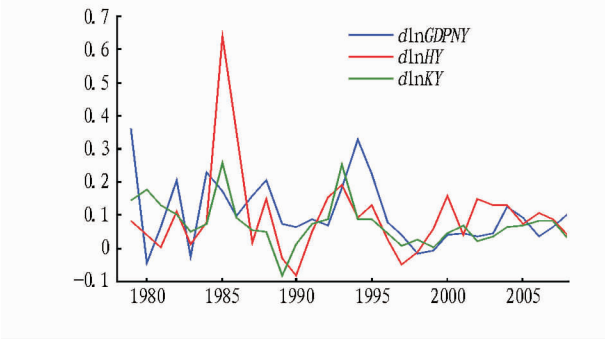

Fig.2 First-order difference of three variables

2.1 Stability test When conducting stability test on the time sequence, I use ADF test method to test ln*GDPNY*, ln*HY*, ln*KY* and their difference sequence. In order to ensure the accuracy and fairness of test results, I use Eviews6.0 software, and the test results are seen in Table 1. The horizontal sequence of ln*GDPNY*, ln*HY*, ln*KY* is stable after first order difference. These variables are first-order integration sequence, and we can further test the co-integration relationship among them.

Table 1 ADF test on the time series of ln*GDPNY*, ln*HY* and ln*KY*

Variable	ADF test value	Test type (c,t,1)	Critical value (5% significance level)	Critical value (1% significance level)	Conclusion
ln*GDPNY*	−0.945 992	(*c*,*t*,1)	−3.574 244	−4.309 824	Instable
*d*ln*GDPNY*	−4.755 532	(*c*,0,0)	−2.967 767	−3.679 322	Stable
ln*HY*	−2.839 184	(*c*,*t*,3)	−3.587 527	−4.339 330	Instable
*d*ln*HY*	−3.748 388	(*c*,0,0)	−2.967 767	−3.679 322	Stable
ln*KY*	−2.019 366	(*c*,*t*,4)	−3.595 026	−4.356 068	Instable
*d*ln*KY*	−3.846 868	(*c*,0,3)	−2.981 038	−3.711 457	Stable

The correlation analysis shows that there is a close correlated relationship among ln*GDPNY*, ln*HY*, ln*KY* (The correlation coefficient is close to 1), and the correlated coefficients are 0.965 365 442 and 0.989 167 183 respectively. In the calculation theory of the total output value of production, the total output value of production, freight volume and passenger capacity cannot form the identity relation directly. The freight volume and passenger capacity are just the correlation factors of the total output value of production. So I analyze the linear relationship among freight volume, passenger capacity and the total output value of production respectively. Then I consider the co-integration relationship and causality relationship among these variables.

2.2 Regressive analysis

2.2.1 The relation analysis of freight volume and the total output value of agricultural production. The correlation analysis of total output value of agricultural production ln*GDPNY* and freight volume ln*HY* shows that the correlation coefficient of the two is 0.965 365 442, and there is strong correlation between the two. I further draw the scatter diagram of the two variables, and its shows that the tendency of two variables is identical. By the estimated parameter, the model is established. The regressive analysis is conducted by the least square method. The results show that *R*-squared and Adjusted *R*-squared are both close to 1, which indicates that the fitting result of model is good. *F*-statistic is 0.000 000, the regressive equation is highly outstanding. The regressive equation is as follows:

$$\ln HY = -1.554\,237 + 0.864\,923 \ln GDPNY \quad (1)$$

I conduct the single root test on estimated residual sequence of the regressive equation. Under the test type (0,0,1), *t*-Statistic is −2.466 720, smaller than the threshold (−1.952 910) of 5 percent significant level. The estimated residual sequence is stable sequence, and there is sole co-integration relationship between ln*HY* and ln*GDPNY*.

2.2.2 The relation analysis of passenger capacity and the total output value of agricultural production. By the same method, I analyze the total output value of agricultural production ln*GDPNY* and freight volume ln*KY*. The correlation coefficient of the two is 0.989 167 183. The scatter diagram shows that the tendency of the two variables is identical. By the estimated parameter, the model is established. *R*-squared and Adjusted *R*-squared are both close to 1. *F*-statistic is 0.000 000, and

there is high degree linear relation among variables. The regressive equation is prominent.

The regressive equation is as follows:

$$\ln KY = 0.640\,435 + 0.610\,013 \ln GDPNY \quad (2)$$

I conduct the single root test on the estimated residual sequence of regressive equation. Under the test type (0,0,1), *t*-statistic is −2.515 048, smaller than the threshold (−1.952 473) of 5 percent significant level. The estimated residual sequence is stable sequence, and there is sole co-integration relationship between ln*KY* and ln*GDPNY*.

2.3 The Granger causality test According to the Akaike Information Criterion (AIC), the lag order of all variables is 1. The Granger causality test of the two variables can be shown in the Table 2. Under 5 percent significant level, ln*GDPNY* is the reason of ln*HY* and ln*KY* insignificantly. Namely ln*HY*, ln*KY* and ln*GDPNY* form the one-way Granger causality relation respectively.

Table 2 Granger causality test results of ln*GDPNY*, ln*HY* and ln*KY*

0 hypothesis	Number of analyzed variables	*F* test result	Associated probability
ln*GDPNY* is not Granger causality of ln*HY*	30	0.290 37	0.594 4
ln*HY* is not Granger causality of ln*GDPNY*		3.376 40	0.077 2
ln*GDPNY* is not Granger causality of ln*KY*	30	0.588 53	0.449 6
ln*KY* is not Granger causality of ln*GDPNY*		3.126 23	0.088 3

3 Conclusion and discussion

The results of research shows that the growth of the freight transportation amount of Zhejiang Province and passenger capacity plays significant role in promoting agricultural economic development; the agricultural economic development plays insignificant role in promoting the growth of the freight transportation amount. When conducting empirical research, due to the interference of metering model, it might generate the phenomenon of "fake regression". In a nutshell, what the model analyzes are the mathematical relations among several time sequences. The model itself cannot reflect various kinds of factors in the practical social economy. Hence, it is necessary to explain theoretically the results of empirical analysis so as to restore the economic relations among variables in the extreme and eliminate the interference of distortion factor of model.

3.1 The logistics transportation of Zhejiang Province promotes the agricultural economic development prominently

The classical economist Adam Smith poses in his representative works *The Wealth of the Nations* that the radicalness of labor production force, and the proficiency, skill and judge are shown when using labor, which are apparently the result of division of labor. He opines that the division causes the promotion of production force, but meanwhile Smith poses that the division is restricted by market scope. The development of modern transportation can provide support conditions for decrease of transportation expenditure and expansion of market scope. The industrialized agriculture is no longer confined in production chains. The extension of production, and the circulation of input products and output products have become a part of modern agriculture, hence the development of logistics transportation is bound to promote agricultural economic growth and the role of promotion is prominent.

In the 1820s, the German economist Von Thunen took the transportation as important factor to research the spatial layout of agricultural production force systematically, and posed the agricultural location theory. At the time, the transportation was not developed and the transformation conveyance was still carriage, so the impact of transformation on the model of agricultural management is decisive. For the nonce, although the transportation is very advanced, the impact of transportation on agricultural development is no longer decisive. But the impact of transportation on agricultural structure adjustment still exists.

From the foregoing theory, we know that the transportation promotes the development of production force and agricultural economy by influencing market and division of labor. The analytical results of empirical research in Zhejiang Province correspond to it, which can verify and evince the foregoing theory and have empirical feasibility.

3.2 The agricultural economic development of Zhejiang Province plays inconspicuous role in promoting logistics transportation amount According to the traditional theory of transportation, the transportation cannot create physical value itself. Its main function is to realize the spatial effect of logistics. The demand of transportation has the derivative feature. The input and output in the agricultural production all need the support of transportation to take part in other production departments and social economy. It is indisputable that the processing of agricultural products, marketing and even the upgrade of agricultural structure all exert great impact on the transportation demand. The results of model show that the agricultural economic growth of Zhejiang Province promotes the logistics transportation inconspicuously. It has a relationship with the local status of agricultural development and its status in the national economy.

The per capita hold of agricultural resources of Zhejiang Province is small. The regional distribution of agricultural resources has a great difference, and the natural disaster such as typhoon. Taking land resources as an example, the per capita land area of whole province is 0.23 hm^2, less than the 30 percent of the national average. Meanwhile, it tend to bear the pressure of the increasing population[7]. The proportion of the agricultural economy of Zhejiang Province in whole regional economy decreases incessantly. The agricultural GDP in 1978 accounted for 38.06 percent of the provincial GDP, which decreased to 24.87 percent in 2000. In 2008 the proportion was 5.01 percent. So the role of development of agricultural economy in promoting national economy is counteracted by its decreasing proportion in national economy. In terms of the historical data, it is difficult to show the role of transportation in promoting logistics transportation amount prominently.

4 Conclusion

From the perspective of the transportation amount of passenger and freight, the research conducts quantitative and qualitative analysis of the relationship between logistics transportation and agricultural economy. The results show that the improvement of logistics transportation conditions plays the role of promoting rural economic development prominently, and the rural economic development can also expand the demand of logistics transportation and promote the increase of logistics transportation amount. But as regards different regions and different organization forms of industrial structure, this interaction is varied. Taking Zhejiang Province as an example, the logistics transportation plays the role of promoting rural economic development prominently, but the rural economy plays the inconspicuous role of promoting logistics transportation. The conclusion has regional characteristics, and has a close relationship with the proportion of agricultural economy in national economy of Zhejiang Province.

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3 Conclusion and suggestion

3.1 Conclusion It can be concluded that corn production in main producing areas is mainly scale inefficiency and is at the stage of decreasing returns to scale. Pure technical efficiency of corn production is effective in most main producing regions. Total Factor Productivity of corn production is improved in main producing regions, because the speed of technical progress is greater than the speed of efficiency reduction. In the years 1998 – 2008, corn production in main producing regions is rational in structure and is not affected by the natural disasters.

3.2 Suggestion The main producing regions should appropriately reduce the material inputs, strengthen the adoption and promotion of new technologies and the research and development of corn seed resources, improve the infrastructure construction of corn production, and promote the further improvement of technical efficiency of corn production.

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