Research on the influence of international logistics cooperation on the regional economy

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Abstract. This study examined the present state of economic growths in Korea and China. It also investigated the long term relationship between economic growth and logistics cooperation, assuming the situation of economic cooperation between the two aforementioned countries would persist. Unit Root Tests, Eagle-Granger cointegration test were selected in the following econometric model. Economic growth and logistic development were represented by GDP and Turnover Index of Transportation freight volume respectively. The result shows the relationship between economic growth and logistics cooperation between China and Korea. According to the results of the model, increasing the growth has been realized in the development of logistics. To better take advantage of the China-Korea cooperation in logistics and transportation, new development pattern is needed.

Keywords: international logistics; regional economy; cooperation; Engle-Granger tests

1 Introduction

As economy development in China gains momentum, the economic relationship between two countries will be future maintained and strengthened. As a result, the Korea-China economic region has the possibility to rise as the third axis of the world economy by cooperating through economic integration. It is expected that the strong growth of China, steady growth of Korea, can extend the economic power of these two countries and allow the Great Tumen area to become one of the most dynamic economic regions of the world.

Logistics is the management of the flow of material and related information between suppliers to consumers. It makes enormous improvements between the point of origin and the point of consumption. Logistics section plays an important role in regional

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economic transactions, growth of trade and regional integration. With economic globalization and the deepening of social division labor, logistics as a sophisticated organization and management technology, which showed more and more important strategic position in the economic development, and gradually cause for concern.

Due to the geographical proximity and cultural bonds between China and south Korea, the economic integration of two countries has been progressively enhancing through the increase of intra-regional trade and logistics. The trade and logistics exchanges have been basically stable for over 20 years between China and south Korea, which firmly testified that the economy resilience and dependence leads to great achievement between China-south Korea economic and logistics cooperation. There has been a continuing goal for two countries to set up a free trade framework and reached free trade agreement until the Regional Comprehensive Economic Partnership agreement recently signed for three countries. It demonstrates the cooperation environment for cooperation of trade and logistics will further be promoted in the future.

Thus the interaction between logistics and economic growth between two countries has become a hot research spot.

2 Literature review

Several researchers from East Asian countries have paid special attention to the close geographical location of Korea and China. With this physical feature, there are currently many precedent studies estimating the economic growth of East Asia through economic cooperation of Korea and China; they analyze the economic effects of the cooperation on each country by using qualitative and quantitative methods. Kim (2000) asserts on highlighting the experiences of EU and NAFTA's economic cooperation when considering the political and economic distinctiveness of East Asia 1. He also maintains that a special model be designed to apply to the geographical feature of East Asia. By using actual data on past events related to existing free trade agreements (FTAs), Lee et al. (2004) studied how the FTAs between Korea and China contribute to the economic growth of each country 2. They also developed a methodology to explore the trade creation effect of the three countries. Lee et al. (2004) expects that the FTAs of the three countries would promote growth for each state, with the effect on Korea the largest. In another research 3, Lee & Wang (2004) analyzed the relationship of trade structure with economic growth by focusing on the change of trade structure; the dynamic panel model has been used for this purpose 4. Lee, Hongshik et al. (2004) analyzed the effects of changes in the trade structure across Korea, Japan, and China by contracting the FTA of each country's economic growth 5. They concluded that FTA contracts have a positive effect on the three countries' economic growth.

Bayraktutan (2012) believed that improvements in logistics contribute to production and consumption in economic activities 6. Thus logistics plays an important role in economy boosting and industrial development. Held et al., (2000) concluded that the regional logistics is critical in the development of regional economy in a way of improving logistic infrastructure and services 7. Wen-Jie Zhang (2002) made a theory research on relationship between economy globalization and logistics development by

analyzing profit and core competence in regional companies through the economy development of Chinese logistics market 8. Gong Zhong (2003) established a model to testify the core inner causes of regional logistics and regional economic growth by selecting freight, freight turnover, logistics network as variables 9. Li and Zhang (2007) evaluates the regional logistics adaptability by figuring out the correlation between the regional logistics and the regional trade. Region's trade volume and its indicators of logistics growth were selected in regression models 10.

3 Analysis

3.1 Methodology

The relationship between economy and logistics will be investigated in time series using Unit root tests and Cointegration test. The most commonly used techniques are Dickey-Fuller, Augmented Dickey Fuller and Phillips-Perron tests. Trade volume and freight volume were chosen as two variables in this study. Data is derived from custom data database in China and South Korea, UN database, ITF (International Transport Forum) dataset, ASEAN StateDataPortal. The following analysis shows two variables are firmly cointegrated in long run.

3.2 Test

First, analyzing the impact of logistics cooperation on bilateral trade between countries. Due to the impact of logistics cooperation between countries through preferential policies will reduce logistics costs, it leads to a reduction in trade-friendly costs, and deepening in the division of labor on trade production of Chinese products. The volume of freight and the amount of intermediate goods traded between two countries are chosen as the variables.

Table 1. Total volume of Trade and Freight between China and Korea

YEAR	TOTAL VOLUME OF TRADE (One hundred million U.S. dollars)	TOTAL VOLUME OF FREIGHT (millions tons)
2010	188,411,436	3,595,643
2011	220,617,247	3,860,570
2012	215,107,159	4,492,765
2013	228,922,375	5,437,040
2014	235,369,927	5,833,506
2015	227,374,209	4,804,376
2016	211,413,101	5,523,681
2017	239,980,114	5,592,285
2018	268,613,647	5,982,010

2019	243,431,269	6,551,384
2020	241,450,090	7,189,911

In order to eliminate the different variances in the data, and make each time series data after processing will not change its own nature and interrelation, we firstly take the natural logarithm of the variables.

Table 2. Natural logarithm of two variables

YEAR	LOG (TRADE)	LOG (FREIGHT)
2010	19.054	15.095
2011	19.212	15.166
2012	19.187	15.318
2013	19.249	15.509
2014	19.277	15.579
2015	19.242	15.385
2016	19.169	15.525
2017	19.296	15.537
2018	19.408	15.604
2019	19.310	15.695
2020	19.302	15.788

Because the time series itself is unstable, and the test results may appear the phenomenon of "pseudo-regression", before doing the cointegration test, the data will be tested using ADF unit root test to testify its stationarity.

First of all, carry out the logarithmic single root test for the freight volume of China and South Korea:

Null Hypothesis: FREIGHT has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.271478	0.1284
Test critical values:	1% level	-5.295384	
	5% level	-4.008157	
	10% level	-3.460791	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 10

Fig. 1. China-Korea freight volume ADF Unit Root Test

Null Hypothesis: D(FREIGHT) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.087857	0.0162
Test critical values:	1% level	-5.521860	
	5% level	-4.107833	
	10% level	-3.515047	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 9

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FREIGHT,2)
Method: Least Squares
Date: 07/01/21 Time: 16:07
Sample (adjusted): 2012 2020
Included observations: 9 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FREIGHT(-1))	-1.223319	0.240439	-5.087857	0.0022
C	-218450.8	462429.0	-0.472399	0.6533
@TREND(2010)	80656.86	67798.42	1.189657	0.2791

R-squared	0.837366	Mean dependent var	-136266.7
Adjusted R-squared	0.783155	S.D. dependent var	1105600.
S.E. of regression	514840.8	Akaike info criterion	29.40230
Sum squared resid	1.59E+12	Schwarz criterion	29.46805
Log likelihood	-129.3104	Hannan-Quinn criter.	29.26043
F-statistic	15.44634	Durbin-Watson stat	2.632202
Prob(F-statistic)	0.004302		

Fig. 2. China-Korea freight volume Unit Root Test in first difference

As can be seen from the above figure, after taking the Unit Root Test in first difference of the logarithmic sequence of freight volume between China and South Korea, the result of t statistics is-5.088, which is less than the critical value of ADF with a confidence degree of 95%. At the confidence level of 95%, the absolute hypothesis is rejected, Sequence is stationary.

We then take the unit root test for the logarithm of trade volume between China and Korea.

Null Hypothesis: TRADE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.265868	0.1358
Test critical values:	1% level	-5.521860	
	5% level	-4.107833	
	10% level	-3.515047	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 9

Fig. 3. China-Korea trade volume ADF Unit Root Test

Null Hypothesis: D(TRADE) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.193763	0.0457
Test critical values:	1% level	-5.521860	
	5% level	-4.107833	
	10% level	-3.515047	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations
and may not be accurate for a sample size of 9

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TRADE,2)
Method: Least Squares
Date: 07/01/21 Time: 15:56
Sample (adjusted): 2012 2020
Included observations: 9 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TRADE(-1))	-1.181677	0.281770	-4.193763	0.0057
C	4887585.	9075331.	0.538557	0.6096
@TREND(2010)	412514.7	1264694.	0.326177	0.7554

R-squared	0.761619	Mean dependent var	-3222750.
Adjusted R-squared	0.682159	S.D. dependent var	16969388
S.E. of regression	9566904.	Akaike info criterion	35.24672
Sum squared resid	5.49E+14	Schwarz criterion	35.31246
Log likelihood	-155.6102	Hannan-Quinn criter.	35.10485
F-statistic	9.584893	Durbin-Watson stat	2.351968
Prob(F-statistic)	0.013546		

Fig. 4. China-Korea freight volume Unit Root Test in first difference

It can be seen from the above figure that after the unit root test in first difference, the t statistic is—4.19, which is less than the critical value of ADF with a confidence degree of 95%. At the confidence level of 95%, the sequence is stable.

From the above test results, it can be concluded that the freight and trade series variables is stable in confidence of 95%.

Therefore, the cointegration Engle-Granger test can be carried out on the basis of the Unit Root Test in first difference.

Dependent Variable: TRADE
Method: Least Squares
Date: 07/01/21 Time: 21:43
Sample: 2010 2020
Included observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FREIGHT	16.57409	5.141386	3.223662	0.0104
C	1.37E+08	28985481	4.721201	0.0011

R-squared	0.535891	Mean dependent var	2.29E+08
Adjusted R-squared	0.484323	S.D. dependent var	20775100
S.E. of regression	14918729	Akaike info criterion	36.03710
Sum squared resid	2.00E+15	Schwarz criterion	36.10944
Log likelihood	-196.2040	Hannan-Quinn criter.	35.99150
F-statistic	10.39200	Durbin-Watson stat	1.797030
Prob(F-statistic)	0.010428		

Fig. 5. The cointegration test of freight and trade volume

The Equation can be achieved:

$$InT = 16.574InFT + 1.37 * 10^8 \tag{1}$$

(3.223) (4.721)

$$R - squared = 0.536 \tag{2}$$

$$F - statistic = 10.392 \tag{3}$$

$$D - W = 1.797 \tag{4}$$

The data in parentheses is the statistical value of the corresponding estimator t.

Through the above regression analysis, it can be seen that the capabilities of fitness of the equation has reached a acceptable level, F statistics show that the equation is established.

$$e = InT - 16.574InFT - 1.37 * 10^8. \tag{5}$$

We test the stability of e by making an ADF unit root test, the results shows as following:

Null Hypothesis: E has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.073970	0.0164
Test critical values:	1% level	-5.521860	
	5% level	-4.107833	
	10% level	-3.515047	

*MacKinnon (1996) one-sided p-values.
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 9

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(E)
Method: Least Squares
Date: 07/01/21 Time: 21:01
Sample (adjusted): 2012 2020
Included observations: 9 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
E(-1)	-2.806959	0.553208	-5.073970	0.0039
D(E(-1))	1.258784	0.347306	3.624423	0.0151
C	-31594829	12226380	-2.584152	0.0492
@TREND(2010)	6154564.	2107662.	2.920091	0.0330

R-squared	0.858097	Mean dependent var	-869934.6
Adjusted R-squared	0.772956	S.D. dependent var	21187170
S.E. of regression	10095505	Akaike info criterion	35.39418
Sum squared resid	5.10E+14	Schwarz criterion	35.48184
Log likelihood	-155.2738	Hannan-Quinn criter.	35.20502
F-statistic	10.07848	Durbin-Watson stat	3.221010
Prob(F-statistic)	0.014647		

Fig. 6. The unit root test

As can be seen from the above figure, the residual el has passed the unit root test at the 5% level, so the residual sequence is a stationary sequence. As a result, there is a long-

term cointegration between the sequence of the freight volume and the sequence of trade volume between China and South Korea. The volume of freight and trade between China and Korea are cointegrated.

This shows that there is a possible relationship between the freight volume and the trade volume of goods between South Korea and China.

In the long run, for every additional unit of freight volume, the trade volume will increase by 16.573 units.

4 Conclusion

The logistics industry is undergoing a rapid growth in recent years in Asia especially in China and Korea due to the prosperous development of Asian regional cooperation.

This result shows the long-term relationship between GDP (represent to economic growth) and freight (represent to logistics cooperation) between China and Korea. So, a one unit change of freight volume resulting changes of 16.573 units of trade volume. According to the results of the model, increasing the growth has been realized in promoting development of logistics.

The recommendation is deepening bilateral cooperation mechanism on transportation and logistics in ways such as Neal-Net etc. To better take advantage of the China-Korea cooperation in logistics and transportation, new development pattern is needed.

The panel data analysis does not show a precise interrelation between logistics and regional economy. We propose to specify the relationship in future studies. The dependent variable will be expanded by testing more inner factors that contributed to boosted economy.

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