Print ISSN: 2288-4637 / Online ISSN 2288-4645
doi:10.13106/jafeb.2021.vol8.no2.0453

International Logistics: Does It Matter in Foreign Trade?

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Received: November 05, 2020 Revised: December 30, 2020 Accepted: January 08, 2021

Abstract

Economic globalization provides a good channel for the development of foreign trade around the world. Due to this background, this paper sets the Organization for Economic Co-operation and Development (OECD) countries as a sample to explore the importance of international logistics in foreign trade. An annual panel data from 2000 to 2017 will be used to conduct an empirical estimation under the panel unit root test and the fixed effect model. Foreign trade is treated as an explained variable and international logistics is treated as explanatory variables. The findings show that international logistics have a positive spillover effect on export trade and the speed of international logistics development has a regulatory effect on the relationship between both of them, which presents a U-shaped curve. When the speed of international logistics development is slow, an increase of it restrains the positive spillover effect of international logistics on export trade. However, when it rises to a certain extent, this increase releases the positive spillover effect of international logistics on export trade. As can be seen by the evidence that this paper provides, the impact of international logistics on foreign trade is dynamic. Moreover, this paper also puts forward some corresponding measures about the relationship between both of them.

Keywords: International Logistics, Foreign Trade, Panel Unit Root Test, Fixed Effect Model

JEL Classification Code: F14, L93, R40

1. Introduction

The deepening of global economy has provided a channel for all countries to conduct international economic activities. In fact, frequent international economic activities will bring unpredictable shocks to the whole economic system. For instance, international logistics has grown into one of the most important emerging services. Meanwhile, its important role in world economy has become more and more prominent, which is called the "third source of profit" of enterprises. In economics, strictly speaking, the relationship between international trade and international logistics is that of "twin brothers". International trade mainly solves the problem of transfer of ownership in commodity and commodity transactions, which involves commodity circulation, capital flow and information flow. On the other hand, international logistics focuses on solving the problem of product space displacement in the process of transfer of goods' ownership, which mainly involves the transportation, storage and delivery of goods. Therefore, it can be concluded that international logistics and international trade can complement each other. On the one hand, international trade provides the precondition and foundation for the development of international logistics. The development scale and speed of international trade determines the development of international logistics. On the other hand, international logistics is the basic guarantee for the development of international trade, and international logistics has a counter-force effect on the development of international trade.

The relationship between international logistics and international trade is still a puzzle in current empirical

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estimations. Therefore, a lot of scholars have fulfilled empirical estimations on this proposition with different samples and different time spans. For example, Dong (2017) has explored the impact of the economics of coastal urban logistics on international trade development with the same on China's coastal cities. Weng (2018) sets Fujian (a province of China) as an example to analyze the significance of modern logistics to Fujian's foreign trade development. Meanwhile, Le (2018) sets Vietnam as an example to discuss the relationship between logistics performance and bilateral trade. In fact, even though a lot of researches have focused on this proposition, most of their research results are different. Due to this reason, this paper treats the Organization for Economic Co-operation and Development (OECD) countries as a sample with an annual panel data from 2000 to 2017 to explore the importance of international logistics to foreign trade (export trade). Moreover, a series of econometric approaches such as panel unit root test and fixed effect model will be employed to fulfil an empirical estimation. Meanwhile, foreign trade (export trade) is treated as an explained variable.

International logistics and the speed of international logistics development are treated as explanatory variables. These variables will be used to fulfil an empirical estimation to exploit the relationship between international logistics & export trade and to reveal the regulatory effect on the relationship between the speed of international logistics development and export trade. The findings of this paper show that international logistics has a positive spillover effect on export trade and the speed of international logistics development has a regulatory effect on the relationship between international logistics and export trade, which presents a U-shaped curve. When the speed of international logistics development is slow, an increase of the speed of international logistics development restrains the positive spillover effect of international logistics on export trade. However, when the speed of international logistics development rises to a certain extent, the further improvement of the speed of international logistics development releases the positive spillover effect of international logistics on export trade. Of course, some important variables (GDP per capita, population, relative price, one-period lagged outward foreign direct investment) selected in this paper also have a significant effect on export trade in OECD countries.

With this in mind, the rest of this paper will be as follows. Chapter two discusses the previous researches and displays the learnings of this paper. Chapter three describes the variables of this paper and sets a model based on these variables. Chapter four analyzes the relationship between these variables on account of some related econometric approaches. Chapter five analyzes the conclusion of this paper and puts forward some corresponding measures in view of empirical evidences this paper provided.

2. Literature Review

With the deepening of economic globalization, international logistics as a bridge and hub of international trade development, breaks the confinement of national boundaries and provides a good foundation for international trade. Carruthers and Bajpai (2002), study the trends in trade and logistics from an East Asian perspective. They analyze the development trend of East Asian transport and logistics industry. They find that the competitive advantage and growth performance of East Asian trade are determined by the benefits of transport and logistics such as shipping, warehousing facilities and communications. Carruthers et al. (2003) also set East Asian as a sample to analyze the relationship between trade and logistics. They find that reducing the cost and raising the quality of logistics and transport systems can improve international market access and lead directly to an increase in trade. Meanwhile, Devlin and Yee (2005), attempt to study trade logistics in developing countries with a sample from the Middle East and North Africa. They find that a good logistics system can increase the growth of non-oil export trade, which is consistent with the previous experience of existing trade initiatives that can be supported by a powerful logistics system and the potential gains from trade agreements. However, Nordås et al. (2006) use the gravity model to discuss the impact of logistics on trade. They find that there is a mutual effect between logistics and trade. That is to say, they can affect each other.

Pomfret (2010) finds that Central Asian countries continue to take advantage of their comparative advantages in raw material exports, but their trades are hampered by poor transport facilities and the failure to improve trade soft infrastructure. These weaknesses are exacerbated by inland growth, but Central Asia may turn this to its advantage because of its proximity to the world's most dynamic large economies. To benefit from this, the hard and soft infrastructure of transport and trade needs to be upgraded, and the promotion of regional cooperation in transit needs to stimulate intraregional and regional foreign trade. Meanwhile Hausman et al. (2013) also do a research on this proposition. They find the effect of logistics performance on bilateral trade is statistically significant. Faria et al. (2015) try to assess Brazil's logistics performance index, in connection to its principal competitors in conducting international trade. The international trade data is collected from SECEX and COMTRADE, while the logistics performance index is provided by the World Bank. Statistical approaches like the cluster analysis and the multiple comparison tests of means are employed to analyze the data. After using logistics performance index for the 39 competitors, their findings reveal that logistics are inefficient in Brazil. The differences between logistics performance indicators also seem to be related to the solution of the new public policies

of governments and the highlighting of the logistics barriers in Brazil's international trade. In terms of economic growth, He and Wei (2017) find that it has a positive effect on e-commerce trade. In the same year, Gani (2017) sets sixty countries including Australia, Norway, France and so on as an example to explore the impact of logistics performance on international trade. He finds that in general, logistics performance has a positive and statistically significant effect on export.

With a sample of Asian countries, He (2018) finds that the exchange rate regimes can affect cross-border trade. Furthermore, Wang and Choi (2018) analyze how logistics performance affects international trade volume and compares the different effects between developing and developed countries by employing a gravity model with panel data from 43 countries in 2010, 2012 and 2014. Their findings show that an improvement of logistics performance index has more impact on export volume than that on import volume. It also has a more powerful influence on developed countries' trade volumes than on developing countries' trade volumes. Wang et al. (2018) explore the association between green logistics and international trade. They use Heckman's two-stage procedure to estimate an augmented gravity model which generally includes green logistics variables with a sample of 113 countries and regions from 2007 to 2014. Their findings show that the exporting and importing countries' logistics performance indexes are positively associated with trade volume. Meanwhile, the logistics performance index of exporting countries positively affects trade probability. When taking the whole sample into consideration, the exporting countries' green logistics performance has a positive impact on probability and export volume. For trade flows between developing & developing countries and developed & developed countries as well as developing & developed countries, the importing countries' green logistics performance has a significant and negative impact on the exporting countries' export volume. In accordance with trade flow between developed & developing countries, the importing countries' green logistics performance has a significant and negative effect on export probability and it has a positive impact on export volume.

Zhan and Wang (2019) use 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 the vector auto-regression model. Their results indicate that a long-run equilibrium relationship exists between the 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 logistics. In addition, the increase of logistics supply has an encouraging effect on the development of foreign trade in Sichuan Province, but its impact is not as good as that of the logistics demand. Lin and Cheng (2019) also arrive at the same idea even though it is with a different sample. He and Wang (2019) set ASEAN countries as an example to explore the determinants of cross-border e-commerce trade. They find that the terms trade has a negative effect on cross-border e-commerce trade. Siddiqui and Vita (2019) focus on the comparative analysis of the impact of logistics performance on trade with respect to the garment sector in Cambodia, Bangladesh, and India. Although logistics performance is at the grass-roots level, it is seen that it has a significant impact on trade through various studies as well as empirical analyses. They employ the panel data analysis to assess the impact of logistics performance on trade across the three countries of Cambodia, Bangladesh and India over the time period ranging from 2001 to 2016 for the garment sector. Their results indicate that, logistics performance has a positive effect on trade in the case of the garment sector.

The papers quoted above analyze the relationship between logistics and international trade in different perspectives. However, most papers are focused on the linear relationship between both of them. In this paper, what is interesting and novel is that, not only will the linear relationship between both of them be considered, but also their nonlinear relationship. Of course, this point is also a difference to be accounted for when compared with existing papers. In other words, this is the kind of difference in the contribution that this paper has made to the proposition.

3. Theoretical Framework

3.1. Variable Description

Under the background of economic globalization, international logistics provides a good condition for the development of foreign trade. Even though some scholars have studied this proposition, the internal mechanism between international logistics and foreign trade is still unclear due to the lack of data at present. Therefore, panel data from the organization for economic co-operation and development (OECD) countries is selected as a sample to reveal the intrinsic mechanism between both of them.

In this paper, foreign trade will be treated as an explained variable which is represented by the volume of export trade (goods and service) and it will be assigned by the logarithm ($\log ex_{i,t}$). Moreover, international logistics will be treated as the core variable which is represented by international freight transport million ton per kilometer and it will be assigned by the logarithm ($\log\log i_{i,t}$). The speed of international logistics development will also be treated as the core variable which is represented by the growth rate of international logistics and it will be calculated as the result of

$\frac{d\log i_{i,t} - d\log i_{i,t-1}}{d\log i_{i,t-1}}$. Also, it will be marked as $d\log i_t$. The rest will be treated as control variables including the GDP per capita, population, relative price and outward foreign direct investment. Stated in details, the GDP per capita is always treated as an important factor to affect the export trade in many previous researches. Likewise, this paper also introduces the GDP per capita which will be assigned by the logarithm ($\log pgdp_{i,t}$).

The larger population size, according to the production function, means more output. However, a large amount of output will stimulate export trade. Hence it is introduced in this paper, which will be assigned by the logarithm ($\log pop_{i,t}$). The concept of relative price is introduced in this paper, and because of that, the positive difference between two countries' price levels will yield additional benefits in terms of the home country. Of course, because of this advantage, the home country is willing to achieve stipulated export trade. Also, it will be assigned the logarithm ($\log rp_{i,t}$). The outward foreign direct investment has a certain impact on the productivity of the host country's domestic enterprises. The competitive effect of foreign capital injection will occupy the market of domestic enterprises. It will also help the host country's enterprises to improve their productivity through the technology spillover effect of foreign capital enterprises on the host country's enterprises. Its comprehensive effect will affect the productivity of enterprises, and then affect the export trade of the whole country. The influence it has depends on the importance of role that it played. Additionally, in the process of globalization, the growth of foreign trade also affects the investment decisions of foreign investors in the host country. Hence, in order to avoid the endogenous problems caused by the two-way causality between the outward foreign direct investment and the export trade, the one-period lagged outward foreign direct investment is introduced in this paper and it will be assigned the logarithm ($\log ofdi_{i,t-1}$).

This paper selects the organization for economic co-operation and development (OECD) countries as an example to explore the internal mechanism between international logistics and foreign trade. All the panel data employed in this paper is sourced from the World Bank, the data center of OECD, the United Nations conference on trade and development and some related data bases.

3.2. Model Specification

From chapter two, it can be concluded that a lot of economists have studied this proposition in different aspects. However, most of their studies focus on the linear relationship. In this paper, the non-linear relationship has also been taken into consideration. The model with international logistics is presented as:

$$\begin{aligned}\log ex_{i,t} &= \alpha_0 + \alpha_1 \log\log i_{i,t} + \alpha_2 \log pgdp_{i,t} \\ &+ \alpha_3 \log pop_{i,t} + \alpha_4 \log rp_{i,t} + \alpha_5 \log ofdi_{i,t-1} \\ &+ \nu_i + \eta_t + \mu_{i,t}\end{aligned} \tag{1}$$

Where i indicates the country; t indicates the year; v_i indicates the individual effect (country); η_t indicates the time effect (year). $u_{i,t}$ is independently and identically distributed among countries and years. $\alpha_0 ... \alpha_5$ are estimated coefficients. The positive and negative sign of α_1 represents the influence direction of international logistics on export trade. If α_1 is positive and significant in statistic, the international logistics will have positive effect on export trade. Otherwise, it will have a negative effect on export trade. The model with the speed of international logistics development is presented as:

$$\begin{aligned}\log ex_{i,t} &= \beta_0 + \beta_1 \log\log i_{i,t} + \beta_2 d\log i_{i,t} \\ &+ \alpha_3 \log pgdp_{i,t} + \beta_4 \log pop_{i,t} + \beta_5 \log rp_{i,t} \\ &+ \beta_6 \log ofdi_{i,t-1} + \nu_i + \eta_t + \mu_{i,t}\end{aligned} \tag{2}$$

The speed of international logistics development is introduced into model (2). Compared with model (1), model (2) attempts to test whether the international logistics has a positive spillover effect of regulating the speed of international logistics development on export trade or not. If α_1 is not equal to β_1 (α_1 and β_1 must be significant in statistic), it means that international logistics has a positive spillover effect of regulating the speed of international logistics development on export trade. Otherwise, it will not have a positive spillover effect of regulating the speed of international logistics development on export trade.

The model with cross term between international logistics and speed of international logistics development is presented as:

$$\begin{aligned}\log ex_{i,t} &= \gamma_0 + \gamma_1 \log\log i_{i,t} + \gamma_2 \log d\log i_{i,t} \\ &+ \gamma_3 \log\log i_{i,t} \times d\log i_{i,t} + \gamma_4 \log pgdp_{i,t} \\ &+ \gamma_5 \log pop_{i,t} + \gamma_6 \log rp_{i,t} + \gamma_7 \log ofdi_{i,t-1} \\ &+ \nu_i + \eta_t + \mu_{i,t}\end{aligned} \tag{3}$$

Compared with model (2), the cross term ($\log\log i_{i,t} \times d\log i_{i,t}$) is introduced into model (3). It indicates the regulatory effect of the speed of international logistics development, that is, the international logistics and the speed of international logistics development jointly affect export trade. If γ_1, γ_2 and γ_3 are positive and significant in statistic, the international logistics and the speed of international logistics development jointly affect the export trade. Otherwise, it will not have a joint effect on export trade. The model with cross term between international logistics

and square of speed of international logistics development is presented as:

$$\begin{aligned}\log ex_{i,t} &= \delta_0 + \delta_1 \log\log i_{i,t} + \delta_2 \log d\log i_{i,t} \\ &+ \delta_3 \log\log i_{i,t} \times d\log i_{i,t} + \delta_4 \log\log i_{i,t} \times d\log i_{i,t}^2 \\ &+ \delta_5 \log pgdp_{i,t} + \delta_6 \log pop_{i,t} + \delta_7 \log rp_{i,t} \\ &+ \delta_8 \log ofdi_{i,t-1} + \nu_i + \eta_t + \mu_{i,t}\end{aligned} \quad (4)$$

Compared with model (3), the cross term ($\log\log i_{i,t} \times d\log i_{i,t}^2$) is introduced into model (4). The purpose is to explore whether there is a curve effect in the mechanism of international logistics on the relationship between the speed of international logistics development and the export trade or not. If δ_4 is positive and significant in statistic, it means that there is a curve effect in the mechanism of international logistics on the relationship between the speed of international logistics development and export trade. If not, there is no curve effect in the mechanism of international logistics on the relationship between speed of international logistics development and export trade. Moreover, model (3) and model (4) are used to verify the regulatory path of international logistics to the relationship between speed of international logistics development and export trade. The coefficient of determination can be employed to determine which model is the best one to reflect the relationship between international logistics, the speed of international logistics development and export trade. If model (4) is better than model (3), γ_3 should be less than zero and δ_4 should be greater than zero (both must be significant in statistic). In other words, it means that the speed of international logistics has a regulatory effect on export trade. This regulatory effect presents a U-shaped relation. Otherwise, model (4) will not hold true. Additionally, if model (3) is better than model (4), it means that the speed of international logistics has a regulatory effect on export trade. This regulatory effect presents a linear relation. Otherwise, model (3) will not hold true.

4. Empirical Analyses

4.1. Summary Statistics

This paper sets OECD countries as an example to explore the importance of international logistics to foreign trade. Annual panel data from 2000 to 2017 will be employed to fulfil an empirical analysis under a series of econometric approaches. There are eight variables including one explained variable [export trade ($\log ex_t$)] and seven explanatory variables [(GDP per capita ($\log pgdp_t$), population ($\log pop_t$), relative price ($\log rp_t$), international logistics ($\log\log i_t$), one-period lagged outward foreign direct investment ($\log ofdi_{t-1}$), speed of international logistics development ($d\log i_t$) and square of speed of international logistics development ($d\log_t^2$)]. The summary statistic of them will be shown in Table 1.

4.2. Panel Unit Root Test

In order to avoid the occurrence of pseudo-regression and other problems and according to the structural characteristics of the data, the panel unit root test is performed before estimating the panel regression. Clearly, common unit root test methods often have errors in unit root test of panel data. The robustness of the results must be guaranteed when the panel regression analysis is carried out. Compared with the research done by He and Feng (2019), in this paper, the Im–Pesaran–Shin (IPS) test, Fisher test, Phillips–Perron (PP) test, Levin-Lin-Chu (LLC) test and other methods are used to test the stationarity of each variable. The test process will be kept in line with the models below.

Based on the research of Levin et al. (2002), the LLC test model gives:

$$\Delta y_{i,t} = \rho_i y_{i,t-1} + \sum_{j=1}^{k} \gamma_{i,j} \Delta y_{i,t-j} + X'_{i,t}\beta_{i,t} + \mu_{i,t} \quad (5)$$

Where $X'_{i,t}$ indicates the exogenous variables.

Based on the research of Im et al. (2003), the IPS test model gives:

$$\Gamma_t = \left(\frac{\sqrt{N}[t_{NT}(p) - a_{NT}]}{\sqrt{b_{NT}}}\right) \to N(0,1) \quad (6)$$

Where $a_{NT} = \left(\frac{1}{N}\right)\sum_{i=1}^{N} E[t_{NT}(p,0)]$, $b_{NT} = \left(\frac{1}{N}\right)\sum_{i=1}^{N} \mathrm{var}[t_{NT}(p,0)]$. t_{NT} indicates the ADF-statistics with lag p of the N cross-sectional individuals. $E[t_{NT}(p,0)]$ indicates the ADF-statistic mean with lag p of N department. $\mathrm{var}\left[t_{NT}(p,0)\right]$ indicates the ADF-statistic variance with lag p of N department.

Based on the research of Hadri (2000), the Hadri test model gives:

$$LM_1 = \frac{1}{N}\left(\sum_{I=1}^{N}\left(\sum_{T} S_i(t)^2 / T_2\right) / \bar{f}_0\right) \quad (7)$$

$$LM_2 = \frac{1}{N}\left(\sum_{I=1}^{N}\left(\sum_{T} S_i(t)^2 / T^2\right) / f_{i0}\right) \quad (8)$$

Where $S_i(t)^2 = \sum_{s=1}^{t} \hat{\varepsilon}_{i,t}$ indicates the sum of residuals; $\bar{f}_0 = \sum_{t=1}^{n} \frac{f_{i0}}{n}$ indicates the Individual mean.

Table 1: Summary Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
$\log ex_t$	594	0.153	0.094	0.052	0.474
$\log pgdp_t$	594	2.362	3.120	-14.724	25.763
$\log pop_t$	594	0.526	0.683	-1.256	2.493
$\log rp_t$	594	2.766	5.956	-19.204	66.670
$\log\log i_t$	594	4.807	0.760	2.800	6.921
$\log ofdi_{t-1}$	594	3.807	0.981	0.433	5.598
$d\log i_t$	594	0.002	0.243	-2.095	1.833
$d\log_t^2$	594	0.059	0.362	0.000	4.391

Table 2: Results of Panel Unit Root Test

Approach	Statistics	Variable							
		$\log ex_t$	$\log pgdp_t$	$\log pop_t$	$\log rp_t$	$\log\log i_t$	$\log ofdi_{t-1}$	$d\log i_t$	$d\log_t^2$
IPS	W-stat	-1.123	-7.179	-9.325	-10.151	-0.178	-7.282	-144.826	-3146.620
	P-vale	0.131	0.000	0.000	0.000	0.429	0.000	0.000	0.000
ADF	χ^2	105.731	161.845	124.904	209.024	92.510	168.360	444.909	353.360
	P-vale	0.001	0.000	0.000	0.000	0.017	0.000	0.000	0.000
PP	χ^2	102.692	208.656	94.703	219.056	86.394	176.071	555.570	381.601
	P-vale	0.003	0.000	0.012	0.000	0.047	0.000	0.000	0.000
LLC	T-stat	-4.705	-11.619	-5.949	-15.177	-2.567	-6.859	-224.009	-2014.970
	P-vale	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000
HADRI	Z-stat	7.517	6.474	9.026	11.444	8.782	5.766	8.674	8.786
	P-vale	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: LLC indicates that the null hypothesis means that the unit root exists in the sequence. IPS indicates that the null hypothesis means that the unit root does not exist in the sequence. ADF indicates that the null hypothesis means that the unit root exists in the sequence. PP indicates that the null hypothesis means that the unit root exists in the sequence. HADRI indicates that the null hypothesis means that the unit root does not exist in the sequence.

Based on the researches of Dickey and Fuller (1979), and Phillips and Perron (1988), Fisher-ADF and Fisher-PP test model gives:

$$\chi^2 = -2\sum_{i=1}^{N}\log(p_i) \tag{9}$$

Where p_i indicates the corresponding p-value of ADF test and PP test respectively.

The results of panel unit root test show in Table 2.

Table 2 exhibits the panel unit root results of all variable used in this paper. $\log ex$ does not have a unit root except Hadri test. $\log pgdp$ does not have a unit root except Hadri test and IPS test. $\log pop$ does not have a unit root except Hadri test and IPS test. $\log rp$ does not have a unit root except Hadri test and IPS test. $\log\log i$ does not have a unit root except Hadri test. $\log ofdi$ does not have a unit root except Hadri test and IPS test.

$d\log i$ does not have a unit root except Hadri test and IPS test. $d\log^2$ does not have a unit root except Hadri test and IPS test. In summary, it can be confirmed that all variables used in this paper are stationary.

4.3. Results

In this paper, pool model, one-way fixed effect model, two-way fixed effect model and random effect model are used to conduct an empirical analysis. Meanwhile, some econometric approaches such as Chow test, F-test and Lagrange multiplier (LM) test will be used of to choose the best estimation method. The estimated results will be shown in Table 3.

Table 3 indicates the estimated results of pool model and individual fixed effect model. It can be confirmed that the null hypothesis is rejected in the light of result of F-statistic. In other words, the estimation of fixed effect model will be more precise than that of pool model. Then, a random effect should be taken into consideration. The estimated results will be shown in Table 4.

According to the estimated results of <Table 4>, it can be found that the null hypothesis of LM test is rejected. Said differently, the estimation of random effect is not sufficient. Therefore, the fixed effect will be used to fulfil an estimation. Combined the results of <Table 3> and <Table 4>, both results of fixed effects show the GDP per capita has a positive effect on export trade. The reason is that an increase in the GDP per capita will lead to an excess domestic demand. If so, the export trade will be increased. This result is in accordance with researches done by Dedeoğlu and Kaya (2013) and Hsiao and Hsiao (2006). Moreover, the population also has a positive effect on export trade. The large scale of population means that the labor input will be increased.

On account of the production function, more labor input indicates more output. So, the possibility of export will be increased due to greater output. This result matches the research performed by Xiong et al. (2018). However, the relative price has a negative effect on export trade. The reason is that the higher price in the foreign market will provide an opportunity for domestic goods to seek higher profits in the foreign market. Therefore, export trade will be increased due to this reason. This result is also consistent with the research conducted by Riggi and Venditti (2015) who have attempted to exploit the relationship between both of them.

Table 3: Results of Pooled Models and Individual Fixed Effect Models

Variable	Pool Model				Individual Fixed Effect Model			
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
$\log pgdp_t$	0.123 [0.180]	0.123 [0.191]	0.119 [0.191]	0.174 [0.180]	0.819*** [0.112]	0.675*** [0.113]	0.653*** [0.112]	0.801*** [0.114]
$\log pop_t$	0.063** [0.020]	0.063** [0.020]	0.062** [0.020]	0.063** [0.020]	0.092*** [0.014]	0.969*** [0.014]	0.930*** [0.014]	0.095*** [0.014]
$\log rp_t$	-0.056 [0.041]	-0.058 [0.040]	-0.049 [0.041]	-0.037 [0.041]	-0.065* [0.039]	-0.072* [0.041]	-0.076 [0.039]	-0.072* [0.040]
$\log ofdi_{t-1}$	0.014 [0.012]	0.014 [0.012]	0.013 [0.011]	0.011 [0.011]	0.066** [0.032]	0.072** [0.031]	0.073** [0.032]	0.071 [0.029]
$\log\log i_t$	0.038 [0.024]	0.038 [0.024]	0.039 [0.023]	0.041 [0.023]	0.040** [0.019]	0.064*** [0.021]	0.04*** [0.019]	0.067*** [0.021]
$d\log i_t$		0.579 [0.367]	0.529 [0.421]	0.627 [0.340]		0.510*** [0.071]	0.206** [0.099]	0.178** [0.082]
$\log\log i_t \times d\log i_t$			-0.122 [0.100]	-0.196 0.101			-0.159*** [0.011]	-0.244*** [0.012]
$\log\log i_t \times d\log_t^2$				0.061* [0.023]				0.047** [0.021]
Constant	0.349*** [0.101]	0.349*** [0.102]	0.354*** [0.100]	0.357*** [0.099]	-0.937 [0.179]	-0.124 [0.318]	-0.121 [0.315]	-0.139 [0.330]
R^2	0.308	0.307	0.308	0.314	0.623	0.729	0.632	0.729
Observation	561	561	561	561	561	561	561	561
F-Statistic	241.429	236.531	210.934	195.457	68.822	65.379	53.256	51.315
Fixed Effect	-	-	-	-	country	country	country	country

Note: [ ] indicates the standard errors; * indicates p<0.1; ** indicates p<0.05; *** indicates p<0.01.

Table 4: Time and Individual Fixed Effect Models and Random Effect Models

Variable	Time and Individual Fixed Effect Models				Random Effect			
	Model (9)	Model (10)	Model (11)	Model (12)	Model (13)	Model (14)	Model (15)	Model (16)
$\log pgdp_t$	0.288*** [0.022]	0.201*** [0.021]	0.253*** [0.022]	0.294*** [0.023]	0.721*** [0.029]	0.669*** [0.028]	0.647*** [0.029]	0.744*** [0.029]
$\log pop_t$	0.062*** [0.014]	0.067*** [0.014]	0.061*** [0.014]	0.066*** [0.014]	0.061*** [0.015]	0.064 [0.014]	0.060 [0.014]	0.061 [0.016]
$\log rp_t$	-0.098** [0.042]	-0.106** [0.046]	-0.109*** [0.040]	-0.107** [0.042]	-0.057* [0.035]	-0.059* [0.036]	-0.063* [0.035]	-0.061* [0.035]
$\log ofdi_{t-1}$	0.087** [0.042]	0.086** [0.041]	0.086** [0.041]	0.086** [0.042]	0.061** [0.030]	0.063** [0.031]	0.064** [0.030]	0.063** [0.032]
$\log \log i_t$	0.036*** [0.021]	0.061*** [0.022]	0.059*** [0.021]	0.064*** [0.023]	0.028 [0.021]	0.039* [0.021]	0.049** [0.022]	0.021 [0.022]
$d \log i_t$		0.483*** [0.012]	0.322*** [0.011]	0.183*** [0.012]		0.175 [0.011]	0.247** [0.013]	0.230* [0.012]
$\log \log i_t \times d \log i_t$			-0.622** [0.251]	-0.430* [0.251]			-0.610** [0.245]	-0.511** [0.250]
$\log \log i_t \times d \log_t^2$				0.043* [0.024]				0.074*** [0.026]
Constant	0.074 [0.181]	-0.108 [0.325]	-0.103 [0.326]	-0.123 [0.341]	0.118* [0.066]	0.087 [0.079]	0.087 [0.079]	0.079 [0.080]
R^2	0.529	0.534	0.537	0.538	0.725	0.693	0.792	0.774
Observation	561	561	561	561	561	561	561	561
F-Statistic	48.551	45.215	43.913	41.822	-	-	-	-
LM	-	-	-	-	377.106	385.946	393.507	414.042
Fixed Effect	Country Year	Country Year	Country Year	Country Year	Country -	Country -	Country -	Country -

Note: [ ] indicates the standard errors; * indicates p<0.1; ** indicates p<0.05; *** indicates p<0.01.

The one-period lagged outward foreign direct investment also has a positive and significant effect on export trade. This is because foreign-funded enterprises have a higher export tendency than domestic-funded enterprises. The inflow of vertical outward foreign direct investment increases the production of intermediaries. Thereby the export trade of intermediaries will be increased. This result is in line with the research that Liu et al. (2016) have explored the relationship between outward foreign direct investment and export using a pendulum gravity. The most important explanatory variable is international logistics. Based on the results of model (5) and (9), international logistics has a positive effect on export trade. Meanwhile, it shows that an increase in the international logistics has a positive spillover effect on export trade. For the OECD countries, the international logistics support system is relatively perfect, the contradiction between supply and demand of related supporting facilities is relatively small, and the deep integration of real economy and international logistics is relatively close, which promotes the spillover effect of international logistics on export trade to a certain extent.

After that, attention will be paid to the regulatory effect between speed of international logistics and export trade. According to the results of model (6) and model (10), international logistics has a positive effect on export trade even by adding the speed of international logistics development. Said specifically, the coefficient of international logistics on export trade increases from 0.040 to 0.064 between model (5) and model (6). The coefficient of international logistics on export trade increases from 0.036 to 0.061 between model (9) and model (10). These differences indicate that the speed of international logistics development indeed has a regulatory effect on the relationship between international logistics and export trade. Under the regulatory effect of speed of international logistics development, the spillover effect of speed of international logistics development on export trade has increased, and the positive spillover effect has not changed. The regulatory effect of speed of international logistics development is only to change the magnitude of the positive spillover effect of speed of international logistics development on export trade, but not to change the direction of its spillover effect. However, due to the regulation of speed of international logistics development, the elasticity of speed of international logistics development of export trade increases, and the sensitivity of export trade to international logistics also increases.

Table 5: Robustness Test (70% of the Original Sample as a New One)

Variable	Individual Fixed Effect Model				Time and Individual Fixed Effect Models			
	Model (17)	Model (18)	Model (19)	Model (20)	Model (21)	Model (22)	Model (23)	Model (24)
$\log pgdp_t$	0.324*** [0.053]	0.229*** [0.054]	0.225*** [0.053]	0.401*** [0.055]	0.211*** [0.054]	0.120*** [0.056]	0.112*** [0.054]	0.541*** [0.053]
$\log pop_t$	0.015 [0.011]	0.016 [0.012]	0.016 [0.011]	0.016 [0.012]	0.012 [0.013]	0.013 [0.014]	0.013 [0.013]	0.013 [0.011]
$\log rp_t$	-0.037* [0.022]	-0.042* [0.023]	-0.043*** [0.021]	-0.037* [0.021]	0.065 [0.024]	0.050 [0.023]	0.050 [0.024]	0.077 [0.025]
$\log ofdi_{t-1}$	0.080** [0.034]	0.080** [0.033]	0.081** [0.032]	0.078** [0.031]	0.074** [0.031]	0.073** [0.029]	0.074** [0.029]	0.072*** [0.028]
$\log\log i_t$	0.027 [0.022]	0.053** [0.021]	0.052** [0.021]	0.057** [0.023]	0.029 [0.021]	0.066** [0.025]	0.066*** [0.022]	0.074*** [0.022]
$d\log i_t$		0.025** [0.012]	0.033*** [0.011]	0.029** [0.012]		0.017 [0.014]	0.029** [0.013]	0.037** [0.013]
$\log\log i_t \times d\log i_t$			-0.126*** [0.031]	-0.213*** [0.033]			-0.067* [0.035]	-0.167** [0.034]
$\log\log i_t \times d\log_t^2$				0.023* [0.012]				0.018* [0.011]
Constant	0.063 [0.162]	-0.062 [0.344[3]	-0.056 [0.344]	-0.084 [0.344]	0.045 [0.172]	-0.137 [0.368]	-0.134 [0.368]	-0.174 [0.371]
R^2	0.535	0.538	0.536	0.537	0.434	0.425	0.402	0.424
Observation	429	429	429	429	429	429	429	429
F-Statistic	65.214	64.135	62.627	60.517	-	-	-	-
LM	-	-	-	-	285.971	289.625	292.042	299.994
Fixed Effect	Country -	Country -	Country -	Country -	Country Year	Country Year	Country Year	Country Year

Note: [ ] indicates the standard errors; * indicates p<0.1; ** indicates p<0.05; *** indicates p<0.01.

Based on the R^2 values of model (7), model (8), model (9) and model (10), it can be judged that model (8) and model (10) are better than model (7) and model (9). The coefficients of the cross-term between international logistics and speed international logistics development ($\log\log i_t \times i\log i_t$) are significantly negative (the coefficient in model (8) is -0.244 and the coefficient in model (10) is -0.430). However, the coefficients of the cross-term between international logistics and speed international logistics development ($\log\log i_t \times i\log i_t^2$) are significantly positive (the coefficient in model (8) is 0.047 and the coefficient in model (10) is 0.043). This result verifies that the positive spillover effect of international logistics on export trade is indeed related to the speed of international logistics development. Furthermore, it also shows that the regulatory effect of speed of international logistics development on the relationship between international logistics and export trade presents the U-shaped curve. Based on the U-shaped regulatory effect of speed of international logistics development on the relationship between international logistics and export trade, the relationship between international logistics and export trade can be further clarified. That is to say, the relationship between international logistics and export trade is not fixed, but dynamic with the change of speed of international logistics development.

4.4. Robustness Test

Because the relationship between economic variables is affected by many factors, the traditional and existing empirical estimates are prone to over-estimation or estimation bias. Therefore, in order to make the results of Table 3 and Table 4 more accurate and credible, a robustness test needs to be conducted. In this paper, we randomly select 70% of the original sample as a new sample to fulfil a robustness test. The results of robustness test will be shown in Table 5.

Table 5 illustrates the results of robustness test with a new sample randomly selected from the original sample. It can be found that compared with characteristics of Table 3 and Table 4, most of that are inherited from Table 5. Only few variables do not get through the significant test and the magnitude of few coefficients changes a little. Therefore, it can be concluded that the estimation of Table 3 and Table 4 is accurate, efficient and robust.

5. Conclusions and Suggestions

Economic globalization provides a good channel for the development of economic activities around the world, especially in the field of foreign trade. However, the frequency of foreign trade has provided impetus for the development of international logistics. Meanwhile, the development of international logistics also provides the basis and guarantee for foreign trade. Due to the unbalanced development of logistics in the world, it is difficult to collect data related to international logistics. So, this paper sets OECD countries as an example to explore the importance of international logistics to foreign trade (export trade). The reason why these countries are selected as a study subject, is that compared with the rest of world, these countries have a relatively perfect international logistics system and the relevant data of these countries can be obtained. Then an annual panel data from 2000 to 2017 was employed to fulfil an empirical estimation under a series of econometric approaches such as panel unit root test, pool estimation and fixed effect estimation. In order to reveal the dynamic characteristics of international logistics and export trade, this paper employs two indexes (international logistics and speed of international logistics development) to study the dynamic relationship between both of them in OECD countries. The findings of this paper show that the international logistics has a positive spillover effect on export trade and the speed of international logistics development has a regulatory effect on the relationship between international logistics and export trade, which presents a U-shaped curve. When the speed of international logistics development is slow, an increase of the speed of international logistics development restrains the positive spillover effect of international logistics on export trade. However, when the speed of international logistics development rises to a certain extent, the further improvement of the speed of international logistics development releases the positive spillover effect of international logistics on export trade. Of course, some important variables (GDP per capita, population, relative price, one-period lagged outward foreign direct investment) selected in this paper also have a significant effect on export trade in OECD countries.

With the increase of uncertainty in the world, the development of foreign trade (export trade) also fluctuates dynamically. For instance, since the global economic crisis happened in 2008, the export trade of countries around the world, including OECD countries, has been greatly negatively affected. Therefore, this paper provides a new scope to analyze the impact of export trade in terms of international logistics. Some corresponding measures will be given according to the evidences this paper provided. At present, international logistics has set up a free, open and universal global platform for new export trade modes. Consumers and small & medium-sized enterprises can use this platform to engage in export trade. International logistics has become one of the most important factors to drive the development of export trade. Firstly, a perfect international logistics support system and international logistics related laws and regulations should be established. At the same time, OECD countries should take good use of the speed of international logistics development to promote the development of export trade.

The slow development of information infrastructure, financial payment and security, and the international credit system have led to the imperfection of the support industry of international logistics. On the one hand, these negative factors hinder the positive spillover effect of international logistics on export trade. On the other hand, they also hinder the further development of the speed of international logistics development, which is not conducive to the scale effect of international logistics on export trade. Therefore, OECD countries should intensify their efforts to support and improve the relevant supporting system of international logistics and the development of related industries, accelerate the critical point of the speed of international logistics development on the U-shaped regulatory role of international logistics on export trade and give a full play to the positive spillover effect of international logistics on export trade. Secondly, the validity of the traditional export trade policy has suffered losses under the existing international logistics. The current customs clearance, commodity inspection and other mechanisms cannot meet the needs of international logistics development. Therefore, promoting the innovative development of international logistics and supplementing the supporting policies related to international logistics are important measures to break through the difficulty of international logistics development. Then, OECD countries can make good use of international logistics to promote export trade. Finally, OECD countries also introduce some policies to management like the GDP per capita, population, relative price and one-period lag outward foreign direct investment so as to promote the development of their export trade.

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