The Asian Journal of Shipping and Logistics 32(3) (2016) 179-186

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The Asian Journal of Shipping and Logistics

Journal homepage: www.elsevier.com/locate/ajsl

Analysis of the Market Structure and Shift-effects in North China Ports*

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ARTICLE INFO

Article history:
Received 28 July 2016
Received in revised form 30 August 2016
Accepted 1 September 2016

Keywords:
Hirshmann–Herfindahl Index (HHI)
Boston Consulting Group (BCG) Matrix
Shift-effect Analysis
North China Port

ABSTRACT

This study divides the foreign trade traffic of major North China ports into export and import cargoes for the past 10 years. Then, the concentration ratios and shift effects are analyzed in order to determine their relationships with the ports' competition structures. Here, the HHI, a BCG matrix analysis, and the shift effects are applied as study methods. The results indicate that the oligopoly market structure of major North China ports has gradually decreased. Furthermore, the concentration ratios of import cargoes are higher than those of export cargoes, indicating that competition to attract import cargoes will intensify. Therefore, the effects of the South Korea–China FTA mean that the competition structures of these ports with regard to export and import cargoes are highly likely to be differentiated further over time.

1. Introduction

Other than when the trade scales decreased in the aftermath of the global economic crisis in 2008, Sino-Korean trade has grown continuously at rates of approximately 10%. In addition, as trade increased, South Korea's dependence on foreign trade with China increased significantly. Following the adoption of the South Korea–China free trade agreement (FTA) on December 20, 2015, custom duties on 958 items, including high-frequency medical devices, transformers, and aviation lamp oil (amounting to USD 8.7 billion per year), were immediately eliminated. Then, as of January 1, 2016, there were reductions in custom duties on a further 5,779 items. Custom duties will continue to decrease each year, with those on China's side, on 5,846 items (LCD panels, cold-rolled stainless steel plates, air conditioners, electric rice cookers, etc.), to be eliminated within 10 years. In addition, by 2034, 20 years after drawing up of FTA, China will abolish custom duties on 7,428 items, representing 90.7% of all items imported from South Korea. Furthermore, South Korea will abolish custom duties on 11,272 products, representing 92.2% of all products imported from China (overview of the South Korea-China FTA).

Therefore, the South Korea–China FTA will immediately lead to reductions in custom duties, in diverse ways, including trade expansion, cost reductions, shorter transport times, the removal of non-custom duty barriers, national income increases, market expansion, system reforms, and foreign direct investment (FDI) inflows. These changes will increase shipping port traffic volumes, resulting in positive effects.

http://dx.doi.org/10.1016/j.ajsl.2016.09.007
2092-5212/

With these changes in commerce policies, trade and traffic volumes between the two countries are expected to increase significantly, particularly in the case of electronic products, machines, automobiles, and agricultural and marine products. As a result, South Korean ports are expected to undergo considerable changes because they will be affected directly by the South Korea–China FTA. The FTA is expected to increase the volume of exports and decrease the volume of imports through the ports in northern China, such as Tianjin, Qingdao, and Weihai, the largest gateways to China, which will subsequently affect the adjacent South Korean ports. Therefore, relevant countermeasures need to be prepared and implemented as a matter of urgency.

Many studies have analyzed the competitive relations among major ports in North East Asia. For example, Park (2001), Jeong (2013), Yang et al. (2008), and Lee et al. (2015) analyzed the concentration ratios of major container ports in North East Asia and South Korea, as well as the competitive relations among the ports using shift-share analyses. However, most existing studies that seek to identify the relationship between North China's major ports and the competition structure are limited, because they are based on the total export/import traffic volumes of each port. Therefore, the composition of the competition in terms of the ports' export and import traffic volumes following the South Korea–China FTA and future changes in commerce policies (e.g., the formation of economic blocs) cannot be clearly understood, which means concrete policy directions cannot be presented easily.

To this end, the present study divides the foreign trade traffic volumes of major ports in North China over the last 10 years into export and import cargoes in order to analyze the relevant concentration ratios and shift effects. The aim of the study is to analyze the relationship between the major ports in North China and the competition structure. In this way, the changes in the competition structure for these cargoes can be identified, and the efficient operation of the ports and creation of policies can be presented by analyzing the cargo concentration ratios and shift effects. Here, the Hirshmann–Herfindahl Index (HHI) is first applied to determine the concentration and dispersion of the import and export traffic volumes of the major ports in North China. Thereafter, the Boston Consulting Group (BCG) matrix is applied to track the dynamic positioning of the ports and, finally, the competition structure of major ports in North China is analyzed by means of a shift-effect analysis.

This paper is structured as follows. First, section 2 reviews previous studies related to port concentration ratios and competition structures. Section 3 analyzes the present situation of major ports in North China and examines the changes in the export/import traffic volumes and capacities of the port facilities. Section 4 applies the study methodology, analyzing the concentration ratios and competition positioning of the ports, and then identifies competitive relations through shift effects. The final section summarizes the results and presents possible directions for future research.

2. Literature Review

2.1. *Review of Previous Domestic/Foreign Studies Related to North China Ports*

First, in order to review studies that have analyzed the market concentration ratios of ports, Hayuth (1981) examined the changes in the market structures of U.S. container ports using concentration ratio indexes. Thereafter, based on Hayuth's (1981) theory, many researchers analyzed changes in market structures by considering the characteristics of individual regions. For example, Notteboom (1997) studied the changes in port structures in Europe using concentration ratios, while Wang (1998) studied changes in the competition structure of Hong Kong ports.

Ji (2013) analyzed the concentration ratios of container throughputs of ports in the Yangtze River Delta from 2000 to 2010 using HHIs. These ports generally showed market concentration ratios that were distributed and partially concentrated.

Li et al. (2015) analyzed the concentration ratios of containers of coastal ports in China from 1982 to 2012 using concentration ratio (CR) indexes. Their results showed that the concentration ratios have decreased continuously since 1982, indicating that competition in these container markets has intensified.

The abovementioned studies analyzed the structures of port markets using concentration ratios. However, they are not easily able to identify which ports have become more competitive, and which have become less competitive. Therefore, other researchers analyzed changes in the traffic volumes of ports and the competition structures of the market using concentration ratio analyses, share-shift analyses, and BCG analyses.

Park (2001a) analyzed the concentration ratios of South Korean ports based on the total cargo throughputs by port from 1966 to 2000 through three methods: the Rimmer model, the Hyle model, and the Hirshmann–Herfindahl model. A characteristic of the concentration ratio analysis is that all ports, including those divided into competing groups in three areas—the west sea area, the south sea area, and the east sea area—were analyzed separately. However, the ports were divided into groups from a geographical viewpoint, without dividing them, for example, into competing groups reflecting their size or the characteristics of their waterways.

Jeong (2013) analyzed the changes in the traffic volume structures of Inchen Port and North China ports using 2003–2011 data. The results show that the HHI indexes of the ports decreased, indicating a decrease in the oligopoly structure of the market. Port structures were analyzed using a BCG matrix. The results showed that although the annual average traffic volume of Inchen Port has recovered since 2009, the market share among all ports decreased to approximately 4.8%. Thus, the rate of increase was lower than that of competing ports. In addition, their shift-share analysis showed that the absolute annual average increase in the volume of traffic attracted by Inchen Port during 2009–2011 was approximately 200,000 TEU.

Lee and Kwon (2014) compared and analyzed the competitiveness among North East Asia ports using a DEA and shift-share analysis for the period 2003–2012. Their results show that all North East Asia ports grew, but that Shanghai Port, Shenzhen Port, and Hong Kong Port showed a slowdown in port growth. Furthermore, all South Korean ports showed a slowdown in growth.

Cao et al. (2004) analyzed changes in the concentration ratios and port structures of 18 ports in the Pearl River Delta, the Yangtze River Delta, and the Pan Bo Hai Delta using an HHI and share-shift analysis. According to the results of the analysis, the concentration ratios of Chinese coastal ports increased during 1999–2001. Competition among ports was intense, and competition within each of the three groups was more severe than competition among port groups.

Liang et al. (2008) studied the market structures of ports in the Yangtze River Delta using a share-shift analysis, finding that competition among ports in the area was fierce and that market structures showed dispersing trends. Moreover, they found that the competitiveness of Shanghai Port had weakened, while that of Ningbo Port had strengthened.

Kevin et al. (2004) analyzed the effects of the gradual strengthening of the competitiveness of Chinese container ports, centering on the maritime logistics of the port of Hong Kong.

Marti (2012) evaluated the competitive relations among southeastern Florida ports using the shift-share technique. The results of the analysis indicated that competition among ports was fierce because they were geographically and structurally similar.

2.2. *Present Situation of North China Ports: Number of Vessels That can Enter the Ports*

Table 1 shows the changes in the number of vessels that can enter North China ports. Here, the numbers of vessels that can enter nine of the 12 North China ports are identified. The number of vessels that could enter Dalian was 101 in 2001, and increased to 240 by 2014, the highest number among North China ports. The annual average increase rate was 33%. In the case of Yingkou, initially, 30 vessels could enter the port, but this number had increased rapidly to 87 by 2014, with an annual average increase rate of 42%. This shows that port construction in Yingkou increased rapidly. As of 2014, 162 vessels could enter Tianjin Port, which the second highest among North China ports. Here, the annual average increase was 30%. The number of vessels that could enter Qinhuangdao Port was 92, an annual average increase rate of 23%. In this case, the port growth speed was a little lower than that of other ports. The number of vessels that could enter Yantai Port, in Shandong Province, was 98, with an annual average increase rate was 40%. In the case of Qingdao and Rizhao, port construction speeds were relatively low, with annual average increase rates of 23% and 28%, respectively. Lianyungang had 62 berths, and the annual average increase rate was 22%.

Table 1
Number of vessels that can enter North China ports

Classification	Dalian	Yingkou	Tianjin	Qinhuangdao	Qingdao	Weihai	Rizhao	Yantai	Lianyungang
2001	101	30	74	49	49		25	35	34
2002	102	32	76	49	49		26	35	34
2003	206	30	76	52	54		34	37	36
2004	223	31	114	57	55		37	37	37
2005	223	31	116	62	59		35	43	37
2006	222	41	132	73	60		31	53	40
2007	226	48	142	80	67		36	82	42
2008	222	54	139	75	69		37	85	37
2009	221	55	134	86	79		44	88	55
2010	225	68	151	86	81		48	85	55
2011	223	76	154	86	81	60	49	92	55
2012	231	82	159	86	85	66	53	95	58
2013	237	83	160	86	88	109	51	98	53
2014	240	87	162	92	90		52	98	62

Source: Yearbook of Chinese Ports

Table 2 shows the changes in traffic volumes of North China ports from 2004 to 2014. Among the 12 ports, Dandong showed the highest increase rate, with traffic volume increasing by 12 times. When Dandong is excluded, the increase rates of Yingkou, Rizhao, and Yantai were relatively high. The entire traffic volume of North China ports increased from 995.46 million tons in 2004 to 3.287.01 million tons in 2014, with an annual average increase rate of 49%. The above analysis shows that although the traffic volumes of 12 North China ports increased rapidly, the rates of increase of individual ports differed. The traffic volume increase rates of Dandong, Rizhao, and Yantai were higher than those of Dalian and Qingdao, which were originally major ports.

Table 2
Changes in the traffic volumes of North China ports

Port	Total volume (Unit: Ten thousand ton)			
	2004	2014	Rate of increase (%)	CAGR
Dalian	14516	42337	192	43
Yingkou	5978	33073	453	77
Dandong	1053	13758	1207	136
Jinzhou	2455	9520	288	57
Tianjin	20619	54002	162	38
Qinhuangdao	15037	27403	82	22
Qingdao	16265	46802	188	42
Weihai	1143	3898	241	51
Rizhao	5108	33502	556	87
Yantai	3431	23767	593	91
Lianyungang	4352	19638	351	65
Nanjing	9589	21001	119	30
Total	99546	328701	230	49

Source: Yearbook of Chinese Ports

Table 3 shows the changes in the export/import traffic volumes of North China ports. As of 2014, the export traffic volume of Tianjin was shown to be the highest, and that of Dandong was shown to be the lowest. The export traffic volumes of 10 ports, excluding Qinhuangdao and Rizhao, showed increasing trends. Here, although the export traffic volumes of Dalian and Qingdao were high, those of Weihai, Yantai, and Nanjing increased rapidly. In particular, ports in Shandong province were highly competitive in terms of exports. This suggests that the region was concentrating on export-related industries, and the export-related competitiveness of these ports was being strengthened.

Unlike exports, the volumes of import traffic of all North China ports showed increasing trends. For example, as of 2014, the export traffic volume of Tianjin was shown to be the highest, followed by Qingdao. In contrast, the import traffic volume of Jinzhou (6.1 million tons) was shown to be the lowest. The overall import traffic volume increased by three times, from 249.96 million tons in 2004 to 962.60 million tons in 2014. Unlike the export rates, the increases in the rates of imports in Yingkou, Dandong, Jinzhou, Weihai, Rizhao, Yantai, and Lianyungang were much higher than those of Dalian and Qingdao. When the export and import traffic volumes are combined for the North China ports, Tianjin and Qingdao were shown to be active in foreign trade, with faster expansion in import traffic volumes than in export traffic volumes in terms of port market structures.

Table 3
Changes in the export/import traffic volumes of North China ports

Port	2004		2014		rate of increase %		CAGR	
	Export	Import	Export	Import	Export	Import	Export	Import
Dalian	1865	3056	4466	8065	139	164	34	38
Yingkou	926	1017	1613	5617	74	452	20	77
Dandong	229	150	238	1003	4	569	1	88
Jinzhou	207	237	359	610	73	157	20	37
Tianjin	5610	5182	9658	19835	72	283	20	56
Qinhuangdao	4407	954	450	1073	-90	12	-53	4
Qingdao	3329	8799	8730	22364	162	154	38	36
Weihai	286	231	990	969	246	319	51	61
Rizhao	1481	1885	817	20791	-45	1003	-18	123
Yantai	358	1186	1851	6056	417	411	73	72
Lianyungang	964	1796	2099	8937	118	398	30	71
Nanjing	410	503	1034	940	152	87	36	23
Total	20072	24996	32305	96260	61	285	17	57

Source: Yearbook of Chinese Ports

3. Empirical Analysis

3.1. *Analysis of Port Concentration Ratios*

Before analyzing the structures of North China ports, this study analyzes the changes in the levels of competition among ports based on the volume of traffic they handle. The importance of concentration ratio indexes in measuring the degree of concentration comes from the advantage of easy quantification and judgment.

Many previous port concentration ratio analyses have used the HHI as a concentration ratio index. This index is a useful tool for understanding the degree of importance of port areas[1]. Unlike the CR index, the HHI can explain the share occupied by several top enterprises, and the share occupied by small and medium-sized enterprises. Here, when concentration ratios are low, the degree of competition should be high, and vice versa. A concentration ratio index of 1 means all traffic in the area is handled by one port, while a ratio of 1/n applies if the traffic volumes are evenly distributed among all ports.

$$D_j = \frac{\sum_{i=1}^{n} TEU_{ij}^{\ 2}}{\left(\sum_i^n TEU_{ij}\right)^2}, \frac{1}{n} < D_j < 1$$

$D_j = Concentration\ index\ of\ Port\ Group\ j$

$TEU_{ij} = the\ Cargo\ volume\ of\ Port\ i\ in\ Group\ j$

$n = the\ number\ of\ port\ groups.$

According to the results of the analysis, when all traffic volumes are considered, the HHI of North China ports showed a continuously decreasing trend, from 0.133 in 2004 to 0.118 in 2009 and 0.107 in 2014. This indicates that the market share and market influence of the large ports in North China gradually decreased, while the market share of other ports showed a gradual relative increase. That is, the competition structure of North China ports shows a dispersed form, as shown in Table 4.

In particular, in 2009, after the financial crisis in 2008, major ports drastically increased their investment in port construction to overcome the global recession that brought about the financial crisis. For instance, Dandong invested CNY 2,809 billion in an additional 11 berths, while Rizhao invested CNY 2,150 billion in 2009 on an additional eight berths.

The reduction in the concentration ratios could be attributable to the growth of Rizhao, Qingdao, and Dalian, but could also be the result of continuous growth in small and medium-sized ports, such as Lianyungang and Yingkou. In other words, because the port HHIs in this area have been decreasing every year, this indicates growth in small and medium-sized ports, while the growth in the traffic volumes of large ports has been maintained or has increased slightly. With regard to export traffic volumes, the HHI of North China ports increased from 0.174 in 2004 to a maximum value of 0.211 in 2009, before decreasing to 0.194 in 2014. The concentration ratios of import traffic volumes show similar trends. The HHI increased from 0.199 in 2004 to a maximum value of 0.231 in 2009, before decreasing to 0.167 in 2014. The concentration ratio of the total amount shows a continuously decreasing trend, from 0.133 in 2009 to 0.107 in 2014.

Therefore, in the case of export traffic volumes, the port concentration ratios were shown to have increased slightly, with traffic volumes being concentrated on certain ports, which is attributable to the enhancement of export competitiveness. In the case of import traffic volumes, port concentration ratios gradually decreased, indicating that traffic volumes were dispersed and that competition intensified.

Table 4
HHI of North China ports

Year	Total	Export	Import
2004	0.133	0.174	0.199
2005	0.127	0.159	0.183
2007	0.122	0.175	0.186
2008	0.12	0.187	0.185
2009	0.118	0.211	0.231
2010	0.114	0.204	0.171
2011	0.109	0.197	0.167

3.2. *Portfolio Analysis*

In this section, the implications of the changes in the competition structure of ports in the North China region during 2004–2014 are reviewed using a portfolio analysis. Therefore, a dynamic BCG matrix analysis is applied. This method considers the current position and the changes in the competitive positioning of ports over time.

The BCG matrix method was introduced by the Boston Consulting Group in the United States, and is also known as the growth-share matrix method. The (static) BCG matrix is an analysis technique used to evaluate the current position of businesses and their strategies by analyzing the relationship between the growth rate of the relevant market and the relative market shares. In addition, because future positions should be considered, a dynamic BCG matrix analysis is conducted. The BCG matrix is used to determine how the competitive positions of ports have changed over time. Here, the horizontal and vertical matrixes represent the

[1] Notteboom (1997), pp. 99–115.

relative market shares and annual average growth rates, respectively, and are calculated as follows .

In the analysis results, the Question Mark represents ports that show high market growth rates, but relatively low market shares. These ports can be regarded as being between the introductory period and the early stage of the growth period in the life cycle. The Star represents ports with high market growth rates and high relative market shares. These ports are in the growth period in the life cycle. The Cash Cow represents ports that show low market growth rates, but play a leading role in the relevant market and maintain a relatively high market share. These ports are between the late growth period and the decline period in the product life cycle. Lastly, the Dog represents ports with low market growth rates and relatively low market shares. These are in the late growth period and the decline period in the product life cycle. As with the Cash Cow ports, these ports have unclear future prospects, owing to their low market growth rates, and should be judged on their potential for future regrowth.

First, the dynamic matrix of export traffic volumes during 2004 to 2007 was constructed. The results show that Rizhao, Nanjing, Yingkou, Dalian, Dandong, and Jinzhou are categorized as Dogs; Yantai, Lianyungang, and Weihai are Question Marks; Dalian and Qingdao are Stars; and Qinhuangdao and Tianjin are Cash Cows. Qinhuangdao and Tianjin showed low market growth rates, but can be regarded as playing leading roles in their relevant markets. They maintain relatively high market shares, and are between the late growth period and the decline period in the product life cycle. A review of the dynamic matrixes of export traffic volumes during 2012 to 2014 shows that Jinzhou and Rizhao are Question Marks; Dandong, Qinhuangdao, Nanjing, Weihai, Yantai, Yingkou, and Lianyungang are Dogs; and Dalian, Qingdao, and Tianjin are Cash Cows. There were no Stars. Whereas Dalian, Qingdao, and Tianjin grew before reaching the decline period, Jinzhou and Rizhao entered the early growth period.

The characteristics of this area were examined using a dynamic matrix analysis, with the following results. First, the dynamic flows of the 12 major North China ports were relatively unstable for approximately 10 years. In the dynamic matrix structure, large variations in the yearly changes among the ports are evident. Therefore, the positions of individual ports in this area in the matrix may change remarkably later.

Second, among the changes during 2004–2007, 2008–2011, and 2012–2014, recovery trends during 2012–2014 appeared clearly in all ports except in Yantai, Dalian, and Nanjing. This is evidence that the export traffic volumes of most ports were recovering, although the increase rates were lower than those in the past were. The changes in the positions of individual North China ports in the BCG analyses of export traffic volumes from 2004 to 2014 are shown in Table 5.

Table 5
Changes in the positions of individual North China ports (export volume)

Direction of change			
Dalian	Cash Cow	Qingdao	Cash Cow
Yingkou	Dog	Weihai	Dog
Dandong	Dog	Rizhao	Qusetion Mark
Jinzhou	Qusetion Mark	Yantai	Dog
Tianjin	Cash Cow	Lianyungang	Dog
Qinhuangdao	Dog	Nanjing	Dog

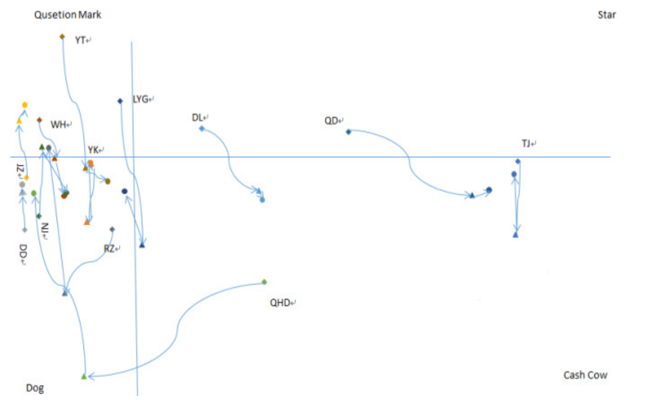

Fig. 1. Changes in the dynamic matrixes of export traffic volumes, 2012–2014

A dynamic matrix of import traffic volumes was constructed and analyzed for the period 2004–2007. The results show that Weihai, Yantai, and Lianyungang fell under the Question Mark; Dalian, Tianjin, and Rizhao fell under the Star; Yingkou, Qinhuangdao, Nanjing, Jinzhou, and Dandong fell under the Dog; and Dalian, Tianjin, and Qingdao fell under the Cash Cow.

Then, based on the import traffic volumes in the matrix for 2012–2014, Jinzhou and Dandong were Question Marks; Qinhuangdao, Yantai, Yingkou, Nanjing, Lianyungang, and Weihai were Dogs; and Dalian, Yantai, Tianjin, Qingdao, and Rizhao were Cash Cows. Whereas Dalian, Qingdao, and Tianjin were moving toward a period of decline, Jinzhou and Rizhao were moving toward early growth.

According to the results of the BCG analyses of exports and imports, Dalian, Qingdao, and Tianjin were developing at gradually decreasing speeds, while Jinzhou and Rizhao were developing at high speeds. The competition structures of North China ports will be analyzed in more detail later using shift effects.

The changes in the positions of individual North China ports, based on BCG analyses of import traffic volumes from 2004 to 2014, are shown in Table 6.

Table 6
Changes in the positions of individual North China ports (import volume)

Direction of change			
Dalian	Cash Cow	Qingdao	Cash Cow
Yingkou	Dog	Weihai	Dog
Dandong	Dog	Rizhao	Question Mark
Jinzhou	Question Mark	Yantai	Dog
Tianjin	Cash Cow	Lianyungang	Dog
Qinhuangdao	Dog	Nanjing	Dog

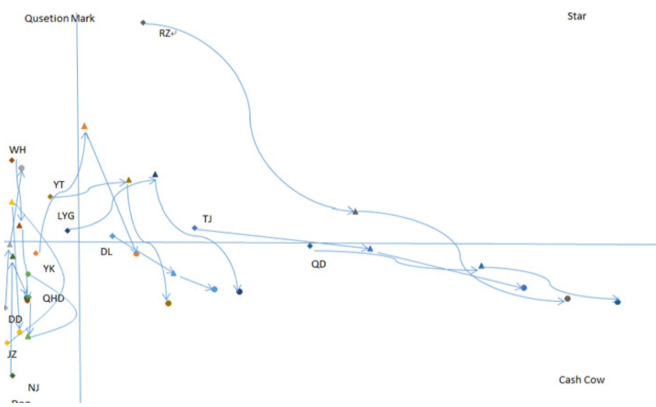

Fig. 2. Changes in the dynamic matrixes of import traffic volumes, 2012–2014

3.3. *A shift-effect analysis*

Although useful for representing structural changes (positioning) of individual ports visually, a BCG analysis is limited because it cannot identify the amounts of changes in traffic volumes. Thus, a shift-effect analysis is conducted to analyze the changes in the traffic volumes of individual ports within the area. In this way, the flow of traffic volumes of North China ports can be roughly understood. However, a shift-effect analysis has limitations in terms of identifying changes in external environmental conditions or internal competitive situations. Nonetheless, the implications of the results are relatively clear, because the analysis is based on actual realized economic results (Seo et al., 2012). Limitations of this technique are that it cannot explain clearly why certain ports grow or decline, or why shifts and shares occur among ports. It is a simple descriptive tool used to summarize and explain information. Nevertheless, this is a valuable tool when examining changes in competitiveness following changes in the regional traffic volumes and the relative competitiveness of ports. This model is used frequently to evaluate the competitiveness of ports because of its effectiveness and contribution to the understanding of port geography (Marti, 2012).

Although shift effects represent the traffic volume that a port has captured from competing ports in the same region, this scenario is possible under complete competition only. However, completely competitive markets do not exist among port markets, and traffic volumes increase or decrease because of quite diverse factors and environmental changes. However, the present study excludes such diverse factors or environmental changes, and instead emphasizes the shift effects of flows of traffic volumes among 12 North China ports.

$$SHIFT_i = TEU_{it1} - \frac{\sum_{i=1}^{n} TEUit1}{\sum_{i=1}^{n} TEU_{it0}} * TEU_{it0}$$

$SHIFT_i = t_0 - t_1$; *the cargo flow decrease of a port*
n = *the number of the port in the group.*

Traffic volume shifts among North China ports were analyzed to determine the changes in traffic volumes of North China ports. The results show that the traffic volume of Dalian has steadily shifted to other ports. Approximately 21.02 million tons, 9.34 million tons, and 3.11 million tons were shown to have shifted during 2004–2007, 2008–2011, and 2012–2014, respectively. In addition to Dalian, the traffic volumes of Tianjin and Qinhuangdao also shifted to other ports. From 2004 to 2014, 55.948 million tons from Dalian, 140.82 million tons from Tianjin, 69.05 million tons from Qingdao, 106.61 million tons from Nanjing, and 222.49 million tons from Qinhuangdao shifted to other ports.

Yingkou, Dandong, Weihai, Rizhao, Yantai, and Lianyungang have been steadily absorbing traffic volumes from other ports since 2004. In particular, significant growth trends have appeared in Yingkou, Dandong, Rizhao, and Yantai. From 2004 to 2014, Yingkou, Dandong, Jinzhou, Weihai, Rizhao, Yantai, and Lianyungang absorbed 133.336 million tons, 102.81 million tons, 141.36 million tons, 1.238 million tons, 166.354 million tons, 124.378 million tons, and 52.677 million tons of traffic volumes, respectively, from other ports. These results are consistent with the results of the concentration ratio (HHI) analysis.

Table 7
Traffic volume shift effects among North China ports (unit: ten thousand ton)

Classification	2004–2007	2008–2011	2012–2014	2004–2014
Dalian	-2102.3	-934.5	-311.4	-5594.8
Yingkou	2163.4	3828.0	788.7	13333.6
Dandong	840.9	2666.4	4307.2	10281.0
Jinzhou	-609.6	930.9	136.1	1413.6
Tianjin	-3695.9	-4785.0	-2111.0	-14082.0
Qinhuangdao	-370.6	-6761.0	-8204.4	-22249.2
Qingdao	-824.8	-5057.6	724.0	-6905.0
Weihai	-190.4	720.7	182.5	123.8
Rizhao	4481.1	3993.0	2238.8	16635.4
Yantai	2742.6	2272.4	1453.3	12437.8
Lianyungang	1195.2	1460.2	297.1	5267.7
Nanjing	-5251.5	1666.5	-451.3	-10661.9

With regard to export traffic volume shift effects of individual North China ports, the traffic volumes of Qingdao, Weihai, and Lianyungang shifted to other ports from 2012. In contrast, Jinzhou and Rizhao were shown to have absorbed traffic volumes from other ports.

Table 8
The export traffic volume shift effects of individual North China ports (unit: ten thousand ton)

Classification	2004–2007	2008–2011	2012–2014	2004–2014
Dalian	849.0	746.8	-537.8	1464.4
Yingkou	61.9	-13.4	219.4	122.6
Dandong	-106.9	37.9	-0.6	-130.6
Jinzhou	-9.8	93.8	143.1	25.8
Tianjin	604.4	-794.1	652.7	629.0
Qinhuangdao	-3464.0	-1326.9	-30.9	-6642.9
Qingdao	1383.8	1178.4	-395.2	3372.1
Weihai	157.3	275.5	-88.0	529.7
Rizhao	-686.4	-463.9	175.7	-1566.6
Yantai	1580.9	395.2	37.1	1274.8
Lianyungang	753.0	-360.3	-108.8	547.5
Nanjing	-150.2	231.0	-66.7	374.1

The import traffic volume shift effects of individual North China ports differed from the export and import traffic volume shift effects. Dalian absorbed 2 million tons of import traffic volumes from other ports during 2012–2014. Yingkou, Dandong, Tianjin, Qinhuangdao, and Lianyungang also showed tendencies to absorb import traffic volumes from other ports. In contrast, the import traffic volumes of Qingdao, Rizhao, Yantai, and Nanjing were shown to have shifted to other ports.

Table 9
The import traffic volume shift effects of individual North China ports (unit: ten thousand ton)

Classification	2004–2007	2008–2011	2012–2014	2004–2014
Dalian	849.0	746.8	-537.8	1464.4
Yingkou	61.9	-13.4	219.4	122.6
Dandong	-106.9	37.9	-0.6	-130.6
Jinzhou	-9.8	93.8	143.1	25.8
Tianjin	604.4	-794.1	652.7	629.0
Qinhuangdao	-3464.0	-1326.9	-30.9	-6642.9
Qingdao	1383.8	1178.4	-395.2	3372.1
Weihai	157.3	275.5	-88.0	529.7
Rizhao	-686.4	-463.9	175.7	-1566.6
Yantai	1580.9	395.2	37.1	1274.8
Lianyungang	753.0	-360.3	-108.8	547.5
Nanjing	-150.2	231.0	-66.7	374.1

Upon reviewing the shift effects of North China ports during 2004–2014, it can be seen that although Dalian, Tianjin, Qingdao, Nanjing, and Jinzhou became less competitive for all foreign trade, to some extent, these ports are still relatively competitive in terms of exports. Then, Yingkou, Yantai, Lianyungang, and Weihai seem to have become more competitive in terms of both exports and imports. While Dandong and Rizhao are competitive for all foreign trade, they are more competitive for imports than they are for exports. Qinhuangdao seems to have become less competitive in terms of both exports and imports.

4. Conclusion

In the present study, the foreign trade traffic volumes for the past 10 years of major North China ports were divided into export and import cargoes in order to analyze the relationships of the concentration ratios and shift effects with the ports' competition structures. An HHI, BCG matrix analysis, and shift-effect analysis were applied as study methods.

The results are as follows. First, to understand the market structures of major North China ports, port concentration ratios were analyzed using the HHI. The results showed that oligopolies in this area gradually decreased. This is attributable to the continuous growth of small and medium-sized ports, such as Lianyungang and Yingkou, as well as the decrease in growth of Rizhao, Qingdao, and Dalian. Whereas the HHI of import traffic volumes gradually decreased, the HHI of export traffic volumes was shown to have increased slightly. This is judged to mean that export cargoes were concentrated in some ports, while the competition for import cargoes intensified. Second, to review the competitive positioning of individual North China ports, the competition structures among ports were analyzed using a BCG matrix based on the average market shares and annual average growth rates of port traffic volumes. The dynamic matrix of export traffic volumes showed that the dynamic flows of 12 major North China ports over the last 10 years were relatively unstable. Recovery trends in 2012–2014 appeared clearly in all ports, except for Yantai, Dalian, and Nanjing. In the case of import traffic volumes, Dalian, Tianjin, and Rizhao moved from being Stars to Cash Cows, while Jinzhou and Dandong moved to become Question Marks.

Third, a shift analysis was used to identify how traffic volumes shifted among the ports. According to the results, when all traffic volumes were considered, the traffic volumes of Dalian, Tianjin, and Qinhuangdao were judged to have steadily shifted to other ports. In addition, Yingkou, Dandong, Weihai, Rizhao, Yantai, and Lianyungang were shown to have steadily absorbed traffic volumes from other ports since 2004. The export/import traffic volume shift effects showed that Dalian, Tianjin, Qingdao, Nanjing, and Jinzhou are still competitive in terms of export cargoes, while Yingkou, Yantai, Lianyungang, and Weihai have become more competitive in terms of both exports and imports. Dandong and Rizhao are more competitive for imports than they are for exports. Lastly, Qinhuangdao has become less competitive, to some extent, in terms of both exports and imports.

To summarize, in terms of the market structure of major North China ports, the oligopoly phenomenon has gradually decreased, and the concentration ratios of import cargoes are higher than those of export cargoes, indicating that competition for import cargoes will intensify. In particular, as international trade increased continuously in the midst of rapid increases in FDI in the hinterland of major North China ports, the complementarities between FDI and trade attracted increasing attention. Here, the increases in international trade can be attributed to the direct effects of FDI in major North China port regions, such as export induction, export substitution, re-imports, and import diversion, as well as to indirect effects such as export opportunities in investing countries owing to an increase in demand and the economic growth of these countries (Export-Import Bank Law of Korea, 2011). Therefore, Dalian, Tianjin, Qingdao, Nanjing, and Jinzhou can be said to have become more competitive for exports, because many foreign enterprises have invested in these regions. In addition, Dandong and Rizhao can be said to have become more competitive for import cargoes because there has been relatively less investment by foreign enterprises in the secondary and tertiary industries, or because FDI has been flowing into these regions. In addition, in the case of Yingkou, Yantai, Lianyungang, and Weihai, inflows and the localization of many foreign investing enterprises have increased continuously. Therefore, the South Korea–China FTA means that the competition structures of major North China ports for export and import cargoes are highly likely to become further differentiated over time.

In the present study, the competition structures of major North China ports for export and import cargoes were analyzed to determine the export/import competition structures of individual ports. However, there are limited data on the present situation of Chinese ports. Thus, deriving specific implications for securing a competitive advantage for exports and imports is difficult. This limitation is expected to be overcome as additional studies are conducted on major North China regions and ports, and when more comprehensive statistics have been accumulated.

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