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Study on the Relationship between Logistics Industry and Foreign Trade in Sichuan Based on VAR Model

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Abstract: This paper used the data of Sichuan Province from 1986 to 2015 as a sample to analyze the relationship between Sichuan logistics industry and foreign trade based on VAR model. The results show that there is a long-term equilibrium relationship between logistics industry and foreign trade in Sichuan Province. Increasing logistics demand can improve the level of foreign trade development in Sichuan Province, and the development of foreign trade in Sichuan Province can also increase the demand for animal currents. The two complement each other. In addition, the increase of logistics supply has a promoting effect on the development of foreign trade in Sichuan Province, but its impact is not as good as that of logistics demand.
Key words: Sichuan Province; logistics Supply; logistics Demand; Foreign Trade; VAR Model

1 Introduction

In recent years, the relationship between foreign trade and logistics has become increasingly close, and logistics plays an increasingly important role in the circulation of foreign trade. At present, study on the relationship between logistics and foreign trade has yielded a lot of achievements and developments, among which the representative ones are:

Abroad, Michael & Susan believes that the increase of logistics efficiency will stimulate the growth of import and export [1]; Nguyen & Tongzon found that the improvement of logistics infrastructure cannot directly improve Australian international trade, while the development of international trade can promote the construction of its domestic logistics infrastructure [2]; Hoekman & Nicita analyzed the relationship between international trade and LPI in low-income countries, they found that tariff and non-tariff barriers are still major obstacles to international trade. Improving logistics performance can promote the development of international trade in developing countries [3]; Felipe & Kumar found that the improvement in trade facilitation facilities can significantly increases the trade flow of complex, high-tech products in Central Asian Countries [4]; Zeng found that lowering the cost of logistics has a significant boost to import and export trade [5]; Puertas, Marti & Garcia found that LPI's six indicators have a positive effect on international trade, and that different indicators have different effects on international trade. Some scholars believe that the quality indicators of logistics infrastructure in LPI have the greatest impact on international trade [6]; Marti, Carlos & Puertas found that the logistics performance depends largely on income and geographical area. High income countries are in the group of best performers, which is highly dominated by the EU [7]; D'Aleo & Sergi found that a positive influence of global competitiveness index on GDP and this effect is by far more evident when other variables (e.g. the logistics performance index) interact simultaneously [8].

In China, Ling Wang found that there is a one-way causal relationship between the changes in Shanghai's port cargo throughput and the increase in the total import and export volume [9]; Ouyang Xiao Xun & Huang Fuhua found that there is a unique co-integration relationship among the logistics industry, domestic trade, and foreign trade. The logistics industry's role in promoting foreign trade and domestic trade is stable, but domestic trade plays a more significant role in logistics than foreign trade [10]; Zhu Kunping & Zhang Ximei found that the dependence of Hebei's port logistics on foreign trade is much greater than that of foreign trade on port logistics [11]; Liang Wen, Zhang Qin and Yuan Shuaishi found that Anhui's foreign trade has a positive effect on logistics demand, but logistics demand has no obvious effect on foreign trade. At the same time, logistics supply has a positive effect on foreign trade, while foreign trade has no obvious effect on logistics supply [12].

According to the above literature review, we can see that the related research on the relationship between logistics and foreign trade has yielded fruitful results, which laid the foundation for the study of this paper, but there are also research gaps. For example, the domestic research area is mainly concentrated in the more developed Shanghai, Anhui Province. , Hebei and other eastern coastal areas, which involve less in the central and western regions such as Sichuan Province. As a major economic province in the central and western regions, Sichuan Province plays an important role in the economic development of foreign trade.

Therefore, on the basis of previous research, this paper uses the data sample of Sichuan Province from 1986 to 2015, based on the VAR model, using cointegration test, Granger causality test, and impulse response function for the mutual understanding of modern logistics and foreign trade in Sichuan Province. The relationship is studied in order to supplement and improve the existing research.

2 Variable and Data

To study the relationship between logistics and foreign trade, it is necessary to select the appropriate variables to establish the analysis model. Therefore, based on previous research results, this paper selects evaluation indicators from the perspectives of logistics supply and logistics demand to measure the development of the logistics industry in Sichuan Province. The logistics network mileage (LR) is selected to represent the logistics supply level in Sichuan Province and the unit is kilometers. The total transport volume (LC) is selected to represent the level of logistics demand in Sichuan Province, in units of 10,000 tons. The total import and export volume (Z) is selected to represent the level of Sichuan's foreign trade development, and the unit is tens of thousands of US dollars. The data in this paper are sourced from the "China Statistical Yearbook", "Sichuan Statistical Yearbook" and the China Statistical Website. A total of 30-year time series data from 1986 to 2015 were selected. In order to eliminate the possible heteroscedasticity, natural logarithmic transformation is performed on LR, LC, and Z. The natural logarithm logistics network mileage, the total transportation volume, and the total import and export volume are represented by lnLR, lnLC, and lnZ.

3 Empirical Analysis

3.1 Unit Root Test

This paper selects the ADF unit root test method to test the stability of all time series data to avoid the occurrence of spurious regression. The results are shown in Table 1.

Table 1 ADF Unit Root Test Results

variable	（C，T，K）	ADF value	Critical value （1%）	Critical value （5%）	Critical value （10%）	Conclusion
lnZ	（C，T，7）	-2.123	-4.324	-3.581	-3.225	unstable
lnLR	（C，T，7）	-2.373	-4.324	-3.581	-3.225	unstable
lnLC	（C，T，7）	-2.341	-4.441	-3.633	-3.255	unstable
VlnZ	（C，0，7）	-3.249	-3.689	-2.972	-2.625	smooth
VlnLR	（C，T，7）	-4.120	-4.324	-3.581	-3.225	smooth
VlnLC	（C，T，7）	-5.037	-4.416	-3.622	-3.249	smooth

Note: “ V”is a first-order difference symbol, “C, T, K” is a test form, where C represents a constant term, “T” represents a time trend, and “K” represents a lag order.

From the results in Table 1, lnZ, lnLR, and lnLC are all first-order single integer sequences at the 5% significance level. Therefore, the VAR model is constructed using the time series data of VlnZ, VlnLR, and VlnLC.

3.2 VAR Model Construction

The VAR model is often used to reflect relevant economic variables. Regression of each endogenous variable as a lag term for all endogenous variables can better illustrate the dynamic effects of various explanatory variables on economic variables. The VAR model expression is as follows:

$$Y_t = C + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + ... + \beta_P Y_{t-P} + \varepsilon_t \quad (1)$$

In equation (1), “t” is the number of samples, “Y_t” =(V$\ln Z_t$, V$\ln LR_t$, V$\ln LC_t$), “C” is the intercept column vector, is the coefficient vector, “P” is the lag order, and “ ε_t ” is a 3-dimensional random error vector.

The VAR model was constructed using Eviews6.0 software. According to the AIC and SC criteria, the VAR model was determined to have a maximum lag order of 4. So the final fitted VAR model is as follows:

$$Y_t = \begin{bmatrix} 0.052 \\ 0.093 \\ 0.115 \end{bmatrix} + \begin{bmatrix} 0.247 & -0.072 & -0.084 \\ 0.002 & 0.099 & -0.248 \\ 0.102 & 0.111 & 0.348 \end{bmatrix} Y_{t-1} + \begin{bmatrix} 0.023 & 0.172 & 0.199 \\ 0.241 & -0.079 & 0.081 \\ 0.034 & 0.156 & -0.052 \end{bmatrix} Y_{t-2}$$
$$+ \begin{bmatrix} 0.098 & -0.779 & -0.046 \\ 0.443 & -0.179 & -0.218 \\ 0.011 & -1.187 & 0.153 \end{bmatrix} Y_{t-3} + \begin{bmatrix} -0.121 & 0.041 & 0.092 \\ -0.137 & -0.308 & 0.216 \\ -0.097 & 0.082 & 0.112 \end{bmatrix} Y_{t-4} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \quad (2)$$

The AR root test was used to test the stability of the estimated VAR model, as shown in Figure 1.

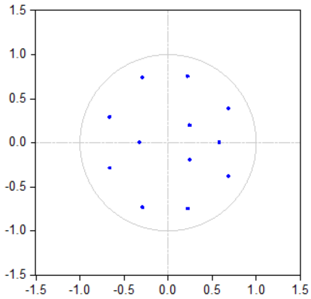

Figure 1 VAR Model Stability Test

As can be seen from Figure 1, all estimated points are within the circle, so the VAR model being estimated is stable, and the results obtained are valid, indicating that there is a long-term stable relationship between the three selected variables and can be further analyzed.

3.3 Cointegration Test

The Johansen cointegration test was used to determine if there was a long-term equilibrium between V lnZ, VlnLR and VlnLC. The results are shown in Table 2.

Table 2 Johansen cointegration test

Null hypothesis	Eigenvalues	Trace statistics	Threshold(5%)	Conclusion
None	0.933	79.762	29.797	Refuse
At most 1	0.304	9.615	15.495	Accept

From the results in Table 2, it can be seen that there is a long-term equilibrium relationship between V lnZ, VlnLR, and VInLC, and there is a maximum of one.

3.4 Granger Causality Test

The Granger causality test was used to determine whether there was a causal relationship between V lnZ, VlnLR, and VlnLC. The results are shown in Table 3.

Table 3 Results of Granger Causality Test

Null hypothesis	F statistics	P value	Conclusion
VlnLR is not a Granger cause of VlnLC	0.343	0.898	Accept
VlnLC is not a Granger cause of VlnLR	10.397	0.001	Refuse
VlnZ is not a Granger cause of VlnLC	3.974	0.027	Refuse
VlnLC is not a Granger cause of VlnZ	3.655	0.035	Refuse
VlnZ is not a Granger cause of VlnLR	0.610	0.718	Accept
VlnLR is not a Granger cause of VlnZ	3.427	0.042	Refuse

According to the results in Table 3, at the 5% level of significance, the sequence ∇lnLC is the two-way Granger cause of the sequence ∇lnZ, indicating that the total transport volume (LC) and the total import and export volume (Z) can explain each other to some extent. The sequence ∇lnLR is the one-way Granger reason for the sequence ∇lnZ, indicating that the logistics network mileage (LR) can explain the total import and export volume (Z) to some extent.

3.5 Impulse Response Function Analysis

The impulse response function can describe the impact of an endogenous variable on the impact of standard deviation on other endogenous variables. The results are as follows:

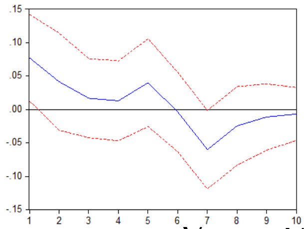

Figure 2 Response of ∇lnZ to ∇lnLC

According to Figure 2, when the total transport volume impacts one standard deviation of the total import and export volume, the total transport volume in the first period has a significant boosting effect on the total import and export volume. Afterwards, the promotion effect has generally weakened in the fourth period. Negative effects began to occur in the 6th period, and the negative effects in the 7th period reached the maximum value, and the negative effects decreased continuously until they stabilized.

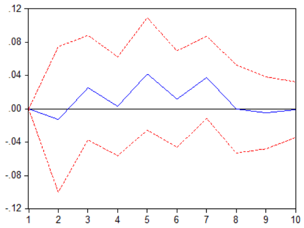

Figure 3 Response of ∇lnLC to ∇lnZ

As can be seen from Figure 3, when the total import and export volume impacts one standard deviation of the total transport volume, the total import and export volume has a minor negative effect on the total transport volume in the first period, and the negative effects decrease in the second period, and quickly. Turning to the promotion effect, afterwards, in the third to the eighth period, the promotion function showed a large fluctuation, tending to be stable later.

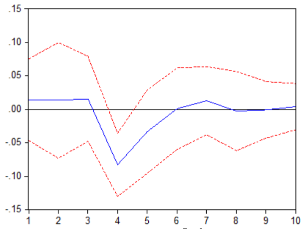

Figure 4 Response of ∇lnZ to ∇lnLR

From Figure 4, when the total import and export volume impacts one standard deviation of logistics network mileage, the logistics network mileage has a stable promotion effect on the total import and export volume in the first three phases, but it began to have a negative effect in the third period, and reach the lowest point in the fourth period, then the negative effect continued to decrease until it stabilized.

4 Conclusion

According to the above research results, the following conclusions can be drawn:

First, the results of the Cointegration Test show that there is a long-term equilibrium relationship between Sichuan's total import and export volume, total transport volume, and logistics network mileage.

Second, according to Granger Causality Test, the total amount of transport is the two-way Granger cause of the total volume of imports and exports, indicating that logistics demand can have an impact on the development of foreign trade in Sichuan Province. On the contrary, the development of foreign trade can also have an impact on logistics demand. The logistics network mileage is a one-way Granger cause for the total volume of imports and exports, indicating that logistics supply can have an impact on the development of foreign trade in Sichuan Province.

Third, the results of the Impulse Response Function proved the above conclusions once again, and further concluded that the increase in logistics demand can enhance the level of foreign trade in Sichuan Province. At the same time, the development of foreign trade can also promote the increase in logistics demand. The two complement each other. In addition, the increase of logistics supply has a catalytic effect on the promotion of the development of foreign trade in Sichuan Province, but its impact is not as good as that of logistics demand.

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