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The Impact of Logistics Infrastructure Development in China on the Promotion of Sino-Korea Trade: The Case of Inland Port under the Belt and Road Initiative*

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Abstract

Purpose – This study investigates the impact of inland port development in China on the promotion of bilateral trade flows between China and South Korea.

Design/methodology – The probable association between the establishment of inland ports and Sino-Korea trade was estimated using gravity models. In this regards, two sets of data were collected. The first dataset consists of the baseline variables of a gravity model, while the second one includes variables of logistics infrastructure development. The indicators of logistics infrastructure development include inland ports, the amount of government expenditure on transport infrastructure, the lengths of roads and railways, the number of trucks and the number of logistics industry workforce.

Findings – The results show that inland port development has a positive impact on facilitating bilateral trade between China and South Korea. However, the positive association holds only for Chinese regions with a large trade volume and a proximity to seaports. In other regions, the impact of inland ports is not statistically significant.

Originality/value – To the best knowledge of the authors, this study is the first attempt to explore the economic impact of inland ports in China. In addition, the findings in this paper provide both policy and managerial implications for the future development of inland ports, such as the strategic location of inland ports and integrated intermodal operations.

Keywords: Gravity Model, Inland Port, Logistics Infrastructure, Sino-Korea Trade
JEL Classifications: F14, F40, R42

1. Introduction

This study investigates the impact of inland port development in China on the promotion of bilateral trade between China and South Korea. Since diplomatic ties were established between the two countries in 1992, bilateral trade flows have been escalating remarkably.

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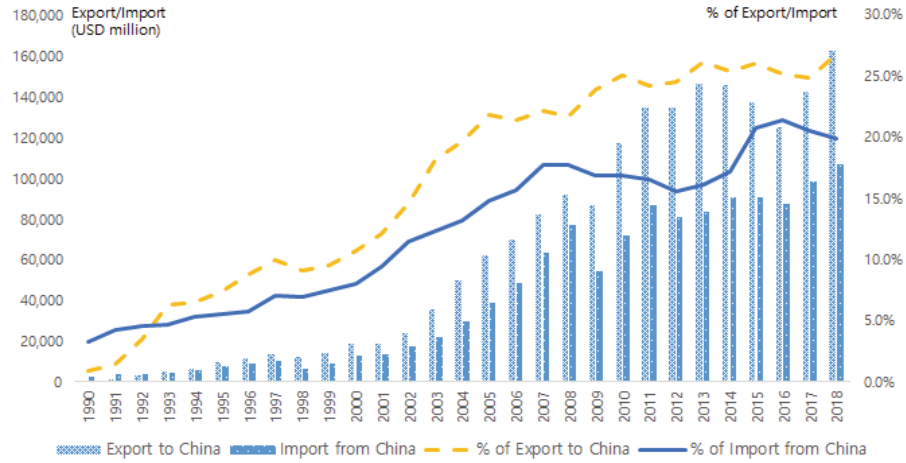
From the perspective of South Korea, China is now the largest export market with a volume of exports growing from USD 2,654 million in 1992 to USD 162,125 million in 2018, while the share of exports to China has increased from 3.5% to 26.8% in the same period, respectively (see Fig. 1.). Similarly, for the same period, Korea's imports from China have expanded from USD 3,275 million (a share of 4.6%) to USD 106,489 million (a share of 26.8%).

Among a plethora of factors, the development of logistics infrastructure plays a key role in promoting Sino-Korea trade. It is widely believed that the growth of international trade is driven by technological advances in transport and communication systems. Efficient logistics operations enable exporters and importers to reduce transportation costs, optimize manufacturing planning, and synchronize business information, all which cultivate an atmosphere of facilitating international trade flows.

Fig. 1. Korea's Exports and Imports with China (1990-2018)



Source: Korea International Trade Association (2019).

This paper pays particular attention to the role of inland ports in facilitating the economic relationship between China and South Korea. According to the definition of UNCTAD (2011), inland ports are 'specific sites to which imports and exports can be consigned for inspection by customs and which can be specified as the origin and destination of goods in transit.' Although the concept of the inland port is not new (Roso and Lumsden, 2009), China's development of inland ports in recent decades has gained growing attention since the country announced the Belt and Road Initiative (hereafter referred to as the 'BRI') in 2013. Targeting development into the most promising current economic corridors, the BRI is a long-term national strategy coordinating China and its neighboring countries, highlighting cross-border and multilateral cooperation, and offering new opportunities for China's inland regions (Wei, Sheng and Lee Tae-Woo, 2018). Accordingly, the development of inland ports is one of the major pillars of the national strategy because they act as a catalyst for logistics integration between seaports and landlocked regions in China. For instance, Xi'an International Inland Port, located at the Xi'an International Trade & Logistics Park (Shaanxi Province), accommodated 1,235 train arrivals and departures, and handled 1.2 million metric

tons of goods in 2018, equivalent to an increase of 6.37 and 5.18 times greater from 2017, respectively. The recently developed inland port is now leading other facilities in terms of actual handling capacity, heavy load rate, and freight volume. Further, a number of Korean logistics service providers are interested in the Xi'an International Inland Port as they are trying to export goods to Europe through the Trans China Railway (TCR), which offers a new mode of Silk Road multimodal transport. In addition, the construction of inland ports plays a significant role in logistics aggregation, which is widely believed to promote the stable development of an economy and society by improving logistics efficiency and the linkage of multimodal transportation (Kayikci, 2010).

Despite the important role of inland ports, the vast majority of extant research on this subject focuses on the definition, functionality, optimal location, operational efficiency, and development policies for inland ports. This study, to the best of our knowledge, is the first attempt to provide empirical evidence on the economic contribution of inland port development. To this end, this paper investigates the impact of inland ports on the promotion of cross-border trade between South Korea and 30 individual Chinese regions for the period of 2000-2017. By doing so, this paper enriches previous theoretical and empirical research on the determinants of Sino-Korea trade, and the relationship between international trade and logistics infrastructure. The empirical findings in this study suggest several practical implications for several directions of logistics infrastructure development to boost international trade and the efficient use of inland ports by exporters and importers. We found that inland port development has a positive impact on Sino-Korea trade. However, the positive association holds only for Chinese regions with a large trade volume with South Korea and well-organized connectivity to adjacent seaports.

The rest of this paper is organized as follows. Section 2 reviews extant literature on the relationship between transport infrastructure development and economic growth, the development of inland ports, and determinants of bilateral Sino-Korea trade flows. Section 3 explains the methodologies and the dataset employed in this paper. Section 4 presents the results of gravity model estimations and discusses possible explanations. Finally, Section 5 provides the implications and conclusions of this paper.

2. Literature Review

2.1. Relationship between Logistics Infrastructure and Economic Development

It is widely believed that the development of logistics infrastructure is a major catalyst for economic growth. However, the causality, or the lead-lag relationship, between logistics development and economic growth is still open to discussion from both perspectives of the theoretical background and empirical evidence. For example, discussing the causes of the growth of world trade, Krugman, Cooper and Srinivasan (1995) presented two views on this subject. The first was a journalistic discussion focusing on integration driven by technological advances in transportation and communication. The second was the economists' view highlighting the removal of protectionist measures. Theoretically, the endogenous growth theory states that investment in endogenous factors, such as education, technology, and knowledge promotes economic growth (Arrow, 1962; Romer, 1987). In a similar vein, the New Economic Geography stream presented that the location of a firm was determined by an interaction between scale and transport cost, and as a consequence, these factors have an impact on regional economic activity (Fujita and Krugman, 2004). According to Wagner's

Law (Wagner and Weber, 1977), on the other hand, the relationship was diametrically opposed to the endogenous growth theory, which indicated that an increase in infrastructure investment was triggered by economic growth.

Empirical evidence on the relationship between transportation infrastructure development and economic growth is also mixed, and the literature has not yet been resolved satisfactorily (Ayogu, 2007). On one hand, a voluminous body of research supports the causal relationship running from transportation infrastructure to economic development. For example, Aschauer (1989) found that non-military public capital stock (streets, highways, airports, mass transit and sewers, to name a few) played a key role in determining productivity. Fan and Chan-Kang (2008) and Lall (2007) also documented the economic contribution of transport infrastructure on the development of regional economies in China and India, respectively. In addition, previous literature also highlighted the importance of efficient logistics system in the promotion of international trade between nations (for example, see Hummels, 2007; Lai Kee-Hung et al., 2019). On the other hand, another strand of research reported a reverse association between logistics infrastructure and economic development of a country. For instance, Kustepeli, Gulcan and Akgungor (2012) provided empirical evidence that there were no long-run relationships between highway infrastructure expenditures, economic growth, and international trade in Turkey, and similar results are also reported in the case of India by Maparu and Mazumder (2017).

2.2. Inland Ports in China

Against a background of globalization and the rise of logistics supply chains, the meaning of an inland port is richer and more diverse than a simple hinterland extension of a seaport (Raimbault, 2019). In particular, in developing countries, a growing deal of attention is paid to the development of inland ports due to the driving effect of regional economic growth (Raimbault, Jacobs and van Dongen, 2015; Santos and Soares, 2017). Despite the importance of inland port development, research on this subject mainly focuses on the operational and planning perspectives (for example, see Monios and Wilmsmeier, 2012) with a gradual shift to governance and management (for example, see Tadic, Krstic and Brnjac, 2019) in recent years, and little research attention has been paid to the economic impact on surrounding regions (Witte, Wiegmans and Ng, 2019). Research on Chinese inland ports are no exception, and the vast majority of extant studies address (1) definition and functions, (2) optimal location, (3) operational efficiency, and (4) policy. Lee Choong-Bae (2017) and Lee Choong-Bae and Lee Jong-Chul (2017) reviewed the development of inland ports in China and suggested the classification of inland ports by ownership and operational function. Liu Yanfeng and Lee Choong-Bae (2018) analyzed the geographical distribution of Chinese inland ports and competitiveness via the SWOT-PEST method. Ka Bian (2011) and Li, Shi and Hu (2011) dealt with the location selection of Chinese inland ports. Beresford et al. (2012) and Li, Dong and Sun (2015) proposed strategic directions for inland port development in China.

2.3. Determinants of Sino-Korea Trade

Given the remarkable growth of the bilateral trade described in the previous section, South Korea is presently the third largest trading partner of China, following the USA and Japan, and the largest source of imports, while China ranks first in terms of trade surplus, international trade, and an outward investment target for Korea. Therefore, there has been a great deal of research attention to the driving forces of Sino-Korea trade. While most studies on the determinants of bilateral trade between China and South Korea paid attention to income

growth (Wang Peng-Yan and Choi Chang-Hwan, 2014), the free trade agreement (Kang Bo-Kyung and Lee Kab-Soo, 2009; Kang Da-Yeon and Jeon Young-Seo, 2014), and foreign direct investment (Im Hye-Joon, 2007; Jun Joo-Sung and Wang Seung-Hyeon, 2015; Kwon Taek-Ho and Joo Kyeong-Won, 2009; Lee Dong-Won and Huh Hyeon-Seung, 2009), there has been little research highlighting the importance of logistics infrastructure. Lee Tae-Woo et al. (2018) reported that port connectivity and maritime logistics facilitate trade flows between Korea and the northeast regions of China. Peng and Wang (2017) found that logistics co-operation between China and South Korea could help the technological advancement of the two countries, as well as realize common economic and trade development.

From the review of extant studies above, it is obvious that there is a research gap in the role of inland ports in boosting bilateral trade between China and South Korea. Considering existing evidence on the positive influence of logistics efficiency on promoting economic growth and international trade (for example, see Ahn Young-Gyun and Lee Joo-Won, 2016; Jun Sung-Hee, 2018; Lee Hong-Shik and Bang Ho-Kyung, 2009; Lee In-Koo, 2011), it is likely that transport infrastructure development is positively associated with bilateral trade flows between China and Korea. Additionally, as China's under-developed inland transport infrastructure, along with government regulations and regional protectionism, fragment distribution channels throughout the whole country (Jiang and Prater, 2002), it can be conjectured that the development of inland transport facilities in recent years contributes to regional economic growth by stimulating both domestic and cross-border transactions. In this regard, this paper explores the economic contributions of Chinese inland ports as a kind of emerging logistics infrastructure that enables logistics service providers to integrate operations. Alternatively, as one of the major goals of the BRI, an inland port as an extension of coastal ports will promote the intensive integration of regional transport resources and the logistics industry, and become an accelerator of economic development. Therefore, how to carry out effective interconnection, improve the efficiency of logistics operations, and reduce the cost of transnational logistics has far-reaching strategic significance for the economic integration of Northeastern Asia, including China and South Korea, as well as economic and trade exchanges with other countries on the Eurasian continent (Dodgson et al., 2015).

3. Methodology and Data Description

We employ a gravity model to investigate the impact of inland port development on the promotion of commercial transactions between China and Korea. Utilizing the gravitational force concept in Newtonian Physics, the gravity model of international trade explains the determinants of the volume of bilateral trade flows, such as GDP, population, FDI, and geographical distance, to name a few. Developed by Tinbergen (1962), the gravity model has gained popularity in empirical research on bilateral trade, and later, was supported with theoretical foundations by Anderson (1979), Bergerstrand (1985), Eaton and Kortum (2002) and Helpman, Melitz and Rubinstein (2008).

In this paper, we employ a gravity model estimating the trade flows between 30 Chinese regions and South Korea. The trade flows are the sum of bilateral exports and imports. The independent variables are divided into two groups. The first group includes the baseline variables of the gravity model: the Gross Regional Product (GRP) of 30 Chinese regions, the GDP of South Korea, the geographical distance between each provincial capital city of China and Seoul (the capital city of South Korea), and FDI inflows from South Korea to each Chinese region. The second group includes variables indicating the development of the logistics infrastructures of Chinese regions: the establishment of inland ports, government

expenditures on transport infrastructure, road mileage, railway mileage, the number of trucks, and the size of the workforce engaged in the logistics industry. Therefore, the gravity model in this paper is written:

$$\ln Exim_{ckt} = \ln KGDP_t + \ln GRP_{ct} + \ln Dis_{sc} + \ln FDI_{kct} + IP + \ln Exp_{ct} + \ln Road_{ct} + \ln Rail_{ct} + \ln Truck_{ct} + \ln Worker_{ct} + \varepsilon_t \quad (1)$$

where $Exim_{ckt}$ is the sum of exports and imports between each Chinese province (c) and Korea (k) in year t; $KGDP_t$ is the gross domestic product of Korea in year t; GRP_{ct} is the gross regional product of a Chinese region in year t; Dis_{sc} is the geographical distance between capital cities of China (c) and Seoul (s); FDI_{kct} is the amount of foreign direct investment from Korea (k) to each Chinese region (c) in year t; IP is the dummy variable taking a value of one when an inland port is established in a Chinese region, and zero otherwise; Exp_{ct} is the amount of government expenditure on transport infrastructure in each Chinese region in year t; $Road_{ct}$ is the length of roads in a Chinese region in year t; $Rail_{ct}$ is the length of railways in a Chinese region in year t; $Truck_{ct}$ is the number of cargo trucks in a Chinese region in year t; $Worker_{ct}$ is the number of workforce involved in the logistics industry in a Chinese region in year t.

The dataset for the analysis on the impact of logistics infrastructure development on the Sino-Korea bilateral trade flows was collected from various sources. Exports and imports between China and Korea were obtained from K-stat, the trade statistics service of the Korea International Trade Association. The GDP and the FDI of Korea were retrieved from the World Bank and the Korea Export-Import Bank, respectively. The Gross Regional Product and the statistics for logistics infrastructure development of Chinese provinces were collected from the China National Bureau of Statistics.

Table 1 provides the means of the variables we employed in this paper for the period of 2000 - 2017. For a more detailed analysis on the impact of the development of the logistics infrastructure, the sample of 30 Chinese regions was partitioned into three terciles (Small, Medium and Large) based on the size of trade flows.[1] The Large group includes Jiangsu, Guangdong, Shangdong, Shanghai, Tianjin, Zhejiang, Liaoning, Beijing, Fujian, and Henan. The Medium group includes Hebei, Shaanxi, Sichuan, Chongqing, Anhui, Hubei, Shanxi, Jiangxi, Hunan, and Jilin. The Small group includes Inner Mongolia, Heilongjiang, Guangxi Zhuan, Gansu, Ningxia Hui, Guizhou, Yunnan, Xinjiang, and Qinghai.

In terms of trade flows, Jiangsu was the largest trading partner for Korea with a sum of exports and imports (Exim) as great as USD 38,284 million per annum for the sample period (2000-2017), followed by Guangdong and Shangdong with Exim amounts of USD 38,014 million and USD 22,789 million, respectively. In addition, the Jiangsu region also ranks as the most popular investment destination for Korean firms with FDI inflows from Korea at as much as USD 716 million. In terms of GRP and government expenditure on transport infrastructure, Guangdong is the largest economy among the 30 Chinese regions with a GRP of RMB 4,212 billion and annual budget (Exp.) of RMB 1,743 billion. From the the geographical dimension, Liaoning is in the shortest distance from Seoul, while Xinjiang is the farthest region, with a distance of 3,334 kilometers.

[1] Officially, there are 31 administrative areas in China. Nevertheless, this paper addresses only 30 areas omitting the Tibet Autonomous Region (Tibet AR) since the trade flow between Tibet AR and Korea is barely tangible with a sum of exports and imports (from the persepective of Korea) at USD 23 million for the period of 2000-2017.

Table 1. Trade Flows, GRP, FDI and Logistics Infrastructures of 30 Chinese Regions (Average of 2000-2017)

(Unit)	Exim USD mil	GRP RMB bil	Dis. km	FDI USD mil	IP	Exp. RMB bil	Road km	Rail km	Trucks 10,000	Workers
Panel A: Exim Large										
Jiangsu PE	38,284	3,837	969	716	Y	1,344	120,222	1,917	1,038	178,973
Guangdong PE	38,014	4,212	2,071	207	Y	1,743	168,111	2,694	1,410	262,060
Shangdong PE	22,789	3,548	892	519	Y	1,500	185,233	3,894	1,316	207,219
Shanghai CY	15,958	1,543	871	198	N	626	10,322	383	266	112,278
Tianjin CY	11,742	866	872	194	Y	454	13,111	822	266	52,038
Zhejiang PE	9,209	2,496	1,028	112	Y	1,307	89,072	1,672	983	125,543
Liaoning PE	7,049	1,561	563	194	Y	827	88,639	4,539	512	199,635
Beijing CY	6,704	1,314	956	407	N	579	18,978	1,194	616	206,044
Fujian PE	4,148	1,413	1,469	12	Y	1,188	82,106	2,044	372	88,703
Henan PE	2,871	2,090	1,236	8	Y	1,008	190,000	4,294	809	255,582
										Panel B: Exim Medium
Hebei PE	2,733	1,809	1,098	30	Y	1,249	132,322	5,322	963	167,652
Shaanxi PE	1,528	956	1,667	163	Y	770	117,389	3,633	365	160,486
Sichuan PE	1,457	1,639	2,239	39	Y	1,688	216,867	3,378	670	164,204
Chongqing	1,453	807	2,083	46	N	776	91,967	1,322	220	106,047
Anhui PE	1,078	1,192	1,091	15	Y	682	132,561	2,933	407	111,346
Hubei PE	1,046	1,542	1,404	35	N	1,190	174,067	3,100	413	191,158
Shanxi PE	1,005	788	1,271	19	Y	597	109,189	3,722	433	168,089
Jiangxi PE	844	898	1,429	23	N	478	116,622	2,883	268	121,958
Hunan PE	799	1,523	1,670	23	Y	981	170,972	3,483	432	152,641
Jilin PE	741	783	714	58	Y	525	76,194	4,050	279	111,835
										Panel C: Exim Small
Inner Mongolia AR	500	960	1,368	-	Y	842	133,244	8,278	342	135,234
Heilongjiang PE	497	929	910	10	Y	572	124,489	5,789	327	187,256
Guangxi Zhuan AR	356	892	2,422	-	N	828	90,622	3,361	303	112,672
Gansu PE	228	385	2,068	4	N	381	96,022	2,761	170	83,690
Ningxia Hui AR	176	154	1,815	-	Y	136	21,567	1,022	84	24,009
Hainan PE	174	200	2,528	4	N	200	22,283	517	72	16,770
Guizhou PE	169	509	2,262	1	Y	755	119,678	2,167	239	64,110
Yunnan PE	133	734	2,683	3	Y	1,065	197,811	2,550	440	97,523
Xinjiang AR	83	518	3,334	-	Y	520	133,883	3,861	243	85,266
Qinghai PE	58	127	2,233	-	N	235	51,978	1,678	62	27,544

Source: Korea International Trade Association (for EXIM), Korea Export-Import Bank (for FDI), China National Bureau of Statistics (for GRP, Exp., Road, Rail, Truck, Worker), China Ports and Harbor Association (for IP).

The dataset for the establishment of inland ports in each region was retrieved from the China Ports and Harbors Association. In our model, we used a dummy variable that took a value of 1 when an inland port was established in a certain region in year t, and 0 otherwise. We identified that inland ports were in operation in 21 regions, and the earliest was the inland port established in Heilongjiang in 2006. In each group, based on the size of trade flows, 8, 7, and 6 regions were included in the Large, Medium, and Small groups, respectively. In terms

of the length of roads and railways, Sichuan and Inner Mongolia ranked first position, respectively. Finally, given the fact that Guangdong is the largest economy in China, it is fairly natural that the region ranked first in employing trucks and workers in the logistics industry. During the sample period, the average GDP of Korea was USD 1,036 billion (untabulated), and following Baldwin and Taglioni (2006), both the GDP of Korea and GRPs of Chinese regions are in nominal values.

4. Empirical Results

4.1. Comparison between Pre- and Post-Inland Port Construction Periods

As the first step in investigating the impact of the development of inland ports on bilateral trade flows between China and Korea, we first investigated whether there have been changes in the share of each region's Exim (the sum of exports and imports in terms of US dollars) since the establishment of the inland ports. When the construction of inland ports in a certain region has a positive impact on bilateral trade between China and Korea through an efficient logistics operation, it is likely that the share of the region's Exim increases significantly.

Table 2 presents a comparison of the share of Exim between the pre- and post-inland port construction periods. However, it is hardly conclusive that the establishment of inland ports can promote Sino-Korean trade. Among the 21 Chinese regions where inland ports were developed, only 9 regions witnessed increases in the average shares of exports and imports

Table 2. Changes in the Share of Exim Chinese Regions between the Pre-IP and Post-IP Periods

Exim Group	Region	Pre-IP		Post-IP		Increase/ Decrease
		Period	% of Exim	Period	% of Exim	
Large	Jiangsu PE	2000-2011	19.93%	2012-2017	21.92%	Increase
	Guangdong PE	2000-2015	21.33%	2016-2017	24.18%	Increase
	Shangdong PE	2000-2007	15.42%	2008-2017	13.05%	Decrease
	Tianjin CY	2000-2011	7.76%	2012-2017	6.17%	Decrease
	Zhejiang PE	2000-2011	5.90%	2012-2017	4.98%	Decrease
	Liaoning PE	2000-2011	5.06%	2012-2017	3.78%	Decrease
	Fujian PE	2000-2010	2.96%	2011-2017	2.24%	Decrease
	Henan PE	2000-2011	0.66%	2012-2017	2.56%	Increase
Medium	Hebei PE	2000-2006	1.38%	2007-2017	1.67%	Increase
	Shaanxi PE	2000-2015	0.55%	2016-2017	2.29%	Increase
	Sichuan PE	2000-2016	0.69%	2017	1.46%	Increase
	Anhui PE	2000-2011	0.56%	2012-2017	0.71%	Increase
	Shanxi PE	2000-2012	0.85%	2013-2017	0.49%	Decrease
	Hunan PE	2000-2011	0.57%	2012-2017	0.45%	Decrease
	Jilin PE	2000-2015	0.68%	2016-2017	0.33%	Decrease
Small	Inner Mongolia AR	2000-2016	0.36%	2017	0.32%	Decrease
	Heilongjiang PE	2000-2005	0.78%	2006-2017	0.25%	Decrease
	Ningxia Hui AR	2000-2009	0.09%	2010-2017	0.11%	Increase
	Guizhou PE	2000-2014	0.11%	2015-2017	0.17%	Increase
	Yunnan PE	2000-2013	0.09%	2014-2017	0.08%	Decrease
	Xinjiang AR	2000-2015	0.07%	2016-2017	0.05%	Decrease

with Korea, while the rest have undergone a decrease. The most remarkable increase in the share of trade flows were found in the Guangdong and Jiangsu regions. Specifically, the share of Guangdong's Exim increased from 21.33% during 2000 - 2015 (Pre-IP) to 24.18% in 2016 - 2017 (Post-IP). In stark contrast, Shangdong region underwent a sharp decrease in its share of Exim from 15.42% during 2000 -2007 to 13.05% from 2008 - 2017. However, any remarkable pattern was found based on the size of exports and imports. Therefore, we further investigated the impact of inland ports on the promotion of bilateral trade flows between China and Korea using gravity models.

4.2. Gravity Model Estimations

Table 3 presents the results of gravity model estimations for the impact of inland port development on the promotion of Sino-Korea trade. For each tercile based on the size of exports and imports, we performed 3 different models. In order to check the fitness of the dataset, the first model (Model 1) was an estimation with the baseline variables for a general gravity model, including the GDP of Korea (KGDP), GRP of a Chinese region (GRP), the distance between capital cities (DIS), and the FDI from Korea to a Chinese region (FDI). On top of the baseline variables, a dummy variable (IP) that took the value of 1 if an inland port was established in a certain Chinese region in year t, and 0 otherwise, was added in the second model (Model 2) to investigate the impact of inland port development. Finally, to control the effect of the development of other transport infrastructure variables, the third model (Model 3) included government expenditures on transport infrastructure (EXP), road mileage (ROAD), the length of railways (RAIL), the number of trucks (TRUCK), and the size of the workforce in the logistics industry (WORKER).

The impact of inland port development on bilateral trade flows varies according to the amount of exports and imports. For the Exim Large group, it was found that the establishment of inland ports was positively associated with the size of Sino-Korea trade, and the relationship is statistically significant at the 1% level. While the positive impact of inland port development was also found in the Exim Medium group, it is not statistically significant. Surprisingly, the association between inland port and bilateral trade is negative for the Exim Small group, and there is no statistical significance. The positive association between inland port development and the size of exports and imports still holds after controlling for the effect of other logistics infrastructure variables in Model 3 for the Exim Large group, which indicates the establishment of inland ports plays an important role in promoting Sino-Korea trade.

Table 3. Results of Gravity Model Estimations

	Model 1		Model 2		Model 3	
Panel A: Exim Large						
KGDP	0.706	[3.472] ***	0.588	[2.920] ***	0.326	[0.994]
GRP	0.453	[5.418] ***	0.338	[3.809] ***	1.590	[6.093] ***
DIS	0.659	[4.645] ***	0.822	[5.593] ***	0.726	[4.440] ***
FDI	0.417	[16.432]***	0.453	[16.714]***	0.365	[10.750]***
IP			0.392	[3.251]***	0.369	[2.761]***
EXP					-0.292	[-2.054]**
ROAD					-0.253	[-1.806]*
RAIL					0.165	[0.899]
TRUCK					-0.367	[-2.521]**
WORKER					-0.451	[-3.669]***
C	-21.310	[-3.954]***	-18.335	[-3.442]***	-11.947	[-1.348]

Table 3. (Continued)

	Model 1		Model 2		Model 3	
Panel B: Exim Medium						
KGDP	0.250	[0.940]	0.255	[0.960]	0.247	[0.781]
GRP	0.860	[8.130]***	0.820	[7.254]***	0.218	[0.955]
DIS	-0.416	[-3.157]***	-0.375	[-2.723]***	-0.355	[-1.982]*
FDI	0.068	[3.245]***	0.073	[3.379]***	0.059	[2.947]***
IP			0.131	[1.006]	-0.052	[-0.444]
EXP					-0.282	[-2.039]**
ROAD					-0.059	[-0.558]
RAIL					-0.454	[-2.144]**
TRUCK					0.748	[4.138]***
WORKER					0.824	[4.761]***
C	-5.166	[-0.775]	-5.277	[-0.791]	-12.206	[-1.403]
Panel C: Exim Small						
KGDP	0.231	[0.784]	0.268	[0.898]	0.807	[1.504]
GRP	0.334	[3.108]***	0.369	[3.221]***	2.131	[4.231]***
DIS	-0.850	[-4.207]***	-0.941	[-4.148]***	0.748	[1.924]*
FDI	0.154	[4.039]***	0.155	[4.046]***	0.130	[3.478]***
IP			-0.216	[-0.889]	-0.049	[-0.204]
EXP					0.223	[0.949]
ROAD					-0.807	[-4.359]***
RAIL					0.194	[0.742]
TRUCK					-1.575	[-3.720]***
WORKER					0.734	[2.178]**
C	2.348	[0.330]	1.787	[0.250]	-40.097	[-2.373]**

Notes: 1. t-statistics are provided in parentheses.
2. *p<0.1, **p<0.05, ***p<0.001.

4.3. Discussions

The variations in the impact of inland port development on bilateral trade between China and South Korea according to trade volume can be possibly explained by the competitiveness of inland ports. Considering the fact that the function of inland ports is to reduce time and costs for international trade by providing consolidation, customs clearance, inspection, and quarantine services, it follows that their competitiveness depends on the volume of international trade and geographical location (see Gooley, 1998; Ka Bain, 2011). Lee Choong-Bae (2018) analyzed the competitiveness of 28 Chinese inland ports using an Analytic Hierarchy Process (AHP) based on a questionnaire survey for 25 practitioners and documented that economic (or cargo volume) and geographical elements were the most critical factors. Specifically, the study reported the relative importance among the factors determining the competitiveness of certain inland ports was in the order of the distance from a nearby seaport, the location on the main arterial route, the traffic volume of railways and roads, and the degree of the Location Quotient (LQ)[2] index.

[2] LQ is a ration of the employment share of the industry of interest in the area of interest, and the employment share of that industry in a reference area (Rivera, Sheffi and Welsch, 2014).

Consistent with previous literature, we found that inland ports had a positive impact on the facilitation of trade between South Korea and Chinese regions with large export and import volumes (the Exim Large group). In addition, among this group, 8 regions, with the exceptions of Beijing CY and Henan PE, are located in coastal areas. In stark contrast, there were only 1 (Hebei PE) and 2 (Guangxi Zhuan AR and Hainan PE) regions of coastal areas in the Exim Medium group and Exim Small group, respectively. Therefore, it can be concluded that the establishment of inland ports promotes trade flows between China and South Korea when there are large volumes of exports and imports and efficient connectivity with adjacent seaports. Therefore, the findings in this study indicate that the construction of inland ports can promote Sino-Korea trade when maritime and land logistics activities are efficiently integrated.

5. Conclusions

This paper investigated the role of inland ports in China in facilitating bilateral trade between China and South Korea using gravity models. We found that inland ports had a positive impact on the promotion of Sino-Korea trade. However, the impact of inland port development varies by trade volume and seaport proximity. In this paper, the positive association between the establishment of inland ports and Sino-Korea trade holds only for Chinese regions that are major trading partners of South Korea. In addition, given the fact that those regions were located in coastal areas, the positive impact of inland ports was driven by efficient connectivity to nearby seaports. From the analysis above, the findings in this paper offer several important academic and practical implications.

5.1. Academic Implications

This study explored the economic contribution of inland ports to bilateral trade between China and South Korea. While the vast majority of research in this field focuses on optimal location, operational efficiency, and policy implications, this study is, to our best knowledge, the first attempt to investigate the economic impact of inland port development. Given the fact that South Korea is an open economy with trade dependence (the sum of exports and imports divided by nominal GDP) reaching up to 70.4% and 99.7% of the country's international trade serviced by ships,3 maritime transport has been regarded as a core element in Sino-Korea trade, as pointed out in Lee Tae-Woo et al. (2018). In line with previous literature, by documenting that connectivity between seaports and inland ports can boost bilateral trade, this paper highlights that a well-organized logistics system that coordinates physical flows of cargo from origins to end-users are closely associated with increasing economic cooperation between China and South Korea.

Furthermore, the finding of a positive relationship between the development of inland ports and bilateral trade flows offers a valuable implication for future research. For instance, it is of utmost importance to examine the impact of inland port development at the country level. As documented in Witte, Wiegmans and Ng (2019), research on inland ports is increasingly diversified in a geographical context, notably for Europe (Lattila, Henttu and Hilmola, 2013; Santos and Soares, 2017), Asia (Monios and Wang, 2013), and Latin America (Wilmsmeier and Monios, 2016). Therefore, it is likely that the economic contribution of inland ports varies by geographical location or operational characteristics. In addition, it is

[3] Numbers are retrieved from K-Stat, (http://stat.kita.net), Accessed on March 8, 2020.

also interesting to explore whether inland ports can be a catalyst for the economic growth of developing and under developed regions.

5.2. Policy Implications

Findings in this paper also provide practical implications for government policy-making regarding logistics infrastructure. Implementing a free-market policy in 1978, China has opened its doors to international trade and investment from international companies. Benefiting from the economic reform, the country has grown to the second largest economy in the world, taking a share of 15.8% of global GDP and 11.7% of international trade in 2018, a remarkable rise from 1.7% and 0.8% in 1978, respectively.[4] However, the economic development of China was initiated from the southern and eastern coastal regions, and landlocked areas in the west are still relatively less-developed. In this regard, relieving the economic gap between the east and west provinces is one of the major goals of the BRI, and the development of inland ports plays a key role in bridging the developed and less-developed regions. Moreover, as an increasing number of neighboring countries are responding to the BRI, the ultimate strategic significance of logistics corridors from both economic and environmental perspectives is stressed with deepening understanding of the national plan (Wang Chao et al., 2020). Therefore, it is likely that the economic link along these corridors promotes the coordinated development of the regional economy of China. To this end, the Chinese government has recently announced a national logistics hub construction plan aiming to build approximately 150 national logistics hubs (mostly, located in inland regions) by 2025.

As the construction of inland ports involves a variety of decision-making stages, such as selecting a strategic location, establishing a governance structure, and planning an efficient operation, to name a few, the finding in this paper that the positive impact of inland ports on facilitating Sino-Korea trade holds only for Chinese provinces with nearby seaports suggests a strategic point relevant to the selection of inland port locations. Therefore, policy-making for inland port development should consider integration between seaports and inland ports, and the interaction between maritime and land logistics activities. By doing so, it is likely that economic cooperation among countries on logistics corridors is promoted and deepened.

5.3. Managerial Implications

Finally, Korean companies that have major economic interests in trading with Chinese counterparts can take advantage of the findings of this study. As a kind of non-tariff trade barrier, transport costs affect the relative prices of commodities, and consequently, result in competition restriction and a distortion in trade flows (Hummels, 2007; Hummels and Schaur, 2013). Alternatively, this indicates that exporters and importers that can efficiently coordinate supply chain connectivity among maritime transport, land logistics, and warehousing storage have a competitive edge. Thus, Korean exporters and importers can achieve better economic performance when they integrate the logistics hub functions of cargo distribution, storage, transfer, and a combination of transportation modes as a core part of business operations.

On top of this, Korean companies should consider the use of Chinese inland logistics infrastructures as a land-bridge for overseas business expansion toward western China, and further to, Europe. Driven by the national initiatives of the 'Western Development Plan' and the 'Silk Road Economic Belt', China's central and western regions are increasingly open to

[4] Numbers were retrieved from the World Bank (data.worldbank.org). Accessed on March 19, 2020.

FDI and trade with foreign countries. Correspondingly, with the improvement of the inland logistics infrastructure system, a growing number of multi-national corporations are gaining access to internal China. Specifically, considering that China is the second largest trading partner of the European Union, the integration of multimodal transport consisting of a shipping, railway, and logistics hub can provide Korean companies with new opportunities in business with the western part of the Eurasian continent.

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