

The Impact of International Logistics to International Trade Research Based on an Empirical Analysis of the Data in 1995-2014 in Shandong Province

Zhenyu Jiang¹ and Yaohua Wu¹

¹Modern Logistics Institute, Shandong University, China

Abstract. By using time series model, this paper uses the data of Shandong province GDP, total value of import and export, the port cargo throughput and traffic volume from 1995 to 2014 in Shandong province, and empirical research on Shandong international logistics and international trade relations is based on the co-integration theory and Granger Causality Test. The empirical results show that the relationship has been long-term stable co-integration, and the one-way causation is between the port cargo throughput, traffic volume and the total amount of import and export, and deduced guiding mechanism of international logistics to international trade. So government ought to pay attention to strengthen international logistics influence to international trade, and complete open trade policy, strengthen the logistics personnel training, increase the intensity of port infrastructure construction, accelerate the process of bonded area logistics system.

1 Introduction

With the advent of modern times, international trade globalization and transport logistics integration have already become general direction and an important theme of the development of world economy. Also the development of the logistics industry has gained more and more support and attention, not only because it is a kind of advanced management technique or a way of organization on its own, but also it has gradually become an important index to measure the whole national comprehensive power and level of modernization. With the in-depth development of the reform and opening, and the increasingly rapid tendency of the economic globalization and trade internationalization, international trade, which is as the close tie between China and the rest of the world, has created a certain effect on the economic development of China and the world and also becomes a core and focus of the world economic competition, subtly affecting a country's world status and economic pattern. Joint development of the international logistics and international trade is both a kind of development status and a requirement in our own time. Many countries have realized international commercial trade and international business services through economic globalization and the integration of information technology to pursue the economic benefit maximization and efficiency of international trade market.

In recent years, Shandong province attaches great importance to the development of international trade, especially international logistics, both offering huge investment and cultivation, either in the construction of

logistics infrastructure or in the logistics technical innovation. Also Shandong province has obtained some results in constantly consummating the logistics infrastructure, pushing forward the market-based logistics process and the electronization of logistics industry. Since the fully implement of five-year plan for 2011 to 2015, the reform of Shandong province's international trade has rapidly developed, adjusting structure, changing economic increasing methods and growing steadily, which also makes some achievements. In 2011, Shandong province's total volume of import and export breaks the barrier of 200 billion dollars at first time, totaling \$235.87 billion, with year-on-year growth of 24.7 percent, hailing it as a "milestone" for the international trade of Shandong province. At the same time, Shandong province, whose international logistics industry maintains its stable and fast growth, is one of the China's developed provinces of trade. Since "Twelve Five-Year" plan, the logistics market of Shandong province is growing continuously. And this amount accounts for 6.5 percent of regional GDP and for 14.9 percent of proportion of the third industry. Its steady growth model protects the development of the international trade of Shandong province, playing an vital role in the support and safeguard. And with more and more attention payed on the logistics industry, Shandong province has made great progress either in the infrastructure construction and Industrial linkage development or in the process of international trade and logistics information development. During the "Twelfth Five-year Plan" period, logistics enterprises in Shandong province has reached more than 22000, among which there are 836 key enterprises. There are 339

logistics parks in Shandong province, whose development not only promotes the social employment and strengthens the social security, but also boosts the regional economic development and promotes the scale effect. Shandong province has increased production berths of coastal ports to 540, and open 8 civil aviation and 368 air routes, among which there are 41 international flights, primarily establishing the framework of the international trade of Shandong province. Modern information technology, such as Internet and cloud computing gradually start to apply in the international trade and economy of circulation. Most of international logistics enterprises have established logistics information management system and determine the information of transportation, warehousing and forwarding of international goods by real-time controlling. And they promote the construction of logistics information sharing platform while they also perfect the standardization of international logistics, setting 49 standards for logistics successively, which exerts an enormous influence on the development of Shandong province's logistics. Thus it can be seen that the international trade and logistics in Shandong province, which is one of the China's developed province of trade, are developing in coordination. Driven by the national strategy Blue Economic Zone of Shandong Peninsula, the international logistics' demand and standard of Shandong province will get more improvement and more progress.

No matter from the development status of international trade and international logistics or the support of policy, it embodies the attention of our country paid to the both aspects. China's logistics industry after more than 30 years of reform, release and accumulation, is striding forward towards modernization, intensification, standardization and the investment in logistics infrastructure and the logistics efficiency is getting better and better, so the research for international trade and international logistics is valuable for theory and practice. But believe it or not, there are some problems in the development of international business and international logistics in China, such as high costs of logistics, insufficiency in logistics demand, unreasonable network layout, and imperfect technology standards and so on. So China's logistics industry must keep updating and innovating, realizing the service ability, improving the efficiency, in order to adapt to the rapid development of international business and lay a solid foundation for development of international business.

2 Literature review

Logistics, originated in western countries, is a highly-developed discipline in terms of its scope, process and methods. The studies conducted in this field are comprehensive and detailed with advanced approaches. However, the case is different in China. In fact, the concept was recently introduced and did not receive enough attentions until the globalisation has shown its irresistibility. As a result, certain challenges still wait to be conquered. Yet the theoretical researches did achieve abundant results and provided a solid foundation for this article.

2.1 Relationship between international logistics and international trade

The International logistics and international trade are of inseparable and complementary relationship. The former is emerged due to the prosperity of international trade while it now pushes the latter into a better future. This relationship reflects their mutual support and influences during interaction. Besides, the concepts of low-carbon economy and environmental logistics also contribute to tightening these two fields and turning them into the new normal of economic growth after the financial crisis based on the theory of sustainable development [1]. Consequently, increasing number of experts and scholars at home and abroad have dedicated themselves to the empirical study of international logistics and international trade, some of which studied the data of bilateral trade and international logistics between China and Australia. The results showed that the bilateral trade has a positive and noticeable influence on the development of the international logistics. However, the influence is not significant due to the late start and slow process of logistics in China. Further studies analysed cases of international trade between Australia and other countries, such as China, America, Japan, etc., by VAR model. Besides, Tongzon (2009) recognised the accelerator role international trade has played in the development of international logistics industry [2]. Still, Nguyen and Tongzon (2009) also found the lack of infrastructure and investment causes the lagging growth of logistics and failed to promote the international trade [3]. While in China, experts at first also used Ganger Causality Test to examine this relationship by the volume of seaborne trade and the statistics of import and export between China and Europe, North America and Japan from 1983 to 2004. Yang (2007) proved the existence of strong feedback and causality in international logistics and international trade [4]. Zhang (2011) explored the same phenomenon by taking the bilateral trade and cargo throughput between China and Thailand into consideration. Their conclusion is that certain interaction between international trade and logistics do exist in China-Thailand trade yet the promotion from international trade to international logistics are more significant than the other way around [5]. Same result has been reached by the appliance of logistics in modelling analysis. The scientific modelling of Yue (2013) in empirical study of the total volume of international trade and cargo volume of China and Japanese from 1994 to 2011 demonstrated that the development of international logistics did encourage the business interaction. However, it pointed out that the future boost of international logistics has to rely on innovation instead of pure expansion [6]. Besides, appreciable achievements can be noticed based on data collected from provincial level. Taking the total value of international logistics as the reflection of its development state, Wang and Liu (2014) conducted empirical studies on the data of international trade and logistics in Tianjin municipality, which indicated a notable Ganger Causality and a long-term balance between the total value of international logistics and the trade volume of exportation and importation [7]. On top of that, similar conclusions

have also been reached in Wang's study analysing the volume of cargo traffic, port throughput and import and export in Shanghai from 1978 to 2008. The co-integration relationship among the three variables can be further explained as the following three aspects by Wang (2010): the trade value of import and export shows a positive effect on the port throughput; no clear contribution is made when the value of throughput increased; and the value of cargo traffic has a time-leg effect on the trade value of import and export [8]. Their findings revealed the one-sidedness of expanding the construction and coverage of logistics parks and provided suggestions on using innovative method to conduct a deep reform of the logistics industry. Furthermore, Wang and Wang (2011), and Gao and Meng (2012) arrived at the same conclusion with statistics from Taiwan and Guangdong province, respectively, proposing a significant influence of international logistics on international trade in a stable and lasting relationship while little from international trade to international logistics [9-10].

2.2 The influence of international logistics on international trade

The International trade and international logistics has mutual influence in the developing process. In other words, a strong relevancy can be recognised in these two fields. Therefore, a large number of experts and scholars carry on studies of the influential mechanism and factors focusing on logistics efficiency, costs, etc. It aims to produce more powerful momentum of international logistics for international trade through decreasing logistics costs, increasing service standard, improving profits and adding commercial value. Kong (2010) applied the impulse response function of VAR model on the time series data between 2002 and 2008 to launch a quantitative analysis. The result illustrated that the development of international logistics in China has generated a significant positive influence on international trade [11]. More particularly, Devlin and Yee (2002) took specific trade in the Middle-East and North Africa (such as tuna and coffee in Yemen) as research samples to conduct empirical studies on time cost which is an important section of international trade cost. As the results demonstrated, the international logistics efficiency affects the international trade level through the impact on the time costs [12]. Also, the analysis and evaluation of international trade behaviour and logistics level between America and Canada provided evidence for the promotion of international logistics efficiency by decreasing the logistics costs by Keane and Feinberg (2007). This phenomenon facilitated the trade and economic benefits of the two countries and accelerated the overall development of international trade [13]. Detailed analysis was conducted by Nordas et al. (2006) as well [14]. They adopted the international trade statistics of 191 countries and found out how exactly international logistics and international trade influenced each other. The result illustrated that the decrease of time cost is achieved by raising logistics efficiency in international trade. Besides, they noticed the inverse relation between time costs and the possibility of trading, in which the lower the

cost becomes, the higher the possibility would be. Additionally, the possibility of international trade can promote logistics industry domestically and internationally. In this area, Li (2012) analysed data of international trade and logistics from 108 countries and proposed six main factors that influence the international logistics development on the national basis, which are customs efficiency, infrastructure, international shipping, service quality, the ability to track cargos, and punctuality [15]. Conforming to Li's findings, different factors affect the development of international logistics on different levels and there is clear existence of a positive relation between international trade and logistics. In terms of specific area in China, Chen (2007) conducted a modelling analysis of the relationship between the international trade and logistics in Shanghai [16]. The measurement result illustrates a parallel growth in international trade and logistics. Yet through the data of throughput and logistic growth curve, the international logistics has a clear motivation to international trade. Other researches such as Li and Sun (2013) creating modelling using statistics of Yunan province from 1981 to 2010 pointed out the stable Ganger causality on a long-term basis between international trade and logistics. Only the influence of logistics on international trade is more significant [17].

3 The empirical study of the relationship between the international logistics and trade in Shandong province

3.1 Selection for data index and data processing

Before the empirical analysis for correlation between the international logistics and international trade, we need to choose proper variables for the data description and the model building. At first, this paper selects GDP as the index to measure economic development level; secondly, the gross import and export value (XM) is chosen as the index to measure the international trade level. Thirdly, for the reason that there lacks unified measure in the international logistics, to better reflect the relationship between the international logistics and international trade, this paper selects cargo throughput (TTL) and cargo transportation (YSL) as the index to measure the international logistics.

The data in this paper are from China Statistical Yearbook and Shandong Statistical Yearbook, intercepting the gross domestic product (GDP), total export-import volume (XM), cargo throughput (TTL) and cargo transportation (YSL) in Shandong province from 1995 to 2014. By taking logarithm of GDP, XM, TTL and YSL to eliminate the possible heteroscedasticity, the results are as follows: \ln GDP, \ln XM, \ln TTL and \ln YSL. The results are in the Table 1.

Table 1. Sample data

Obs.	LNGDP	LNXM	LNTTL	LNYSL
1995	8.507819	14.148410	11.570628	11.105649

1996	8.679958	14.295708	11.701941	11.165692
1997	8.785244	14.377199	11.819336	11.195196
1998	8.856711	14.323376	11.810323	11.249129
1999	8.921837	14.418237	11.843365	11.292428
2000	9.028515	14.731400	11.984484	11.434780
2001	9.126419	14.878949	12.170342	11.507551
2002	9.237518	15.037571	12.303018	11.584818
2003	9.399153	15.311948	12.452503	11.675996
2004	9.617260	15.620209	12.629640	11.790830
2005	9.818304	15.855285	12.858424	11.904961
2006	9.994251	16.069831	13.060616	12.028804
2007	10.157234	16.321999	13.262946	12.198580
2008	10.339588	16.576437	13.396799	12.419121
2009	10.431071	16.444545	13.501786	12.558358
2010	10.575664	16.754412	13.669571	12.605033
2011	10.722427	16.976723	13.776645	12.660207
2012	10.820043	17.016405	13.879943	12.707666
2013	10.919267	17.100768	13.982185	12.749562
2014	10.992497	17.137360	14.066993	12.472209

Source:China Statistical Yearbook and Shandong Statistical Yearbook.

3.2 Data dependence analysis

This paper regards the correlation coefficient among the 4 variables, which is through complex computing, as the evaluation standard to distinguish the correlation and its degree by means of Eviews8.0 to get the correlation coefficient. The results are in the Table II. It can be seen from the data that the variables are almost positively related to each other. So conclusions show that there may be a certain correlation among the 4 variables.

Table 2. Correlation among GDP, XM, TTL and YSL

	LNGDP	LNXM	LNTTL	LNYSL
LNGDP	1.0000	0.9955	0.9990	0.9869
LNXM	0.9955	1.0000	0.9969	0.9867
LNTTL	0.9990	0.9969	1.0000	0.9873
LNYSL	0.9869	0.9867	0.9873	1.0000

It is obvious that the correlation coefficients among gross domestic product (LNGDP), total export-import volume (LNXM), cargo throughput (LNTTL) and cargo throughput (LNYSL) are more than 0.9850, which means there are significantly correlated with each other.

3.3 The test of data stability

Through the test of correlation from data dependence analysis, it can be concluded that there are a significantly positive correlation among the 4 variables in some degree. However, there is another kind of possibility in the factual economic situation, that is there may be no correlation in theory between two or among several variables, just because some kind of economic phenomenon leading to

the same correlation among 4 variables. Therefore, the illusion of the correlation has shown up, which is so called spurious regression. So in order to discuss the relationship between the international trade and the international logistics, this paper will give experimental variables stationary test and then the Granger Causality Test.

This paper will make use of ADF unit-root test to implement the stationary test, that is by using Eviews8.0 to take the Augmented Dickey-Fuller test on the gross domestic product (GDP), total export-import volume (XM), cargo throughput (TTL) and cargo throughput (YSL) in Shandong province and difference sequence. The results are as follows in the Table III.

Table 3. ADF test results

Variables	ADF statistical value	Data test type (c, t, q)	Critical Value			Prob.*
			1%	5%	10%	
Ln(GDP)	-3.007936	(c, t, 1)	-4.571559	-3.690814	-3.286909	0.1568
D(lnDGP)	-4.411935	(c, t, 3)	-4.616209	-3.710482	-3.297799	0.0145
Ln(XM)	-1.617651	(c, t, 1)	-4.532598	-3.673616	-3.277364	0.7469
D(lnXM)	-3.687115	(c, 0, 0)	-3.857386	-3.040391	-2.660551	0.0141
Ln(TTL)	-2.849741	(c, t, 1)	-4.571559	-3.690814	-3.286909	0.1995
D(lnTTL)	-3.815301	(c, t, 0)	-4.616209	-3.710482	-3.297799	0.0417
Ln(YSL)	-1.500834	(c, t, 1)	-4.571559	-3.690814	-3.286909	0.7906
D(lnYSL)	-4.533857	(c, t, 0)	-4.616209	-3.710482	-3.297799	0.0116

D: first difference; c: intercept; t: time trend; q: lag order.

By results of ADF test, when significance level is 0.05, the ln(GDP), ln(XM), ln(TTL) and ln(YSL) are all non stationary series, but after first difference, they are all stationary series under the same significance level, which fully indicate that ln(GDP), ln(XM), ln(TTL) and ln(YSL) are all integrated of order one.

3.4 The test of Co-integration relationship

Granger and Engel once put it forward in the 1987 that if there were at least two time series which were non stationary but their linear combination was stationary, it mean that there was a co-integration relationship among the sequences. Through the ADF test results from data stability test showing the conditions that the four time sequences ln(GDP), ln(XM), ln(TTL) and ln(YSL) meet. This paper will take VAR co-integration relationship test on the sequences above. Johansen trace approach is used to test the number of integration relationship, and the results are in the Table IV.

Table 4. Johansen trace test

Unrestricted Co-integration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical	Prob.**
None *	0.957950	79.10161	47.85613	0.0000
At most 1	0.591453	28.39934	29.79707	0.0718
At most 2	0.470111	14.07696	15.49471	0.0808
At most 3*	0.217078	3.915553	3.841466	0.0478
Trace test indicates 1 co-integrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table IV shows that there are two Co-integration equation among the four variables, $\ln(\text{GDP})$, $\ln(\text{XM})$, $\ln(\text{TTL})$ and $\ln(\text{YSL})$, the conclusion is that there are co-integration relationship among the variables.

3.5 The test of Granger causality

This research employs a lagged variable into other equation, and the Granger relationship exists when the variable in equation is affected by the lagged one. Using command Granger causality test from Eviews8.0, the model tests the causality of $\ln(\text{GDP})$, $\ln(\text{XM})$, $\ln(\text{TTL})$ and $\ln(\text{YSL})$ to see if the Granger causality exist.

Table 5. Granger causality test.

Null Hypothesis:	Obs	F-Statistic	Prob.	Conclusion
①LNTTL does not Granger Cause LNGDP	19	4.63062	0.0470	Reject
	18	0.00535	0.9426	Accept
	17	1.06977	0.4051	Accept
②LNTTL does not Granger Cause LNXM	19	0.02311	0.8811	Accept
	18	0.93444	0.4177	Accept
	17	0.91445	0.4684	Accept
③LNXM does not Granger Cause LNGDP	19	10.6389	0.0049	Reject
	18	0.31014	0.7386	Accept
	17	0.60058	0.6292	Accept
④LNGDP does not Granger Cause LNXM	19	4.7E-06	0.9983	Accept
	18	0.03301	0.9676	Accept
	17	0.17485	0.9110	Accept
⑤LNXM does not Granger Cause LNTTL	19	7.78327	0.0131	Reject
	18	1.13336	0.3518	Accept
	17	1.56248	0.2590	Accept
⑥LNXM does not Granger Cause LNYSL	19	9.33627	0.0076	Reject
	18	3.03615	0.0828	Reject
	17	3.54048	0.0560	Reject
⑦LNYSL does not Granger Cause LNXM	19	0.00535	0.9426	Accept
	18	0.01526	0.9849	Accept
	17	0.51472	0.6813	Accept
⑧LNGDP does not Granger Cause LNYSL	19	2.62531	0.1247	Accept
	18	3.39637	0.0651	Reject
	17	2.85079	0.0912	Reject
②LNTTL does not Granger Cause LNXM	19	0.02311	0.8811	Accept
	18	0.93444	0.4177	Accept
	17	0.91445	0.4684	Accept

Results show in TableVI: on the assumption of 10% significance level, Empirical results of hypothesis include ①LNTTL does not Granger Cause LNGDP and ②LNXM does not Granger Cause and the LNGDP indicate that with a lag phase the total amount of import and export cargo throughput is the Granger reason of GDP. But in the lags

of two and three phases this Granger causality does not exist.

In addition, the null hypothesis can be accepted under the 10% significant level that the cargo throughput and the gross domestic product is not the Granger reason of the total amount of imports. Conclusion can be tested from one and three phase lagged hypothesis including ② LNTTL does not Granger Cause LNXM and ④LNGDP does not Granger Cause LNXM.

Through the comparison of ⑤LNXM does not Granger Cause LNTTL and ⑥LNXM does not Granger Cause LNYSL, concluding that import and export are always the Granger reason of freight volume growth, it is also the lagged Granger reason of cargo throughput growth, which shows a one-way causal relationship between the amount of cargo transport, cargo throughput and the total amount of import and export. Namely, the development of the total import and export together with import and export growth will accelerate cargo transportation volume and cargo throughput of Shandong province in the long term. However, this promoting effect is not obvious between the amount of cargo transport, cargo throughput and the total import and export trade growth in Shandong Province.

Finally, test results of hypothesis ③LNXM does not Granger Cause LNGDP and ⑧LNGDP does not Granger Cause LNYSL show that in one phase lag, the total amount of import and export is the Granger reason of GDP, and in the two period lag, domestic product is the Granger reason of freight volume of Shandong Province. Therefore, causality of the total amount of import and export in addition to the domestic product and the total freight volume both have certain time-lag effect and even longer effect of the latter.

4 Conclusions and policy suggestions

4.1 Conclusions

Relying on the results of above empirical analysis, this paper summarized relevant main conclusions as follows.

Firstly, seen from a long-term, there is a long-term equilibrium relationship between economic development and international trade, international logistics in Shandong province. The respective time series of gross regional production, total export-import volume, freight traffic volume and cargo handling capacity are all non-stationary series. But after the first order difference, these four variables are stationary time series, thus indicating they are all one-order integrated series essentially that the long-term co-integration relationship exists among all data.

Secondly, the total export-import volume has a one-way causal relation to freight traffic volume and cargo handling capacity that shows the increase of total amount of international trade in Shandong province will corresponding promote the development of international logistics in the province and improve the benefits of international logistics. However, the development of international logistics in Shandong province has a relatively weak impact on international trade.

Thirdly, the analysis results show that total export-import volume is the Granger-cause of gross regional production in the condition of lag phase I, and the gross regional production in Shandong province is the Granger-cause of freight traffic volume in lag phase II. Therefore, the effect of gross regional production on total export-import volume and the impact of gross regional production on freight traffic volume have certain hysteresis effect, and the latter's lagging effect longer. In other words, in the long-term, the increase of international trade in Shandong province will drive growth of gross regional production which in turn drives growth of international logistics yield in Shandong province. This well confirmed that there is a permanently interconnected guide mechanism between international trade and international logistics in Shandong province.

4.2 Policy suggestions

Based on the conclusion above and integrated Shandong's own development status, the paper raised three policy suggestions:

Firstly, as to macro-policy, Shandong province should make full use of congenital advantage such as geographical location, resource endowment and sufficient labor. Then, based on the strategic background of the flourish of Shandong Peninsula Blue Economic Zone, Shandong province should strengthen the link and interact with international trade and international logistics, and enact relevant policies to promote the development of international trade and international logistics. In order to standardize the order of the international trade market and construct the international logistics development environment, the concrete method including support policy of international logistics enterprise, establish and perfect the international logistics infrastructure and international logistics system, improve efficiency, reduce the intermediate process, and strengthen departments' coordination. Meanwhile, Shandong province should grasp the development opportunity with Japan and South Korea, with its unique geographical location and good open condition to vigorously attract foreign investment, optimize investment environment, introduce foreign advanced logistics management and technology experience, and expand domestic and foreign logistics strategic alliance, driving the development of international trade and international logistics to the largest extent in Shandong province.

Secondly, from the micro-construction aspect, Shandong province has superior location since it located in the northeast Asia ocean transport hub. Therefore, it should strengthen the international logistics infrastructure construction in bonded zones to ensure the easy access to highway, railway and maritime transportation, and realize regional economic integration to ensure the international multimodal transport. Meanwhile, Shandong should enhance the modernization of distribution park management process by making innovative reconstruction based on the existing infrastructure and setting up the internationalization of public information platform, as well as make full use of information technology and high-tech

products improving the internationalization and efficiency of logistics operations in order to provide good hardware guarantee for the international trade in bonded area. About port construction, Shandong province should take the port of Qingdao for the center, coordinate with the port of Yantai, Weihai and Rizhao for common development to promote the integration of resources and realize the port area linkage. In the meantime, Shandong should increase port construction, expand radiating and driving function of ports, give full play to its own characteristics to avoid the "convergence" of port development. Finally, drive the construction of international logistics through the expansion of port economic hinterland, and promote the development of international trade in Shandong province.

There are lots of colleges, universities, scientific research institutions in Shandong province, and the scholars majoring in trade engineering have a firm background and professional. Therefore, to train more and better professional trade worker, Shandong province should aim to create a mode for integration of training and researching, learn advanced philosophy and training experience from abroad, and cooperate with international trade enterprises. To stimulate the development of international trade induced by Shandong province, Shandong province should develop a comprehensive, effective, creative policy based on the future development direction of Shandong Province free trade zone and by integrating of experienced advanced and fresh innovated logistics workers.

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