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Similarity Analysis of Exports Value Added by Country and Implication for Korea's Global Value Added Chains

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Abstract

Purpose – This paper investigates the structure of exports across countries in terms of value added. Exports value added is examined under two categories, domestic and overseas. Using a statistical classification method by distance based on these two value added categories, this paper estimates the similarity of exports value added across countries including Korea.
Design/methodology – The model of study is to employ a generalized distance function and then derive the Manhattan and Euclidean distances. The paper also performs cluster analysis using the Partitioning Around Medoids (PAM) and hierarchical methods to classify the 44 sample countries considered in this study.
Findings – Our main findings are as follows. The 44 countries can be classified under 5 groups by their domestic and overseas value added in exports. Korea has a sandwich global value chains (GVCs) position between Japan, China, and Taiwan in the East Asian region.
Originality/value – Existing papers point out the double counting problem of trade statistics as the intermediate goods trade across borders increases. This paper addresses the double counting problem by using the World Input-Output Table. The paper shows the need to explore the similarity of value added in exports structure across countries and investigate the GVCs position and role of each country.

Keywords: Cluster Analysis, Distance Function, Global Value Chains (GVCs), Value Added In Exports
JEL Classifications: F13, F15

1. Introduction

Recent studies have discussed the global trade patterns with focus on Global Value Chains (GVCs). The world is currently facing the dual phenomenon of trade integration and production disintegration (Feenstra, 1998). The division of production across borders is not a new phenomenon, but the insight that technological development has significantly expanded the level of GVCs participation and scope of activities is a new perception (Hur Yun-Seok and Han Nak-Hyun, 2018; OECD, 2013). This suggests that international trade is no longer a commodity trade, but a form of trading of roles (WTO IDE-JETRO, 2011). Therefore, an important policy issue is to participate in certain jobs and processes and create value added GVCs. For individual companies, an important management issue is to transfer core processes overseas as well as procure foreign intermediate goods.

This paper applied Koopman, Wang and Wei's (2014) methodology to measure the degree of participation in value added GVCs, largely dividing them by country into domestic and overseas value added. These two criteria are used to explore the similarities between countries

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in cross-sectional comparison, that is, their exports trade structure. The purpose of this study is to investigate the implications of Korea's exports structure for GVCs and how similar it is to that of specific countries.

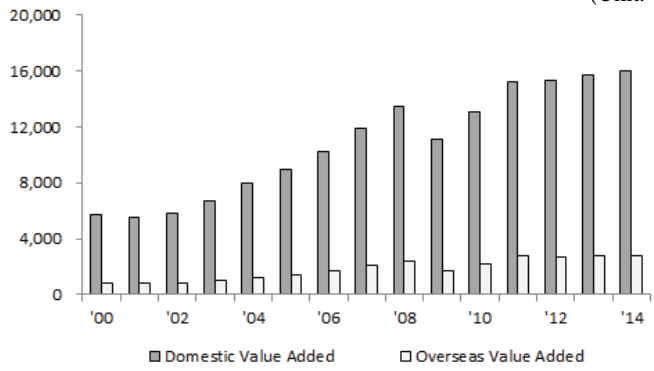
The composition of this paper is as follows. Section 2 examines the current status and trends of domestic and overseas value added through exports using Koopman, Wang and Wei's (2014) method. Section 3 reviews previous studies related to GVCs. Section 4 explains the model settings and data used to determine the basis of the domestic and overseas value added similarity level. Section 5 provides the analysis results, while Section 6 presents the paper's conclusions and implications.

2. Analysis of Export Value Added

Koopman, Wang and Wei (2014) divided export value added into nine categories, including a double calculation part. This paper excludes the double counting part and calculates the value added under domestic and foreign (hereinafter referred to as overseas value added) categories.[1] Fig. 1 shows the results of decomposing the domestic and overseas value added through exports by year using the World Input-Output Table (WIOT) from 2000 to 2014.

Fig. 1. Value Added by Domestic and Overseas Exports Trends

(Unit: US$ in billions)



Source: Author's calculation based on Koopman, Wang and Wei (2014).

From the value added trends by year, the domestic value added was about US $5,698 billion and overseas value added was US $846 billion in 2000. In the wake of the financial crisis, the domestic and overseas value added decreased slightly in 2009. However, as of 2014, the domestic value added was US $15,998 billion and overseas value added was US $2,804 billion. This shows that the overseas value added increased 3.3 times during the period. In addition, the overseas value added as a share of total added value was 12.6% in 2000, 14.7% in 2011, and 14.4% in 2014, indicating a steadily increasing trend.

[1] The nine items presented in Koopman, Wang and Wei (2014) can be summarized as follows: (1) domestic value added through final goods and intermediate exports; (2) domestic value added when the target country processes and exports to third countries; (3) domestic value added by re-entry when final goods and intermediate goods are exported; and (4) foreign value added through final goods and intermediate goods exports (Yoon Seung-Hwan and Cho Jung-Hwan, 2019). In this study, we added items (1), (2), and (3) to the final domestic value added, and item (4) to the overseas value added.

Table 1 below shows the domestic and overseas value added through exports to major countries as of 2014. The overseas value added shares of Korea, China, and Taiwan were relatively high at 22.2%, 15.1%, and 25.5%, respectively. In the European countries, Netherlands and Denmark accounted for more than 20% share. However, the United States, Austria, and Japan showed relatively low value added shares at 5.5%, 8.3%, and 9.9%, respectively. China, Taiwan, and Korea showed high rates because of their high proportion of intermediate goods processed and then re-exported to third countries. Thus, the participation of GVCs in these countries is considerably higher than in other countries.

Table 1. Domestic and Overseas Value Added Ratios by Country

(Unit: %)

Country	Domestic value added	Overseas value added	Country	Domestic value added	Overseas value added
AUS	89.5	8.3	ITA	85.2	12.2
BRA	90.0	8.1	JPN	88.1	9.9
CAN	83.5	14.5	KOR	73.7	22.2
CHN	81.5	15.1	MEX	83.1	15.5
DEU	80.5	15.5	NLD	72.2	20.9
DNK	74.6	20.9	NOR	85.4	10.8
ESP	83.9	13.5	RUS	77.5	17.4
FRA	83.9	13.1	SWE	81.2	14.7
GBR	85.9	11.0	TUR	81.8	15.3
IDN	85.4	11.8	TWN	68.6	25.5
IND	86.5	11.4	USA	92.8	5.5

Source: Author's calculation based on Koopman, Wang and Wei (2014).

Table 1 shows that the degree of domestic and overseas value added of the countries differ, but it does not provide useful information on the difference in value added structure of each country. Therefore, this study investigates the degree of similarity by country using the statistical classification method for domestic and overseas value added. For this, we review the existing literature on the export value added and explain the model setting and data required to examine the similarity level by country. Using this, we present the degree of similarity of export value added by country including Korea.

3. Literature Review

As the trade of intermediate goods across borders increased, a persistent problem is that the trade statistics on the aggregate data do not substantially reflect the trade pattern due to overestimation of intermediate trade. Thus, many of the existing studies point out the need to examine the basis of value added trade patterns. We therefore discuss appropriate trade policies and multilateral economic cooperation.

Feenstra (1998) pointed out that global trade seems to be more integrated than ever before, although characterized by division of production when intermediate trade is considered. Studies have shown that intermediate goods trade has greatly expanded through outsourcing since the 1970s. They calculated the proportion of foreign intermediate goods included in imports and exports of capital goods and consumer goods, and showed that trade patterns had an impact on employment and wages. Several studies devised ways to directly calculate

the share of intermediate goods and measured the degree of global production network, that is, participation of GVCs.

Hummels, Ishii and Yi (2001) presented a methodology to measure the degree of imports included in the exports to other countries, that is, vertical specialization (VS). This is the degree of foreign contribution inherent in domestic exports. An analysis of the data of 10 OECD countries and Ireland, Korea, Taiwan, and Mexico showed that the degree of VS increased by nearly 30% between 1970 and 1990.

Sturgeon and Gereffi (2009) pointed out that the data of existing international production and trade provide only limited information on value added sources, and do not reflect the exact nature of services trade such as accounting, marketing, and logistics from the GVCs perspective. They stated that such services that can be outsourced need to be uniform and have standardized statistics around the globe.

Johnson and Noguera (2012) showed that the trade balance between the United States and China in 2004 was 30–40% lower than the usual level. Therefore, the trade in value added standards can more accurately reflect the actual trade patterns in double calculation problems due to cross-border trade and multinational production chains.

Inomata (2013) noted that by using WIOT data, the limitations of the existing trade statistics method can be overcome.[2] This study used the IDE-JETRO's Asian International Input-Output Table (AIOT) data to show that intermediate goods are supplied to China from East Asian countries on GVCs. Once China receives the goods, it shows the characteristics of a country producing intermediate goods to export to third countries.

Timmer, Los and Vries (2013) also showed that the proportion of foreign added value included in the product increased between 1995 and 2008, with the vertical differentiation phenomenon more intense than ever before. The analysis suggested that capital and high-skilled labor contribute more to the added value than low-skilled labor.

In contrast, Johnson (2014) proved that the trade structures of total value-based trade and value added in exports are quite different. Measured by value added in exports, the share of exports of the manufacturing industries is lower than that of total exports. This indicates that the level of vertical division of labor between countries in the manufacturing industries is higher than that in the service industry.

Studies also examine the trade policies based on GVCs and regional and multilateral economic cooperation. The OECD (2013) also suggests that regional and multilateral trade and investment agreements should be assessed from the perspective of GVCs and their impact on jobs and value chains. In addition, as the GVC participation level deepens, the negative impacts of one country may spread to other countries.

Yun (2015) analyzed the structure of international division in Korea, the United States, China, Japan, and the EU countries using the WIOT, and showed that Korea has a sandwiched position between the developed countries and China in terms of GVC structure.

From an evaluation of the industrial competitiveness level using the revealed comparative advantage for value added export, Lee Chang-Soo, Cheong A-Rion and Chung Yu-Ri (2016) suggested that the competitiveness of manufacturers is better maintained in Korea than in China or Japan.

Hur Yun-Seok and Han Nak-Hyun (2018) analyzed the cumulative effects of tariffs when crossing borders, and suggested that the respective countries' tariffs should be reduced from the perspective of GVCs. High tariffs would increase the cost of production for the GVCs'

[2] The study also pointed out that the added value in GVCs of a specific product (e.g., ipod) can be measured by, for example, investigating individual company data such as existing papers. However, this method cannot consider the macroscopic aspects of the entire industry.

participating companies every time they cross borders, ultimately hindering the competitiveness of their export products. The study showed that it is important to relax the service regulations embodied in products to secure their competitiveness.

Kwon Soon-Koog (2014) showed the need to closely examine the possibility of intermediary supply and raw material procurement from Korean companies based on the GVCs structure when considering the need and application of the Trans-Pacific Partnership Agreement. Kang Jun-Gu, Kim Tae-Jin and Shim Seung-Jin (2017) suggested the need to analyze the effect of trade creation and conversion of the Korea-China FTA considering the value added based on trade statistics rather than aggregate level. Kim Zu-Kweon (2018) used the trade in value added (TiVA) data to calculate the competitiveness of Korea's manufactures in exports and showed that the TiVA data might be more relevant for explaining current trade status than traditional gross trade data.

As for individual industries, the GVCs seem to participate more intensely in Korea's manufacturing industry than primary industry. As regards the chemical, metal, electronics, and automobile industries, the GVCs' participation strengthened during 2008 and 2009 (Lee Chang-Soo and Cheong In-Kyo, 2015). From an analysis of the IT industry, Choe Jong-Il (2018) showed the need to shift the domestic export structure, which depends highly on the assembly of finished products, to a higher value added structure based on network analysis.

4. Model Setup and Data Explanation

4.1. Model Setup

In this study, we apply a method to decompose the export value added as proposed in Koopman, Wang and Wei (2014) with the export value added items divided into domestic and overseas value-added items. Domestic value added refers to the value ultimately added in home country through exports, whereas overseas value added refers to the value added overseas. The concrete formulas are shown in equations (1) and (2) below.

The left-hand side of equations (1) and (2) represent respectively the domestic value (DV) and overseas value (OV) added through exports, V is the value added matrix of each country, B is Leontief's inverse matrix, Y is the final demand matrix, A is a matrix of value added coefficients, and I is a unit matrix. Subscripts s, t, and r denote the respective exporting countries.

$$\begin{aligned} \mathrm{DV} = {} & V_s \sum_{r \neq s}^{G} B_{ss} Y_{sr} + V_s \sum_{r \neq s}^{G} B_{sr} Y_{rr} + V_s \sum_{r \neq s}^{G} \sum_{t \neq s,r}^{G} B_{sr} Y_{rt} \\ & + V_s \sum_{r \neq s}^{G} B_{sr} Y_{rs} + V_s \sum_{r \neq s}^{G} B_{sr} A_{rs} (I - A_{ss}) Y_{ss} \end{aligned} \tag{1}$$

$$\mathrm{OV} = \sum_{t \neq s}^{G} \sum_{r \neq s}^{G} V_t B_{ts} Y_{sr} + \sum_{t \neq s}^{G} \sum_{r \neq s}^{G} V_t B_{ts} A_{sr} (I - A_{rr})^{-1} Y_{rr} \tag{2}$$

We first define the export distance between two countries considering the domestic and overseas value added, and then analyze the similarity between the countries using statistical and cluster analysis techniques. The export distance between two countries can be derived from the generalized distance Minkowski distance function, as shown in the following equation.

$$d(i,j) = (|x_{i1} - x_{j1}|^q + |x_{i2} - x_{j2}|^q + \cdots + |x_{ip} - x_{jp}|^q)^{1/q} \quad (3)$$

In equation (3), i and j denote the respective countries, and subscript p stands for both the domestic and overseas value added. In the above generalized distance function, superscripts q defines the special distance functions, the Manhattan distance (q=1) and Euclidean distance (q=2), respectively. The Manhattan and Euclidean distance functions are derived from the generalized distance function and differ from each other in only index value. In this study, both the Manhattan and Euclidean distances are measured; the Euclidean distance is used to analyze the similarity of export structure when applied to cluster analysis.

The degree of similarity between countries can be measured through cluster analysis. Cluster analysis is an analytical method to classify clusters into specific groups using given data (Kaufman and Rousseeuw, 1990). This method can be used to find k groups whose mean of distance in the group is maximized through a defined distance function. The characteristics of the given data need to be reflected through the given distance function to distinguish the number of groups in advance. Cluster analysis can give the results of PAM and hierarchical techniques separately.

4.2. Description of Data

The WIOT shows the distribution structure of 44 countries for 56 products in 2014. The longitudinal direction reflects the input structure of products by country, while the horizontal direction shows the distributional structure. This study sums up the industry-specific figures and transforms them into data showing the input and distributional structures by country. The target countries are presented in appendix Table A.

The export value added is based on the net added value, as in Choi Nak-Gyoon and Park Soon-Chan (2015), rather than total added value. The net value added is the WIOT net added value, which considers the net of product tax, Cif/Fob adjustments, and resident and non-resident purchases. This is because the adjusted net value-added criterion more accurately reflects the value added through production factors such as capital and labor.

The summary statistics calculated by dividing the domestic and overseas value added based on net value added through exports are shown in Table 2 below.

As the summary statistics show, in the exports value added of 44 major countries, the mean of domestic value added is about US $3,200 billion and overseas value added is US $1,402 billion; the overseas value added is 43.8% of the domestic added value.

Table 2. Summary Statistics of Value Added in Exports

(Unit: US$ in billions)

Value added in exports	Obs.	Min.	First Qu.	Mean	Third Qu.	Max.
Domestic value added	44	162	213	3,200	5,735	8,929
Overseas value added	44	1,194	1,298	1,402	1,506	1,610

5. Results

Table 3 shows the results of analyzing 44 export distances between two countries based on domestic and overseas value added according to the 2014 WIOT. Only 22 countries, including Germany, Denmark, Spain, France, the Netherlands and Sweden, out of the 28

European countries are listed due to space constraints.

The diagonal element for distance of a home country is 0 in Table 3 due to the nature of the distance function. Since the distance does not change even when the order of the target country is changed, the symmetric element values remain the same. Thus, this study presents the Manhattan distances in the upper and Euclidean distances in the lower triangular matrix, without denoting the symmetric element values.

From the Manhattan distance, indicated by a shade in the table, the distance between the United States and Taiwan is 44.2. As for minimum distance, the distance between France and Spain is 0.4. This is the closest export structure.

The Euclidean distance function results are the same as the Manhattan distance values. For Korea, the United States and Russia have the highest Euclidean distances at 25.4 and 23.7, respectively. The export distance values of Denmark and the Netherlands are lowest at 1.6 and 2.0, respectively. The Manhattan distances show the same results: the largest export distances are for the United States and Russia, and the smallest distances are for Denmark and the Netherlands, but the figures are different.

These results imply that the Korean export structures are different from those of the United States and Russia when the export distances are based on the domestic and overseas added values created through exports. However, Denmark and the Netherlands show export structures similar to those of Korea. These figures do not provide criteria for determining whether the export structure of two countries is complementary or competitive, but we just analyzed the structural similarity of the export network between two countries through the distance function.

Table 3. Analysis of Export Distance between Two Countries

	AUS	BRA	CAN	CHN	DEU	DNK	ESP	FRA	GBR	IDN	IND	ITA	JPN	KOR	MEX	NLD	NOR	RUS	SWE	TUR	TWN	USA
AUS	0.0	0.8	12.2	2.2	16.1	27.4	10.7	10.3	6.2	7.5	6.0	8.2	2.9	29.6	13.5	29.8	6.6	3.8	14.7	14.6	38.0	6.2
BRA	0.6	0.0	12.9	3.0	16.8	28.2	11.5	11.1	7.0	8.2	6.7	8.9	3.7	30.4	14.2	30.5	7.4	3.0	15.4	15.4	38.8	5.5
CAN	8.6	9.2	0.0	10.0	3.9	15.2	1.5	1.8	6.0	4.7	6.2	4.0	9.3	17.4	1.3	17.6	5.6	16.0	2.5	2.4	25.8	18.4
CHN	1.6	2.1	7.0	0.0	13.9	25.2	8.5	8.1	4.0	5.2	3.8	6.0	0.7	27.4	11.2	27.6	4.4	6.0	12.5	12.4	35.8	8.4
DEU	11.4	12.0	3.1	9.9	0.0	11.4	5.4	5.7	9.9	8.6	10.1	7.9	13.2	13.6	2.6	13.7	9.5	19.9	1.4	1.5	21.9	22.3
DNK	19.5	20.0	10.9	17.9	8.0	0.0	16.7	17.1	21.2	20.0	21.5	19.3	24.5	**2.2**	14.0	2.5	20.8	31.2	12.7	12.8	10.6	33.6
ESP	7.6	8.1	1.1	6.0	3.9	11.9	0.0	**0.4**	4.5	3.3	4.7	2.5	7.8	18.9	2.7	19.1	4.1	14.5	4.0	3.9	27.3	16.9
FRA	7.3	7.9	1.5	5.8	4.1	12.1	**0.4**	0.0	4.1	2.9	4.4	2.2	7.4	19.3	3.1	19.4	3.7	14.2	4.3	4.3	27.7	16.6
GBR	4.4	5.0	4.3	3.0	7.0	15.0	3.2	2.9	0.0	1.2	1.0	1.9	3.3	23.4	7.2	23.5	0.7	10.0	8.5	8.4	31.8	12.4
IDN	5.3	5.8	3.4	3.8	6.2	14.2	2.3	2.1	0.9	0.0	1.5	0.7	4.5	22.2	6.0	22.3	1.0	11.3	7.2	7.2	30.6	13.7
IND	4.2	4.8	4.4	2.7	7.3	15.3	3.4	3.2	0.7	1.2	0.0	2.2	3.1	23.7	7.5	23.8	1.7	9.8	8.7	8.6	32.0	12.2
ITA	5.8	6.3	2.9	4.2	5.7	13.7	1.8	1.6	1.4	0.5	1.6	0.0	5.3	21.5	5.3	21.6	1.6	12.0	6.5	6.4	29.8	14.4
JPN	2.1	2.6	6.6	0.5	9.4	17.4	5.5	5.3	2.5	3.3	2.2	3.7	0.0	26.7	10.6	26.9	3.7	6.7	11.8	11.7	35.1	9.1
KOR	21.0	21.5	12.4	19.5	9.6	**1.6**	13.4	13.7	16.6	15.7	16.8	15.2	19.0	0.0	16.2	**2.8**	23.0	**33.4**	14.9	15.0	8.4	**35.9**
MEX	9.5	10.1	1.0	8.0	2.6	10.1	2.1	2.5	5.3	4.4	5.3	3.8	7.5	11.6	0.0	16.3	6.8	17.3	2.7	1.4	24.5	19.7
NLD	21.3	21.9	12.9	19.8	9.9	2.4	13.8	14.0	16.9	16.0	17.2	15.6	19.3	**2.0**	12.2	0.0	23.2	33.6	15.1	15.2	8.2	36.0
NOR	4.8	5.4	4.1	3.4	6.7	14.7	3.0	2.7	0.6	0.9	1.3	1.4	2.9	16.3	5.1	16.5	0.0	10.4	8.1	8.0	31.4	12.8
RUS	2.7	2.2	11.3	4.3	14.1	22.1	10.3	10.0	7.1	8.0	6.9	8.5	4.8	**23.7**	12.2	24.0	7.4	0.0	18.5	18.4	41.8	2.4
SWE	10.5	11.0	2.3	9.0	1.0	9.0	3.0	3.2	6.0	5.2	6.3	4.7	8.5	10.6	2.1	10.8	5.7	13.1	0.0	1.3	23.3	20.9
TUR	10.3	10.9	1.8	8.8	1.3	9.1	2.8	3.0	5.9	5.1	6.1	4.6	8.3	10.7	1.3	11.1	5.7	13.0	0.9	0.0	23.4	20.8
TWN	27.0	27.6	18.5	25.5	15.6	7.5	19.4	19.7	22.6	21.7	22.8	21.2	25.0	6.0	17.6	5.9	22.2	29.7	16.5	16.7	0.0	**44.2**
USA	4.4	3.9	13.0	6.0	15.9	23.9	12.0	11.8	8.9	9.7	8.6	10.2	6.5	**25.4**	13.9	25.7	9.2	1.8	14.9	14.8	**31.4**	0.0

Note: The upper triangular matrix, shaded with diagonal elements, represents the Manhattan distance, and the lower triangular matrix represents the Euclidean distance.

Fig. 2. PAM Graph Result

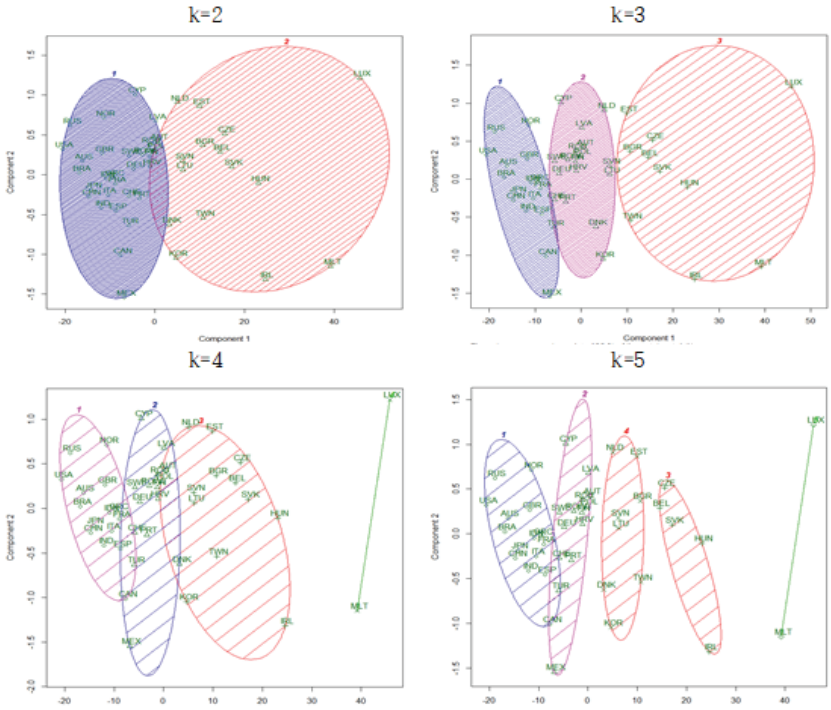
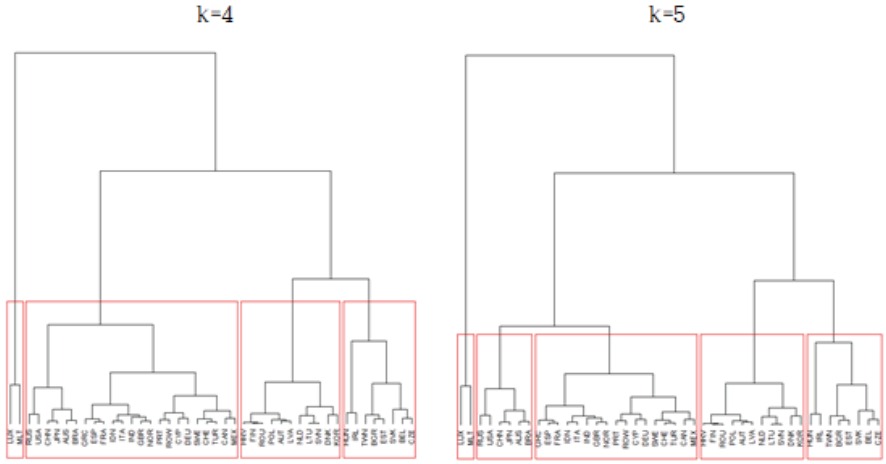


Fig. 3. Dendrogram Results



The cluster analysis results based on the Euclidean distance are shown in Fig. 2 and 3. For the case of k = 2 or k = 3, group 3 includes Luxembourg and Malta; these are located on the right-hand side and show a considerable distance difference. However, for k = 4 or k = 5,

Luxembourg and Malta are distinguished from each other. The same result can be obtained using the hierarchical technique. From these results, the 44 countries are categorized under 5 groups through the segmentation technique. The countries in the groups show similar domestic and overseas value added characteristics.

Table 4 classifies the 44 countries under 5 groups based on Fig. 2 and 3, summarizing the following statistical results.

The domestic and overseas value added as a percentage of net added value are on average 43.3% and 44.7% respectively in Luxembourg and Malta, which are in group 1. Group 2 countries, including Russia, the United States, China, Japan, Australia, and Brazil, have an overwhelmingly high domestic value added of 90.0%.

Groups 3 and 4 include countries with higher overseas value added than the group 2 countries. Group 3, which includes Greece, Spain, and France, has 83.0% domestic value added and 13.8% overseas value added. Group 4, which includes Finland, Netherland, and Korea, has 75.1% domestic value added and 19.6% overseas value added. Finally, group 5 includes countries with lower domestic value added and higher overseas value added compared to other groups; this group includes Hungary, Ireland, and Taiwan.

Table 4. Classification Results by Country

(Unit: %)

No.	Countries (k=5)	Domestic value added		Overseas value added	
Group 1	LUX, MLT	Obs.: 2 Max: 46.6	Mean: 43.3 Min: 40.0	Obs.: 2 Max: 45.8	Mean: 44.7 Min: 43.6
Group 2	RUS, USA, CHN, JPN, AUS, BRA,	Obs.: 6 Max: 92.8	Mean: 90.0 Min: 88.1	Obs.: 6 Max: 9.9	Mean: 8.0 Min: 5.5
Group 3	GRC, ESP, FRA, IDN, ITA, IND, GBR, NOR, PRT, CYP, DEU, SWE, CHE, TUR, CAN, MEX, ROW	Obs.: 17 Max: 86.5	Mean: 83.0 Min: 78.9	Obs.: 17 Max: 16.6	Mean: 13.8 Min: 10.8
Group 4	HRV, FIN, ROU, POL, AUT, LVA, NLD, LTU, SVN, DNK, KOR	Obs.: 11 Max: 77.6	Mean: 75.1 Min: 71.8	Obs.: 11 Max: 22.3	Mean: 19.6 Min: 17.4
Group 5	HUN, IRL, TWN, BGR, EST, SVK, BEL, CZE	Obs.: 8 Max: 68.6	Mean: 64.3 Min: 58.2	Obs.: 8 Max: 34.7	Mean: 28.2 Min: 23.9

From the table, group 4 countries have a higher proportion of overseas value added than group 2 and group 3 countries. Korea has a higher share of overseas value added than group 2 countries Japan and China, but lower share than group 5 country Taiwan.

Thus, even in the same East Asian region, each country contributes differently to domestic and overseas value added in GVCs structure. These results particularly indicate that as regards export value added, Korea has a sandwich position between Japan, China, and Taiwan in the same East Asian region, reconfirming the findings of Yun (2015). In other words, Japan exports technical intermediate goods to other countries such as Korea, while Korea processes intermediate goods into final products and re-exports them to Taiwan. Thus, the export strategies Korea needs to pursue to improve its export value added, which are different from those of Japan or Taiwan.

6. Conclusion and Implication

As global trade patterns change and develop from the past single products production to various forms of vertical differentiation through intermediary trade, international trade patterns are changing from trading of goods to trading of roles. In order to address the double calculation problems pointed out in previous studies, we use the research methodology of Koopman, Wang and Wei (2014) and the 2014 WIOT to convert the value added through exports into domestic and overseas value added. The degree of similarity of countries is presented through distance function and cluster analysis. This analysis compares the cross-sectional exports structure of countries.

The analysis results are summarized as follows. First, the Manhattan and Euclidean distance functions showed the countries with similar export trade structures France and Spain to have the closest export structure. As regards Korea, the export structure is most similar to Denmark but significantly different from the United States. Second, from cluster analysis using PAM and the hierarchical method based on domestic and overseas added value, 44 countries can be categorized under 5 groups. Third, when the target countries are divided into five groups, the segmentation method shows a difference in domestic and overseas value added for each group. In particular, Korea is similar to Denmark and Finland in that it has a relatively high share of overseas value added, but differs from countries such as the United States, China, and Japan, where the share of domestic value added is high. In addition, Korea is located between Japan and Taiwan, and even though they are in the same East Asian area, they differ in GVCs structure.

From the results of this analysis, Korea needs to adopt strategic measures to improve its domestic added value relative to Japan and China, while increasing its total added value.

The contribution of the paper is that we used the method to distinguish across countries by the value added in exports and suggested the appropriate trade policy in terms of the GVCs.

This study is presently limited to cross-sectional analysis, but by extending it to time series and industry analysis, we might be able to identify and present the structural changes in industry structure. Further analysis is needed to clarify the degree of similarity of export structures in terms of GVCs.

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Appendix

Table A. Country List

Country	Abbrev.	Country	Abbrev.	Country	Abbrev.
1. Australia	AUS	16. France	FRA	31. Malta	MLT
2. Austria	AUT	17. United Kingdom	GBR	32. Netherlands	NLD
3. Belgium	BEL	18. Greece	GRC	33. Norway	NOR
4. Bulgaria	BGR	19. Croatia	HRV	34. Poland	POL
5. Brazil	BRA	20. Hungary	HUN	35. Portugal	PRT
6. Canada	CAN	21. Indonesia	IDN	36. Romania	ROU
7. Switzerland	CHE	22. India	IND	37. Russia	RUS
8. China	CHN	23. Ireland	IRL	38. Slovakia	SVK
9. Cyprus	CYP	24. Italy	ITA	39. Slovenia	SVN
10.Czech Republic	CZE	25. Japan	JPN	40. Sweden	SWE
11. Germany	DEU	26. Korea	KOR	41. Turkey	TUR
12. Denmark	DNK	27. Lithuania	LTU	42. Taiwan	TWN
13. Spain	ESP	28. Luxembourg	LUX	43. United States	USA
14. Estonia	EST	9. Latvia	LVA	44. Rest of World	ROW
15. Finland	FIN	30. Mexico	MEX		