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Soo Won Mo

Kwang Bae Lee

Yong Joo Lee

Hong Gyun Park

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Original Article

Analysis of import changes through shift-share, location quotient and BCG techniques: Gwangyang Port in Asia

Soo Won Mo [a], Kwang Bae Lee [b], Yong Joo Lee [c], Hong Gyun Park [b,*]

[a] *Mokpo National University, Republic of Korea*
[b] *Sunchon National University, Republic of Korea*
[c] *Central Washington University, USA*

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ABSTRACT

The main aim of this article is to analyze the import changes of Gwangyang Port using shift-share, location quotient and BCG matrix techniques. We perform the standard shift-share analysis and spatial shift-share analysis for the period 2010–2018 and investigate the import performance of Gwangyang Port for coal, iron ore, natural gas and vegetable matter. The static analysis shows that the regional shift effect, which is the most important component, is negative for coal and iron ore, but positive for natural gas and vegetable matter. The spatial shift-share analysis also indicates that Gwangyang Port experiences not only the gains in regional competitiveness but the industrial advantage for iron ore, natural gas and vegetable matter owing to its higher competitiveness. Incorporating location coefficients into BCG matrix for coal imports, we also show that Gwangyang Port succeeds upgrading its position for natural gas and vegetable matter, but fails escaping from transformation category or upgrading its position for coal and iron ore.

1. Introduction

The import of Gwangyang Port recorded the compound average growth rate of 1.1% from \$12.2 billion in 2010 to \$13.3 billion in 2018 in terms of value, while its import increased from 57.8 million tons to 71.9 million tons in terms of volume, with a CAGR of 2.6%. During the same period, furthermore, the standard deviation of annual growth rate for import value was 18.6, more than three times that of import volume. The coefficient of variation of import value, 0.152, was also much larger than that of import volume, 0.076. For coal (MTI 132), which is a major import item of Gwangyang Port, the compound average growth rate of import value, 1.9%, was not significantly different from that of import volume, 2.1%. However, the standard deviation of the annual growth rate of import value, 32.5, was by far larger than that of volume, 9.0. This indicates that Gwangyang Port's imports exhibit a great difference in volatility of value and volume and the former is more stable than the latter. Therefore, it can be reasonable to target volume rather than value which is more sensitive to the changes of the price and the exchange rate.

Gwangyang Port's main import items are coal (132), iron ore (112), natural gas (134), and vegetable materials (013), at a 3-digit disaggregation of MTI (code previously granted by the Ministry of Trade and Industry of Korea), which accounted for 56% of imports in 2018. It also shows that there were great variations in import volume changes depending on which product was imported. The change rate of natural gas leaped from 1.7% in 2014 to 6.3% in 2018 and vegetable matter rose from 5.3% in 2010 to 10.6% in 2018, while coal and iron ore did not show any significant change. We also see that import volumes varied considerably depending on individual ports. For coal import, Dangjin Port and Taean Port experienced 19% and 24% increase during 2015–2018 respectively, but Gwangyang Port and Pohang Port had negative growth rate of 10% and 32%. For natural gas, the growth rate of Gwangyang Port amounted to as much as 42%, while Incheon Port and Pyeongtaek Port showed only an increase rate of 16.1% and 8.7% respectively.

The purpose of our study is to assess the performance of Gwangyang Port from varied perspectives relative to other ports in Korea.

Voluminous research on measuring competitiveness on Korean ports has been conducted in the past, most which employed econometric techniques such as DEA (Bichou, 2011; Itoh, 2002; Omrani & Keshavarz, 2016; Schoyen & Odeck, 2013; Wanke, 2013) AHP

* Corresponding author.
E-mail addresses: soowon@hanmail.net (S.W. Mo), kblee@scnu.ac.kr (K.B. Lee), Yongjoo.Lee@cwu.edu (Y.J. Lee), phg@scnu.ac.kr (H.G. Park).

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(Celik, Er, & Ozok, 2009; Chao, 2017; Chiu, Lin, & Ting, 2014), and time series analysis. Aiming to investigate the relative performance of Gwangyang port, we applied diverse techniques in our study that can disentangle national, sectorial, and regional trends, which are different from the methods that the existing research largely used. Particularly, we perform a standard shift-share analysis that envisages the whole period and analyze the changes in competitiveness among ports through spatial shift-share analysis. In addition, the location quotients are incorporated into the BCG matrix to reveal the changes in the degree of specialization and competitiveness and draw conclusions.

2. Shift-share analysis

Shift-share analysis is a traditional tool for interregional comparison, measuring and evaluating sectoral performance. A wide variety of applications have appeared since introduced the methodology. Its widespread use is explained by its simplicity, modest data requirements, and the fact that the results are relatively easy to assess and interpret (Chiang, 2012; Dogru & Sirakaya, 2017; Marquez, Ramajo, & Hewings, 2009; Oyewole, 2016). Shift-share analysis decomposes the change of employment (or income) in a particular region into three components: the national share component (NC), the sectoral shift component (SC), and the regional shift component (RC).

The national share component attempts to measure employment (or income) growth or decline that would have occurred in the region if employment (or income) had grown at precisely the same rate as the national average (Tervo & Okko, 1983). Hence, if the region grows at the same rate as the national average, the region does not possess any comparative advantage. According to the model used by Sirakaya, Uysal, and Toepper (1995), the NC is computed by multiplying the regional base year employment (or income) in each sector by the average national employment (or income) growth rate and then summing the products. The resulting figures illustrate the quantity of newly created employment (or income) that are attributable to the national economic trends and nothing else.

The second of the three components, the sectoral shift component, associates the differential growth rate between the region in question and the nation with overall strengths and weaknesses of the specific industry sector. Ideally, it is expected that a large proportion of the region's employment (or income) should be concentrated in faster-growing industries and by the same token, a smaller percentage of a region's employment (or income) should be in slower-growing sectors of the regional economy. The industrial mix effect is calculated by multiplying the local employment (or income) in the specific sector by the difference in the national growth rate for that sector and the growth rate for the entire economy.

The third component, the regional shift component (also called the "regional competitive effect"), indicates that the region under study is more or less efficient (competitive) in securing a larger share of employment (or income) than its counterpart (the nation). The regional shift component is calculated by multiplying the regional employment (or income) in the specific sector by the difference in the growth rate of that sector nationally and regionally (Dogru & Sirakaya, 2017). This paper introduces the classical shift-share model in the following equation:

$$\begin{aligned} M_{ij}^1 - M_{ij}^0 &= \Delta M_{ij} = NC + IC + RC \\ &= \alpha_0 M_{ij}^0 + (\alpha_1 - \alpha_0) M_{ij}^0 + (\alpha_2 - \alpha_1) M_{ij}^0 \end{aligned} \quad (1)$$

where M_{ij}^1 is the import volume in sector i of port j at final year; M_{ij}^0 is the import volume in sector i of port j at beginning year; NC is the national share component; SC is the sectoral shift component; RC is the regional shift component; α_0 is the port growth rate of import over the entire period 1–0; α_1 is the port growth rate of import in sector i over the entire period 1–0; α_2 is the growth rate of import in sector i in port j over the entire period 1–0.

While shift-share analysis in the traditional formulation does not account for interactions across neighboring regions, a spatial version enables us to overcome this drawback (Espa, Filipponi, Giuliani, & Piacentino, 2014). The idea is that the decomposed effects are not spatially independent, i.e. the performance of neighboring regions can affect the performance of a particular region. Nazara and Hewings (2004) first introduced shift-share analysis with spatial structure, incorporating a spatial lag growth rate $\hat{\alpha}_2$ in the basic decomposition, as follows:

$$M_{ij}^1 - M_{ij}^0 = \alpha_0 M_{ij}^0 + (\hat{\alpha}_2 - \alpha_0) M_{ij}^0 + (\alpha_2 - \hat{\alpha}_2) M_{ij}^0 \quad (2)$$

$\hat{\alpha}_2$ is the growth rate of import in sector i in neighbors of region j over the entire period 1–0.

On the right-hand side of Eq. (2), the first component measures the national effect (NS), as in classical shift-share. The second component is now a measure of the neighbor-nation industry mix effect (NNIM) and shows a positive value when the growth rate of sector i in the neighbors of region j is higher than the national rate. The third component is the region neighbor regional-shift effect (RNRS). This has a negative value when the regional change is worse than that recorded in the neighboring regions, that is, region j fails to take advantage of the positive influence of its neighbors.

Unlike the standard version, spatial shift-share includes both simple and combined effects. The combined effect, measuring differences of more than one aspect at the same time, is characterized by problems of interpretation. For example, the neighbor-nation industry mix effect $(\hat{\alpha}_2 - \alpha_0)$ in Eq. (2) measures the sectoral difference between sector i and all sectors and the spatial-unit difference between the neighbors of region j and the nation at the same time. If (comma deleted) on one hand, a combined effect can be decomposed into a sequence of simple effects, then on the other hand, a certain degree of parsimony is required in each decomposing procedure. As shown by Nazara and Hewings (2004), twenty different spatial decompositions can be obtained from all the possible combinations of simple and combined effects, and their selection depends only on the research aim. In our case, the main aim was to look at the neighborhood effect in business change at different spatial levels of aggregation. For this, the decomposition in Eq. (2) is only partially suitable, and a further step seems to be necessary. Generally, interpretation of the neighborhood effect is exclusively based on the third component of Eq. (2). However, the information contained in that component may sometimes be misleading. For example, the neighborhood effect may show a positive value but the difference in performance between neighbors and nation is negative. In such a case, the competitive effect of region j is mainly due to individual factors, rather than to neighborhood advantages. In order to get over this obstacle, the second component of Eq. (2) can be decomposed into two simple effects:

$$(\hat{\alpha}_2 - \alpha_0) M_{ij}^0 = (\hat{\alpha}_2 - \alpha_1) M_{ij}^0 + (\alpha_1 - \alpha_0) M_{ij}^0 \quad (3)$$

To sum up, the decomposition adopted in the analysis is as follows:

$$M_{ij}^1 - M_{ij}^0 = \alpha_0 M_{ij}^0 + (\alpha_1 - \alpha_0) M_{ij}^0 + (\hat{\alpha}_2 - \alpha_1) M_{ij}^0 + (\alpha_2 - \hat{\alpha}_2) M_{ij}^0 \quad (4)$$

The third component, $(\hat{\alpha}_2 - \alpha_1)$ and fourth component, $(\alpha_2 - \hat{\alpha}_2)$ of Eq. (4) may be interpreted as a measure of the neighbor-nation regional-shift effect (NNRS) and the region-neighbor regional shift effect (RNRS), respectively.

We performed the standard shift-share analysis for the period 2010–2018. The data on import, broken down by individual port and product, come from the Korea International Trade Association,

Table 1
Standard shift-share analysis: coal (thousand tons).

		DM	NC	SC	RC
Dynamic	2010–2011	2,894	1,222	640	1,032
	2011–2012	2,787	261	−988	3,513
	2012–2013	2,894	46	183	−2,510
	2013–2014	1,416	910	137	369
	2014–2015	1,300	524	310	466
	2015–2016	−2,072	531	−933	−1,670
	2016–2017	−481	719	1,190	−2,390
	2017–2018	−58	−38	−735	715
	2010–2014	4,816	2,439	−28	2,405
	2015–2018	−1,311	1,736	−168	−2,879
	2010–2018	3,505	4,175	−197	−474
Static	2010–2018	3,505	3,922	−227	−190

Note: DM (import change), NC (national share component), SC (sectoral shift component), RC (regional shift component).
Source: Authors' computations, based on data from the Korea International Trade Association (https://www.kita.net/) on-line.

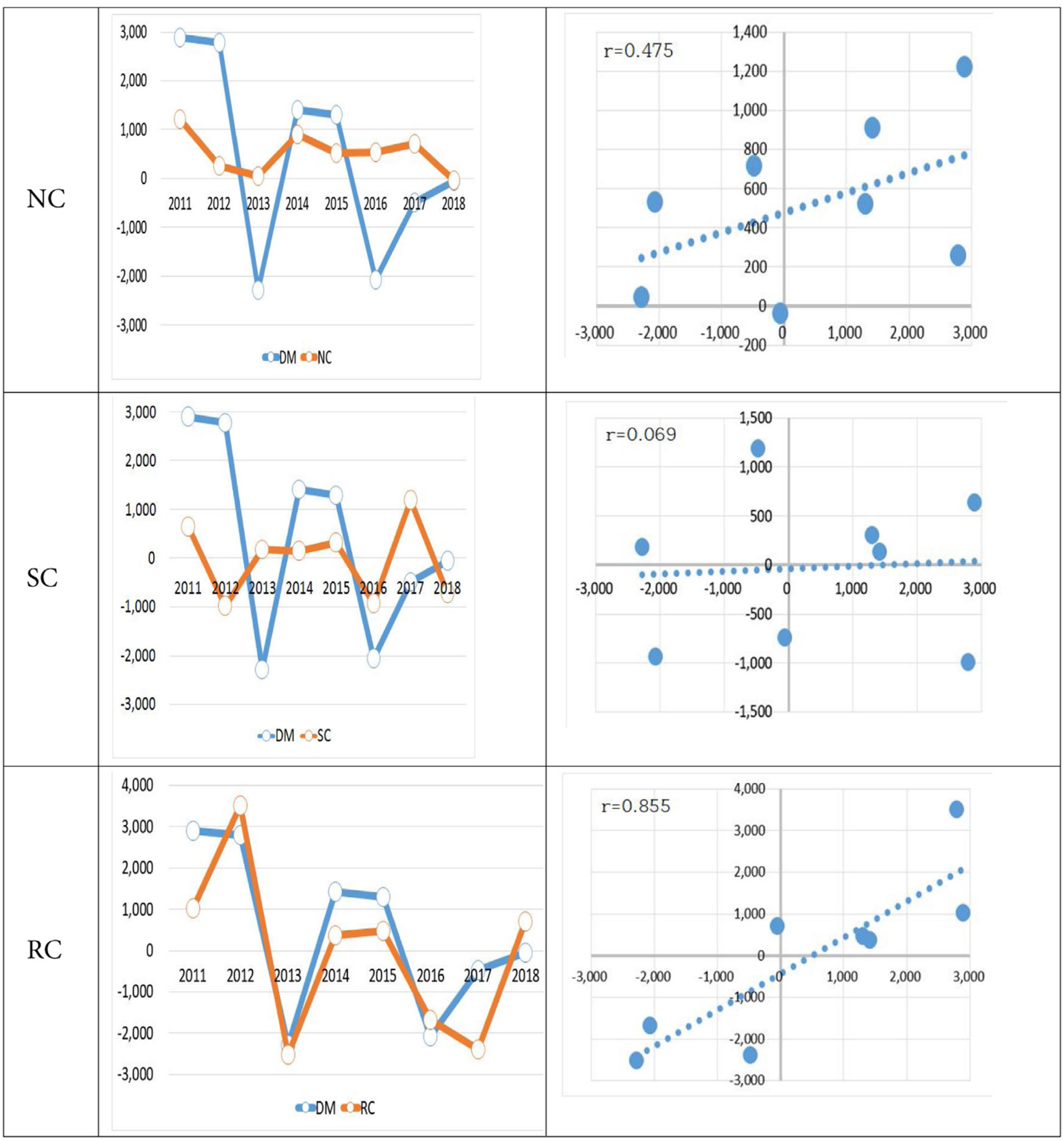

Fig. 1. Import changes and decomposition by components: coal.
Note: DM (import change), NC (national share component), SC (sectoral shift component), RC (regional shift component).
Source: Authors' computations, based on data from the Korea International Trade Association (https://www.kita.net/) on-line.

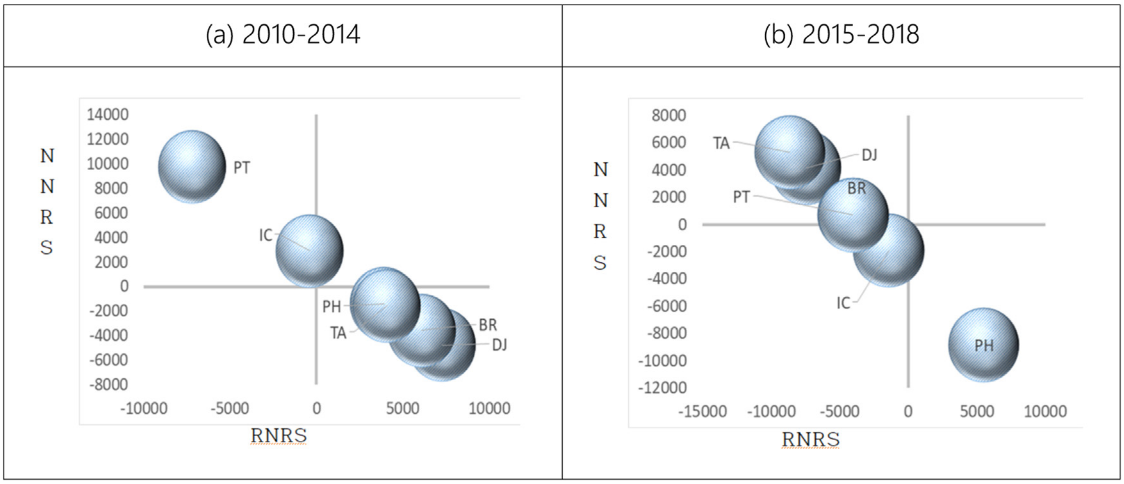

Fig. 2. Neighbor-nation regional-shift vs. region-neighbor regional-shift: coal. Note: NNRS (neighbor-nation regional-shift), RNRS (region-neighbor regional-shift).

Table 2
Standard shift-share analysis: iron ore (thousand tons).

		DM	NC	SC	RC
Dynamic	2010–2011	−801	1,867	2,576	−5,244
	2011–2012	1,678	337	162	1,178
	2012–2013	−3,052	56	−1,251	−1,857
	2013–2014	4,019	1,092	3,236	−310
	2014–2015	−40	680	−775	56
	2015–2016	−1,079	653	−1,313	−418
	2016–2017	2,328	929	−640	2,039
	2017–2018	−540	−54	412	−898
	2010–2014	1,844	3,567	5,371	−7,094
	2015–2018	709	1,581	−1,608	736
	2010–2018	2,513	5,561	2,406	−5,454
Static	2010–2018	2,513	5,992	2,796	−6,274

Note: DM (import change), NC (national share component), SC (sectoral shift component), RC (regional shift component).
Source: Authors' computations, based on data from the Korea International Trade Association (https://www.kita.net/) on-line.

namely the KITA.ORG online database. We investigated the regional performance of 4 import sectors: coal, iron ore, natural gas and vegetable matter.

As a result of the static analysis for the period from 2010 to 2018 (Table 1), coal imports in Gwangyang Port increased by 3505 thousand tons. The national component accounted for the increase of 3922 thousand tons, but the sectoral shift component and the regional shift component decreased 227 thousand tons and 190 thousand tons respectively. The result also indicates that the regional shift component of the dynamic analysis for the 2010–2018 period, 474 thousand tons, is considerably different from that of the static analysis. This means that volatility in regional shift components are far greater than that of national and sectoral components. Coal imports changed from a 4816 thousand tons increase to a 1311 thousand tons decrease between the period 2010–2014 and the period 2015–2018. The regional shift component also changed from a 2405 thousand tons increase to a 2879 thousand tons decrease. The results from our analysis for the coal indicate that the decrease of coal imports in Gwangyang Port over 2015–2018 is interrelated with preponderantly negative regional competitive components.

In Fig. 1, which shows the breakdown of the import change of coal by component, the line indicating the national share component shows a very large deviation from the line indicating the actual import change in most periods except for 2014 and 2018. The line indicating sectoral shift component also moves away from the line showing the actual fluctuation of coal imports in the periods except 2018. In contrast, the regional shift component line moves in the same direction in close proximity to the actual change for most of the periods. This indicates that regional competitiveness affects the coal import change most powerfully in Gwangyang Port. We ascertain this result from the fact that in the scatter diagram showing the relationship between the three components and the import fluctuation, the correlation coefficients are found to be highest in the regional shift component of 0.855 compared to the national share component of 0.475 and the sectoral shift component of 0.069. The regional components are the closest to the regression line of all three components.

In Fig. 2, which is the result of the spatial shift-share analysis for coal imports, Pyeongtaek and Incheon Ports recorded higher growth than the national average in 2010–2014 and showed a competitive advantage over Gwangyang Port. The competitiveness of Pohang, Taean, Boryeong, and Dangjin ports did not reach the national average and fell behind Gwangyang Port. In 2010–2014, Gwangyang Port had a competitive disadvantage over Pyeongtaek Port and Incheon Port, while Gwangyang Port had a competitive edge over Pohang Port, Taean Port, Boryeong Port, and Dangjin Port. This position changed dramatically in 2015–2018. Gwangyang Port fell behind not only Taean Port, Dangjin Port, Boryeong Port, and Pyeongtaek Port which showed high growth, but also Incheon Port which had poor growth. It can be seen that the competitiveness of Gwangyang Port greatly deteriorated for coal imports.

Table 2 shows that over 2010–2018 the import of iron ore increased by 2513 thousand tons, of which the national component and sectoral component contributed to the increase of 5992 thousand tons and 2796 thousand tons, respectively, while the regional

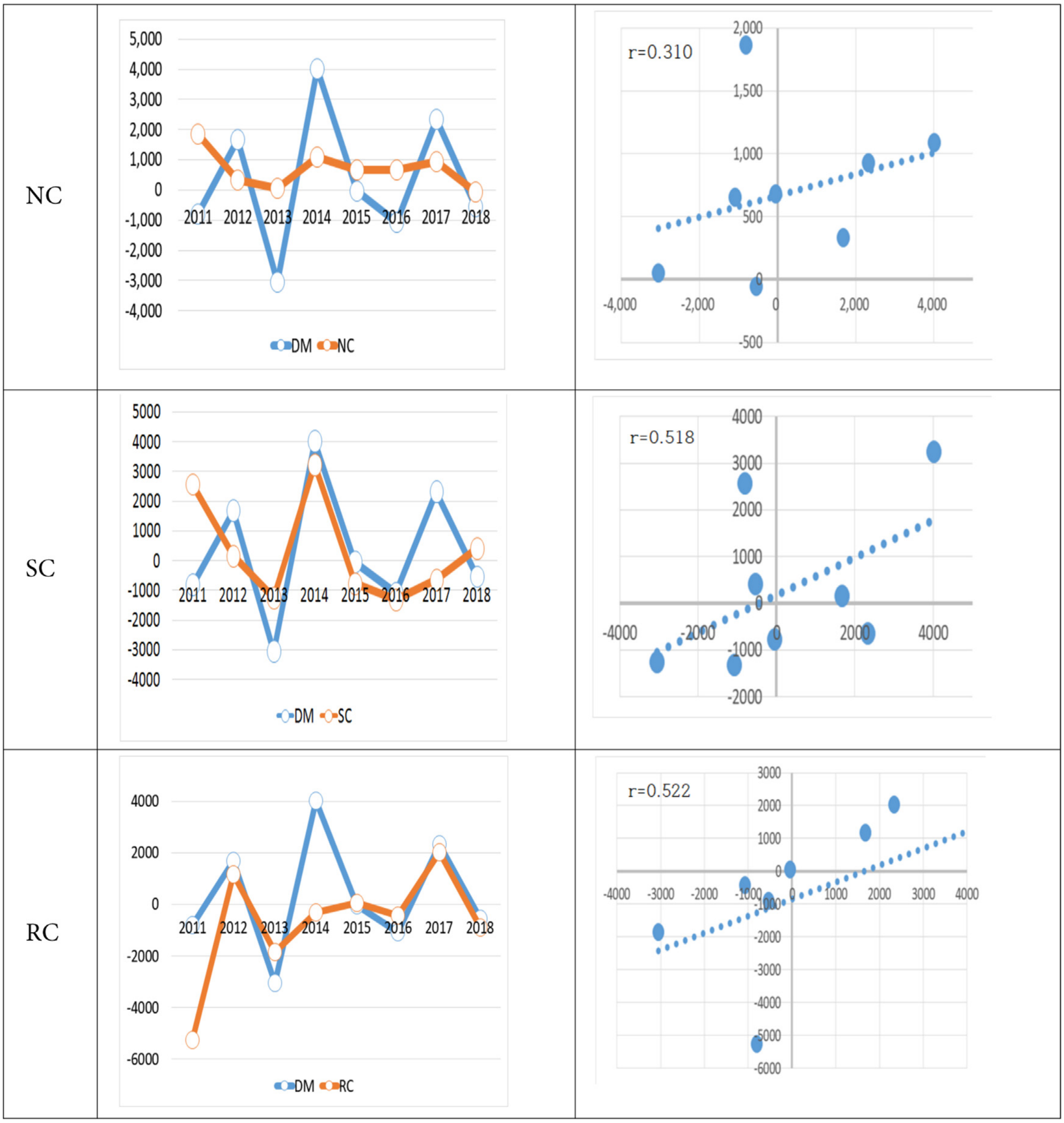

Fig. 3. Import changes and decomposition by components: iron ore.
Note: DM (import change), NC (national share component), SC (sectoral shift component), RC (regional shift component).
Source: Authors' computations, based on data from the Korea International Trade Association (https://www.kita.net/) on-line.

component had a very large negative figure of 6274 thousand tons. The result also shows that the regional shift component of the dynamic analysis for the 2010–2018 period, 6274 thousand tons, has a great difference from that of the static analysis. This means that volatility in regional shift components are far greater than that of national and sectoral components. The sectoral shift component changed very unfavorably from positive 5371 thousand tons to negative 1608 thousand tons, while the regional shift component changed favorably from the 7094 thousand tons loss to the 736 thousand tons gain between the period 2010–2014 and the period 2015–2018. The results for the iron ore indicate that Gwangyang has experienced the gains in the regional competitiveness as well as the deterioration in the industry mix.

Fig. 3 shows the breakdown of the import change of iron ore by shift-share component. The two lines indicating sectoral shift component and regional shift component move closely with the line indicating the actual import change in 2011, 2013, 2014 and 2016. There is also no significant difference between the two components as the regional component has a large deviation in 2011 and 2014, and the sectoral component has a long distance in 2011 and 2017. This means that both regional competitiveness and sectoral structure affect the change of import in iron ore in Gwangyang Port. We also see that in the scatter diagram showing the relationship between the three components and the import fluctuation, the correlation coefficients of the national, sectoral and regional components are 0.310, 0.518 and 0.522. There is no significant difference between the sectoral and regional components.

In Fig. 4, which is the result of the spatial shift-share analysis for iron ore imports, Pyeongtaek-Dangjin Port had a positive NNRS and a negative RNRS, indicating higher growth rate than national average in 2010–2014 and a competitive advantage over Gwangyang Port. To the contrary, Pohang Port had lower growth rate than national average and a competitive disadvantage over Gwangyang Port with a negative NNRS and a positive RNRS. However, for the period 2015–2018, Gwangyang Port achieved a competitive edge over Pohang Port growing faster than port average, not to mention

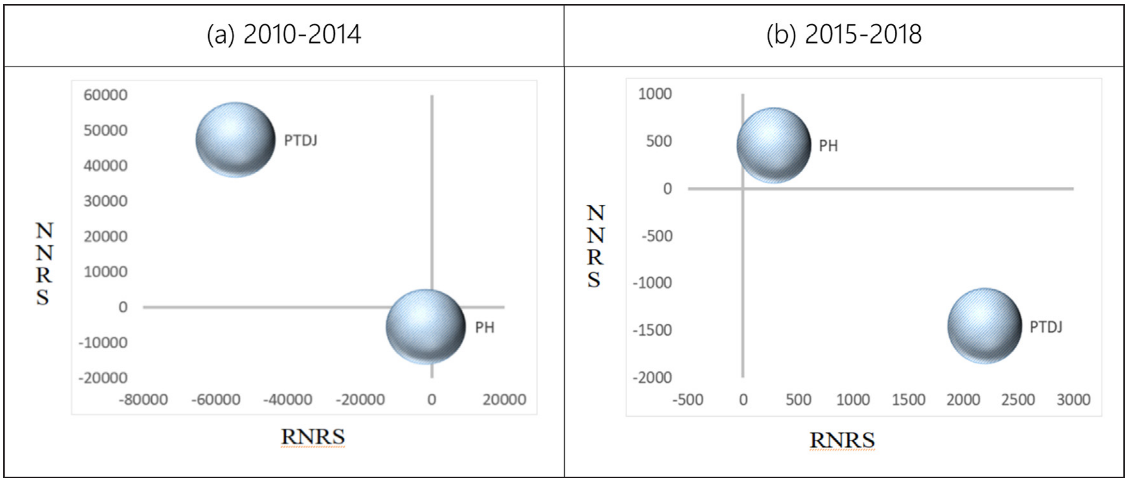

Fig. 4. Neighbor-nation regional-shift vs. region-neighbor regional-shift: iron ore.
Note: NNRS (neighbor-nation regional-shift), RNRS (region-neighbor regional-shift).

Table 3
Standard shift-share analysis: natural gas (thousand tons).

		DM	NC	SC	RC
Dynamic	2010–2011	−53	98	106	−257
	2011–2012	−77	18	−34	−61
	2012–2013	−13	3	141	−156
	2013–2014	−48	56	−207	103
	2014–2015	533	29	−147	650
	2015–2016	83	40	−59	102
	2016–2017	273	61	201	11
	2017–2018	435	−4	335	104
	2010–2014	−191	187	−32	−346
	2015–2018	792	96	446	250
	2010–2018	1,133	300	336	497
Static	2010–2018	1,133	315	137	681

Note: DM (import change), NC (national share component), SC (sectoral shift component), RC (regional shift component).
Source: Authors' computations, based on data from the Korea International Trade Association (https://www.kita.net/) on-line.

Pyeongtaek-Dangjin Port simultaneously recording poor performance. We can see that the competitiveness of Gwangyang Port improved greatly for iron ore imports.

Table 3 shows that over 2010–2018 the import of natural gas increased by 1133 thousand tons, of which national component, sectoral component and regional component accounted for 315 thousand tons, 137 thousand tons and 681 thousand tons, respectively. The actual imports increased by 983 thousand tons owing to the sectoral shift component as well as the regional shift component changing favorable from negative to positive effects, though the positive national share effect dwindled from 187 thousand tons to 96 thousand tons between the period 2010–2014 and the period 2015–2018. The results for the natural gas indicate that Gwangyang has experienced both the gains in regional competitiveness and the industrial advantage.

In Fig. 5, which shows the breakdown of the import change of natural gas by component, the line indicating the national share component not only shows a very large deviation from the line indicating the actual import change in 2011, 2015, 2017 and 2018, but it also shows that they move in different directions from each other. The sectoral shift component also moves in different directions and fails to explain the big gap between the actual change line and the sectoral line in 2015. The regional shift component line moves closer than the other components for most of the periods and succeeds in explaining the deep gap between the sectoral component in 2015 and the national component in 2015 and 2018. This indicates that regional competitiveness influences the natural gas import change in great depth in Gwangyang Port. We ascertain this result from the fact that in the scatter diagram showing the relationship between the three components and the import fluctuation, the correlation coefficients are found to be highest in the regional shift component of 0.760 compared to the national share component of 0.315 and that the sectoral shift component of 0.241 and the regional components are the closest to the regression line of the three components.

Fig. 6 shows the results of the spatial shift-share analysis for natural gas imports. Pyeongtaek Port had a positive NNRS and a negative RNRS, indicating higher growth rate than national average and a competitive advantage over Gwangyang Port in 2010–2014. Pohang Port had a negative NNRS and a negative RNRS, showing lower growth rate than national average but a competitive advantage over Gwangyang Port. However, for the period 2015–2018, Gwangyang Port achieved a competitive edge over both ports as the performance of Pyeongtaek Port and Pohang Port got sluggish.

As shown in Table 4, the import of vegetable matter increased by 1271 thousand tons, most of which were attributed to the favorable regional shift component. The import of vegetable matter increased by 452 thousand tons from the period 2010–2014 and increased by 763 thousand tons from the period 2015–2018 as the positive regional component grew greatly from 341 thousand tons to 727 thousand tons, though the positive national component dwindled and the negative regional component enlarged. Although the industrial structure has been adversely affected, it shows that the advantage of regional competitiveness has contributed greatly. The

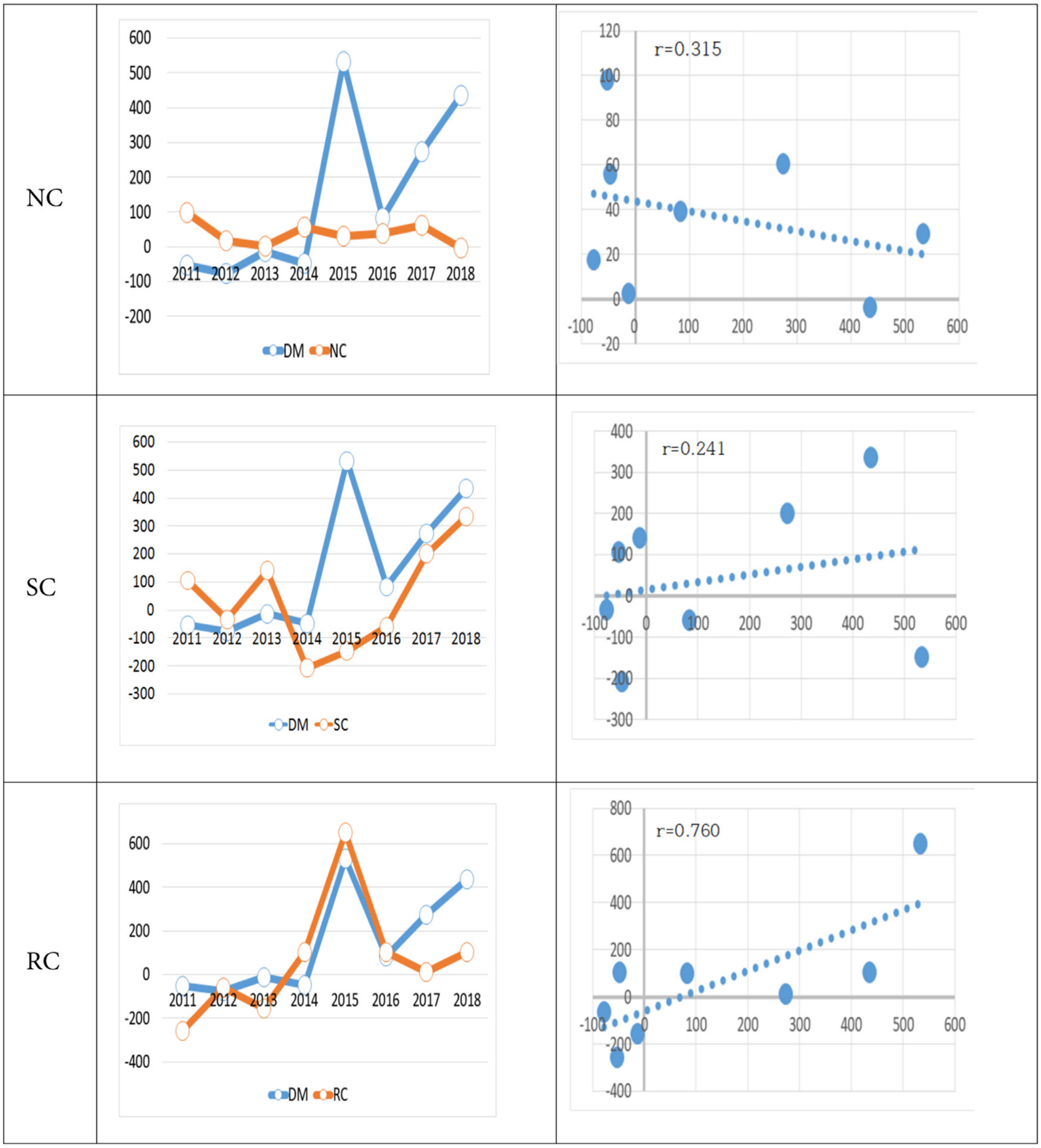

Fig. 5. Import changes and decomposition by components: natural gas.
Note: DM (import change), NC (national share component), SC (sectoral shift component), RC (regional shift component).
Source: Authors' computations, based on data from the Korea International Trade Association (https://www.kita.net/) on-line.

results for vegetable matter indicate that Gwangyang is interrelated with preponderantly positive regional competitiveness.

Fig. 7 shows the breakdown of the import change of vegetable matter by shift-share component. The national share component moves far from actual change line and in opposite directions in 2012, 2016, 2017 and 2018. The sectoral shift component also moves a large distance in opposite directions in 2011, 2016 and 2017. Contrary to the other two components, the regional component moves very closely with the actual import change in the same direction for most of the periods. This means that regional competitiveness is the most important component in vegetable matter import change in Gwangyang Port. We also see that in the scatter diagram showing the relationship between the three components and the import fluctuation, the correlation coefficient, 0.760, is the greatest of all three components.

Fig. 8 shows that Pyeongtaek Port with positive NNRS and negative RNRS recorded higher growth rate than national average as well as Gwangyang Port in 2010–2014. Gunsan Port had positive NNRS but negative RNRS, indicating that growth rate fell behind Gwangyang Port. In Busan, Incheon and Ulsan, NNRS was negatively negative, and RNRS was not positive enough to compete with Gwangyang Port. Busan, Incheon and Ulsan Ports were not enough to compete Gwangyang Port with negative NNRS and positive RNRS. The competitiveness of Gwangyang Port did not reach Pyeongtaek Port, but it outweighed Gunsan, Busan, Ulsan and Incheon Ports. The results showed that Gwangyang Port had an advantage over all ports. The competitiveness of Gwangyang Port was the second to Pyeongtaek Port in 2010–2014, but Gwangyang Port became the most competitive port surpassing Pyeongtaek Port in 2015–2018. This indicates that the competitiveness of Gwangyang Port was getting higher.

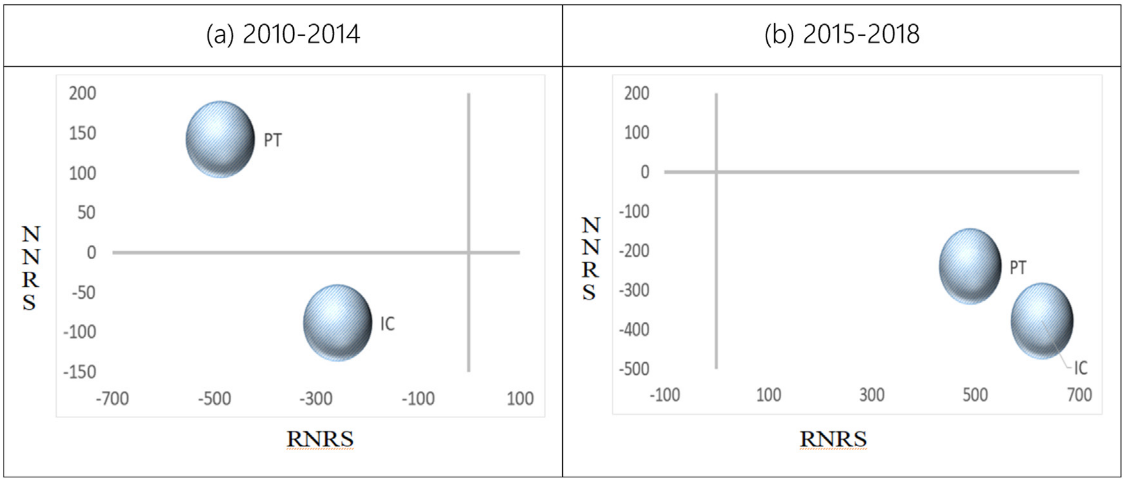

Fig. 6. Neighbor-nation regional-shift vs. region-neighbor regional-shift: natural gas.
Note: NNRS (neighbor-nation regional-shift), RNRS (region-neighbor regional-shift).

Table 4
Standard shift-share analysis: vegetable matters (thousand tons).

		DM	NC	SC	RC
Dynamic	2010–2011	78	59	−110	129
	2011–2012	273	12	133	128
	2012–2013	81	2	23	56
	2013–2014	21	55	−33	−1
	2014–2015	56	30	−17	43
	2015–2016	164	30	−12	145
	2016–2017	479	49	−128	557
	2017–2018	120	−3	137	−13
	2010–2014	452	113	−2	341
	2015–2018	763	73	−37	727
	2010–2018	1,271	234	−7	1,044
Static	2010–2018	1,271	189	−42	1,124

Note: DM (import change), NC (national share component), SC (sectoral shift component), RC (regional shift component).
Source: Authors' computations, based on data from the Korea International Trade Association (https://www.kita.net/) on-line.

3. Location quotient and BCG analysis

The location quotients are incorporated into the BCG matrix. While the location quotient gives a static picture of an individual port, the BCG matrix takes into account the effect of time exposure and point on the dynamism of the import specialization of the port (Mura, Haviernikov´a, & Machov´a, 2017). The two-dimensional area formed by location quotient of 2014 (LQ (2014)) and location quotient of 2018 (LQ (2018)), LQ growth rate for 2010–2014 and 2015–2018 of a given product represented its market form. The LQ growth rate is as follows:

$$\Delta LQ_i = \frac{LQ_i^1 - LQ_i^0}{LQ_i^0} \times 100\%$$

We divided the import product markets into four types: Star, Mature, Emerging, and Transforming (Liu & Sun, 2002). Subsequently, the data are recorded into the BCG matrix thereby the products are broken down into four types: STARS, MATURE, EMERGING and TRANSFORMING. Each type fulfills a different role in local or regional ports and thus requires different development activities. STARS: The ports are defined as sectoral clusters with high and positive level of LQ, which is increasing over time. The ports have highly attractive market share, even assuming their further progress. It is recommended to let the ports continue to carry out their activities and promote them further. MATURE: these ports are classified as "mature", with a high level of LQ, but with a declining trend with its negative value measured by LQ. It is recommended to direct the development policy toward promotion of these ports with the aim to progressively move them toward the sector STARS. EMERGING: In this sector we can find the ports that have a low, but increasing level of LQ measured by LQ. Development policy should be directed toward maintaining or promoting the growth of ports also on a national level, so as to convert them into the STARS. If there is a further decline of LQ, it is necessary to move them into the quadrant TRANSFORMING. TRANFORMING: presents the ports with very low level of power (low level of LQ and falling level of ΔLQ). It is recommended to either maintain the port, but without significant support (which may lead to downfall), or promote the port if it has local significance.

Fig. 9 shows the result of incorporating location coefficients into BCG matrix for coal imports. The vertical axis represents the change rate (%) of the location coefficient. During 2010–2014, Taean Port, Boryeong Port, and Dangjin Port belonged to MATURE area, where growth rates were smaller than average (12.2%), but their LQ (2014) were greater than average (2.58). Both Gwangyang Port and Pohang Port located on TRANSFORMING category, where not only growth rate but location coefficient (2014) was below average. Incheon Port and Pyeongtaek Port belonged to EMERGING area, where growth rates were greater than average but their LQ (2014) were below average. During 2015–2018, Taean Port has risen to STAR category, while the other ports retained their positions. Especially, Gwangyang Port has been still located in the TRANSFORMING category and should choose other items replacing coal.

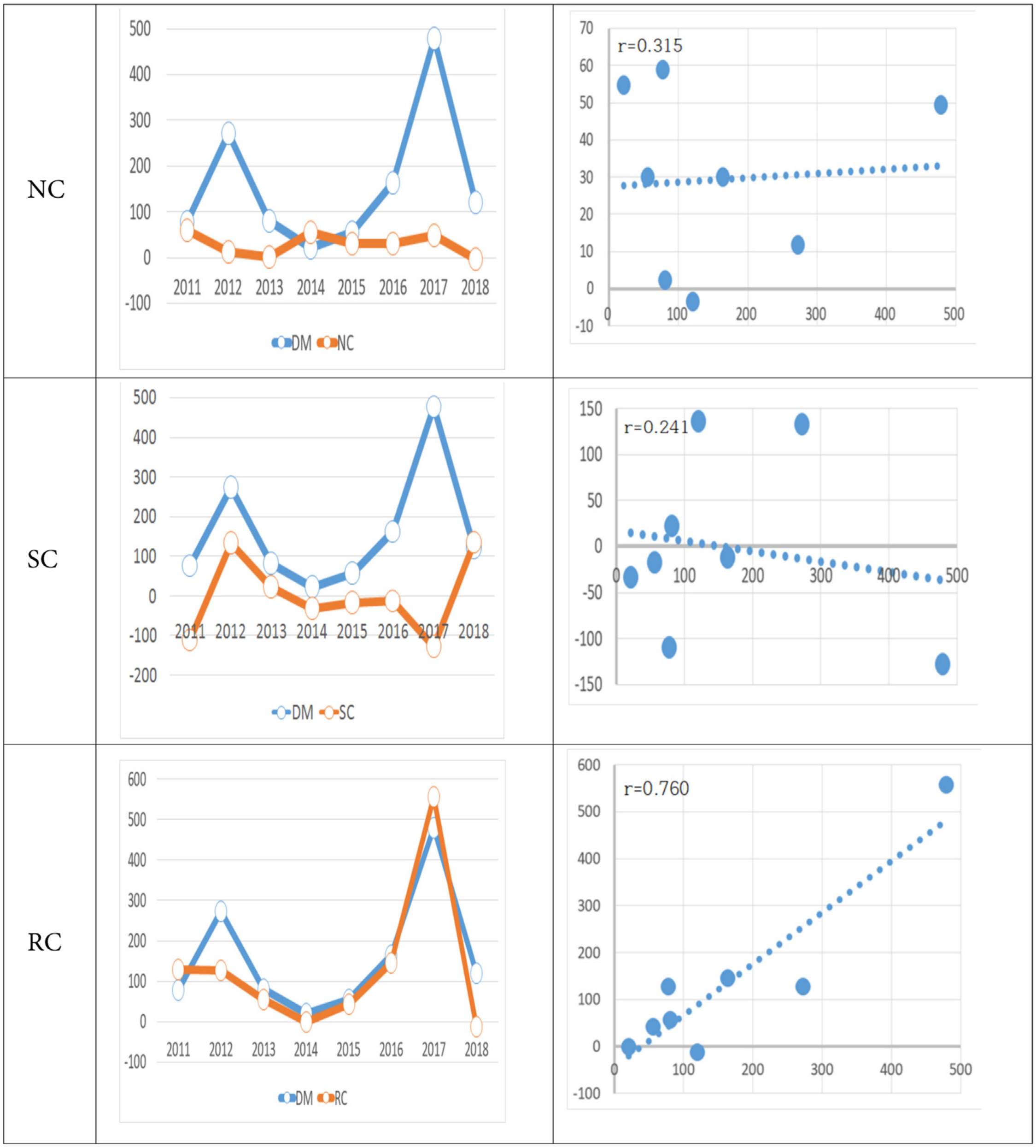

Fig. 7. Import changes and decomposition by components: vegetable matter.
Note: DM (import change), NC (national share component), SC (sectoral shift component), RC (regional shift component).
Source: Authors' computations, based on data from the Korea International Trade Association (https://www.kita.net/) on-line.

Fig. 10 shows the result of incorporating location coefficients into BCG matrix for iron ore imports. During the period 2010–2014, Pyeongtaek-Dangjin Port belonged to in EMERGING area, where growth rate was larger than average (13.3%), but its LQ (2014) was below average (2.9%), whereas Gwangyang Port and Pohang Port located in MATURE category, where LQs (2014) were above average but growth rates were below average. During the period 2015–2018, Pohang Port entered the STAR category, but Gwangyang Port failed upgrading its position and Pyeongtaek-Dangjin Port degraded from MATURE to TRANSFORMING.

Fig. 11 shows the result of incorporating location coefficients into BCG matrix for natural gas imports. During the period 2010–2014, Incheon Port belonged to in STAR area, where growth rate and LQ (2014) were far above average (−17.6%), whereas Pyeongtaek Port and Gwangyang Port located in MATURE and TRANSFORMING category, respectively. During the period 2015–2018, Gwangyang Port achieved large-scale evolution from a TRANSFORMATION category to a STAR category and Pyeongtaek Port also developed from a MATURE position to a STAR position. Incheon Port degraded from a STAR to a MATURE area. It can be seen that Gwangyang Port enhanced its competitiveness significantly for natural gas imports.

Fig. 12 shows the result of incorporating location coefficients into BCG matrix for vegetable matters imports. The vertical axis represents the change rate (%) of the location coefficient. During the period 2010–2014, Gunsan Port located in MATURE area, where growth rate was smaller than average (17.1%), but its LQ (2014) was greater than average (3.3%). Gwangyang Port and Pyeongtaek Port belonged to the EMERGING category, where LQs (2014) were below average but growth rates were greater than average. Ulsan Port, Busan Port and Incheon Port belonged to TRANSFORMING area, where growth rates as well as LQs (2014)

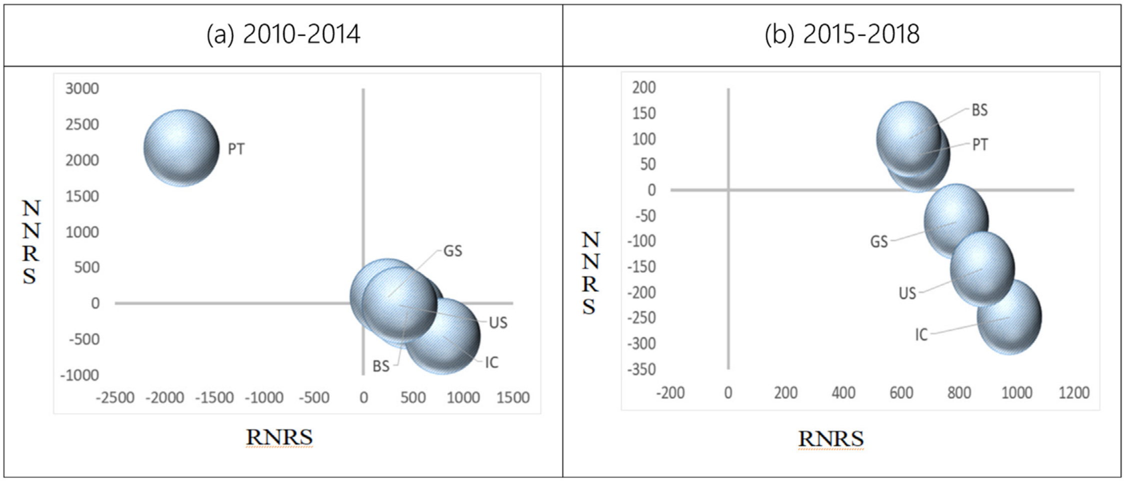

Fig. 8. Import changes and decomposition by components: vegetable matters. Note: NNRS (neighbor-nation regional-shift), RNRS (region-neighbor regional-shift).

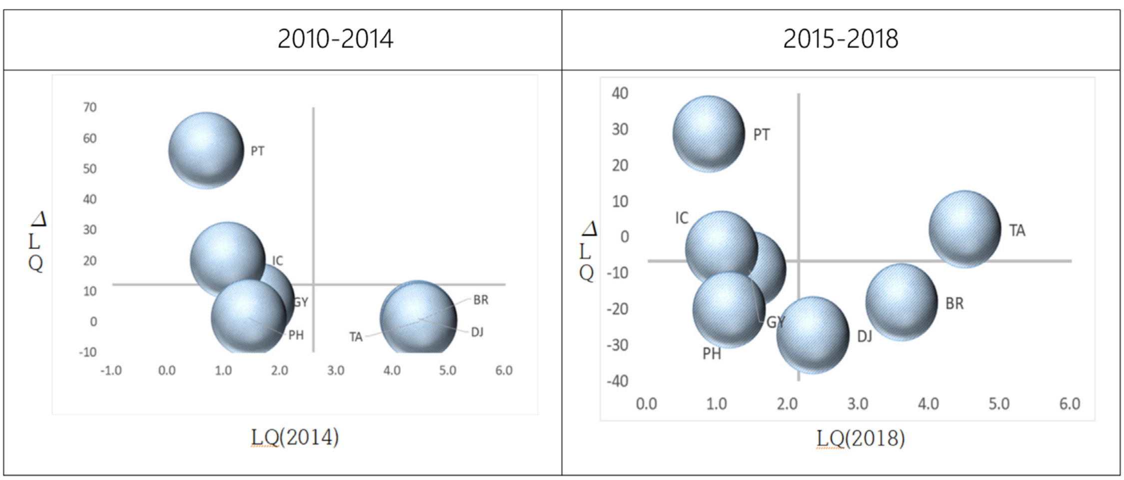

Fig. 9. Shift-share analysis and location quotients: coal.

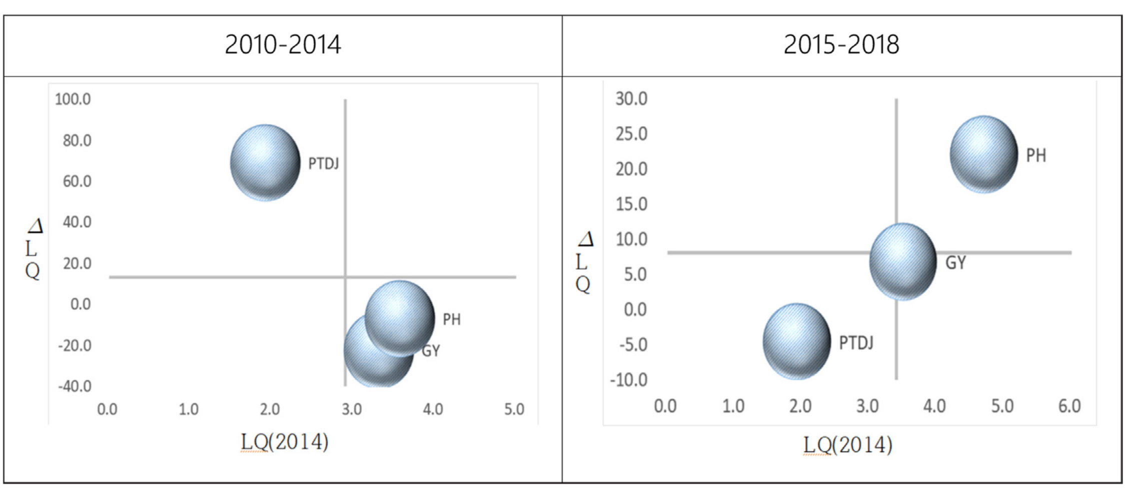

Fig. 10. Shift-share analysis and location quotients: iron ore.

were below average. As Gunsan Port retained MATURE position during the period 2010–2014 as well as 2015–2018, it was highly specialized in importing vegetable matter, but it failed in escaping from sluggish import performance. Ulsan Port and Incheon Port were positioned in the TRANSFORMING category for two periods, while Gwangyang Port and Pyeongtaek Port were retained the EMERGING area. It can be seen that Gwangyang Port continued to increase the import of vegetable matter very actively even though location quotients were smaller than average.

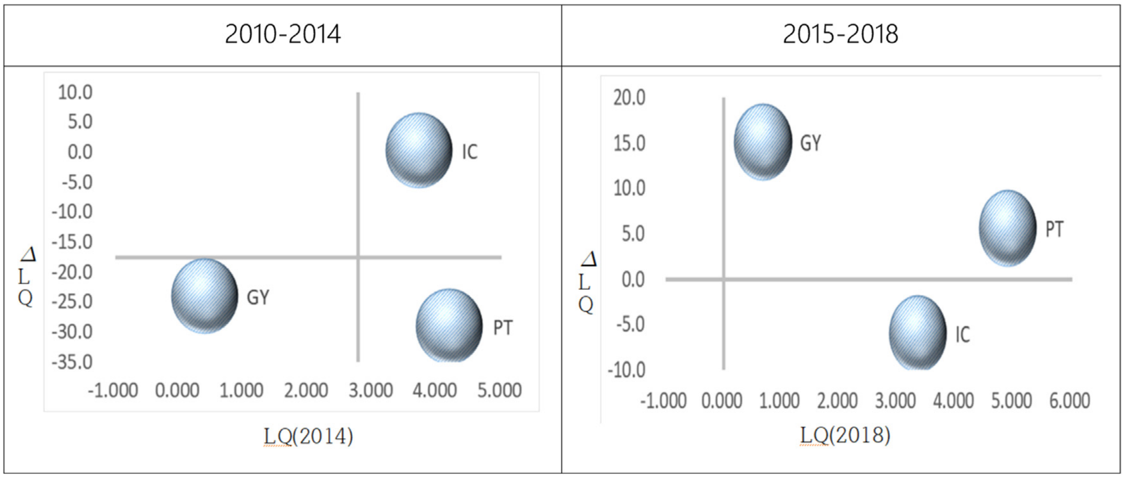

Fig. 11. Shift-share analysis and location quotients: natural gas.

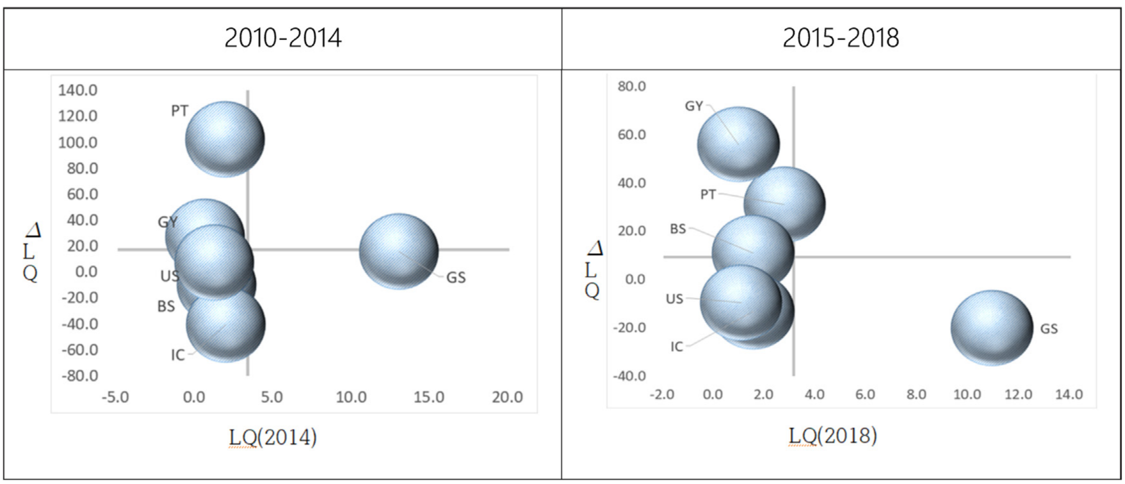

Fig. 12. Shift-share analysis and location quotients: vegetable matter.

4. Conclusions

This paper decomposed the import changes of Gwangyang Port by components and analyzed the change of competitiveness between Gwangyang Port and other ports by applying standard/spatial shift-share, location coefficient and BCG matrix analysis to four import items.

We first performed the standard shift-share analysis and spatial shift-share analysis for the period 2010–2018 and investigated the import performance of Gwangyang Port of four sectors: coal, iron ore, natural gas and vegetable matter. The static analysis for coal indicated the negative sectoral shift component and negative regional shift component in Gwangyang Port and showed that the decrease of coal imports is interrelated with preponderantly negative regional competitive components. We also found that the competitiveness of Gwangyang Port greatly deteriorated for coal imports. The static analysis for iron ore indicated the positive sectoral shift component and very large negative regional shift component, whereas the dynamic analysis showed that the sectoral shift component changed very unfavorable, but the regional shift component changed favorable. The spatial shift-share analysis also showed that the competitiveness of Gwangyang Port improved greatly. The static analysis for natural gas indicated the positive sectoral and regional shift component and Gwangyang has experienced both the gains in regional competitiveness and the industrial advantage. The dynamic analysis showed that the regional shift component was the most important components of the three. The spatial shift-share analysis for natural gas indicated Gwangyang Port achieved a competitive edge over rival ports. The static analysis for vegetable matter indicated the positive regional shift component accounted for much of import change. The dynamic analysis showed the positive regional component grew greatly and was the most important component in vegetable matter import change in Gwangyang Port. The spatial shift-share analysis showed that Gwangyang Port became the most competitive port surpassing the rival ports and the competitiveness was getting higher.

Incorporating location coefficients into BCG matrix for coal imports, Gwangyang Port failed escaping from the TRANSFORMING category, therefore should choose other items replacing coal. For iron ore imports Gwangyang Port failed upgrading its position from MATURE, whereas Gwangyang Port achieved large-scale evolution from a TRANSFORMATION category to a STAR category for natural gas. As Gwangyang Port retained the EMERGING position for vegetable matter, it can be seen that Gwangyang Port succeeded in increasing the import of vegetable matter very actively even though location quotients were smaller than average.

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